An In-Depth Interpretive Case Study in Requirements Engineering Research: Experiences and Recommendations

Marcus Keutel, Werner Mellis

University of Cologne,
Department of Information Systems and Systems Development,
Pohligstr. 1,
50969 Cologne, Germany
{keutel, mellis}@wiso.uni-koeln.de

Abstract. This article reports our experiences with an interpretive case study, investigating requirements engineering (RE) in practice. First, we briefly explain why interpretive case study research (CSR) is an adequate methodology to answer current research questions in RE. Then, we provide recommendations of how to conduct interpretive CSR in RE based on our own experiences with an in-depth single case study. These recommendations are threefold: (1) initiation, (2) data elicitation and (3) data analysis. Thereby, we aim to contribute to methodological literature on interpretive CSR. This paper mainly addresses less-experienced RE researchers who can use our recommendations as a rough guideline for their own case studies. However, we believe that even experienced RE researchers and researchers from other IS areas will make use of this article as they can reflect on their own approaches.

Keywords: case study, case study research, qualitative research, interpretive, interpretivism, requirements engineering, information systems.

1 Introduction

Scholars request extensive empirical research in requirements engineering (RE) [1, 2]. More intensive research in real-life settings is explicitly demanded [3]. Accordingly, we apply the case study research (CSR) methodology[1] to answer current RE research questions which we will state below. In this article, we use this example case study to develop recommendations of how to do interpretive CSR.

Mingers [5] noticed a strong increase in the number of interpretive studies in leading information systems (IS) journals. However, we noticed that there is a lack of methodological literature on this topic. We found guidelines concerning CSR in general, e.g. [6], but we missed hands-on guidelines of how to conduct in-depth

[1] The terms “method”, “methodology” and “research strategy” are used alternatively by different scholars. Rather than entering into this debate, we follow Piekkari et al. [4] and call CSR a methodology.

interpretive IS CSR. Thus, Walsham's work was very helpful for us. He addresses the nature of interpretive IS CSR [7] as well as interpretive research in general [8]. Thereby, he explains methods for conducting such research. In this paper, we add to his work, as we report more detailed experiences in carrying out such fieldwork. We describe concrete challenges we faced and how to overcome these. Thus, our primary target audience are less-experienced RE researchers who can use our recommendations as a guideline for their own case studies. But we hope that also experienced RE researchers and researchers from other IS areas will make use of this article as they may reflect their own approaches.

The remainder of this paper is organized as follows. In the subsequent section, we explain the research questions underlying our example case study. Then, we describe our case study's research design. Afterwards, we proceed to describe the experiences in conducting our in-depth interpretive case study. The essential results of this section are recommendations of how to conduct interpretive CSR in RE.

2 Our Case Study's Research Questions

The answers to our case study's research questions (RQ) stated below are not part of this article as (1) data analysis is still ongoing and (2) this article's focus is on recommendations of how to conduct interpretive CSR in RE. Nevertheless, it is important to understand these RQs as our case study's research design (cf. section 3) and the resulting experiences and recommendations (cf. section 4) are based on these.

IS scholars have proposed a variety of requirements engineering techniques. These techniques' suitability and effectiveness depend on the contexts they are applied in [1, 2]. Accordingly, current RE research should try to understand the problems that RE practitioners face in choosing and applying RE techniques in order to solve requirements risks[2]. Therefore, the following research questions should be answered:

RQ1: How are different situations of requirements risks characterised in practice?

RQ2: Which techniques are considered and finally chosen to cope with different situations of requirements risks?

RQ3: Why are these techniques chosen in their respective situational context?

RQ4: How successful are the applied techniques in coping with requirements risks in different situations?

To develop answers for these research questions, we apply CSR which is an adequate methodology for the following reasons. Scholars recommend to apply CSR at exploratory studies [11]. Additionally and according to Yin [12], CSR is suitable to answer research questions of '*how*' (cf. RQ 1 and RQ 4) and '*why*' (cf. RQ 3). Finally, we follow Mathiassen et al.'s [2] call for "case studies of the relationship between practices and techniques, of how and why techniques are adopted and combined, and of the effects that techniques have on resolving risks" [2, p. 583]. CSR allows to gain rich, contextual insights into the dynamics of phenomena under investigation [13], in our case the RE practice in coping with requirements risks.

[2] These issues are variously labeled as "risk" or "uncertainty". We follow Mathiassen et al. [2] and use the term "requirements risks". Requirements risks potentially lead to wrong or inadequate software solutions, rework, implementation difficulty or delay [2, 9, 10].

