ORGANIZATION AND IMPLEMENTATION OF BRAINSTORMING SESSIONS FOR RISK IDENTIFICATION IN GEOTECHNICAL PROJECTS

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Abstract

The technique known by the name of "Brainstorming" is commonly recognized and recommended by the standards of management as one of the most important in identifying risks. The "Brainstorming" is used mainly as group technique and aims to get the mayor number of risk scenarios, so that a participant in the group presents new ideas in basis of the ones already proposed by the others. Many factors that determine the efficiency of the technique are recognized, such as the number and characteristics of participants, time limit, support tools available, etc. After conducting the study on the topic, improvements have been proposed. Various solutions for session dynamics, content and rules of the session have also been identified. Both support tools and new solutions proposed have been part of a questionnaire to a group of people with experience in brainstorming organization. According to the results of the study it is recommended to run the brainstorming session through a system commonly called "Electronic Board Room. In the case of not having the above mentioned system is essential when trying to identify purely technological risks, use tools like the "Risk Breakdown Structure" and "Flow Chart" and have strongly experienced group facilitator.

Keywords*: risk identification; brainstorming organization; brainstorming rules; brainstorming tools; risk breakdown structure; geotechnical engineering*

Resumen

La técnica conocida por el nombre de “tormenta de ideas” es comúnmente reconocida y recomendada por los estándares de gestión como una de las más importantes de identificación de riesgos. La “tormenta de ideas” se utiliza sobre todo como técnica grupal, cuyo objetivo es sacar el mayor número de escenarios de riesgo, de forma que un participante del grupo presenta ideas nuevas en base de las ya propuestas por el resto de participantes. Existen muchos los factores que influyen la eficiencia de la técnica. Después de realizar el estudio sobre el tema, se han propuesto mejoras para la técnica. También han sido identificadas distintas soluciones para la dinámica, contenido y reglas de esta sesión. Las herramientas de soporte y las soluciones propuestas han formado parte de un cuestionario destinado a un grupo de personas con experiencia en la organización de sesiones grupales. Según los resultados del estudio se recomienda ejecutar la a través de un sistema llamado “Electronic Board Room”. En el caso de no disponer del sistema

mencionado, es imprescindible, para identificación de riesgos puramente tecnológicos, utilizar las herramientas como la “Estructura de Desglose de Riesgos” y el “Diagrama de Flujo”, y disponer de un moderador de sesión experimentado.

Palabras clave: *identificación de riesgos; organización tormenta de ideas; reglas tormenta de ideas; herramientas de soporte; estructura de desglose de riesgos; geotecnia*

1. Introduction

Despite the fact that the construction industry belongs to one of the most important engines of the developed countries economies, it still has to advance in many of its particular problems. According to VanStaveren (2006), there are three main challenges in the construction industry that are searching for the solutions in order to get back the initiative:

1. Increasing complexity of the technological systems.
2. Growing aversion of many people in a lot of countries feel towards corruption and fraud.
3. High failure costs represented to a large degree by the problems related to the ground conditions.

Brandl (2004) indicates that, according to European statistics, about 80-85 per cent of all building failures and damages are related to problems in the ground. It means that until now, ground-related problems remain the biggest cause of delays and cost overruns in civil engineering projects, suggesting that engineers still need a better understanding of the nature of geotechnical risk. Despite the availability of design codes and construction process and material recommendations, it has to be emphasized that security cannot be totally assured; even if the design codes and guidelines are strictly followed (Rodríguez el al, 2006).

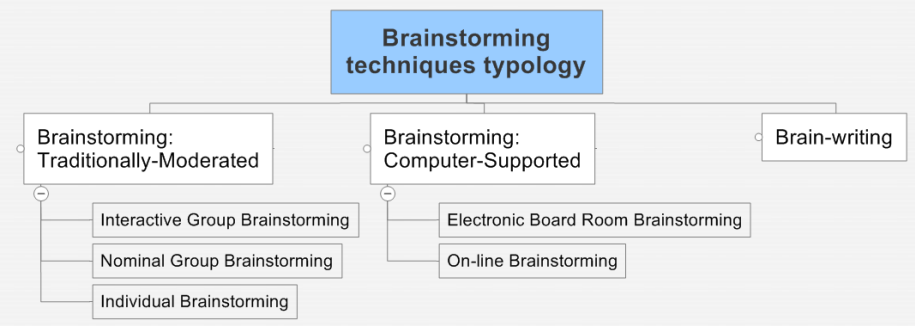
Therefore, from the midst of 90s, many construction industry experts began to propose the integration of Risk Management (RM) methodologies to construction development processes. In recent years, a great progress has been made mainly in the areas of tunnelling, coastal or overseas structures, and dam construction projects.

