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Conducting focus group research in a design science project: Application in developing a process model for the front end of innovation

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Abstract

Focus groups are a popular qualitative research method often applied to different areas of such as in medical research. The aim of this research paper is to apply and test the focus group procedure by Tremblay et al. in the setting of a current design science study on the Front End of Innovation. The main results of the current paper are an empirical testing of the Tremblay et al. method and proposed modifications of this method based on said testing. These results confirm that focus groups, conducted in compliance with said method, can be of great use in design science projects to support refining and evaluating artifacts. The results obtained in such manner can provide essential contributions to the knowledge base. The findings also indicate that the approach by Tremblay et al. does not address particular research-setting specific factors, such as the right timing when to actually conduct the focus group, the background of an organization, the contextual influences in participant selection process or the definition of an appropriate setting for the focus group study. The current paper addresses the strengths as well as the shortcomings detected in the current setting and proposes modifications to the Tremblay method.

Keywords: focus groups, focus group procedure, design science, design science research, build-evaluate-cycle

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1 Introduction

Much of the research in the Information Systems discipline is characterized by two complementary but distinct paradigms: natural science and design science (March, Smith 1995; Hevner, Chatterjee 2010; Hevner et al. 2004). Natural science aims at explaining how and why things are and seeks to develop and justify theories. Usually starting with a hypothesis, natural science research collects data to either prove or disprove the defined hypothesis. Design science positions itself as a problem-solving paradigm (Peffers et al. 2007) and can be defined as an attempt to create outputs that serve a particular human purpose with the objective of producing an artifact which must be designed and then evaluated thoroughly (Helfert, Ostrowski 2012; Hevner,

Chatterjee 2010; March, Smith 1995; Goldkuhl 2013). While behavioural science tries to understand the truth respectively reality, design science hence focuses on creating "things" or artifacts that serve a particular human purpose and address urgent problems. Design science is technology-oriented and its outcomes (the artifacts) have to be assessed against criteria of value and utility (March, Smith 1995). This paper is concerned with design science research. There are basically four different kinds of DSR outputs (artifacts): constructs, models, methods and implementations / instantiations (Goldkuhl, Lind 2010; March, Smith 1995; Hevner, Chatterjee 2010). The fundamental principle of DSR is that knowledge of a problem and its solution is created in iterative build-evaluate respectively theorize-build-evaluate cycles of artifacts (Goldkuhl 2013). Based on this pattern, Hevner et al. (2004) derived seven guidelines to assist researchers to understand the requirements for effective design science research: (1) Design as an Artifact, (2) Problem Relevance, (3) Design Evaluation, (4) Research Contribution, (5) Research Rigor, (6) Design as a Search Process and (7) Communication of Research (Hevner et al. 2004). Hence, the core element of design science is to develop or build artifacts that are theoretically grounded (rigorous knowledge base) and to justify or evaluate those artifacts for the particular environment (relevance for application environment).

Many different methods and techniques can be found and applied in the context of design science to build, evaluate and improve artifacts, including experimental, observational, testing, descriptive and more recently action research methods (Helfert, Ostrowski 2012; Goldkuhl, Lind 2010; Cole et al. 2005; Hevner et al. 2004; Baskerville, Myers 2004; Lindgren et al. 2004). Such methods range from different kinds of literature reviews, benchmarking, surveys or expert interviews to prototype experiments and simulations or multi grounded approaches (Goldkuhl, Lind 2010; Sonnenberg, Brocke 2012a; Hevner, Chatterjee 2010; Helfert, Ostrowski 2012; Sonnenberg, Brocke 2012b). The current paper concentrates on the use of focus groups in design science based projects. According to Tremblay et al. (2010) there are several key reasons why focus groups are an appropriate technique for design science studies: Allowing for an open format, focus groups are flexible enough to be applied in a wide range of design topics and domains. By putting the researcher into direct contact with potential users of the artifact and with domain experts, focus groups support clarifying artifact design questions and probing respondents on key design issues. The high level of interaction in the course of a focus group study allows for deeper understanding on respondents' reactions, on the use of the artifact and on other issues in the respective environment influencing design. Furthermore, the high degree of interaction also fosters the emergence of ideas or opinions that wouldn't have emerged in traditional, individual interviews (Tremblay et al. 2010).

Still, the approach of applying focus groups to build, evaluate and improve design science artifacts is relatively new to the IS field (Smolander et al. 2008; Tremblay et al. 2010). The amount of publications specifically addressing the application of focus groups in a design science setting is low (Tremblay et al. 2010; Gibson, Arnott 2007). Furthermore, existing frameworks in the context of design science do not seem to specifically address research setting specific factors, such as the integration of modern IT infrastructure or the specific characteristics and factors one has to consider e.g. during sample definition. Although the importance of such factors is emphasized by different authors (Gibson, Arnott 2007; Kitzinger 1994; Sim 1998), most focus group procedures do not pay enough attention to them respectively do not ad-

dress them accordingly. Such factors have to be especially emphasized in the course of projects addressing "wicked" problems, which are typical for design science research (Rittel, Webber 1973; Hevner et al. 2004). An acknowledged procedure for applying focus groups in a design science context was proposed by Tremblay et al. (2010). Building on traditional elements of focus groups, Tremblay et al. (2010) derived eight procedural steps on how to plan and conduct focus groups in a design science context. Each step was analyzed taking into account the particularities and primary goals of design science: artifact refinement and artifact evaluation (Tremblay et al., 2010).

The current paper aims at applying the focus group method proposed by Tremblay et al. in the setting of an actual design science study, which – in this particular case – deals with the Front End of Innovation and is set in the area of innovation management. This design science study was selected as an appropriate test setting and aims at developing a process model for the highly unstructured and often ill-defined Front End of Innovation (FEI), which represents the earliest stages of the innovation process (cf. section 2.1). Implicit knowledge and non-standardized processes and activities dominate organizational practice at this stage of innovation management (Stevens 2014; Akbar, Tzokas 2013; Jörgensen et al. 2011; Ho, Tsai 2011). The FEI is a good example for a wicked application domain, which is often characterized by the existence of vicious circles, risks that new solutions may introduce new problems or by a lack of self-evident solution options (Goldkuhl, Röstlinger 2009). Missing know-how about the practices and activities conducted and the challenges and issues encountered at the Front End of Innovation in organizational practice are issues of major concern for process model development (Akbar, Tzokas 2013; Backmann et al. 2007). A thorough analysis in order to deepen our understanding on this highly unstructured and non-standardized part of the innovation process was of crucial importance. Because of the previously mentioned advantages and potentials of focus groups in design science studies (e.g. their flexibility, the high degree of interaction, the large amount of information or the direct interaction between researches and respondents), we decided for applying a focus group study in accordance with the previously introduced procedure proposed by Tremblay et al. (cf. section 4).

The research questions addressed in this paper are the following: Is the focus group procedure proposed by Tremblay et al. (2010) applicable in the context of an actual design science study (RQ1)? What are specific strengths and shortcomings of this procedure and what possible modifications can be proposed (RQ2)? Based on the results of a literature review, we did not find any publication discussing the application and testing of this procedure in the setting of an actual design science study. Hence, the findings of our paper may be of great value for other researchers planning to apply focus groups in the course of a design science study. In order to address the stated research question, focus group literature and existing procedures in this context will be dealt with in a first step (section 3.1, 3.2). Subsequently, the focus group procedure by Tremblay et al. will be explained and analysed in more detail in a second step (section 4). The instantiation of the selected procedure and the outputs and results gained that way will be presented in detail in a third step (section 5), followed by a reflection of experiences and key learnings encountered during the application of the procedure in our design science study (section 6). We conclude our paper by summarising the main findings and contributions in the last section of this paper (section 7).

