A NEW APPROACH FOR SYSTEM REQUIREMENTS ELICITATION USING DISCOUNT FOCUS SUBGROUPS METHOD

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Abstract

Requirements elicitation is a key and critical activity for software/system development success. Several methods and techniques have been developed and used for requirements elicitation. Prior research referred to many problems and shortfalls with existing group-based methods (e.g., brainstorming, focus groups, and joint application development [JAD]). This paper provides a new approach for requirements elicitation using a novel method called discount focus subgroups (DFSG). The current paper demonstrates that DFSG is an alternative effective technique to improve requirements elicitation activity by addressing pitfalls and problems with existing group-based methods. The method is effective in several situations such as when the development team aims to minimize the costs of system development, large numbers of stakeholders need to be involved in large projects like enterprise systems (ERP), the system is novel and where no similar systems have been developed before.

Keywords: Requirements elicitation, systems analysis, group elicitation methods, focus group, JAD, brainstorming, software engineering, DFSG.

1 INTRODUCTION

Requirements elicitation is the first stage of requirements engineering. It can be defined as a process of seeking, uncovering, acquiring, and elaborating requirements for information systems (Zowghi & Coulin 2005). It is essential and crucial for software/system development success. There is agreement among practitioners and researchers that poor requirements elicitation will cause serious errors, which might lead to system failure or extra time and costs if not discovered until the implementation stage (Mulla & Girase 2012; Avison & Fitzgerald 2006; Hickey & Davis 2003). The main aim of requirements elicitation is to understand stakeholders' needs of the system. Requirements elicitation is mainly dependent on the people involved (Zhang 2007). Those involved have different backgrounds and different organizational and individual goals, positions, and personalities. They have different ways of understanding and expressing information and of communicating with others. They might not understand the process of system development. On the other hand, system analysts are likely to be unfamiliar with the application domain and business concepts (Avison & Fitzgerald 2006; Nuseibeh & Easterbrook 2000). This gap creates a communications barrier between the analyst and the domain experts and users. According to many researchers, the main challenge of requirements elicitation stems from poor and complex communication between stakeholders and analysts (Pa & Zin 2011; Aranda, Vizcaíno & Piattini 2010; Coughlan et al. 2003; Coughlan & Marcredie 2002). User-analyst communication is certainly an important part of requirements elicitation. The effectiveness of this communication depends on the communication styles, and these are determined by the elicitation techniques and methods that the system analyst selects.

There are many proposed methods and techniques used for requirements elicitation. Researchers have classified these into different categories, such as traditional, conversational, observational, agile, collaboration, analytical, and group-work techniques and methods (Arshad, Shah & Shahzad 2013; Zowghi & Coulin 2005; Nuseibeh & Easterbrook 2000). This paper will focus mainly on group-based ones. Prior research referred to many problems and shortfalls associated with existing group-based methods (e.g., focus groups, brainstorming, joint application development [JAD]) as illustrated in the next section. The current paper reviews existing techniques for requirements elicitation, with the emphasis on group-based methods and techniques, and proposes a new innovative group-based method (i.e., discount focus subgroups [DFSG]) as an alternative to overcome some of the pitfalls and problems with existing methods.

The remainder of this paper is organized as follows. Section 2 presents a review of the literature on existing requirements elicitation methods and techniques. Section 3 provides an overview of the DFSG method. Section 4 presents the rationale for, and the applicability of, the DFSG method for requirements elicitation. Section 5 provides a discussion on application of DFSG method and potential future work.

2 LITERATURE REVIEW OF REQUIREMENTS ELICITATION TECHNIQUES

Most of the methods and techniques used in requirements elicitation are derived from the social sciences (Zowghi & Coulin 2005), and this is expected as it is a human-based activity. Nuseibeh and Easterbrook (2000) developed a classification system according to the needs of a project. They divided the methods into six categories: 1) traditional techniques (e.g., questionnaires, interviews, and analysis of existing documentation); 2) group elicitation methods (e.g., brainstorming, focus groups, and JAD workshops); 3) prototyping (e.g., early versions of user interfaces); 4) contextual techniques (e.g., observations); 5) cognitive techniques (e.g., protocol analysis, laddering, card sorting and repertory grids); and 6) model-driven techniques (e.g., goal-based and scenario-based methods). In contrast, Arshad et al. (2013) classified them based on user involvement into traditional methodologies (e.g., interviews, questionnaire, ethnography, focus groups) and agile methods (e.g., extreme programming,