Emphasized in the work of Whitman (2000), Clayton (2001), VanStaveren (2006) and many others, it is considered essential for the geotechnical engineer to identify all possible mechanisms of damage (limit state) to prevent. Only after doing that correctly, would be then possible to estimate effectively the probability of risk occurrence and the value of its impact to finally set priority and prepare the risk treatment actions. The registered risks, together with the probability of failure and impact statistics, could provide valuable information for the risk manager who then would be able to prepare optimum risk mitigation measures. This could then produce a “better and cheaper” project effect, and importantly, lowering the price of insurance policy premium.

Among the risk identification techniques recommended by VanStaveren (2006) for geotechnical projects, the use of brainstorming session is recognized. According to studies in civil engineering industry (Lyons, Skitmore, 2004), the brainstorming was nominated as “most common risk identification technique used”. The biggest advantage of this method of identification is "to encourage creativity based on the ideas of others, try combinations and improvements" (PRAM, 2004). In what is called the session of brainstorming there are several types of it that can be seen in the Figure 1. Basically it can be executed by nominal

(non face-to-face idea generation) or interactive groups (face-to-face idea generation). Those sessions that not use informative technologies and on-line network connections as a fundamental base for brainstorming process are known as “traditional”. The “modern” brainstorming session through the use of information technologies, avoids group member influences, but does not satisfy social interaction needs. Due to the limited resources, group member’s technological maturity level, enterprise culture, and so on, the traditional interactive group brainstorming session still remains to be the most frequent one applied in civil engineering.

Figure 1: Typology of brainstorming sessions. (According to VanStaveren, 2008; Chapman, 1998; and Aiken at al, 1996).



2. Objectives and applied methodology in the context of the investigation project and planned studies.

Brainstorming session organization forms a part of an investigation project whose general objectives were the following:

1. Develop and test a concise and consistent methodology for systematic identification of risks related to geotechnical problems of building construction projects.

2. Register geotechnical problems related risks that may directly or indirectly affect the structural safety of the building using selected identification techniques. The concern was focused on operational risks affecting the development of the Geotechnical Project (GP).

3. And finally, give recommendations on the use of the determined risk identification techniques applied on geotechnical issues.

To create a new methodology for risk identification in geotechnical projects several risk identification techniques were planned to be tested to look on their possible application. One of the partial objectives of the investigation project was to prepare and execute Interactive Group Brainstorming (IGB) session and give recommendations on its use in Geotechnical Project (GP). The investigation methodology was designed to achieve the objective which consisted of the following:

1. Analyze the “state of the art” about brainstorming session organization by revision of existing documentation. Identify questions and problems not resolved related to organization of such session for geotechnical project.

2. Search for the answers emerging from identified problems though a structured questionnaire. Form an expert group, create, execute and analyze the results of the questionnaire.

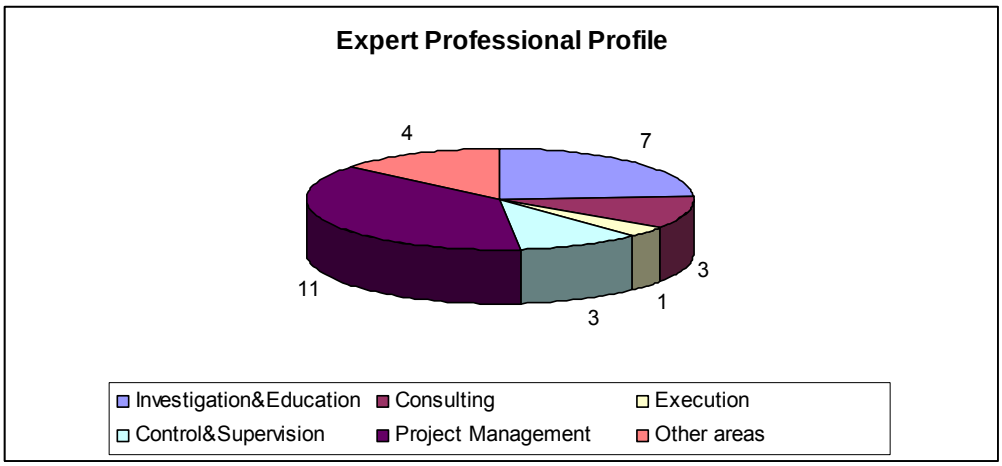
3. Execute real Interactive Group Brainstorming (IGB) session which is to be organized based on the two previously mentioned points, e.g. on the document study and questionnaire results.