2 Background and Research Method

In section 2, the background of the current paper and the research method applied are explained. Section 2.1 focusses on the need for conducting a focus group study and deals with the specific context of the research project in which we applied the focus group procedure. Section 2.2 provides an overview of the methodological steps taken in the course of this paper to address the defined research questions (cf. section 1).

2.1 Background

This paper is set in a current design science study in the area of innovation management, which follows the design science approach. The aim of this project ("InnoStrategy 2.0") is to develop a process model offering specific support for the early stages of the innovation process, which are known as the "Front End of Innovation" (further referred to as FEI) (Koen 2001). Existing findings indicate that improving the FEI process offers the largest potential for improving an organization's innovation capability as a whole with the least effort (Aagaard, Gertsen 2011; Verworn et al. 2008; Backmann et al. 2007; Nobelius, Trygg 2002). Other authors found that the main differences between winners and losers in regard to innovation management can be found in the quality of their predevelopment activities (Cooper 1996), refer to the FEI as "the root of success" for organizations involved with discontinuous product innovation (Reid, Brentani 2004) and clearly state that high failure rates in the NPD process are often related to too little effort put in the FEI activities (Cooper 2011; Ho, Tsai 2011; Verworn 2009; Khurana, Rosenthal 1998). This indicates that the FEI is especially critical for innovatory success and long-term competitiveness (Oliveira, Rozenfeld 2010).

Although the Front End of Innovation (FEI) has received quite some attention in research, a generally accepted definition is still missing (Aagaard, Gertsen 2011), different authors disagree on its boundaries (Martinsuo 2009) and the terminology varies (Nobelius, Trygg 2002). For some authors, the FEI includes concept definition and its preceding stages (e.g. Koen 2001), for others, business and programme planning should be included as well (e.g. Kim, Wilemon 2002, Cooper 2011). Furthermore, a clear discrepancy exists, as to whether the front end of innovation should and can be formalized and systematically managed (e.g. Markham 2013; Reid, Brentani 2004; Montoya-Weiss, O'Driscoll 2000; Cooper 2011; Verworn et al. 2008; Khurana, Rosenthal 1998; Trotter 2011; Boeddrich 2004), or whether a more informal, iterative, chaotic and non-prescriptive approach should be preferred (e.g. Nobelius, Trygg 2002; Stringer 2000; Smith, Herbein 1999; cf. section 1.2). Other authors in turn suggest a hybrid approach and clearly state that "a certain amount of control appears necessary to secure the effective use of resources and the achievement of the company's long-term objectives" (Poskela, Martinsuo 2009, p. 671) and that the attention should be drawn to key activities and tasks at the FEI rather than to their linear order respectively decision gates (Koen 2001).

Considering the above, it becomes obvious that the Front End of Innovation is on the one hand a very important research area that already received quite some attention. On the other hand, there is no clear consensus on how exactly to define the FEI and its boundaries and more or less grave discrepancies concerning an advisable approach to the Front End can be found, depending on the specific sources and authors. Moreover, literature mainly focussed on the idea generation stage, other stages at the

Front End have received rather little attention (Alam 2006). In the course of this paper, the FEI is defined in accordance with Koen et al. (2001, 2014) and hence includes the activities that come before the formal and well-structured new product development (NPD) process. The FEI consists of strategically oriented activities (opportunity identification, opportunity analysis) and the more operative ideation and concept development process (idea genesis, idea selection and concept and technology development) (Koen et al. 2001, 2014).

The amount of holistic and practical approaches on how to manage the FEI is low (Markham 2013) and there are still few empirical studies clarifying Front End practices (Aagaard, Gertsen 2011). According to Koen et al. there have only been eight empirical studies so far that specifically focussed on the FEI and even those are limited to a certain degree. Most focussed on one FEI-project (all except one) or were conducted in relatively small organizations (all except two) (Koen et al. 2014). There is a clear need for further empirical research on the Front End of Innovation and the significance of developing new theories and proposals that support effective implementation of the FEI is immense – from a scientific perspective as well as from a practical one (Oliveira, Rozenfeld 2010; Reid, Brentani 2004; Riel et al. 2013; Saetre et al. 2012; Trotter 2011; Verworn 2009).

Because of the Front End of Innovation being characterized by a highly volatile environment and having hardly been systematically dealt with in practice, the need for finding an appropriate research approach also addressing the specifics of a design science context arose. To address this research gap, the conduction of a focus group study was selected as an appropriate approach to identify, cluster and analyse the activities undertaken, the challenges met and the processes existing at the Front End of Innovation in organizational practice. We use this research context to evaluate the applicability of focus groups in an actual design science based project.

2.2 Research Method

To address the research questions described in section 1, a qualitative research approach was chosen, mainly based on multiple case study research as proposed by Yin (2009). In a first step, existing literature on focus groups as a research method is analysed, and key elements for conducting focus group studies are derived. Secondly, key elements of traditional focus groups are derived from classic focus group literature (cf. section 3). Subsequently, the focus group procedure by Tremblay et al. will be described in detail and will be discussed in relationship with classical focus group key elements (cf. section 4). In Section 5, the Tremblay method will be applied in the previously mentioned current design science study (the main study object of this paper) in order to plan and conduct three focus group studies in three partner organizations (three single cases). Hence, the research method used in this paper is primarily research on design science research and not design science research per se. Data collection for the current paper will be done in the course of focus group conduction for each of the three cases based on observational note-taking by a member of the research team (Flick 2009; Berg 2001, cf. section 5). Furthermore, for each of the cases focus group results will be analyzed in detail in regard to their relevance for the defined purpose of FEI process model development by the research team (cf. sections 4.1 and 5.1). The results of the single cases will then be contrasted and key learnings will be derived in accordance with the multiple case study approach as proposed by

Yin (2009) (cf. section 6). The following figure visualizes this methodological research approach applied:

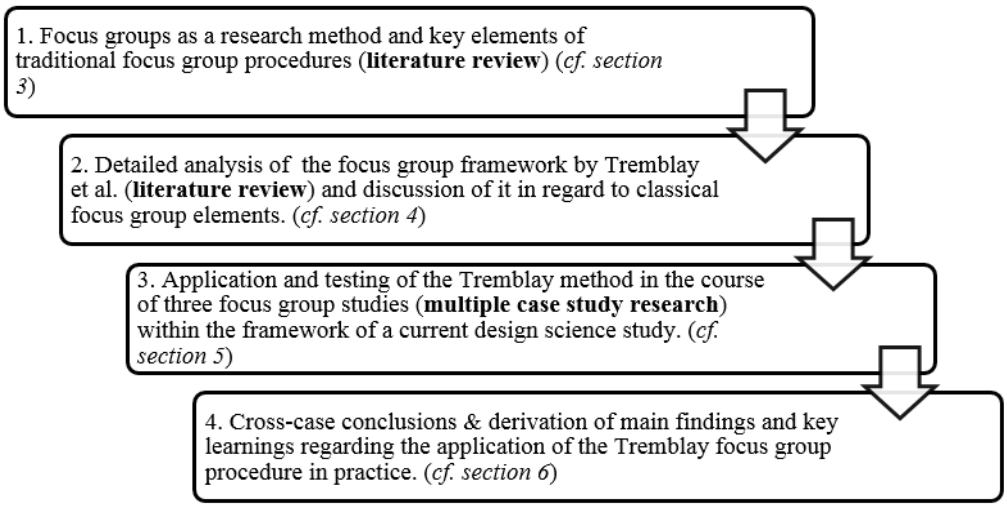

Figure 1: Methodological approach of the current paper

3 Focus Groups as Research Method

Section 3 provides an overview of focus group literature (section 3.1) and discusses key elements of traditional focus group studies (section 3.2).