crystal methodology). In traditional methods, user involvement is not continuous throughout the whole process, whereas in agile methods, which are iterative, the users are involved throughout the entire development process in several meetings. Zhang (2007) distinguished between four types of elicitation methods according to the means of communication: conversational (e.g., interviews, workshop focus groups, and brainstorming), observational (e.g., observation and ethnography), analytics (e.g., documentations, requirements in reuse, laddering, card sorting, and repertory grids), and synthetic (e.g., scenarios, passive storyboards, prototyping, and contextual inquiry). Each type represents a specific interaction model between analysts and stakeholders. Selecting the appropriate requirements elicitation method/technique depends on several factors, such as the project environment, features of the technique, stakeholders' characteristics, requirement sources, characteristics of the problem, and the solution domain (Hickey & Davis 2004; Anwar & Razali 2012). In this paper, we do not advocate the use of one particular method from any specific category, as in some cases multiple methods are preferred to elicit requirements at different stages and conditions. For example, focus groups, which belong to the conversational/group category, can be followed at a later stage of the system development process by a technique from the analysis category, such as prototype. The idea that there is no ideal technique or method in requirements elicitation applies to all situations (Hickey & Davis 2004; Davis & Hickey 2002; Glass 2002; Maiden & Rugg 1996). Multiple methods may sometimes complement each other, with the limitations of one approach being compensated for by the strengths of a number of methods (Anwar & Razali 2012; Zhang 2007; Sutcliffe 1997). In this paper, we focus on existing group-based methods. It is worth mentioning that the intent of this paper is not to provide an alternative method to other methods, such as prototyping, repertory grids, and model-driven techniques, in other categories. Thus, comparisons between the proposed DFSF method and existing methods from other categories are irrelevant. Instead, the proposed method is compared with others from the same category (i.e. group-based methods). It is important to mention that, except for group-based methods, a detailed description of all the other methods and techniques is not the intent of this paper. These are beyond the current paper's scope and have already been intensively reviewed in the literature (Mulla, & Girase 2012; Zowghi & Coulin 2005; Zhang 2007; Tuunanen 2003; Nuseibeh & Easterbrook 2000; Maiden & Rugg 1996).

Among the various methods and techniques, we focus on group elicitation methods, also named conversational methods. These methods provide a means of verbal communication between two or more people to understand the problems and elicit the requirements. Methods in this category include focus groups, brainstorming, and JAD. This category also includes software tools, which automate the aforementioned original methods. They include group support systems workshops (McGoff et al. 1990) and global software development (Aranda et al. 2010). Both were developed to solve group communication problems by bringing efficiency and anonymity to group sessions of people located in different geographical locations. The use of many other automated methods has also been proposed, for example, E-JAD (Carmel et al. 1995), video conferencing of interviews (Lloyd et al. 2002), web-based focus groups (Farinha & Silva 2011), and electronic brainstorming (EBS) (Liikkanen et al. 2011). However, we do not discuss software/groupware tools in this paper because they merely enable and enhance the method that is used. In other words, these are not new methods per se. These software tools were built based on the principles and canons of the methods. We also consider that tools are different from methods/methodologies in the context of systems analysis and design domain.

McGraw and Harbison (1997) referred to several advantages of group-based methods. For example, they noted that sessions with a group help reveal multiple perspectives and lines of reasoning, thereby producing better collective information and more creative solutions than a single source. Turban and Aronson (1998) also highlighted the benefits of group methods, which are shown in Table 1.

- Groups are better than individuals at understanding problems.
- People are accountable for decisions in which they participate.
- Groups are better than individuals at catching errors.
- A group has more information (knowledge) than any one member. Groups can combine that knowledge and create new knowledge. As a result, there are more alternatives for problem solving, and better solutions can be derived.
- Synergy during problem solving may be produced.
- Working in a group may stimulate the participants and the process.
- Group members will have their egos embedded in the decision, so they will be committed to the solution.
- Risk propensity is balanced. Groups moderate high-risk takers and encourage conservatives.

Table 1. Potential benefits of group work (Turban & Aronson 1998, p. 351).

The following subsections discuss common face-to-face group elicitation methods and highlight their main pitfalls and problems.

2.1 Brainstorming

Brainstorming was originally developed by Alex Osborn in 1939 as a method for creative problem solving. He subsequently published his book *Applied Imagination* (1953), in which he provided systemic guidelines for applying brainstorming. Brainstorming is a process where participants from different stakeholder groups engage in informal discussion to rapidly generate as many ideas as possible without focusing on any one in particular (Zowghi & Coulin 2005). Leffingwell and Widrig (2000) divided brainstorming sessions into two phases: idea generation and idea reduction. The primary goal during idea generation is to produce as many ideas as possible. The principal aim during idea reduction is to analyze all the ideas generated. The idea reduction phase includes refining, ranking, and grouping. With the stakeholders' consent, the most usable ideas will become requirements for the product (Robertson & Robertson 1999). One of the advantages of using brainstorming is that it promotes freethinking and expression and so-called "out-of-the-box" thinking and allows the discovery of new and innovative solutions to existing problems (Zowghi & Coulin 2005; Leffingwell & Widrig 2003). In brainstorming sessions, people are told that all ideas are acceptable no matter how crazy they may seem and that they must not slow the process down by criticizing or debating the merits of various ideas (Leffingwell & Widrig 2000). In fact, the main principle of brainstorming is deferring any judgment about the quality of the ideas (Osborn 1953), and it is sometimes referred to as "no criticism" of ideas. According to Osborn, another main principle of brainstorming is to focus on quantity rather than quality. This "imagination of ideas" might be seen as a challenge or a criticism of the method because it is difficult to keep focused and stay within the boundaries of the problem that should be solved (Jonasson 2012). However, it is not usually the intended purpose of brainstorming sessions to resolve major issues or make key decisions (Zowghi & Coulin 2005). The disadvantage of this method is that participants are not permitted to criticize or judge ideas (this comes later) because the sole focus in on generating ideas. Maiden and Robertson (2005) used brainstorming to stimulate creative ideas and to uncover requirements for air traffic management system, concluding that the overall process was successful but not in all workshop sessions. Liikkanen et al. (2011) recommended that a large number of participants is not advisable in brainstorming sessions. Studies found that when there were more than three participants around a table, there was a greater likelihood of them distracting each other and blocking the production of ideas by the person speaking or blocking others from thinking (Wilson 2006; Stroebe et al. 1992). This increased the risk of ideas being forgotten and the likelihood of free riding and increased pressure for social conformity. Diehl and Stroebe (1991, 1987) earlier confirmed this view in a review of 22 studies, demonstrating that group brainstorming produces fewer ideas than individual brainstorming, with the individual working alone.