It can be than possible to analyze the course of the real session and be able to give recommendations on its organization in a real geotechnical project comparing the results of the document study as well as those derived from the questionnaire.

2. Selected expert group profile for questionnaire about Interactive Group Brainstorming session.

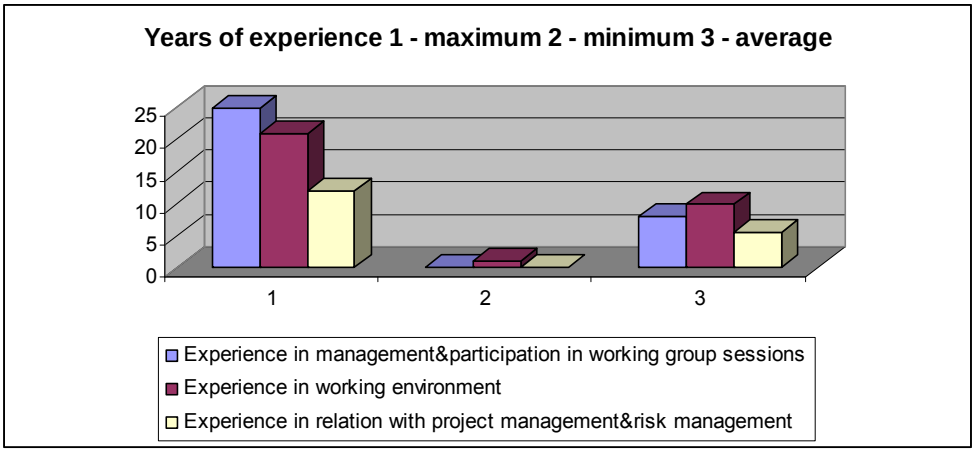
The questionnaire about IGB session was designed following, fundamentally, the rules and recommendations studied from documents dedicated on design and execution of questionnaires, especially the one from Diaz de Rada (Esic, 2001). 10 questions have been raised to the selected expert group through the questionnaire estimated approximately 20 minutes time for its execution.

Figure 2: Expert sample distribution by professional profile.



The expert group was selected according to their professional profile and experience in determined project areas. The questionnaire was sent to 36 selected experts and 13 have responded until this publication has been send to the congress. The process continues to advance and the questionnaire will be send to more experts until a representative sample is reached. The professional profile of those who achieve to respond until now is described on Figure 2.

Figure 3: Maximum, minimum and average years of experience gathered from the expert sample for determined project activities.



More than a half of them have an experience in different working areas which for the case of average years of their work experience seems rather obvious. Figure 3 confirms this, as we can see the expert average years of experience in management and participation in working group sessions, in their actual working environment, and carrying out the activities of Project Management or Risk Management (PM), to be 8, 10 and 5 respectively. Figure 2 show that 11 persons confirm they have experience in PM activities and this was one of good signals of confidence. Among the 13 experts, 5 were having the doctoral degree and 3 of them more then 15 years of experience.

3. Organization and support tools influencing the effectiveness of interactive group brainstorming session for risk identification.

