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Improving distributed collaboration at Porsche Engineering Services GmbH through the application of the EDiT Method

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Abstract

To support development teams with their individual challenges of distributed collaboration in product development, the EDiT method is being developed. This paper contributes to the continuous validation of the EDiT method by a field study at the process team of Porsche Engineering Services GmbH to support the successful transfer into practice. The validation is based on validation by application, validation by evaluation of the contribution to success, and validation by comparison of the requirements. The contribution of the EDiT method could be proven by different measurement criteria, e.g. reducing the average number of days to finish a task by a remarkable amount.

Keywords: distributed development; distributed collaboration; collaborative design; design methods; problem-solving; improvement process; method validation; continuous validation

1. Introduction

According to a survey with human resource managers conducted by the ifo institute the share of employees working in the home office increased by 20 percentage points from 40% to 60% [1]. Gaul and Grieb support this development, as solely the increase of distributed collaboration can be seen as a response to the challenges of the internationalization of competition [2,3]. A study by Vector Consulting Services has shown that almost 50 percent of the more than 2,000 decision-makers surveyed from a wide range of companies consider distributed challenges in the short and medium-term [4]. A possible solution is offered by the survey of the 14th annual state of agile report, where 41 percent of the more than 40,000 respondents, consisting of users and consultants of agile working methods, stated that the management of distributed teams is an advantage of the agile way of working [5]. To meet the challenges of distributed product development and to implement agile working methods as a solution approach, a corresponding method is necessary to support the identification and development of improvement potentials in distributed teams. The EDiT method (Enabling Distributed Teams) under development by Duehr et al. offers such support. Therefore, the method is oriented towards first understanding the individual challenges of a distributed team to then, define and implement the appropriate measures. [6]

In the course of the present work, the EDiT method is applied and validated in a distributed team of Porsche Engineering Services GmbH. The aim is to demonstrate the applicability and the contribution to success of the method in practice and to propose possible improvements to the method to increase the success of the method according to the principle

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of continuous validation. Ultimately, the application of the method should measurably improve distributed collaboration at Porsche Engineering.

2. State of research

2.1. Distributed product development

As early as 1919, Taylor sees in his Principles of Scientific Management the economic advantage of the division of labor as the basis for the effective and efficient execution of work processes [7]. Gierhardt adds that the distributed implementation of product development activities across national borders and regions must be understood as an indispensable consequence of current developments [8]. Kern states that the distribution of tasks among several organizations already creates interfaces that can only be bridged by additional organizational effort, which leads to frictional losses. For this reason, it will be an indispensable task in the future to "remove the barriers between different companies or locations of a company". [9]

In the context of this paper, distributed product development is defined as development by teams that work separately in terms of time, space, and organizational conditions towards a common goal. This includes both national and international collaboration within the development team.

2.2. Enabling distributed teams method

Several methods can be found in the literature that support improving teamwork in product development, e.g. continous improvement with the PDCA cycle or also methods like SCRUM [10,11]. Taking a closer look, it can be observed that these do not consider sufficiently the characteristics of distributed development teams. The EDiT method aims to support distributed development teams to overcome individual challenges in collaboration. The user-oriented method offers a continuous improvement of distributed collaboration. The method under development consists of the following four steps defined by Duehr et al. [6]:

Potential-Analysis: Situation and problem analysis to identify potentially critical activities of the distributed product development process and analyze possible fields of action to improve distributed working.

Measure Definition: Derivation, prioritization, and selection of alternative solutions as measures to address the potentials.

Measure Implementation: Development of the identified potentials based on the implementation of the selected measures.

Measure Evaluation: Measure evaluation (e.g., comparison of effort and benefit) to be able to assess the success of the measure.

To increase the probability of a successful transfer into practice and to ensure that developed method support is tailored to the specific needs of the users, (measurable) success criteria must be defined within the framework of an iterative method development process [12]. Therefore, validation is a central activity in the development process of a method. By generating considerable knowledge, it contributes significantly to successful product development [13]. The validation of this study is essentially based on the three criteria of validity, reliability, and objectivity, whereby validity can be divided into internal and external validity [14], [15], [16], [17].

3. Research objective and methodology

To ensure a successful implementation of the EDiT method under development, it is necessary to validate the EDiT method for improving distributed collaboration in the field at an early stage. At the same time, distributed collaboration is gaining importance in Porsche Engineering due to the reasons of globalization, COVID-19 pandemic, and the usage of worldwide resources. Many teams have had to start working in a distributed manner at short notice, which has created some challenges in the daily collaboration. Thus, Porsche Engineering, as a company that wants to continuously develop and work on a premium level, offers a suitable validation environment for a field study to validate a method that can improve distributed development. At the same time, the EDiT method benefits from the team's experience.