2.2 Joint Application Development (JAD)

JAD was originally developed by IBM in the late 1970s (Jonasson 2012). It is an organized and structured technique for requirements elicitation (Maiden & Rugg 1996) where all key stakeholders, including sponsors, project managers, business users, and IT professionals (system analyst/software engineer), as well as the JAD session facilitator and scribe, are involved in discussing the requirements, analyzing these requirements, and designing user interfaces. The main aim of JAD is to build consensus and agreement among stakeholders about the system requirements (Jonasson 2012). JAD differs from brainstorming because it determines requirements during the design phase, after establishing the main goals of the system (Zowghi & Coulin 2005). Jonasson (2012) pointed out that the optimal number of participants in a JAD session is between five and 10. Liou and Chen (1993) suggested that the following formed the core of JAD sessions: a focused workshop facilitated by JAD leaders and scribes, users' participation and management's commitment, development of shared requirements and design specifications, application of structured procedures and methods, and an accelerated approach in a specific time frame. Jonasson (2012) pointed out that while the customer [i.e. user] is the most important person when gathering requirements, it is the facilitator who is most important to the success of JAD sessions. He also added that while the facilitator is the key to the success the JAD session, the scribe is the key to accurate documentation of everything of value. Poor facilitators will create chaos in a session and quickly lose control. He added "if at the end of three days of a JAD session, there is a blank piece of paper of the minutes of the meeting or a very short document, it probably means there is reliance on memory, which, even in the best cases, is unreliable" (p. was not numbered) Hence, JAD is highly dependent on a facilitator and a scribe. Christel and Kang (1992) recognized that all participants funnel their ideas through a facilitator or a recorder. Thus, the recorder may inadvertently impose an interpretation on the collected data not shared by the group. They pointed out that an ideal method would allow for the transparent capture of the information discussed in meetings and the efficient organization of this information. Liou and Chen (1993) also recognized some problems with JAD, such as the unequal involvement of JAD participants, with only the comments of the most vocal captured, and the limited ability of analysts to judge group consensus in real time.

2.3 Focus Groups

The focus group method emerged in social research in the 1950s (Templeton 1992), where a group of individuals are selected to discuss specific and focused issues based on their own perspective and experience. The recommended number of focus group participants should be within the range of 6–12 (Krueger 2000; Morgan & Scannell 1998; Kelley 1999). Focus groups are normally led by a moderator who should have communication and writing skills. Focus groups are similar to JAD sessions, but the group in the session acts in an advisory rather than a decision-making capacity, and the main outcome is not consensus as is the case in JAD (Jonasson 2012). Key factors in the success of group work are the harmony of the participants and the cohesion within the group. Stakeholders must feel comfortable and confident in speaking openly and freely (Zowghi & Coulin 2005). The homogeneity within the group is desirable in order to capitalize on people's shared experiences (Kitzinger 1995). Morgan (1997, p. 35) suggested that "meeting with others whom they think of as possessing similar characteristics or levels of understanding about a given topic will be more appealing than meeting with those who are perceived to be different." This method has been used for requirements elicitation with homogeneous and heterogeneous stakeholders. Nevertheless, these types of sessions can be difficult to organize due to the number of different stakeholders that may be involved in a project (Zowghi & Coulin 2005). In addition, there are subject to problems of dominant talkers and analysis costs (Farinha & Silva 2009).