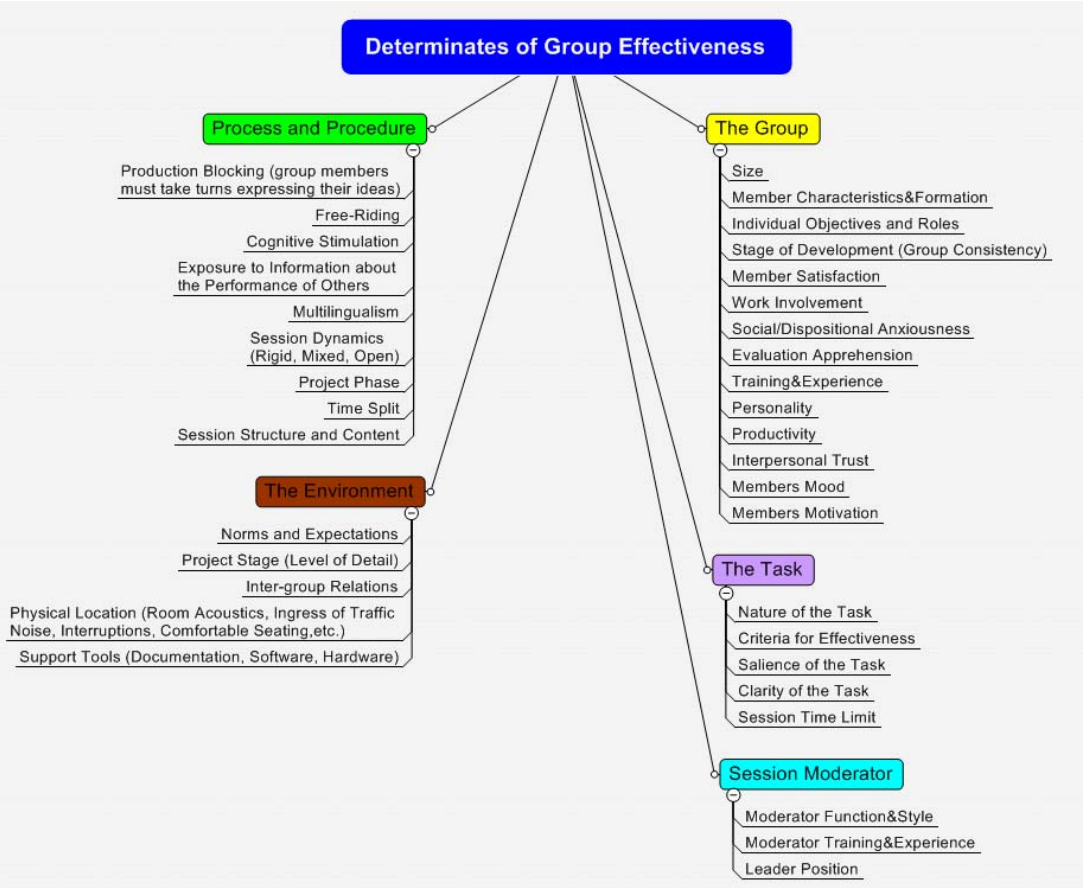
A typical Interactive Group Brainstorming (IGB) session consists of several phases such as introduction, risk scenario identification phase, followed normally by a short break ("coffee break"), after that, the risk scenarios identified in previous phase are reviewed, and finally short conclusions are made related to the organization and effectiveness of the meeting (according to PRAM, 2004). Determined as the main factors that influence the results of the session (Figure 4) are time limit, group size, dynamics, group moderator (facilitator) function and experience, project stage, member characteristics, clarity of the task, and the importance of the support tools. All of those mentioned were subjected on the document review before being put up for review by the questionnaire.

The optimum total time limits are determined in several books and standards. A total time limit of 200 minutes approximately is recommended with 10-90-10-90-5 allocation of time in minutes according to the above defined IGB phases (PRAM 2004). Of course, the optimum time limit can differ; only taking a look on the Figure 4 one can imagine how the factors such as member mood, motivation and characteristics can influence it. For the first question, the experts were asked to define the optimum time limits in minutes for each of the determined IGB phases.

The introduction phase possible content options were described in the second question and the task of the expert here was to determine their importance when mentioned starting the

session. The rating scale here was marked from 0 to 3. While 0 stated for “not to form part of the introduction”, the 3 points were defined as “essential to mention”.