Building on the first approaches of this method, which have already been tested in development practice and whose applicability and contribution to success have been initially proven [18]. Therefore, this paper aims to improve the distributed collaboration at Porsche Engineering Services by applying the EDiT method and subsequently to validate and thereby further develop the EDiT method. For this purpose, the following research questions are to be answered:

1. How should the EDiT method be applied at Porsche Engineering Services GmbH so the EDiT method can be validated in terms of its applicability and contribution to success in a field study?
2. What is the measurable added value created through the application of the EDiT method regarding the improvement of distributed collaboration at the process team at Porsche Engineering and how can the EDiT method be further developed?

In this study, two questionnaires, as well as qualitative and quantitative observations, are used. The first questionnaire is used to collect the feedback of the six team members about the status quo of distributed collaboration initially and after every sprint. It contains 15 questions grouped into five categories: “Effectiveness”, “Circular Approach”, “Task Transparency and Quality”, “Workload and Motivation” and “Teamwork and Communication”. The second questionnaire is solely used at the end of the method application to validate the degree of fulfillment of the requirements of the EDiT method at the Porsche Engineering’s process team. Both questionnaires are answered and analyzed based on a five-point Likert scale using predefined answer options (1 = fully disagree to 5 = fully agree) leading to an analysis of the quantitative data using an ordinal scale [17]. In this paper, observations are done by the researcher as so-called participant observations [17]. To establish comparability between different study results, quantitative as well as qualitative data could be analyzed with

the help of statistical operators and procedures, such as boxplots and statistical mean values [19].

4. Concept for the validation of the EDiT Method

To address and overcome the challenges of distributed collaboration described above a concept for the application of the EDiT method was developed. The concept is based on the three validation types of the EDiT method [20]. The execution at the process team of Porsche Engineering is synchronized with the regularly taking place agile events as described in the following chapters.

4.1. Concept for validation through application

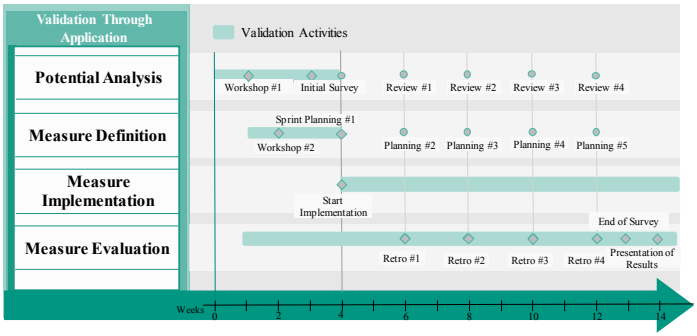

Figure 1: Target process model for the application and validation of the EDiT method

As shown in Figure 1 begins the **analysis of potential** with workshop #1, which should take place with the whole team. The workshop aims to document and identify the challenges of the team. To be able to conduct an efficient workshop, each team member should prepare his personal challenges of the current situation in advance. Following this workshop, the first questionnaire to collect the feedback of the team about the current situation will take place as described in chapter 3. This step of the method will take place regularly in every sprint review.

The **definition of measures** is to take place in a second workshop. This workshop aims to identify a measure for each potential improvement by discussing them as a team. According to workshop #1, the entire team should be present as participants in workshop #2. To be able to implement the measures decided in this workshop, the supervisor should take part. As final documentation, a list should be available that shows all potentials with the corresponding measures. This step will take place regularly in every sprint planning.

Measure implementation starts in week four of the application of the EDiT method. According to the planning, the first sprint cycle starts also in week four.

The **evaluation of measures** takes place at regular intervals. These intervals are to be equated with the sprint cycles so that the measures can be evaluated in each retrospective. The measurement criteria described in the following chapter and the questionnaire created for the potential analysis are to be used for this purpose. The team is free to define further potential for improvement and corresponding measurement criteria in each retrospective.

4.2. Concept for validation through evaluation of the contribution to success

To be able to determine the contribution to success of individual measures in retrospect, the **identification of potentially measurable variables** must take place at the beginning according to the areas for the identification of measurable variables shown in Figure 2. At the same time, it creates an overall view of the method's contribution to success.