Although there are many benefits of group interaction as discussed earlier, there are also disadvantages and limitations. The process of collaborative group work is often plagued with dysfunction known as process losses. According to Turban and Aronson (1998), there have been

attempts to improve the work of groups over the years. If some of the dysfunction could be eliminated or lessened, the benefits would be greatly enhanced. They referred to drawbacks of group work, such as inappropriate representation in the group, a tendency to repeat what has already been said, inappropriate influences (such as domination of time, opinions, or topics by one or few individuals, or fear of speaking), and time consuming to plan. Zowghi and Coulin (2005) also referred to limitations, including dominant participants, biased opinions, high logistic costs, and gathering stakeholders. Obviously, using group techniques for requirement elicitation requires the analyst not only to be proficient in applying the method but also to be proficient in group management, facilitation, and understanding group dynamics. Furthermore, these sessions demand more planning and follow-up and are more time consuming to translate and transcribe than methods with an individual stakeholder (McGraw & Harbison 1997). Moreover, existing methods (e.g., JAD, brainstorming sessions, and focus groups) lack the means to manage the information elicited from large numbers of stakeholders (Dheepa et al. 2013). The methods also fail to scale to big projects with hundreds of stakeholders, many stakeholders are omitted, and their requirements are overlooked (Lim & Finkelstein 2012). Taking into consideration all the aforementioned problems and pitfalls of existing group elicitation methods, the current paper introduces a new method for requirements elicitation that can effectively solve some of their drawbacks.

3 OVERVIEW OF DISCOUNT FOCUS SUBGROUPS (DFSG) METHOD

Halaweh (2013, 2014) developed a new innovative type of focus group called DFSG. He proposed using it as a qualitative research method to investigate IS/IT research phenomena. He listed three situations where this approach could be used: 1) when there are limited funds available for conducting research (monetary and human resources); 2) when researchers are investigating emerging topics (i.e., emerging technology) where it may be difficult to recruit research participants, particularly those who could provide insight and relevant information on the emerging research topic that could not be gained from one-on-one interviews or even focus groups with small numbers of participants; and 3) when a researcher wants to overcome challenges concerning the analysis of qualitative data as qualitative researcher typically spends considerable time transcribing every single recorded word. The latter process may result in hundreds of pages that are not entirely insightful or useful. Halaweh (2013) listed five methodological steps/principles for the application of DFSG (Table 2).

1	Utilize the limited resources available. Find participants from the work environment: in academia, students and instructors at the university; in industry, staff and workers from organizations. Both have various characteristics that are suitable for a large number of research topics. For example, university students are female or male, are of different ages, from different backgrounds, cultures and geographical areas, practice different religions, and some are professional workers in industry, have cell phones, and use the Internet.
2	Divide and assign roles. Divide the participants (the larger the number, the more numerous the insights and issues that emerge from the discussion) into subgroups and appoint one member of each subgroup as a research assistant/moderator to write notes and ideas (in the form of a list) from the subgroup discussions on paper, which will later be delivered to the researcher.
3	Avoid formality. Avoid using recorders and cameras to allow everyone to talk freely and spontaneously. Allow joking, debates, and fun. Avoiding formality increases participation. No one will be shy or judged by his/her speech and answers; rather, those who are unfamiliar with the topic or who have limited knowledge can pose questions and enrich the discussion. Having participants from the same environment (as indicated in step one) will facilitate the discussion and remove the formality, as the participants will know each other.
4	Open the discussion and document cross-discussions and debates among all subgroups that are not recorded by the subgroup leaders and that are derived from the interaction among the subgroups. Take the contribution from each subgroup in a circular round. Start with one idea/issue from each subgroup, then do another round to take another idea/issue, and allow intervention and debate from the other subgroups.

5	Consolidate and cluster lists of ideas written on paper by all subgroup leaders, as well as ideas written during open discussion and debating.

Table 2. DFSG methodological steps/principles (Halaweh 2013)

Halaweh (2013, 2014) pointed out that by applying the above steps, the data collection and analysis are carried out simultaneously, and therefore the researcher will not have to devote time later to transcribing each word and coding the keywords. The listed ideas from all the subgroups are usually ready for clustering and categorizing. Figure 1 shows a typical DFSG meeting in which the above steps are applied.

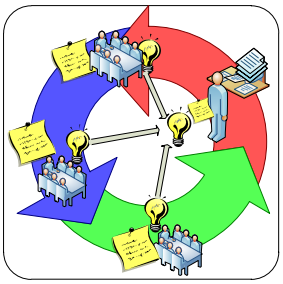

Figure 1. Typical DFSG meeting (Halaweh 2013)

Halaweh showed that DFSG is considered innovative and different from traditional focus groups for several reasons. First, more than 12 participants (the maximum number suggested in the literature) can be involved, and the method remains effective, as they are divided into subgroups. He used 17 and 16 participants in two groups. This is different from all suggestions in the literature. He pointed out that the more participants involved, the more insight and discussion there will be. Using subgroups in one big group is a new way of including a large number of participants. He pointed out that this approach is needed for certain research topics that are new and emerging, as it is expected that some of the participants will be unfamiliar with the topic under investigation, but their role is to raise questions.