3.1 Focus Groups

Focus groups have long been applied in market and medical research and offer great potential for qualitative research in general (Tracy 2013). The term focus group indicates that this method aims to study a clearly defined area or set of issues (focus) in the context of a group discussion (Stewart et al. 2007). The direct interaction between the group members is the main source to collect information in focus groups which would have been less accessible in simple one-to-one interviews (Morgan 1998).
Usually encouraged by a moderator, a small group of people shares ideas and thoughts on open ended but predefined questions. The questions are hereby meant to feel spontaneous, but have to be clearly defined in the so called “questioning route” (Krueger, Casey 2009; Puchta, Potter 1999).

A typical focus group as defined in literature consists of three to 12 participants, depending on the source of literature (Sim 1998; Krueger, Casey 2009; Tracy 2013). When complex issues or problems are the focus of the study, smaller groups are advised and the size of the focus group should not exceed seven participants (Krueger, Casey 2009). Morgan et al. (1998) consider focus groups particularly useful for:

- orienting within a new field of study,
- generating hypotheses based on informants' insights,
- evaluating different research sites or study populations,
- developing interview schedules and questionnaires, and for

- getting participants' interpretations of results from earlier studies.

Additionally, focus groups offer a more economical way of collecting multiple views at one time (Krueger, Casey 2009), provide information on the dynamics of opinions and attitudes by observing group interaction (Morgan 1998), encourage spontaneity, offer a safe forum for expressing opinions, as participants do not feel obliged to answer every question (Vaughn et al. 1996), and support a feeling of belonging to a group (Peters 1993). In a design science context, focus groups offer great opportunities. For the refinement of an artifact design focus groups can be applied to study the artifact in order to propose improvements. Once the artifact is released for field tests in the application domain, focus groups can be applied to establish its utility (Tremblay et al. 2010).

3.2 Key Elements of Traditional Focus Group Studies

In traditional literature, several key elements of conducting focus groups can be found. The following list provides an overview of the most common points and steps one has to take into consideration when planning to conduct a focus group study (Krueger, Casey 2009; Morgan 1998; Stewart et al. 2007):

- A clear objective and research problem has to be defined
- Carefully select participants in accordance to research objectives
    - E.g. a rather heterogeneous group of “strangers” is more open and doesn’t take knowledge of other participants for granted
- Select an appropriate moderator and a suitable setting
    - A feeling of trust and confidence has to be achieved to talk openly and perceive a comfortable group setting
    - A research assistant should act as an observer and time “coordinator” and should take notes during the focus group to facilitate the final result analysis and to provide the moderator with the possibility to focus on communication and interpersonal attributes.
- Develop a predefined yet flexible questioning route
    - The questioning route should support the moderator in being well prepared, but should also give him or her enough freedom to address spontaneously arising questions and issues during the focus group
    - Questions should be formulated open-ended and unsuggestive of expected outcome.
    - The moderator should be supported in focussing on asking questions only and should not provide answers or inputs that may distort results.
- Define a systematic way to visualize, analyze and interpret results
    - Results gained by one researcher should lead to the same or similar results gained by another one using the same raw data.

4 The Focus Group Framework by Tremblay et al.

Tremblay et al. (2010) developed a procedural model on how to apply and adopt focus groups in a design science context (Tremblay et al. 2010). The sequence of those steps is visualized in figure 2 and the content of each step is explained and further enriched with additional literature in more detail in sections 4.1 to 4.8:

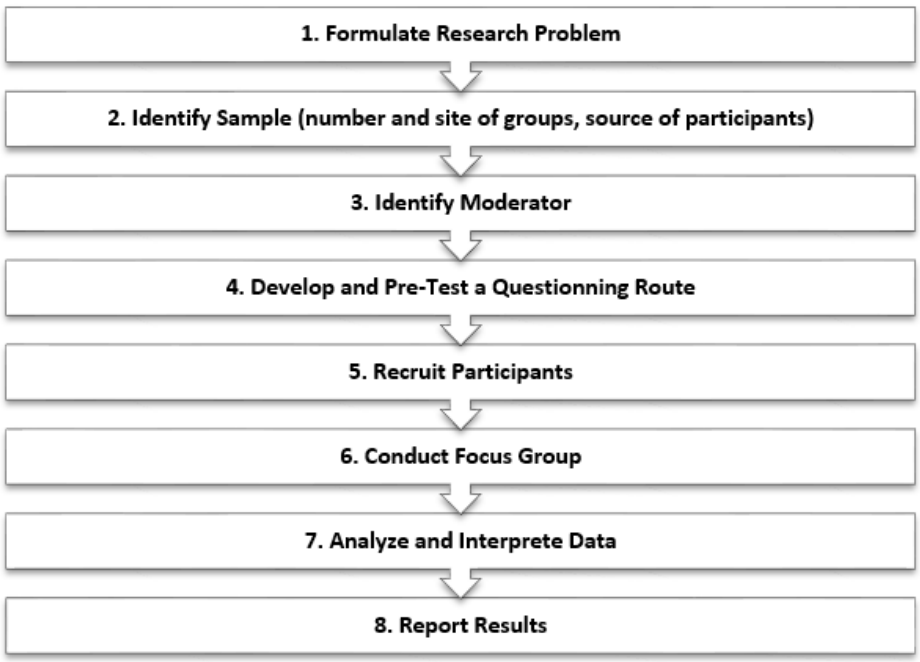

Figure 2: Focus Group Steps by Tremblay et al. (2010)

4.1 Formulate Research Problem

As mentioned before, the core element of design science are iterative build-evaluate cycles. When applying focus groups in a design science project, the aim should be to support the build-cycle by gaining the possibility for artifact improvement and to provide a setting for evaluating the artifact in the course of the evaluate-cycle. Hence, when applying focus groups in a design science project, there are basically two types of focus groups: explanatory and confirmatory ones (Tremblay et al. 2010).

The first step when one plans to conduct a focus group is to define which issue or problem respectively which artifact is to be analyzed in the course of the focus group study. The next step should be to define the objective and purpose of the focus group. We can differentiate between two main goals for a focus group:

- In case the objective is to further define or explain a scientific issue or problem in more detail and in a practically oriented way (problem identification), multiple explanatory focus groups should be applied. Findings and results from one focus group can hereby be transferred from one focus group to the following one to further increase the quality of their results, e.g. by adapting the questioning route

("rolling interview guide", cf. section 4.4) or setting (Piercy et al. 2005; Morgan 1998; Dworkin et al. 2003).