Figure 4: Factors influencing effectiveness of brainstorming sessions (according to PRAM, 2004; Chapman, 1998; and others)

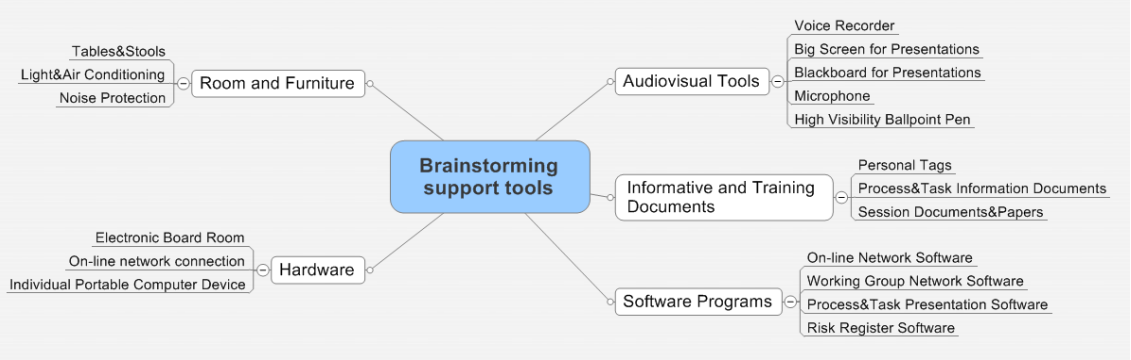


The third question treated the dynamics of session. A typical problem that occurs during the process is the presence of extrovert members and the introvert ones in the group (Chapman, 1998). While the first ones tend to present large number of ideas, the other ones may remain silent for different reasons. The rule of success is not to enhance the participation of extroverts, but to obtain reliable results and consistent ones with the objectives established by the decision-maker. While the “open system” can produce an objective and scope misplace, the “rigid system” tends to annihilate lateral thinking. The session information flow can be controlled either by an experienced group facilitator or by strict rules. The experts were asked here to mark an optimum solution from three proposed, the one that they would prefer in their professional work.

The forth question tried to search for the answers related to the member group composition considering the member characteristics and two geotechnical project phases; predesign and design phase (VanStaveren, 2008). For the mentioned phases two four element matrix have been created having both the same structure and content. The matrix combined same or different decision power levels with unidisciplinary or multidisciplinary group compositions. From that, 4 different combinations for each GP phase have been made and subjected to the

expert judgement. The rating scale here again was marked from 0 to 3. While 0 stated for “inappropriate composition”, the 3 points were defined as “optimum composition”.

Figure 5: List of possible brainstorming session support tools.

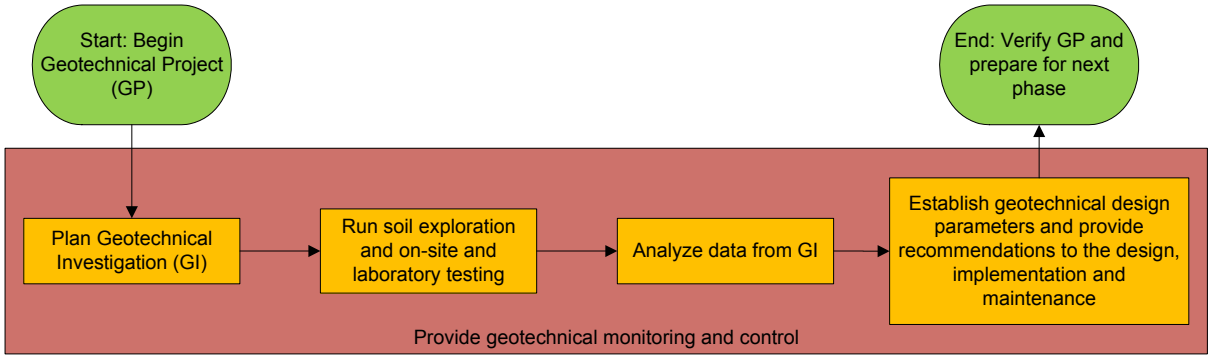


The fifth question was dedicated to the use of selected support tools. As it can be seen on the Figure 5, the tools can be divided in several groups. If one looks back to the Figure 1, he or she then can realize that the use of the support tool is determined strongly by brainstorming session type and can then easily calculate the resources (people, time and cost) needed for such sessions given the quality required by the client. The role of the risk manager (or project manager if there is none) is to take a look on the technique effectiveness for certain project situation while at the same time control the available resources. For a traditional IGB, the use of the electronic board room and on-line support tools can be forgiven, while the rest of the tools that appear on Figure 5 can be completely considered. Also, in the case of traditionally moderated brainstorming session types a group facilitator is needed as one of the resources. As in other questions, the rating scale here was marked from 0 to 3. While 0 stated for “none or negligible influence on the result of the session”, the 3 points were defined as “support tool essential and irreplaceable to obtain good results”.