Another important aspect of DFSG is that it eliminates the costs of using voice/video recorders and of employing research assistants, as well as the time needed to transcribe each recorded word. Instead of transcribing irrelevant speeches, the researcher can focus on issues and themes and have participants record their own ideas. In addition, the cost of finding participants is reduced, as the participants are selected from the researcher's environment or from one that can be easily accessed. Halaweh (2013, 2014) pointed out that DFSG is completely different from "discount usability engineering," which was developed by Nielson (1989) in the human–computer interface field as a formative technique (http://www.nngroup.com/articles/discount-usability-20-years/). Halaweh developed his method in the context of qualitative research as a formative and/or summative data collection and analysis technique involving unique and different procedures. For example, using large groups and dividing the participants into subgroups differ completely from Nielson's (1989) method, which recommends testing interface designs with a maximum of five participants. Other differences between the two methods include asking the participants to take notes and document their ideas (removing the need for transcriptions) and discussing unique items from each subgroup with the whole group.

Finally, based on research on emerging technology (new technology and its impact), Halaweh (2013, 2014) noted that the application of DFSG helps to promote awareness and learning among participants. He concluded that with emerging issues that are not common or widely known, it is acceptable to have some participants who are unfamiliar with the topic under investigation or who have little knowledge and the participants learn from the discussion. This approach is not supported by the traditional focus group method, which focuses only on objective of data collection.

4 RATIONALE FOR APPLICATION OF DFSG METHOD FOR REQUIREMENTS ELICITATION

In this section, we operationalize the concepts and principles of DFSG method for requirements elicitation, and justify using it as an alternative effective technique to improve requirements elicitation activity by addressing problems with existing group-based methods. Table 3 shows the corresponding terms of DFSG for requirements elicitation.

	DFSG research method terms	**Application for requirements elicitation**
Personnel	Research participants	Stakeholders
Appropriateness	Suitable for studying emerging IS/IT phenomena when participants have no/little knowledge about the subject under study	-Suitable for developing a novel and large systems (e.g. ERP) -Unclear requirements -Involving a large number of stakeholders
Design/layout	Dividing a big group into subgroups of participants based on, for example, expertise, demographic variables, or randomly	Dividing a big group into subgroups of users based on their business functional areas, interface views, user community, or randomly (when people are from one functional area)
Output	Data	System requirements
Key role	Researcher	System analyst

Table 3. Equivalent terms of DFSG for requirement elicitation

In existing methods such as brainstorming, JAD, and focus group meetings, not all stakeholders are represented as the recommended numbers or optimal numbers for the meeting is between six and 12 participants at most. In certain large projects, such as enterprise systems (ERP), large numbers of stakeholders are required. Organizations might need to involve more people in the development process of the system. There might be a need for several people from each department or functional area within the organization to be involved. As existing methods do not involve large numbers of stakeholders, there is no guarantee that one or two people from each department are representative. Some people are not included on the assumption that they are not sufficiently knowledgeable or not suitable for political reasons, a process that might give rise to bias in the outcomes. In addition, some people simply may not be involved due to the limited number of permitted participants (at most 12). Furthermore, the inclusion of only a small number of individuals increases the risk of agenda setting by one or two participants. This can lead to the views and requirements of other stakeholders being overlooked or neglected. Therefore, involving a large number of stakeholders will better represent the views of different departments. Meeting people from cross-functional areas and allowing interactions between them is also important for such systems because system components and business processes are interdependent. In some cases, conducting separate meetings with people from each department is not appropriate when the organization's business processes are interdependent and when understanding how work is done requires collaboration between individuals from cross-functional areas. Moreover, conducing separate meetings with several groups of people from different divisions increases costs. Involving large numbers of participants is also vital when the system is novel and where the requirements are not well defined or unclear. In such cases, including greater numbers of stakeholders will yield more opinions and insight about the system's features and capabilities. Existing methods do not show how wide representation and large number of users can be involved. This can be addressed effectively by DFSG where a large number of stakeholders (exceeding 20) can be involved in one meeting and the group can be divided into subgroups of four to seven individuals from each organization's department. Even if the number of participants exceeds 12, the method can still be effective because the session can be managed and organized by appointing one leader from each subgroup to record the participants' needs of the system. The appointed leader can be nominated by the subgroup members or he /she can volunteer to lead the group. The written points represent their agreement on the requirements. These should be documented clearly by the leader on a sheet of paper.

For example, statements can be written in a standard form, such as “The main objectives of the system are to….” The requirement statements can be written as: “The system should/should not or the system should enable or should have …..”. Accurate documentation by the leader is very important in DFSG because no audio or video recorders are used to avoid formality. The absence of audio and video recording will ensure that people speak freely and without restriction and that people’s opinions will not be censored. In addition, all members of the subgroup will speak up in the discussion because they know each other well. In addition, those who may be shy about speaking out are likely to feel more comfortable in a smaller subgroup (four to six members) than in a large group.