	Quantitative	Qualitative
Objective	Jira/Confluence	Observations
Subjective	Questionnaire	Statements in the Retro

Figure 2: Classification of measurement criteria for data collection

To collect feedback of the team before and after implementing a measure, a questionnaire is distributed before and after every sprint representing the subjective and quantitative criteria. To ensure the objectivity of the determination of the contribution to success, statistics from Jira and Confluence serve as objective and quantitative measurement criteria:

- Burndown Chart
- Time-Since-Issue Chart
- Ticket processing time
- Overview of priority of tasks
- Sprint Report

Explaining one example of the above-named criteria, the “Ticket processing time” measures the time of a task completion process: If a new (development) task needs to be done, a ticket is created. Afterward, the task is being processed and reviewed. Following a positive review, the task is declared as *done*, and the ticket will be closed. The time from the creation of the ticket to the closing of the ticket describes the "ticket processing time".

Another component of measurement criteria is offered by observations as objective and qualitative criteria such as tally sheets on meeting attendance or stopping time to check the punctuality of meetings. In addition, it is to be checked whether the team adheres to the developed guidelines. To be able to draw up an effort-benefit comparison in the final interpretation of the results, it is necessary to document the resources required in each step. In this application, these resources include the time spent by the team and the author of this paper.

To ensure that appropriate measurement criteria are selected, potential **disturbance variables are identified** at the outset. The following variables were noted:

- Holiday or sickness-related absences of employees
- Technical difficulties (e.g., VPN problems)
- Scheduling conflicts due to parallel projects
  Scheduling conflicts due to time differences to other locations

As the mentioned disturbance variables can be recognized and understood at an early stage, they do not hinder the collection and evaluation of the above introduced measurable variables. In addition, the process of identifying further

potential for improving during the application of the EDiT-Method is a continuous process. Therefore, the collection of relevant variables, both measurable and disturbance, is also a continuous process.

The initial questionnaire designed after Workshop #1 and the statistics from Jira and Confluence listed above are used to **measure the initial state**. It is essential to ensure that all data for determining the initial state is collected before implementing the measures.

A **measurement of the new state** should take place regularly at the end of each sprint. It is planned to measure the new status in the retrospective of a sprint. This process must be carried out continuously to ensure the most precise possible statement about the benefits of the implemented measures.

The initial analysis - suitability check takes place in parallel with the identification of potential measurable variables. The criteria for selecting suitable measurable variables should be considered. These criteria are the main components for the *selection of suitable measurable variables.*

The step of **final analysis and statistical processing** takes place at the end of the application of the EDiT method by the authors of this paper. This step aims to be able to make a final statement about the method's contribution to success based on the data collected. This data is also the main component of the presentation of results (see Figure 1).

4.3. Concept for the validation by matching the requirements

The questionnaire of the degree of fulfillment should be carried out at the end of the application of the EDiT method. The team must have sufficient experience with the application of the method. In this study, the questionnaire is carried out at the end of the third sprint. According to the categories of the Design Research Methodology [19], the requirements validation questionnaire contains six requirements for support performance, six requirements for applicability, and four requirements for contribution to success elaborated by Duehr et al. [6]

A statistical analysis of the results from the previously collected data takes place in the **final analysis & statistical evaluation** by matching the requirements.

Recommendations for action are to be derived continuously according to the defined and implemented measures. In this study, these recommendations for action are to be made available to the entire company to generate a catalog that provides possible measures for various potential improvements.

The **interpretation of the results** from the measurements of the conditions is to be carried out continuously. The final interpretation should be presented to the team and stakeholders. This **presentation of the results** should contain the final analysis & statistical evaluation and the recommendation for actions.

The step of **further development of the EDiT** method is a continuous task from the beginning of the preparation to the presentation of the results and includes all experiences and data which were made and collected during the application. To ensure that Porsche Engineering contributes to the further development of the EDiT method, the experiences, data, and results as well as the tools used are provided.

5. Results of the validation of the EDiT method

5.1. Results of the validation through application

The validation by application was carried out according to the process model presented in Figure 1. In total, 80 hours were spent. This results in 59 hours for the implementation and evaluation of the workshops and measures and 21 hours for the preparation and follow-up of the respective activities. As planned, the improvement potentials and measures were documented in a list and assigned by field of action. This list is shown in Figure 3.