3 Our Case Study's Research Design

The main focus of this article is to give recommendations for doing interpretive CSR in RE. Given the fact that these recommendations are based on our own experiences with such a case study, it is important to describe the underlying research design. This enables the understanding of the anecdotes in section 4. We describe our research design with regard to the following criteria: (1) philosophical foundations, (2) theorizing, (3) case selection, (4) data sources [14] and (5) the researcher's involvement [8].

3.1 Philosophical Foundations

Different philosophical foundations lead to different judgments about the role of CSR, its application, and the criteria for evaluating its quality. Therefore, researchers should clearly state, which philosophical approach they follow [7, 14]. We position ourselves as interpretive researchers. Interpretivism relies on the assumption that people create and associate their own subjective and intersubjective meanings as they interact with the surrounding world [7, 8, 13, 15]. Consequently, interpretive researchers understand the world under investigation and themselves as not separable. Thus, they attempt to understand phenomena by accessing the meanings that participants assign to these. They are aware that their data gathered are their own constructions of other people's constructions of their perceptions of the world. As we will show in the subsequent sections, the interpretive approach has an impact on all other elements of the research design.

3.2 Theorizing

Following Ragin [16], we decided to use case-oriented theorizing. The value of case-oriented approaches is their ability to produce holistic and particularized causal explanations for the outcomes of each investigated case [14]. In this case, theorizing means "tracing the causal processes that generate outcomes in specific contexts." [14, p. 571] Especially the context of a phenomenon under investigation is thus regarded to be very important to derive meaningful explanations. The generalization takes place within a single setting instead of generalizing a theory across different settings [17, 18].

3.3 Case Selection

We select a single software development project (SDP) which we analyze in detail in order to explain its dynamics. Before we started to search for a SDP we established several prerequisites: (1) The requirements for the software to-be-developed should not yet be elicited. This is necessary to become aware of the analysts' perceptions of requirements risks. (2) The project team should have the opportunity to choose RE

techniques according to the requirements risks perceived. Dictating the techniques in advance would avert the possibility to analyze the consideration process between different techniques within the SDP. (3) Potential RE techniques should not be excluded because of the geographic distance between customer and contractor. (4) For pragmatic reasons we wanted the SDP to be located in Germany and to be scheduled for a duration not longer than one year.

We chose a strategically important project of a leading international insurance company located in Germany that fulfilled all of our criteria. In section 4.1, the experiences with our search for an adequate SDP are explained in detail.

3.4 Data Sources

Multiple data sources are essential to clarify meaning by identifying different ways a phenomenon is seen [19]. In order to get an in-depth understanding of the investigated SDP, we seek to analyse it based on all available data sources.

During the requirements elicitation phase at least one researcher was on-site every day, participating in meetings, formally and informally interviewing project team members as well as analyzing documents at the project's hard drives. Additionally, we had access to the project's RE management system and the emails of key project members. In our case study, three researchers were involved in data collection on-site.

3.5 Researcher's Involvement

In our case study, we adopt the role as neutral observers. According to Walsham [8, p. 321] neutral means that "the people in the field situation do not perceive the researcher as being aligned with a particular individual or group within the organization, or being concerned with making money as consultants are for example, or having strong prior views of specific people, systems or processes based on previous work in the organization." We extend this definition. In our study, neutral also means to influence the observed phenomena at a minimum as we want to learn from uninfluenced reality. Nevertheless, our continuous on-site presence leads to close involvement, allowing in-depth access to the project and its stakeholders, issues, and data.

4 Experiences and Recommendations of Doing Interpretive CSR

In this section, we present recommendations of how to conduct interpretive CSR in RE, based on our experiences with the research design explained above. We believe that these recommendations are especially helpful for RE researchers new to the CSR methodology. Nevertheless, experienced RE researchers and researchers from other IS areas may find some worthwhile suggestions for their research as well.

We divide this section into three parts: (1) the initiation of our case study, (2) the data elicitation, and (3) the data analysis. However, the three parts of our case study

were not performed sequentially. During the initiation, we already collected first data and analyzed the data while continuing the collection on-site.

4.1 Initiation

Search for different partners at the same time. When starting to search for a SDP with certain characteristics (cf. section 3.3), we first focussed on a single company. Given the huge amount of confidential data needed, we participated in many meetings with the company's managers on different hierarchical levels to get their approval for our case study. After deciding to embark on our case study, the company started to search for an adequate SDP. However, it took a couple of months and many meetings with the company's project leaders to realize that we were in an impasse: The company was not able to assign an adequate SDP to our case study. We had lost plenty of time by negotiating with a single company. After this experience, we changed our strategy. We now recommend you to contact a multitude of companies at the same time.