In existing group methods, one or a few individuals may dominate a session. This problem does not occur in DFSG because discussions on requirements take place in a circular format, with each subgroup mentioning one main requirement and the others then commenting on it if they see fit, especially if they had already documented it and drawn attention to the matter. This avoids repetition of the same requirements by another subgroup. Given the interdependent nature of some business processes, the debate will assist in building a common understanding among all those involved in the process.
Existing group methods are totally dependent on a facilitator and a scribe. This can lead to potential bias in involving particular people or documenting certain points and requirements intentionally or unintentionally. To overcome this limitation, in DFSG sessions, the users play those roles and document their needs of the system. DFSG can help to ensure transparency and reduce the possibility of misinterpretation of requirements written by facilitators, scribes, or moderators in other methods. The use of DFSG also reduces costs by removing the need to hire facilitators, scribes, and moderators and the need to transcribe recorded meetings and analyze the findings later.

By applying DFSG, the analyst will not have to spend time analyzing the requirements as they are written in a form ready for clustering, categorization, and conversion into standard models (e.g., ERD or UML). The analyst applies clustering on collected requirements to identify the functional and nonfunctional requirements. Applying clustering in collected requirements ensures that the analyst does not enforce predefined classes of requirements. Rather, they emerge from the written requirements. The proposed system will satisfy stakeholders because those involved document what they want rather than what the analyst, facilitator, or scribe want. This avoids errors due to misunderstanding or misinterpretation being translated into the system.

Based on the above, DFSG can be used for requirements elicitation when 1) the development team aims to minimize the costs and budget in system development; 2) when large numbers of stockholders need to be involved, not only one or two representatives from each department within an organization; (or more than 12 participants (if the participants are homogeneous from one division) the maximum number of the whole group that is recommended by the existing methods); 3) when the system is novel and where no similar systems have been developed and when requirements are not clear or users are not familiar with similar systems; and 4) when the development team needs to be focused on systems requirements, not something else. DFSG removes time normally spent on transcribing and analyzing stakeholders’ needs, a process that takes a long time, and focuses on specific needs rather than unrelated or irrelevant points.

The following table shows the improvements provided by DFSG in comparison with existing methods.

Improvements	**Focus group**	**Brainstorming**	**JAD**	**DFSG**
Wide representation of stakeholders by including large numbers	√	√	√	√√
Reduced costs and time by removing the need to transcribe and to document the requirements	√	√	√	√√
Dependency on stakeholders rather than a facilitator or scribe, thereby avoiding bias, misunderstanding, and misinterpretations	√	√	√	√√
Applicable to novel systems with unclear and unknown requirements (inclusion of a large number of participants means more ideas, thoughts, and insights about system functionality and capabilities)	√	√	√	√√
Low possibility of domination	√	√	√	√√

Table 4. Improvements provided by DFSG in comparison with existing methods.

1) √√ technique strongly recognizes the issue and provides a means to deal with it
2) √ technique does not address the issue at all or provides very little support for it

5 DISCUSSION AND CONCLUSION

This paper described the use of the DFSG method for requirements elicitation to solve problems encountered with existing face-to-face group based methods. DFSG improves requirements elicitation activity by solving several problems. These include 1) limited user participation and representation; 2) costs of conducting meetings, including the costs of moderators, scribes, and facilitators who are required to manage the sessions and document requirements, and the costs of using recorders and transcribing recorded meetings; 3) biases in opinions and documentation by the facilitator or the scribe; 4) individual opinion domination; 5) conflicts among the participants; and 6) time to gather and analyze requirements.

Unlike other methods, DFSG does not require developing software tools (i.e. e-DFSG), as does E-JAD or EBS. The essence of the method is to involve large numbers of stakeholders in the meeting, something that is not supported by existing methods (e.g., focus groups, brainstorming, and JAD) without the use of software tools. In addition, the verbal face-to-face discussions in DFSG assist in building consensus and resolving conflicts. This is achieved at two levels: through discussion among subgroup members first and then through open discussion between all the subgroups. This method can be more effective in situations where it is costly to use or purchase software tools.

Furthermore, the method is more effective than e-methods because face-to-face discussion is required, making it easier to resolve communication problems, such as misinterpretation and misunderstanding, that are likely to appear when software tools are used. DFSG overcomes such problems because issues and viewpoints are clarified in the course of the meeting. However, the DFSG method is not suitable for stakeholders distributed in different geographical locations.

The DFSG method is economical compared with other methods. It is important to mention that the word “discount” in the name of the method does not mean producing lower quantity or quality requirements: Rather, discount means reducing requirements elicitation costs in a smart way. In reality, IT vendors or business organizations that develop systems want to minimize costs as much as possible. The DFSG method is economical, and this helps project managers to reduce costs when the project budget is set. This reduction is achieved through several ways as pointed out earlier.

The DFSG method can help to minimize biases that can arise with the use of facilitators, moderators, or scribes because they are not required. In addition, the method limits potential misunderstandings and misinterpretation that can occur due to them being unfamiliar with the process of software development and the business domain. In DFSG, they are replaced by the users and the analyst, both of whom have very active roles in the process.