- In case the goal of conducting a focus group study is to demonstrate the utility and validity of an artifact in a particular field of application, confirmatory focus groups should be used. In this case, the results of one focus group must not be transferred to another one and no changes ought to be made concerning questioning route and focus group setting.

4.2 Identify Sample Frame

The sample and the participants of the focus group should be chosen in accordance with the research problem and the objectives defined in step 1 (cf. section 4.1). According to literature, a focus group study should be continued until no new insights and knowledge can be collected (Ivanoff, Hultberg 2006; Henwood, Pidgeon 2006). Tremblay et al. (2010) suggest conducting one pilot focus group, two explanatory focus groups and at least two confirmatory focus groups. In this context, the pilot focus group study is used to understand timing issues and deficiencies of the questioning route. The ideal number of participants depends on the objective of the focus group study: smaller groups require each participant to be more active while larger groups may lead to social loafing (Morgan 1998). According to Tremblay et al. (2010) larger focus groups exceeding six participants may be tricky to apply in a design science project since the subject matter in such projects is more complex than topics of traditional focus groups.

4.3 Identify Moderator

Identifying an appropriate moderator is a critical factor for successfully conducting a focus group study (Tracy 2013; Gibson, Arnott 2007; Hollander 2004; Morgan 1995). The moderator should be chosen in regard to skills and personality. As already explained in section 3.2, several points have to be taken into consideration in regard to the moderator's personality: his ability to listen, a respectful tone, communication skills, open mindedness, a friendly character and a sense of humor and last but not least the ability to involve and motivate the participants to contribute and actively take part in the focus group (Krueger, Casey 2009).

Compared to traditional focus group topics, design science project artifacts are often more complex. In this context, the moderator should be able to focus on communication and interpersonal skills only. Hence, providing a second observer who takes notes during the focus group and also acts as a time coordinator is advisable. This does not only represent a major simplification for the moderator, but also facilitates the final result analysis (Folch-Lyon, Trost 1981; Bradley et al. 2002; Tremblay et al. 2010).

4.4 Develop and Pre-Test a Questionning Route

In a design science project, artifact evaluation and improvement is a core element. When conducting focus groups in such a context, the questioning route should at least be pre-tested once before applying it in the actual focus group. Tremblay et al. (2010) suggest testing the questioning route in the course of a pilot case study. Additionally, literature suggests using a rolling interview guide in explanatory focus groups to further develop and improve the aptitude of the questioning route by collecting and im-

plementing feedback in each conducted focus group. Hereby, the questioning route can be adapted based on the learnings and experiences of the preceding focus group by e.g. revising, removing or adding certain questions or by changing the question order (Morgan 1998; Piercy et al. 2005; Stewart et al. 2007; Dworkin et al. 2003). When conducting focus groups with the objective to confirm a developed artifact, a rolling interview guide must not be used as this would distort the results (also cf. section 4.1) (Tremblay et al. 2010).

As discussed before (cf. section 3.2), the questioning route itself should allow flexible ways of communication but yet provide a clear framework and structure for the moderator. Questions should be open ended and not suggestive, the moderator should be supported in only asking questions and should not need to indicate possible answers as this would distort results.

4.5 Recruit Participants

As explained in section 3.2, participant recruitment is a critical success factor and a key element for focus groups. As the subject matter is usually rather complex in design science projects, participants should be familiar with the topic of the focus group. Nevertheless, the heterogeneity of the group could lead to new insights as things are not taken for granted and are discussed more deeply. Hence, in our understanding, the ideal focus group sample in a design science context consists of 4 to 6 participants who are familiar with the application environment of the artifact and yet have different backgrounds, e.g. from a different division or company location (Bloor 2001; Stewart et al. 2007; Tracy 2013; Tremblay et al. 2010).

4.6 Conduct Focus Group

The sixth step is to conduct the focus group according to the defined setting and the developed questioning route. During the focus group, experience regarding the aptitude of the setting and the questioning route can be gained and transferred into subsequent focus groups for improvements (cf. section 4.1). In order to make results traceable literature suggests using audio or video recording for documentation and evaluation purposes (Sim 1998; Kidd, Parshall 2000). The set-up of the technical equipment needed in order to do so, should be tested beforehand (Gibson, Arnott 2007).

Additionally, the moderator should provide some general information on the objectives of the focus group, the general rules and the timeline in the course of a short introductionary presentation (Berg 2001; Tracy 2013).

4.7 Analyze and Interprete Data

After having conducted a focus group, results need to be analyzed and interpreted. Hereby, the scheme used to analyze the collected data should produce the same or similar results independent from the researcher conducting the analysis (Krueger, Casey 2009). Depending on the research objective and the confidentiality of the artifact, an appropriate scheme has to be chosen. In practice, there are many different approaches to analyze qualitative data. Most researchers do not apply one approach only but rather use a mixture of different approaches (Green, Thorogood 2004). In the course of the current project, we applied the framework analysis developed by Krueger and Casey (2009), which suggests a continuum of analysis ranging from the accumulation of raw data to deduction of descriptive statements and the interpretation of data (cf. section 5.7).

4.8 Report Results

According to the design science build-evaluate cycles, focus group results should be reported and evaluated. The conduction of a final confirmatory focus group is advisable, after the explanatory focus groups are done and the results gained in the course of these are aggregated and ready to be confirmed respectively evaluated. Like approaches to analyze qualitative data, there are also many ways of reporting focus group results (Miles, Huberman 1994), which have to be chosen in regard to the quality and nature of the artifact and the research objectives.

In the course of the current paper, the focus group procedure by Tremblay et al. (2010) as described in sections 4.1 to 4.8, was in a next step applied in a current design science based research project (cf. section 5).

5 Application of Tremblay's Framework in a Design Science Project

In section 4 we presented the focus group procedure proposed by Tremblay et al. (2010). In sections 5.1 to 5.8, the authors describe the application of just this procedure in the context of the previously mentioned design science project. The key learnings and main findings respectively issues encountered during application are concluded and summarized in section 6.

5.1 Formulate Research Problem

In accordance with the focus group procedure by Tremblay et al. (2010), we defined the research problem and the objective of the focus group study. As design science artifact for analysis the development of a theory-based process model for the early stages of innovation was selected. An initial draft of the process model was developed based on literature and in particular based on the New Concept Development Model proposed by Koen et al. (2001) (cf. figure 3). Figure 3 provides a short overview of the FEI process stages and the respective key activities covered by the process model:

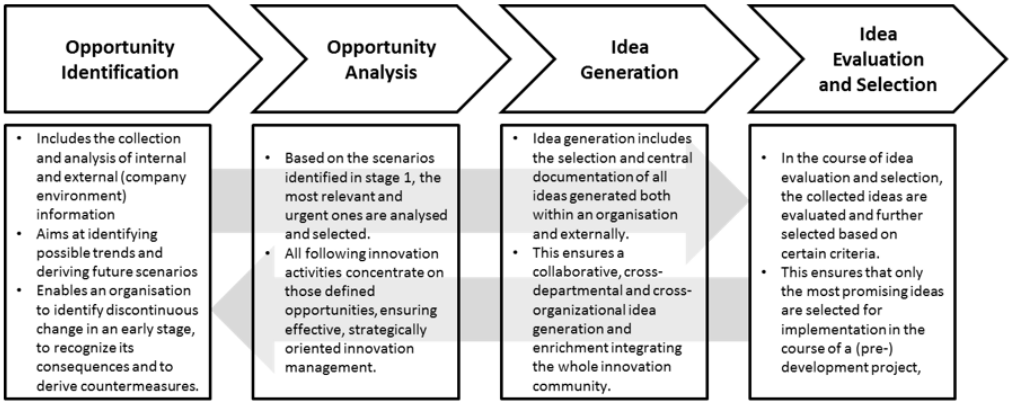

Figure 3: Process model for the early stages of innovation

The objective of conducting the focus group study was to improve the artifact by collecting data on current processes and activities at the Front End of Innovation in selected organizations participating in the current project InnoStrategy 2.0 (cf. section 2.1). The main goal of the focus group study was to enrich and improve the the-

oretical knowledge with insights and knowledge from business practice. Additionally, the results obtained in such manner also contribute to the underlying knowledge base. In the course of the current research project InnoStrategy 2.0, this means that the main objective of and the reason for conducting the focus group study was to create the basis for deriving a theory-based but also practically relevant process model addressing the early stages of the innovation process, as well as to collect critical success factors, challenges and experiences in this context from practitioners. In this respect, we decided to conduct a pre-test (pilot focus group) as well as an explanatory and a confirmatory focus group per organization. Conducting a pre-test focus group is recommended in relevant literature (e.g. Morgan, Spanish 1984; Gibson, Arnott 2007; Birkett et al. 2004; Israni et al. 2009) and provides a setting for testing and evaluating the questioning route as well as the setting of the focus group (cf. section 4.4).

Explanatory focus groups were chosen in order to support artifact refinement, allowing us to analyse the selected research problem and assess the artifact under investigation (our proposed process model (cf. fig. 3)) from a practitioner's point of view (cf. section 4.1). The artifact refinements and adoptions made based on the results of the explanatory focus groups had to be evaluated and the refined artifact had to be analysed. For this purpose, we chose confirmatory focus groups, allowing us to gain additional insight concerning the focus group results (Willig et al. 2014; Epple et al. 2015; Foltz, Sullivan 1999) and the refined process model (cf. section 4.1).

5.2 Identify Sample Frame

As the application domain of the artifact was rather complex in its nature we selected participants who were one the one hand familiar with the topic of innovation management but on the other hand were from different divisions of the respective partner organization. By that, we assured that participants knew what they were talking about but still had different points of views on the artifact under investigation. According to Tremblay et al. (2010), we defined a sample size of 4 participants per explanatory focus group. Participants were informed about the project previously to focus group conduction. Participation was on a voluntary and not on a reward basis. The following table provides an overview of the background and number of the selected focus group participants:

Table 1: Sample of the focus group study

Type of focus group (FG)	**Participants (P)**	**Background P 1**	**Background P2**	**Background P3**	**Background P4**
Pilot FG (participants from all 3 organizations)	4	R&D	Innovation Manager	Innovation Manager	R&D
Explanatory FG organization 1	4	Innovation Manager	R&D	Business Development	R&D
Explanatory FG organization 2	4	Product Manager	Project Manager	R&D	Innovation Manager

Explanatory FG organization 3	4	Product Lifecycle Manage-ment	Marketing	Innovation Manager	R&D
Confirmatory FG organization 1	3	Innovation Manager	Product Develop-ment	R&D	-
Confirmatory FG organization 2	3	Innovation Manager	Head of R&D	R&D	-
Confirmatory FG organization 3	3	Innovation Manager	R&D	Product Lifecycle Manage-ment	-

Additionally, a short information presentation was provided in the forefield to all participants in order to inform them about the subject and objectives of the focus group study.

5.3 Identify Moderator

As the role of the moderator plays a key role for the success of focus groups, we specifically selected an experienced practitioner with background in innovation management and the required personal and communication skills (cf. section 4.3). Besides the moderator, a second observer took notes during the focus group to facilitate the final result analysis and to provide the moderator with the possibility to focus on communication and interpersonal attributes (cf. section 4.3).

5.4 Develop and Pre-Test a Questionning Route

In accordance with section 4.4, we developed a questioning route with the character of a rolling interview guide. The questioning route consisted of 6 question areas for each of the four process stages at the Font End of Innovation as defined in section 5.1. To provide a high degree of flexibility, the question areas were developed independently from each other, so that various ways of answering the questions and spontaneous inputs and changes were possible. These six main question areas were developed deductively based on the proposed process model (cf. fig. 3) and on the findings of an extensive literature review regarding critical success factors and key principles at the Front End of Innovation. The areas defined relevant for each stage at the FEI were: scope, goals, critical success factors and challenges, process, methods and tools and in-/outputs.

These six main question areas were dealt with in each of the four stages of the relevant innovation process; the respective sub questions were adapted. The following table 2 depicts the structure of the interview guide, which was applied in the course of the pilot focus group and the three explanatory focus groups:

Table 2: Structural set-up of the developed interview guide

	Stages at the Front End of Innovation			
Main Question area	**Opportunity Identification**	**Opportunity Analysis**	**Idea Generation**	**Idea Evaluation and Selection**
Scope	Influence of Vision / Mission	Scope	Scope	Scope
	Effects on Vision / Mission			
	Link to strategy			
Goals	Main reasons	Main reasons	Main reasons	Main reasons
	Aims	Aims	Aims	Aims
	Success Criteria	Success Criteria	Success Criteria	Success Criteria
CSFs & Challenges	Challenges	Challenges	Challenges	Challenges
	Critical Success Factors	Critical Success Factors	Critical Success Factors	Critical Success Factors
	Results	Results	Results	Results
Process	Initiation	Selection Criteria	Initiation	Selection Criteria
	Process	Process	Process	Process
	Roles	Decision Makers	Integration of Strategy	Decision Makers
Methods & Tools	Methods & Tools	Methods & Tools	Methods & Tools	Methods & Tools
	Integration of External Environment	Decision Support Techniques	Creativity Support Techniques	Decision Support Techniques
	Method Selection	Method Selection	Method Selection	Method Selection
In- & Outputs	Inputs	Inputs	Inputs	Inputs
	Outputs	Outputs	Outputs	Outputs
	Experiences of Method Application	Experiences of Method Application	Experiences of Method Application	Experiences of Method Application

The pre-test of this questioning route was conducted in the course of a focus group with participants from each of the three partner organizations with the aim of improving the questioning route itself, addressing requirements and meeting expectations of the partner organizations. The participants selected for this pre-test were all R&D respectively innovation managers, enabling them to give detailed feedback.

5.5 Recruit Participants

The recruitment of participants was done directly through the contact partners in the different organizations. Because of the experiences gained in the course of the pilot focus group, the selection of the right participants for the explanatory focus group was simplified (cf. section 4.2). Together with the innovation and R&D managers who took part in the pre-test (cf. section 4.4), the participants were selected and recruitment was done directly by their managers. Hereby, an efficient and effective recruitment process could be achieved, allowing us to select and recruit participants who are familiar with the application environment of the artifact (innovation management) and yet have different backgrounds, e.g. from a different division or company location (cf. section 4.5).

5.6 Conduct Focus Group

The focus group was conducted in the "Research and Transfer Centre Front End of Innovation" (Perteneder et al. 2013; Gaubinger et al. 2013), which provided a system of connected, interactive whiteboards as well as digital paper for further notes taking. This setting allowed the moderator and the participants to take "digital notes" and reduced the time needed to digitise the results. At the beginning, a short introduction phase was held, including a presentation about the artifact and the relevant topic, as

well as an introductionary round and a briefing on how to work with the interactive set of whiteboards and the digital paper.
The whole focus group was also filmed (cf. section 4.6) in order to make results traceable.