Keep documents simple and practitioner-oriented. When we started to search for a partner and an adequate SDP, we sent out a two-page plain text letter, including our research goals and a request for cooperation. Additionally, we used a 20-slide presentation explaining the research problem, our goals, the methodology, and a detailed current status of our research results. Our intention was to help the recipient develop a comprehensive view on our research project. As a result from our first meetings, we learned that this was too much information. Practitioners are mainly concerned with potential benefits for the company and do not want to be bothered with additional information. Thus, we extremely shortened our presentation. With seven slides, each of them directly addressing issues of our planned case study – especially potential benefits for the company - we kept it simple and practitioner-oriented. This format leads you to much more efficient meetings.

Find a champion. On our way to get access to a SDP, we had to convince a lot of people. In such cases a champion [20] helps to assure the necessary support. It is import to differentiate between a real champion and someone who just pretends to support the case study. At the company which finally participated in our case study, we had strong support by a champion, belonging to the company's middle management. He accompanied us in meetings with project leaders of considered projects. In these meetings, he helped to convince the project members to participate in our case study. The champion explained why our case study must be seen as strategically useful for the company and therefore, the SDP is expected to join our case study. Besides the support in these official meetings, he carefully influenced critical project members in informal conversations and constitutes a positive attitude towards our case study.

Address gut feelings. As we have learned during the initiation of our case study, not everyone can be convinced by factual arguments. Some people follow their gut feelings which you should address. During our initiation meetings we met a lot of project members whom we granted confidentiality and anonymity and explained that our research results will not have any negative consequences for them. Nevertheless, we needed intensive one-to-one conversations to overcome their scepticism. We

explained our personal motives in conducting this research project, giving them an opportunity to become acquainted with us and thus convincing them to trust us.

Take more than you need. Our research design demands us to observe just one SDP. Nevertheless, we recommend starting to observe more projects if possible. At our partner company, we initially observed two projects, with the intention to drop the less interesting project after a couple of weeks or months. This turned out to be a good decision: One project showed a lot more potential for our research topic because of more situations dealing with requirements risks. Before you begin to observe a project you do not know what data you will finally get.

Clarify conditions and expectations. Conducting an in-depth case study in a RE context implies having a lot of stakeholders at the company's site, e. g. the company's management, the project leader, software developers, business analysts and customer representatives. Each of them has different expectations concerning the case study's output. When you introduce yourself to a project, you should clearly state, what deliverables your case study will have and how each stakeholder may benefit from them. This helps to strengthen their commitment to the case study and avoids having frustrated stakeholders at the end of your research. Additionally, a clarification of the data elicitation conditions is needed at the beginning of a case study. We made sure that everyone in the project knows what kind of data we are interested in and that it is important for the success of our study to receive all relevant information regarding our research questions. Thus we encouraged the project members to forward us all information possibly relevant for us.

4.2 Data Elicitation

Build trust. People grant access to the information you need only if you are trustworthy. Otherwise, they will tend to hide potentially critical or harmful information. Consequently, we invested plenty of time in networking with project members, e.g., by meeting for lunch or dinner, participating in project team events and informal conversations. These meetings were mainly about non-research related topics. Nevertheless, we did not interrupt our dialog partners when they referred to project related issues. It even occurred that they asked for our opinion regarding other project members or they tried to get information which they assumed we received from another project stakeholder. In these situations, we consequently showed our integrity and confidentiality by neglecting any answer. In most cases, this did not lead to any resentment but to more trustful conversations, containing interesting information regarding our research questions. Nevertheless, it is important to keep a professional distance from each project member. Otherwise, the researcher may become socialized to their specific views and thus may loose the benefit of a fresh outlook on the situation [8].

Collect data broadly. It seems obvious that you should have a clear focus in the data collection within an in-depth case study. In our opinion, limiting the focus too much would be a mistake. During our case study, we participated in a multitude of meetings, which initially just had a peripheral link to our research questions, e.g., effort estimations or conversations about training courses. However, during these meetings issues aroused which directly affected them. Consequently, we recommend

using every opportunity to gather data, which may help to answer your research questions. That means for example that the decision about observing a meeting or not should not solely be made based on the planned topic but on the list of scheduled participants, as contents may shift occasionally.