Unlike other methods, DFSG will not produce a large volume of data because the stakeholders' requirements are already refined, focused and specified clearly in the session and delivered to the system analyst on sheets. As no video or audio records are used, there are no data to transcribe unlike traditional methods, which usually produce large amounts of data. Transcribing these data can take a long time and potentially result in hundreds of pages. The gathering of a large amount of data should not be the purpose per se: Rather, it is the quality of the collected data that matters. One DFSG session might produce 10 pages of clear, direct, structured, and specified requirements (because they are written by the participants themself and focused on the core issues. See for example outputs that were generated from a DFSG session in Halaweh's paper (2014)) that are equivalent perhaps to 50 transcribed pages of recorded JAD or focus group meeting. These 50 pages will include both the requested requirements and other irrelevant and insignificant information, including introductions, participants' stories, cases, jokes, conflicts, and interrupted talks. Therefore, transcribing the meeting and then extracting the requirements from the transcripts require time and effort, neither of which are required in DFSG.

The DFSG method can be used in combination with other elicitation methods that focus on different aspects of the stakeholders' requirements and at different stages of the development process, such as questionnaires and prototypes. As mentioned before, there is no optimal method for all situations, and the use of multiple methods in some situations is necessary.

The current paper provided a conceptual justification for the use of this method and its applicability to requirements elicitation. Thus, complementing this work with practical implementation will increase the validity of the method and assist in generalizing the suitability of the method for requirements elicitation. Another future area of research is to develop evaluation criteria to ensure the quality of the data collected with this method, such as their accuracy, completeness, and validity.

References

Anwar, F. and Razali, R. (2012). A Practical Guide to Requirements Elicitation Techniques Selection-An Empirical Study. Middle-East Journal of Scientific Research, 11 (8), 1059-1067.

Aranda G. A., Vizcaíno, A. and Piattini, M. (2010). A framework to improve communication during the requirements elicitation process in GSD projects. Requirements Engineering, 15, 397-417.

Arshad, S., Shah, M. and Shahzad, S. (2013). Empirical Analysis of Traditional and Agile Requirement Engineering Process. Science, Technology and Development, 32 (1), 44-47.

Avison, D. and Fitzgerald, G. (2006). Information systems development: methodologies, techniques and tools. New York, McGraw-Hill.

Carmel, E. George, J. F. and Nunamaker, J. F. (1995). Examing the Process of Electronic-JAD. Journal of Organizational and End User Computing, 7(1), 13-22.

Chirstel, M.G. and Kang, K.C. (1992). Issues in Requirements Elicitation, Technical Report CMU/SEI-92-TR-012. Software Engineering Institute, Carnegie Mellon University.

Coughlan, J. and Marcredie, R. (2002).Effective communication in requirements elicitation: a comparison of methodologies. Requirements Engineering, 7(2), 47-60.

Coughlan, J., Lycett, M. and Macredie, R. (2003). Communication issues in requirements elicitation: a content analysis of stakeholder experiences. Information and Software Technology, 45(8), 525-537.

Davis, A. and Hickey, A. (2002). Requirements researchers: Do we practice what we preach. Requirements Engineering Journal, 7(2), 107–111.
Dheepa, V., Aravindhar, D. J. and Vijayalakshmi, C. (2013). Novel Method for Large Scale Requirement Elicitation. International Journal of Engineering and Innovative Technology, 2(7), 375-379.
Diehl, M. and Stroebe, W. (1991). Productivity Loss in Idea-Generating Groups: Tracking Down the Blocking Effect. Journal of Personality and Social Psychology, 61 (3), 392-403.
Diehl, M. and Stroebe, W. (1987). Productivity Loss in Brainstorming Groups: Toward the Solution of a Riddle. Journal of Personality and Social Psychology, 53, 497-509.
Farinha, C. and Silva, M. D. (2011). Web-Based Focus Groups for Requirements Elicitation. The Sixth International Conference on Software Engineering Advances (ICSEA 2011), 504-509, Barcelona, Spain, 2011.
Farinha, C. and Silva, M. D. (2009). Focus Groups for eliciting requirements in information systems development. The 14th UK Academy for Information Systems, Oxford, UK.
Glass, R. (2002). Searching for the holy grail of software engineering. Communications of the ACM 45(5), 15-16.
Halaweh, M. (2013). Discount Focus Subgroup Method: An innovative focus group method used in researching an emerging technology. 24th Australasian Conference on Information Systems (ACIS), Melbourne, Australia, 4-6 December, 2013, 1-11.
Halaweh, M. (2014). Discount Focus Subgroup Method: An innovative focus group method used in researching an emerging technology, in Hai-Jew, S. Enhancing Qualitative and Mixed Methods Research with Technology, 494-512, IGI Global.
Hickey, A. M. and Davis, A. M. (2003). Requirements Elicitation and Elicitation Technique Selection: A Model for Two Knowledge-Intensive Software Development Processes. Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03) Hickey, 2003.
Hickey, A. M. and Davis, A. M. (2004). A Unified Model of Requirements Elicitation. Journal of Management Information Systems, 20(4), 65-84.
Jonasson, H. (2012). Determining project requirements: mastering the BABOK and the CBAP exam. Boca Raton, FL : CRC Press.
Kelley, D.L. (1999). Measurement made Accessible: A Research Approach using Qualitative, Quantitative, and Quality Improvement Methods. Sage, London.
Kitzinger J. (1995). Qualitative Research: Introducing focus groups. British Medical Journal. 311, 299-302.
Krueger, R. A. (2000). Focus Groups: A Practical Guide for Applied Research (3rd Ed.). Newbury Park, CA: Sage Publishing.
Krueger, R. A. and Casey, M A. (2000). Focus groups: a practical guide for applied research. California: SAGE.
Leffingwell, D. and Widrig, D. (2000). Managing Software Requirements: A Unified Approach. Upper Saddle River, Addison-Wesley Publishing Company.
Leffingwell, D. and Widrig, D. (2003). Managing Software Requirements - A Use Case Approach, 2nd Ed. Addison-Wesley.
Liikkanen, L. A., Kuikkaniemi, K., Lievonen P. and Ojala P. (2011). Next Step in Electronic Brainstorming: Collaborative Creativity with the Web. In CHI '11 extended abstracts, ACM Press, 2029-2034.
Lim, SL. And Finkelstein, A (2012) StakeRare: Using Social Networks and Collaborative Filtering for Large-Scale Requirements Elicitation. IEEE Transactions on Software Engineering, 38 (3), 707-735.
Liou, Y. and Chen, M. (1993). Integrating Group Support System, Joint Application Development, and Computer-Aided Software Engineering for Requirements Specification. Proceedings of the 26th Hawaii International Conference on System Sciences, Hawaii, IEEE Computer Society, 3-8 January 1993, 4-12.