The sixth question fathoms the question three about session dynamics and analyzes the function and responsibilities of the group facilitator. Basically, the facilitator can be impartial; limiting his activity only on the session dynamics coordination, or it can take part of the discussion as one of the group member. Also the time control differs here, for the case of facilitator being part of the group; he or she controls his time and make his own decision or the time for his intervention is assigned to him like for the rest of the group members. Here, three options were generated from these situations and were put to the expert judgement.

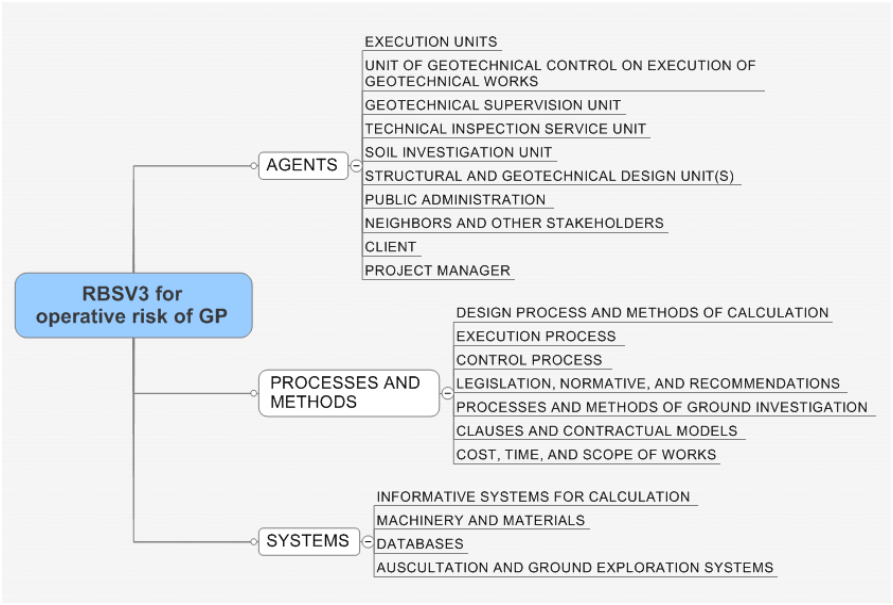
The seventh question introduces two support tools, both of them considered by the authors as necessary for risk identification scope control and designed with different alternatives leaving them for the experts to decide according to their preferences. The first one was the geotechnical project flow diagram, part of it seen on Figure 6 that represents the treated project scheme. In the example, the displayed diagram defines the execution process that leads to detailed geotechnical report creation. For this case, the operational risks of this process are to be identified here. For doing it correctly and register the risks in a controlled manner by their origins, the second tool is recommended to be applied called Risk Breakdown Structure (RBS) (Rodríguez, Hruškovič, 2007).

Figure 6: Example of the part of process flow diagram for geotechnical project subjected to expert opinion.



One of these structures can be seen on Figure 7, as this was one of four alternatives proposed. In the seventh question, the experts were considering only the fundamental phase of the IGB session, e.g. the risk scenario identification phase.

Figure 7: The highest scored geotechnical Risk Breakdown Structure (RBS) according to preliminary results of the questionnaire given from expert opinion.



In this phase, the question of how to divide the designated time for risk identification phase was planned. The options were to divide it following the phases of the flow diagram, or divide it following the risks origins embodied by any of the proposed geotechnical RBSs, or not to divide the time designated to risk identification and leave it completely on the decision of the group members from the beginning to the end of the phase.

The questions eight and nine were treating the optimum number of group members and optimum number of topics respectively. For the ninth question, the experts were guided to use their previous estimation on risk scenario identification phase time limit as the reference.