5.7 Analyze and Interprete Data

The results gained by using the infrastructure of the "Research and Transfer Centre Front End of Innovation" and the video recordings (cf. section 5.6) were analyzed according to the framework analysis developed by Krueger and Casey (2009), which suggest a continuum of analysis ranging from the accumulation of raw data to deduction of descriptive statements and the interpretation of data (cf. section 4.7). The analysis scheme was structured in accordance with the interview guide (cf. table 2), allowing us a systematic, objective representation of results. Figure 4 provides an overview of the data gathered and further processing:

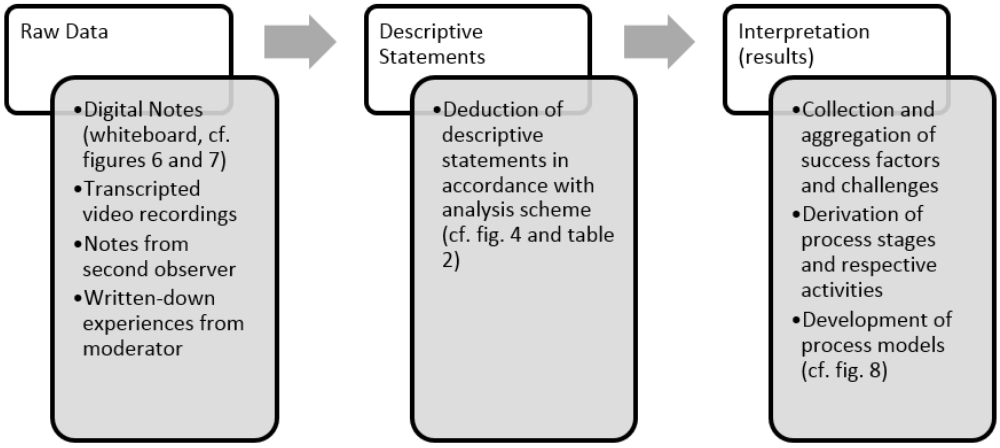

Figure 4: Data analysis and interpretation

In a first step, the video recordings were transcribed. In a second step, the transcripts were combined with the protocol of the second observer, the notes from the interactive whiteboards, the digital paper notes (cf. section 5.6, cf. fig. 5 and 6) and with the written-down experiences of the moderator. Figure 5 exemplarily visualizes the notes taken on the interactive whiteboard in regard to the third process phase (idea generation, cf. section 4.1) and shows the notes to each of the four sub question areas as defined in section 5.4:

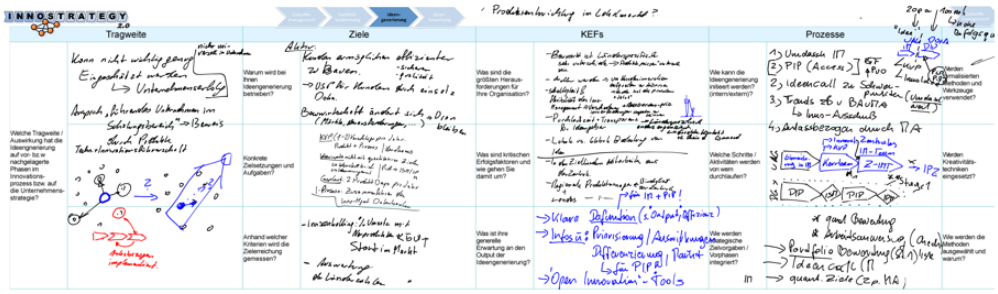

Figure 5: Exemplary overview of notes gained with the interactive whiteboard system (1)

Figure 6 exemplarily represents the notes belonging to the forth process stage (idea evaluation, cf. section 4.1) and addresses sub question areas one to four:

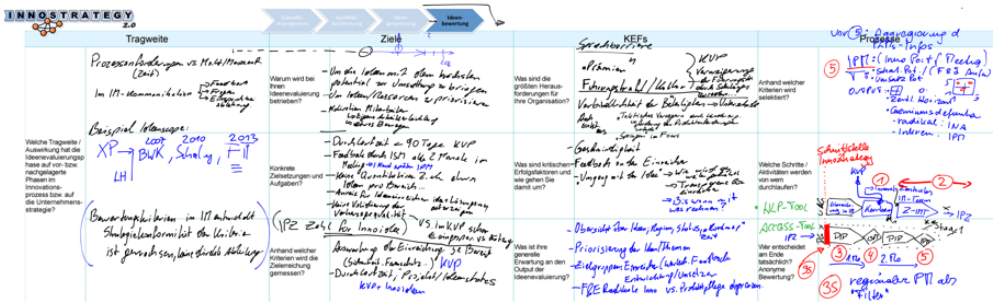

Figure 6: Exemplary overview of notes gained with the interactive whiteboard system (2)

Subsequently, descriptive statements were derived based on the collected and aggregated raw data (cf. fig. 4). Those statements were summarized in tables using the predefined scheme provided by the interview guide (cf. section 5.4). Table 3 provides an exemplary overview of some descriptive statements derived from the aggregated raw data:

Table 3: Deduction of descriptive statements (exemplary section)

Opportunity Identification		**Descriptive Statement**
Scope	Influence of Vision / Mission	Opportunity identification happens only within the framework of corporate strategy, which is defined in 5-year cycles.
	Effects on Vision / Mission	Usually opportunity identification does not influence corporate strategy and is rather used as an argument for keeping the current strategy if it conforms with it.
	Link to strategy	Opportunity identification is directly linked to corporate strategy, however, the strategy does not provide much details on which areas to cover and which not to take into consideration in the course of opportunity identification.
Goals	Main reasons	Opportunity identification is corporate strategy-driven, with the main aim of recognizing trends as early as possible.
	Aims	There is no structured approach to opportunity identifcation, specific aims are not defined.
	Success Criteria	There are no measurements or success criteria provided by the board of management, except the goal of being innovation leader.

Opportunity Identification		Descriptive Statement
CSFs & Challenges	Challenges	It is extremely hard to define the degree of complexity to allow and to establish an unimpeded flow of information and a high level of commitment across the organization.
	Critical Success Factors	The global market is extremely complex and opportunity identification has to cover various regional, political and economical areas (e.g. laws and standards, patents, competitors, experts etc.).
	Results	The desired results are roadmaps for trends (technology-, product- and system-roadmaps), visualized topic clouds and the mapping of trends to strategic buckets.