Field of action	Sprint	Potential for improvement	Measure
Project development task	1-3	Tasks not always prioritized	PO prioritizes backlog
	1	Tasks are not precisely described	Fill backlog with tasks according to best practice
Suitable process approach / Virtual communication	1	Tasks can be created by all stakeholders	Define ticket creation process
	2	Review process not clear. Bottleneck, as all reviews are carried out by the PL	Create a process for processing the different types of tasks
Team development	2-4	No effort estimation of tasks available	Define and track story points
	1	Tasks are distributed and cannot be chosen	Team members have the possibility to choose tasks
Data knowledge and management	2	No regular exchange with stakeholders	Integrate stakeholders regularly in team meetings
	2-4	Stakeholder feedback is integrated late, so the release scope is often unclear.	Validate and adapt current release cycles
Virtual communication & collaboration / Data knowledge and management	1	No regular team exchange to determine when a task is done	Active tracking of ticket progress and opportunity for exchange in daily meetings
	1	No regular team exchange to share experiences	Conduct daily meetings
	3	Lack of clarity about who the actual subject matter experts are	Create overview about process experts

Figure 3: List of measures implemented throughout the application of the EDiT methode

5.2. Results of the validation through assessment of the contribution to success

In the first sprint, only measures relating to the category "Tasks and Tickets" and "Teamwork and Communication" were implemented. For example, tasks were now created uniformly according to a best practice and the daily meeting should improve communication in the team. Furthermore, all existing tasks and tickets were checked for actuality and sorted out if possible.

The second sprint focused on “cleaning up the desk”. Therefore, all tickets were screened, and the team has sorted out the irrelevant tasks and worked specifically on old but still current tasks to create an optimal state for further tasks. In addition, the agile way of working offers the possibility of integrating topic experts into the team for a period so that they can be directly involved in the event of ambiguities.

Accordingly, a topic expert from the customer projects was part of the team in this sprint. To further improve communication, each team member was once again asked to participate punctually in the daily meeting.

The third sprint exclusively contained measures in the category “Tasks and Tickets”. To formulate the tasks in a more result-oriented way, so-called acceptance criteria were introduced. These had to be fulfilled for the task to be evaluated as solved. In addition, the Scrum Board was now shared withing the team in each daily meeting to be able to track more precisely who is working on which task.

The final fourth sprint again focused on the categories “Tasks and Tickets” and “Teamwork and Communication”. First, a chat channel was set up to facilitate communication, and second, the acceptance criteria mentioned above were further defined so that they contain statements that are as atomic as possible and can easily be assessed as "completed" or "not completed".

Based on the collection of quantitative and qualitative, subjective, and objective measurement criteria, a positive change from the baseline condition could be demonstrated. As Figure 4 shows, each category of the subjective questionnaire could be increased compared to the initial state. The value "Tasks and Issues" experienced the greatest increase with an improvement of 2 on a 5-point Likert scale.

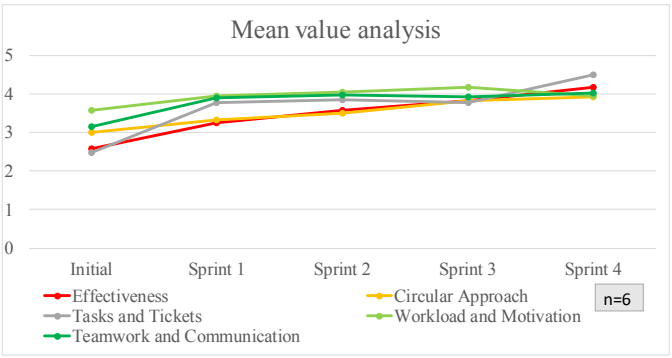

Figure 5: Mean value analysis: feedback of the team

At the same time, all objective measurement criteria taken from the Jira software could be improved. For example, the average number of days that a ticket is unresolved was reduced by 40%. In addition, the meeting efficiency was also improved, so that after the implementation of the measure, only two out of ten of the daily meetings of a sprint started with a delay of less than one minute. The effort incurred can be considered reasonable, which also becomes clear in the following validation of the requirements.

5.3. Results of the validation by matching the requirements

Validation by matching requirements is divided into three components: Support Performance Requirements, Applicability Requirements, and Success Contribution Requirements. In the following, one example of each of the different components is explained in more detail in Figure 5.
The example of the support evaluation clearly shows that the method supported the team in analyzing improvement potentials. Thus, the evaluation of the contribution to success showed the success of the EDiT method based on a significant