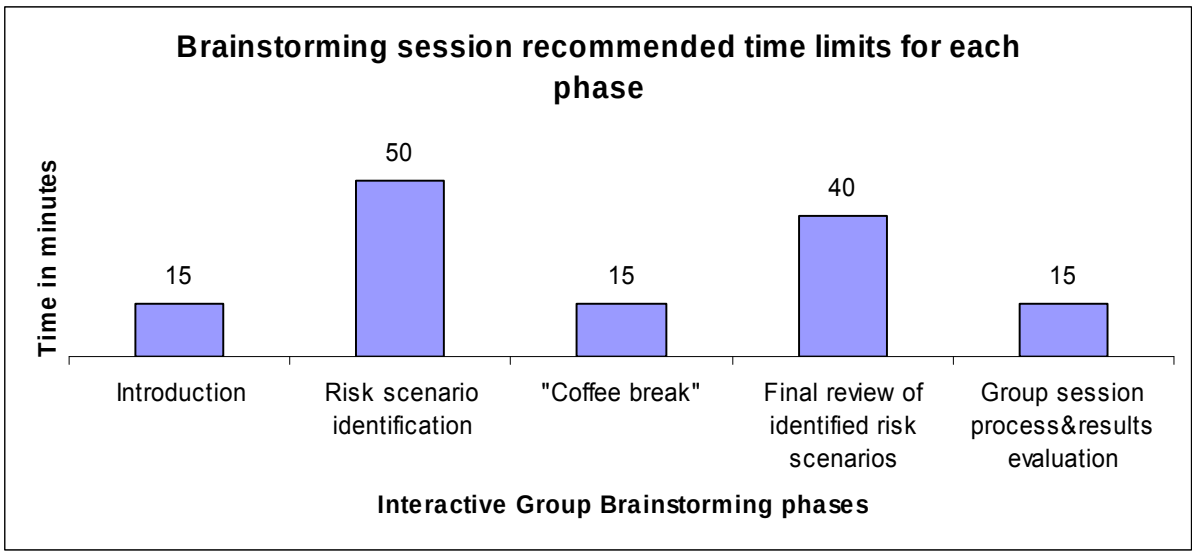
Finally, the ultimate question was asking the experts to classify from 1 to 4 (that is, from the best to the less suitable one) the three proposed geotechnical RBS for operational risk identification. The compositions of RBS differentiated in number of breakdown levels, e.g. level of detail about risk origins, number of risk origins defined in the first breakdown level, and in the very definition of risk origins and the manner of their structuring. The forth option also has been made to be classified by the experts betting for not to use any of the identification and risk register support tools.

4. Preliminary results of the questionnaire.

In first question, where the experts were asked to establish time limits for defined Interactive Group Brainstorming (IGB) phases the average values for each of them were calculated. The results are presented below the text in Figure 8 and are preliminary. More statistical analysis including standard deviation and mean remain to be done. Despite this fact, the answers were quite coherent with only small differences in time limit determinations. Hence, the total time for IGB session summing up all phases is estimated to approximately 135 min. This is about 1.5 times less than the time limit recommendation made by PRAM (APM, 2004). Only two experts have overcome the 200 minutes time recommended for brainstorming session by the mentioned standard.

For second question the expert responses were also very coherent. They function was to establish priorities, or rather importance value for several defined topics to be treated in the introduction phase of IGB session. In the range of 0 to 3, the highest scored were “presentation of the objectives and tasks” (averaging 2.92), “Process and session dynamics presentation” (averaging 2.62), and “presentation of session rules” (averaging 2.54). The lowest scored were “Presentation of session support tools” (averaging 1.62), and “presentation of the definition of brainstorming session” (averaging 1.7).

Figure 8: Expert time estimation averages (minutes) for defined interactive group brainstorming session for geotechnical project.



In third question, that treated the session dynamics, the experts were asked to determine which from the three options related to session organization the optimum one was following their own criteria. From 13 answers, 8 experts marked option C which stated for “open organization”, 4 have opted for option B (“mixed organization”), and finally 1 elected the option A (“rigid organization”).

The forth question treated the composition of group members of the IGB session considering different Geotechnical Project (GP) phases and was quite complicated to understand for almost a half of the experts. There were also experts that claimed that there was no issue to organize such group technique for design phase of the GP. Nevertheless, some of the results derived from this question tend to be of majority opinion. With the rating scale marked from 0 to 3, the results were quite coherent for group composition between same power of decision and unidisciplinary group which was generally rated as “mediocre composition, it needs strict organization and control” for predesign phase (averaging 0.78), and slightly higher ranked for design phase (averaging 1.22). The highest scored group composition for predesign phase was the combination of different decision power and multidisciplinary group achieving the description of “suitable composition, problems may occur, but not affect seriously the expected results” (averaging 2.2). It should be mentioned that the combination between the same decision power and multidisciplinary group achieved almost the same results with a calculated average of 2.1 for predesign phase. Here it can be seen that the opinions differ substantially and further investigation has to be done. For the design phase, the highest ranked group composition was the combination between the same decision power and unidisciplinary group achieving an average of 2.2. Again, the results for the most appropriate composition in this GP phase are pretty much the same, stating “suitable composition, problems may occur, but not affect seriously the expected results” also for the combination between different decision power and multidisciplinary group (averaging 1.8). It has to be noted that 5 from 13 experts that have responded to this question did not make any difference in their evaluations between the two GP phases. This could happen also due to complicated formulation of the forth question. Nevertheless, more data are needed to get any reasonable conclusion.