The last step was the development of the final results (data interpretation, cf. figure 4), which did not only include the result tables, but also the processes observable in the respective organization. Process visualization was done in accordance with the widespread process modelling technique of event driven process chains (EPC) (Keller et al. 1992; van der Aalst 1999). An exemplary section of one of the process models derived is visualized in figure 7, describing the activities and steps observed during the assessment of an identified trend and its effects on the innovation portfolio:

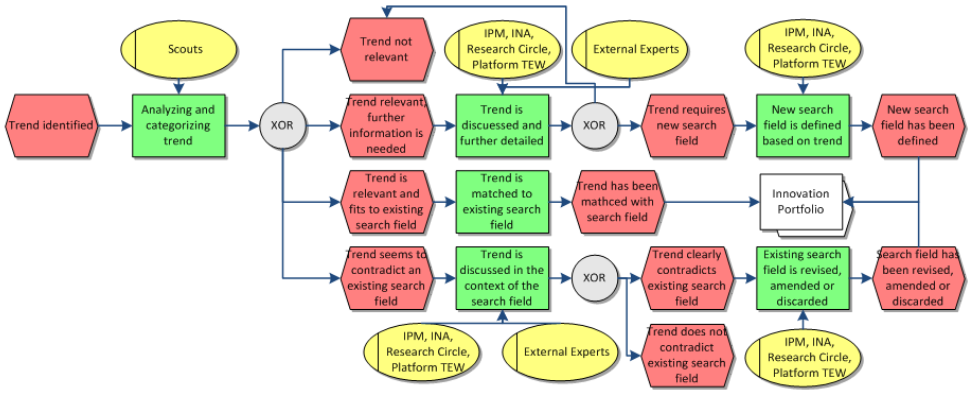

Figure 7: Exemplary process visualization gained by raw data analysis and descriptive statement deduction

5.8 Report Results

After result analysis and interpretation, the findings were reported and evaluated respectively confirmed in the course of a group discussion similar to a confirmatory focus group. For each organization, we collected the results and presented them as well as the adoptions made to the process model to the innovation manager and the development manager respectively the head of R&D to evaluate our results and improve them if necessary. This additional feedback-loop provided us with the possibility for further enhancing our findings on the one hand and on the other hand ensured the correctness of the results gained and the artifact adoptions made (cf. section 4.8).

6 Key Learnings and Main Findings

The aim of the current paper was to apply and test the focus group procedure by Tremblay et al. (2010) in an actual design science study (in this case in the field of innovation management). In total, one pre-test focus group, 3 explanatory and 3 confirmatory focus groups were conducted. The application of the procedure was described in detail in sections 5.1 to 5.8, the strengths (cf. table 4) and shortcomings (cf. table 5) experienced during application are presented in the following tables, followed by a more detailed discussion of the individual points.

Table 4: Strengths of the Tremblay method

Strengths of the procedure	
Structure and understandability	The step-by-step procedure proposed by Tremblay et al. (2010) provided a well-structured and clearly defined set of actions and activities which fit into our design science based research project. The introduction of explanatory and confirmatory focus groups suits well to the build-evaluate cycles of design science research.
Artifact refinement	By conducting the focus group study according to this procedure, we were able to enrich our theory based process model for the early stages of innovation (our artifact in this context)
Pre-test section	The pre-test (pilot focus group, cf. section 4.1 and 5.1) was an important step to assure the aptitude of the questioning route and of the selected facility and its technical infrastructure for the current focus group.
Artifact evaluation	The confirmatory focus groups provided a good setting for evaluating focus group results and the artifact refinements made based on them.
Report results section	Communication and reporting of results was simplified by the provision of concrete examples and advice on how this could look like.

The clear structure and the easy to follow step-by-step procedure were of great use in order to enrich our theory based process model for the early stages of innovation (our artifact in this context). In the course of three explanatory focus groups and three confirmatory focus groups, valuable information could be gained. The results of the explanatory focus groups provided us with comprehensive information and valuable additions to the knowledge base in form of the derived descriptive statements and the visualized process stages at the front end of innovation. In particular the weaknesses observed, the issues encountered in organizational practice and the lack of structure and regulations (in particular at the first to stages of the defined theory based process model) allowed us to further refine the focus of our process model by adding more structure and identifying the key activities for this stage of the innovation process. The confirmatory focus group (one per partner organization) provided us with further information and process knowledge and confirmed the changes which were made to the artifact based on the results of the explanatory focus groups. Nevertheless, there are some points that either were not addressed by Tremblay et al. or were not described in thorough detail.

Table 5: Shortcomings of the Tremblay method

Shortcomings of the procedure	
Setting section	The procedure did not include respectively address a setting-section. Little information on how an appropriate setting and the respective facilities should be chosen was provided.
Researcher's background knowledge	The procedure did not offer details about necessary preparation of the researchers regarding e.g. industry specific background knowledge.
Moderator selection	The role of the moderator was found to be essential for successfully conducting a focus group study. Tremblay et al. (2010) did not provide detailed enough information on this issue.
Conduction timing	The definition of the right timing when to move from planning the focus group to actually conducting it was found to be a challenging issue, which was not discussed in detail by Tremblay et al.
Participant sampling	There was no specific information provided concerning participant sampling in order to tap both knowledge about the research domain and about specific process activities in the course of one focus group.
Specifics of research domain	The need of taking into consideration the specifics of the respective research domain and especially advice on how to do so was not provided by Tremblay.

One general finding we made was that the procedure did not include respectively address a setting-section. Only little information on how an appropriate setting and the respective facilities should be chosen was provided. Based on the literature review presented in section 3 and the experiences made during focus group conduction, we would propose the following refinements respectively additions to the Tremblay method regarding the definition of an appropriate focus group setting: According to Tracey (2013), the focus group room itself should be inviting and motivating, appropriate technology based tools (beamers, whiteboards…) and refreshments should be provided in regard to the defined size of the focus group.

When using technical highly sophisticated infrastructure, an introductionary round and a briefing on how to work with the interactive equipment (cf. section 5.6) is advisable, in order to ensure that participants can easily handle and efficiently use the respective equipment. In the current case, the setting of the focus group study was defined in regard to availability and aptitude of spatial and technical infrastructure. In the course of an initial project team meeting, the "Research and Transfer Centre Front End of Innovation" (cf. section 5.6) and its technical highly sophisticated infrastructure was selected as a suitable setting for conducting our focus group study (Perteneder et al. 2013; Gaubinger et al. 2013). The digital environment supported the moderator in terms of comprehensive problem description, the integration of visualizations and additional processing of generated ideas along with documentation. Furthermore, it enabled a more dynamic work-flow allowing a fast visualization of ideas, which in turn enabled participants to communicate ideas more quickly allowing for a higher level of interaction (Perteneder et al. 2013; Gaubinger et al. 2013). Based on our findings, the Tremblay method should include a setting section or at least provide more detailed advice on how to define an appropriate focus group setting.

A research setting specific finding was that the background of participants has huge implications on focus group success respectively outcome. During pilot focus group conduction (with participants from the first and second management level) we observed that although participants had very good domain know-how, they were not able to provide deeper insights into operative activities and concrete process details. Hence, to tap both knowledge about the research domain and about specific process activities, we would suggest combining participants pair wise. In our design science study's context, we decided to form two pairs per focus group, each of them consisting of a domain expert (e.g. innovation manager) and a process expert (e.g. operative business development manager). We would propose to modify the Tremblay method accordingly respectively we would suggest addressing this issue in a more detailed way and provide possible alternative ways of dealing with it.

Another general finding made was that it is important to possess a certain degree of knowledge about the respective organization and its business area respectively its industry. We observed that it was sometimes difficult for the moderator to ask elaborate questions and initiate a lively discussion when he was lacking knowledge about the organization and its respective industry. Hence, we suggest conducting a short preparatory stage / information research before conducting the actual focus group in order to become familiar with the different backgrounds of the particular organization. In the innovation management context, this e.g. involves developing an understanding for the need to be innovative and the general innovation ontology and cycles in the respective industry.