Lloyd, W. J., Rosson, M. B. and Arthur, J. D. (2002). Effectiveness of Elicitation Techniques in Distributed Requirements Engineering. In: Proceedings of the IEEE Joint International Conference on Requirements Engineering, 2002, 311-318.

Maiden, N. and Robertson, S. (2005). Integrating Creativity into Requirements Processes: Experiences with an Air Traffic Management System. The 13th IEEE International Requirements Engineering Conference (RE'05), Paris, France, 2005.

Maiden, N. and Rugg, G. (1996). ACRE: Selecting methods for requirements acquisition. Software Engineering Journal, 11(5), 183-192.

McGoff, C., Hunt, A., Vogel, D. and Nunamaker, J. (1990). IBMs Experience with Groupsystems. Interfaces, 20(6), 39-52.

McGraw, K. and Harbison, K. (1997). User-Centered Requirements: The Scenario- Based Engineering Process. New Jersey, Lawrence Erlbaum Associates, Inc.

Morgan D. L. (1997). Focus groups as qualitative research, 2nd ed. Sage Publications, London, Chapter 4, 1997.

Morgan, D. L. and Scannell, A. U. (1998). Planning Focus Groups. Sage, London.

Mulla, N. and Girase, S. (2012). A New Approach to Requirement Elicitation Based on Stakeholder Recommendation and Collaborative Filtering. International Journal of Software Engineering & Applications (IJSEA), 3(3), 2012.

Nuseibeh, B. and Easterbrook, S. (2000). Requirements engineering: a roadmap. Paper presented at the Conference on The Future of Software Engineering ICSE 2000, Limerick, Ireland, 4-11 June 2000, 35-46.

Osborn, A. F. (1953). Applied Imagination: Principles and Procedures of Creative Thinking. New York: Scribner.

Pa, N. C. and Zin, A. M. (2011). Requirement Elicitation: Identifying the Communication Challenges between Developer and Customer. International Journal on New Computer Architectures and Their Applications (IJNCAA), 1(2), 371-383.

Robertson, S. and Robertson, J. (1999). Mastering the Requirements Process. Essex, England, Pearson Education Limited.

Stroebe, W., Diehl, M. and Abakoumkin, G. (1992). The Illusion of Group Effectivity, Pers. Soc. Psychol. Bull.18 (5), 643-650.

Sutcliffe, A. (1997). A Technique Combination Approach to Requirements Engineering. In Proceedings of the Third IEEE International Symposium on Requirements Engineering, 65-74.

Templeton, J. F. (1994). The Focus Group: A Strategic Guide to Organizing, Conducting and Analyzing the Focus Group Interview. McGraw-Hill Professional Publishing.

Turban, E. and Aronson, J. (1998). Decision Support Systems and Intelligent Systems. 5th Edition, New Jersey, Prentice-Hall.

Tuunanen, T. (2003). A New Perspective on Requirements Elicitation Methods. Journal of Information Technology Theory and Application, 5 (3), 45-62.

Wilson, C. E. (2006). Brainstorming pitfalls and best practices, Interactions, 13, 50-63.

Zhang, Z. (2007). Effective Requirements Development - A Comparison of Requirements Elicitation Techniques. Software Quality Management XV: Software Quality in the Knowledge Society, E. Berki, J.

Zowghi, D. and Coulin, C. (2005). Requirements Elicitation A Survey of Techniques, Approaches and Tools. In Aybüke Aurum & Claes Wohlin (Eds.), Engineering and Managing Software Requirements. Berlin: Springer.