Take notes without attracting attention. It is important to take notes when you are observing a meeting or talking to project members in order to preserve the information. Taking notes just may become a problem, if you do it very conspicuously. In one of our first meetings at the observed SDP, we continuously took notes. This seemed to irritate some project members. Apparently, we influenced them and some started to be afraid of giving critical comments in the meeting. After a while one participant said: "I would like to know, what you are writing down all the time". For future meetings we learned to behave differently: Now we are noting keywords, sometimes delayed, e.g. not directly after critical comments are expressed. The notes are completed after the meeting is finished. With regard to informal conversations, we take notes only afterwards. This is for the same reason – we do not want to scare the project members.

Share impressions with research colleagues. As stated above, three researchers were collecting data on-site simultaneously. We did not divide the data elicitation in different topics due to pragmatic reasons: We avoided the necessity of having each researcher on-site every day. Consequently, different researchers got into contact with the same topics and project members during their on-site presence. If you follow this approach you need an intensive and regularly sharing of impressions between the researchers, mainly because of two reasons: (1) Project members do not like to be bothered by being asked the same questions twice. (2) In order to understand current discussions, the observing researcher has to be up-to-date concerning the state of the SDP.

Carefully involve the champion. In section 4.1 we stated that a champion is very useful for the initiation of a case study. Of course, the champion can also be helpful during data elicitation, but you should involve him very carefully. We rarely involved him, just in case of challenges which had their origin beyond our sphere of action. Thereby, we avoided having project members feeling under pressure because of the champion's presence. Nevertheless, we stayed in close contact with him, e.g. through weekly lunch meetings, in order to assure his support in potential crisis situations.

Remind project team of your presence. In our case study we learned that after a while some people tended to forget us. We expected this behaviour and thus did not rely on actively being informed about every new development by the project team, e.g. in form of scheduled appointments. Consequently, we implemented some counteractive measures: E.g., we assured access to the key project team members' online calendar and checked regularly if there were are any relevant meetings to which we were not invited. In such cases, we asked the meeting's organizer politely if we could participate. Afterwards, we explained again that it is very important for our study's success to get all relevant information regarding our research questions. Usually the effect was that this SDP team member got a bad conscience. He or she then promised to keep us better in mind and in most cases his turned out to be true. In the following weeks, the information flow concerning the affected project team member was much better than before but sometimes after a while experienced another

worsening. Therefore, you should remind the project team members of your presence from time to time.

4.3 Data Analysis

Regularly reflect on what you have learned. We followed Walsham's recommendation of preparing sets of themes and issues after a certain period of time of data collection [8], that is after a set of interviews or meetings. This first analysis requires a reflection of previous insights and may also lead to redirections in data elicitation. As interpretive researchers, we are aware of our subjective views on the elicited data (cf. section 3.1). Each researcher involved creates a subjective and independent view of the world under investigation. Consequently, each researcher involved should independently summarize his or her findings from time to time. Consolidating the individual insights leads to a more holistic picture, representing all perceptions and thoughts.

Make use of software tools. Even though we agree on Walsham that "software does not remove the need for thought, as the choice of themes remains the responsibility of the researcher" [8, p. 325], we recommend to make use of software tools. During our case study, we collected a multitude of data. According to our experiences, it is very helpful to use a software tool to support the qualitative data analysis, such as QSR Nvivo, the product we use. Such a product is helpful to arrange the data and facilitates collaborative work with multiple researchers. It is also regarded as helpful to justify your findings with evidence, as it helps to link findings back to the original data that supports it.

Reflect with practitioners. Given our positioning as interpretive researchers, we understand phenomena through accessing the meanings that participants assign to these phenomena (cf. section 3.1). These meanings are not obvious in every case. To avoid being on the wrong track, you should reflect preliminary perceptions and interpretations in informal interviews with practitioners. In some cases, this led us to interesting reinterpretations of observed phenomena, such as motives for choices between different RE techniques.

5 Conclusion and Limitations

We derived this article's recommendations from our own experiences in conducting an interpretive in-depth case study. Due to their nature, these recommendations are subjective. Not every recommendation may turn out to be useful in every setting as they are derived from our specific context. A further limitation is the unfinished status of our case study. There may be some more pitfalls, especially during data analysis, which we are not aware of right now. Nevertheless, we believe that the recommendations stated above will help less-experienced RE researchers when conducting such a case study.

We encourage the research community to debate different ways how to conduct CSR. We believe that concrete experiences concerning the adoption of a research methodology help to further develop the methodology. Therefore, especially

experienced researchers are requested to share their knowledge of the methodology-in-use. We hope that our recommendations are also inspiring for those researchers and therefore lead to improvements in their future research projects.

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