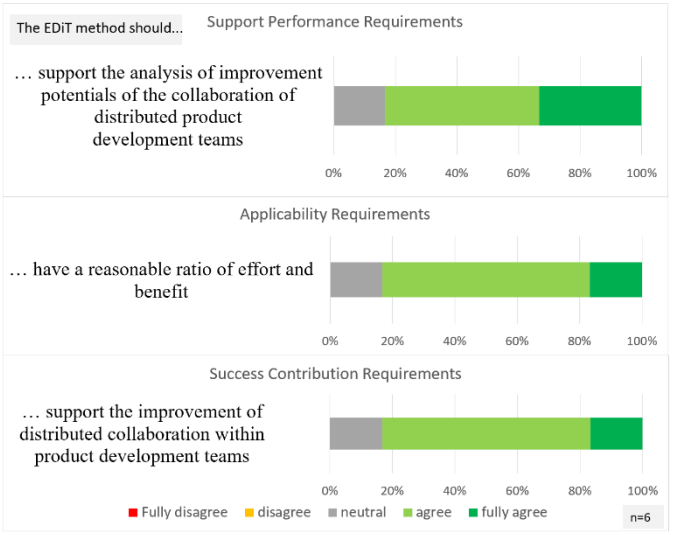

Figure 4: Analysis: degree of fulfillment of the requirements

improvement of the new state compared to the baseline condition of the team development. The achieved success of the implementation and further development of the EDiT method must be compared to an effort of 92 hours. This effort is considered reasonable in the context of this work.

The example of the requirements for the contribution to success shows once again that the method is a reason for the improvement of distributed collaboration.
Based on this final validation, some further developments can be mentioned. For example, the method should contain a kind of toolbox, which includes workshop documents and various measures for the development of improvement potentials. Furthermore, the implementation of the EDiT method at the Porsche Engineering’s process team led to the following further developments:

- Development of a guideline for the implementation of workshops to analyze potentials and define measures.
- Development of a questionnaire to collect measurement criteria
- Extension of the method's system of objective to include support for the introduction of agile working methods.

6. Discussion

At the example of the process team of Porsche Engineering Services GmbH, it could be shown that the four steps of the EDiT method are applicable in industrial development practice. Furthermore, the process model could be further developed for validation through application, validation through evaluation of the contribution to success, and validation through matching the requirements, and a best practice about how to use the method in agile events was derived. Subsequently, the added value of the method was demonstrated in the validation by evaluating the contribution to success using various objective, subjective, qualitative, and quantitative measurement criteria. Compared to the initial state, an improved new state was always made measurable. Through the final validation by matching the requirements, the success was confirmed by the entire process team. Furthermore, some recommendations for action for the further development of the method were drafted.

Despite the complementary data collection of quantitative and qualitative measurement criteria, internal validity is limited. Due to many external influences, it cannot be determined whether the new status was achieved solely through the implementation of the defined measures. Also, the COVID-19 pandemic may have influenced the research as the need to improve collaboration has exceptionally fast increased. As a result of the successful implementation of the measures and the correspondingly diverse selection of variables, sufficient credibility of the results was ensured. External validity is also impaired, as the results collected in this study cannot be easily transferred to other companies. This is due to the individual development situation with individual challenges, which is the focus of the EDiT method. Nevertheless, general cross-company results could be collected through the validation by comparing the requirements. At the same time, the process team of Porsche Engineering reflects reality, which is why a high level of external validity can be assumed.

In principle, it is hardly possible to produce reproducible studies with the same framework conditions in field studies in an industrial environment. This means that there is no high reliability. Since attention was paid to a consistent definition of variables and the results are comparable to those of Duehr et al. study [20], adequate reliability can be assumed.

Finally, objectivity is also not completely given. Some of the results presented may be subjectively influenced. For example, biased completion of the questionnaire due to sympathies cannot be excluded. In this paper, possibly biased data are marked as subjective. At the same time, although there are no degrees of freedom in the statistical evaluation, there are in the selection of the communicated results.

7. Conclusion and outlook

Distributed collaboration poses various challenges. To counteract these challenges at the process team of Porsche Engineering Services GmbH, the EDiT method was applied. The first research question involved designing a variant of the EDiT method that was adapted to the development situation at hand (Figure 3). Here, the added value of the method is first given by the introduction of agile working methods itself, and second, the continuous improvement of distributed work has been measured using subjective, objective, qualitative, and quantitative measurement criteria. E.g., the time tickets are unresolved was reduced by 40% and the subjective feedback regarding the “Tasks and Tickets” increased by two points on a 5-point Likert scale (see Figure 4). Furthermore, especially through the validation by matching the requirements, some hints for the further development of the EDiT method could be formulated, such as the need for a toolbox, which contains workshop documents and possible measures for the development of potential improvement potentials, to further improve the ratio of effort and benefit.

The present contribution can serve as a basis for further research activities. For example, continuous validation must be carried on ensuring a successful introduction into industrial practice. In addition, a study comparing the EDiT method and the PDCA method should take place to examine the added value of the EDiT method more closely. Furthermore, the system of objectives of the EDiT method could be extended so it is also serving as a supporting method for the introduction of agile working methods. This transferability should be investigated further and, subsequently, it should be examined to what extent the EDiT method can also support a company transformation from classic to agile project management.

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