In fifth question, among the support tools subjected to expert assessment (Figure 6), big screen for presentations (averaging 2.5) and meeting site (light&air conditioning, noise protection) with an average of 2.2 were the highest scored; the first one defined as “essential for success” and the second one as “very important to improve quality of the process although it can be replaced”. The lowest values were given to support software (averaging 1.5) such as process&task presentation software or risk register software and mainly for the use of voice recorder during the sessions (averaging 1.1). As for the voice recorder, many of the experts claimed that the use of it could be “absolutely inadequate”. The poor ranking for support software seems almost a mystery, but the reason again may be the misunderstanding due to not detailed explication. Further investigation will reveal it.

In sixth question, that once again treated the session dynamics, the experts were asked to determine which from the three options related to group facilitator function the optimum one was by their own criteria. From the total of 13 answers, 10 experts decided for option A which stated for impartial facilitator limiting his activity only on the approved session dynamics coordination. Only 1 expert has opted for option B, which meant a facilitator assuming the function of the working group member and not having his or her own time limit. And finally, 2 experts have chosen the option C, which was a facilitator assuming the function of the working group member and being restricted by a time limit just like the rest of the participants. The results show clear evidence of impartiality for the group facilitator as a key for a good functioning of the session dynamics.

The results of seventh question about distribution of the topics discussed during the session are balanced in all 3 options. Total of 11 experts responded to this question, 3 of them bet on

option A, 4 decided to select the option B, and equally, 4 looked out for the option C. Reaching a conclusion or give a recommendation on this topic seems to be impossible until now, moreover, there are also undecided experts. Can be possible that this question will never be answered "correctly", as it is known that many times in the project development, the wishes of the client as a decision-maker produce changes that need to be accepted. There are times when the client prefers to centre the session effort to identify risks of specified parts of system, but can exist also the opposite; when he or she prefers to identify risks of specified origins defined by project stakeholders. There is also another option; he or she can asks the Risk Management team for identify the risk scenarios using both the system diagrams and Risk Breakdown Structures (RBS) from the beginning until finish of session. Further investigation is expected to be done here.

In the following questions 8 and 9, an optimum number of group members and optimum number of topics per session were determined. Total of 13 experts have given the answer for that in question 8, 11 experts in the other one. The result is optimum of 6 members and 4 topics per one session as taken from the average.

The last question asking the experts to classify from 1 to 4 (that is, from the best to the less suitable one) the three proposed geotechnical RBS for operational risk identification. Total of 11 experts responded to this question. Compositions A and B were the highest scored with an average of 2 and 2.1 respectively and that stated "quite suitable". The worst combination was not to use any of the support tools for risk identification and risk register with average of 3.3 that stated "limited aptitude".

5. Conclusions and future works

- Average recommended total time limit for traditional Interactive Group Brainstorming session was estimated to 135 min. This is 1.5 times less then recommended by Risk Management standards (200 min). It means that in real projects, the experts are willing to spend less time for this kind of working session.

- The majority of the respondent experts recommended "open organization" of the session conducted by an experienced and impartial group facilitator. At least, session objectives and tasks, and session dynamics and rules have to be mentioned in the introduction.

- A combination of system or process flow diagram with Risk Breakdown Structure (RBS) seems to be necessary when identifying operational risks. It is up to the project decision-maker or Project Manager to establish if he or she is more interested in risk scope control based on RBS or prefers to control them through the analyzed system or process structure.

- To obtain relevant results in some of the questions, it is necessary to gain more expert responses until statistically justify the conclusions. There are also a few cases when the participating expert response was not obtained due to the complexity or misunderstanding. Further modifications are planned to be executed without changing the questionnaire philosophy and meaning of the questions.

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