A research setting specific observation made in this context was that also the research domain has huge implications on focus group planning and conduction. In the specific context of innovation management, the understanding of innovation, innovation readiness and also the capability to innovate often differ strongly not only from organization to organization but also from employee to employee. Hence, we suggest familiarization with the organization, e.g. in the form of an initial meeting including a walk-through of the facility. Furthermore, the background of the participants and their attitude to innovation management should be assessed, e.g. by talking with their respective line managers or supervisors. This is also helpful in order to define a common focus group ontology to ensure that everybody is talking the "same language" respectively to generate a common understanding of terms and vocabulary used.

The role of the moderator was defined to be essential by Tremblay et al. (2010) for successfully conducting a focus group study. During the conduction of the focus groups, we ascertained that the moderator and his ability to ask the right questions at the right time is a core element of a successful focus group. His or her capability to react flexibly and adequately at any time during discussion was particularly important to also involve frustrated or unmotivated participants.

Although Tremblay et al. (2010) emphasized the importance of the moderator, concrete guidelines on how to select and introduce the right person for this position were not provided. We would suggest adding the following refinements to the Tremblay method: In order to increase the credibility of the moderator, we introduced him in the course of the kick-off meeting of our research project (before focus group conduction) providing him with the possibility to present himself. This allowed to become acquainted with each other even prior to the actual focus group. Furthermore, we found that the position respectively the status of the moderator was especially important in terms of trust building and motivation at the beginning of the focus

group study in order to create and maintain a lively discussion among all participants. This was found to be less important later on in the project, after the getting-to-know each other phase. We missed a discussion on this issue in the paper by Tremblay et al. (2010).

Another general and more challenging issue we observed during focus group planning and conduction was the definition of the right timing when to move from planning the focus group to actually conducting it. Tremblay et al. (2010) did not provide information on this topic, which we know is very hard to address. In the current research context, the main challenge encountered in this context was to define the right timing when enough knowledge about the artifact under analysis (the FEI process model) and about the different organizations was gained in order to be able to move from a planning to a conduction stage. We knew that if this step is done too early, the focus group study may be conducted based on wrong assumptions or incomplete knowledge. If this step is on the other hand done too late, the team of researchers may know or believe to know too much and hence could influence study results by suggestive questions and discussion contributions. As we were not able to answer this question, we would suggest further research on how to define the right timing when to move from planning to conducting the focus group.

All in all, the focus group framework by Tremblay et al. (2010) provided a good basis and could be found to be of great use to plan and conduct focus group studies in design science based projects. Nevertheless, the results gained in the course of the application of this procedure also provide interesting starting points for optimization and improvement. Addressing research question 2 (cf. section 1), table 6 summarizes the strengths observed, the shortcomings detected and the modifications proposed per stage of the Tremblay procedure:

Table 6: Summary of strengths, shortcomings and proposed modification per stage

Stage of Tremblay procedure	Strengths	Shortcomings	Proposed modifications
Formulate research problem	• Introduction of explanatory and confirmatory focus groups. • Importance of research goals.	• The specifics of the research domain were not specifically considered.	• Introduction of an initial preparatory stage (specifics of domain, participants attitude towards it and their understanding of it). • If necessary, definition of a common ontology depending on the research domain.

Stage of Tremblay procedure	Strengths	Shortcomings	Proposed modifications
Identify sample	• Clear guidelines on number of focus groups and number of participants.	• The issue of how to tap both knowledge about the research domain and about specific process activities was not discussed in detail.	• Conduction of participant casting (if possible in terms of quantity) respectively joint participant selection with supervisors (cf. section 5).
Identify moderator	• Provision of concise list of important moderator skills. • Clear focus on the importance of the moderator's understanding of and knowledge about the designed artifact.	• No information on how to consider credibility and status in the course of moderator selection.	• Introduction of the moderator prior to the actual focus group, e.g. in the course of a kick-off meeting or in the course of participant selection. • Consideration of moderator position respectively status in the research domain and if applicable also in the research project.
Develop and pre-test a questioning route	• Concise information on how to structure the questioning route. • Suggestion of using a rolling interview guide in explanatory focus groups.	• Implications of various focus group settings on questioning route development were not considered.	• Consideration of available technical infrastructure and its integration in developing and representing the questioning route. • Introduction of a separate setting-definition-stage.
Recruit participants	• Emphasis on the relevance of characteristics of the participants in relation to the artifact.	• Focus is rather on sampling than on actual participant recruitment.	• Provision of structured pre focus group information via handouts or similar information channels (including purpose, targets, participant list and timetable of the upcoming focus group).

Stage of Tremblay procedure	Strengths	Shortcomings	Proposed modifications
Conduct focus group	• Concise explanation of important points to consider in focus group conduction. • Provision of high-level references with further information on conducting focus groups.	• Lack of attention to the issue of when to move from planning to conducting the focus group. • Technical infrastructure and how to integrate it in focus group conduction was not dealt with.	• The issue of defining the right timing when to move from planning to conducting focus groups is very hard to address, future research could deal with this issue. • As mentioned above, we would introduce a setting-stage, which would also have connections to the conduction stage (depending on the infrastructure, e.g. a short training prior to focus group is necessary).
Analyze and interprete data	• Introduction of template analysis as one possibility for analysing and interpreting EFGs and CFGs.	• Linkage to questioning route development was missing.	• Consideration of questioning route when selecting the analysis method and vice versa.
Report results	• Provision of concrete examples / advice on how to report results.	• None.	• None.

7 Conclusion

In the course of this paper, the focus group procedure proposed by Tremblay et al. (2010) was applied in a current design science study in the field of innovation management. Future research is necessary in order to evaluate if our findings are also valid in other application domains. The main findings and key learnings of the current paper were presented in section 6. In conclusion, the procedure by Tremblay et al. (2010) provided a good structure and a systematic approach to support planning and conducting focus group studies in a design science context. The structured step-by-step approach and the introduction of explanatory and confirmatory focus groups proved to be of great value and simplified focus group planning and conduction. Besides the strengths of this procedure, we also observed some shortcomings. For example, a setting-phase was not provided, which should be a core section of a focus group procedure based on our experiences.

Furthermore, the use of modern, interactive ICT-infrastructure and tools should be addressed accordingly, as this could offer huge potential for improving focus group results. We also found that attention should be paid to timing, as it was pretty hard for us to define the right time for moving from planning the focus group to actu-

ally conducting it. Our findings also show that the background and attitude of participants, the industry and specifics of the respective organization and the generation of a common ontology should be included or discussed in a focus group procedure as well. In accordance with Tremblay et al. (2010), we ascertained the importance of the moderator. In brief, we could confirm the applicability of the Tremblay procedure in an actual design science setting (RQ1). The results gained by following this step-by-step-procedure allowed for artifact refinement as well as for artifact evaluation. A limitation of the current work is the focus on only one specific research domain (innovation management). Another limitation could also be the proposed procedure (cf. section 2.2) used to assess the focus group framework by Tremblay et al. Nevertheless, we think that the findings and proposed modifications presented in this paper could be used to adapt the focus group framework by Tremblay et al. (2010) and to propose more detailed modifications to it in the course of future research. The framework by Tremblay et al. has not yet been dealt with in scientific literature and the findings of our paper could be a good starting point for further work on this interesting and valuable procedure.

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