

## Algorithm on Delphi Application for Decisions with Limited Source of Information

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**Abstract:** In information collection, there are practitioners and researchers done their research using various research methodology. But in limited source of information, one of the methodology is Delphi technique. This usually used to obtain the opinion from experts, building a consensus and interaction with decision subject without time and place limit. Delphi technique seems to be beneficial for many types of researches and decision makings. This study aims to introduce an algorithmic Delphi technique based on a literature review.

**Key words:** Delphi technique, decision science, research method, information, literature, Malaysia

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### INTRODUCTION

Delphi used to explore critical issues, forecasting and help to equipped leaders with information that could be used in decision-making, policy formulation or to improve practices in the management science field. In decision science, Delphi can be used to create consensus-based management-guidelines since Delphi is a method that creates consensus (Nworie, 2011).

**Delphi definition:** Delphi has an ability to make effective decisions in limited sources of information. Delphi is used widely for gathering data from participants within their domain expertise (Hsu and Sandford, 2007; McKenna, 1994). This method is a structured communication that aims to produce detailed critical examination and discussion which allows the participants to express their own judgment. The participants will have to take a sequential path through problem-solving process in face to face approach (Hejblum *et al.*, 2008). Other approaches such as computer-based was introduced due to the several modification caused by the technology changes which allows the members take part when they want and only contribute to aspects they able to contributes. When designing and implementing Delphi, expert selection, time frames, the possibility of low responses rate and unintentionally feedback should be considered (Hsu and Sandford, 2007) (Fig. 1).

Delphi build consensus by using multiple iteration rounds to collect data by using interviews an questionnaires as an instrument. Ludwig (1997) indicates: Iterations refer to the feedback process. "The process was viewed as a series of rounds in each round

every participant worked through a questionnaire which was returned to the researcher who collected, edited and returned to every participant a statement of the position of the whole group and the participant's own position. A summation of comments made each participant aware of the range of opinions and the reasons underlying those opinions".

The feedback process allows and encourages the participants to reassess their initial judgment by information provided in previous rounds. This can cause changes and modification by panel of experts during iterations processes after receiving other panels responses (Vernon, 2009). Other characteristic of Delphi is subject anonymity. This characteristic helps in reducing the effects of dominant individual (Hsu and Sandford, 2007; Dalkey 1972).

Controlled feedback also one of Delphi characteristic which distortion of data and deals with groups or individual's interest can be reduced by this characteristic since subject will become more problem-solving oriented through the operation of multiple rounds (Vernon, 2009). Controlled feedback allows experts an opportunity to generate additional opinions and become more thoroughly to clarify the information from the previous rounds (Hsu and Sandford, 2007) (Fig. 2).

Last characteristic is suitability of statistical analysis technique to reduce pressure for conformity (Dalkey, 1972). It ensures each participant opinions will be well presented within final rounds. The tools statistical analysis allows the objectives and impartial analysis and summarization of the collected responses (Murphy *et al.*, 1998).

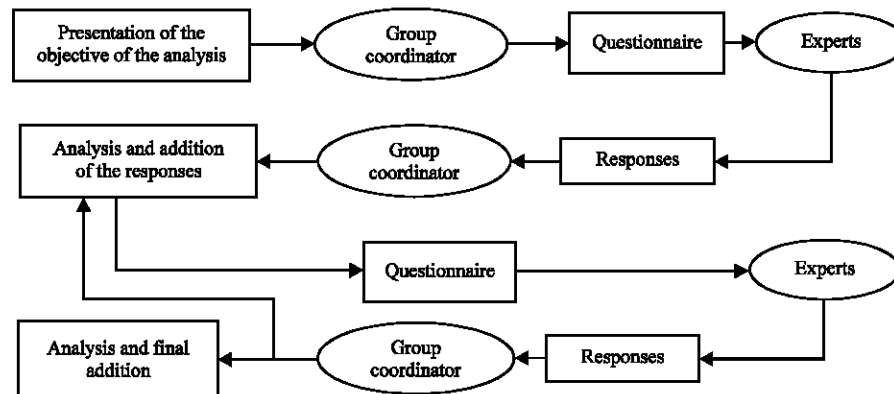


Fig. 1: Communication in Delphi technique (Inaki *et al.*, 2006)

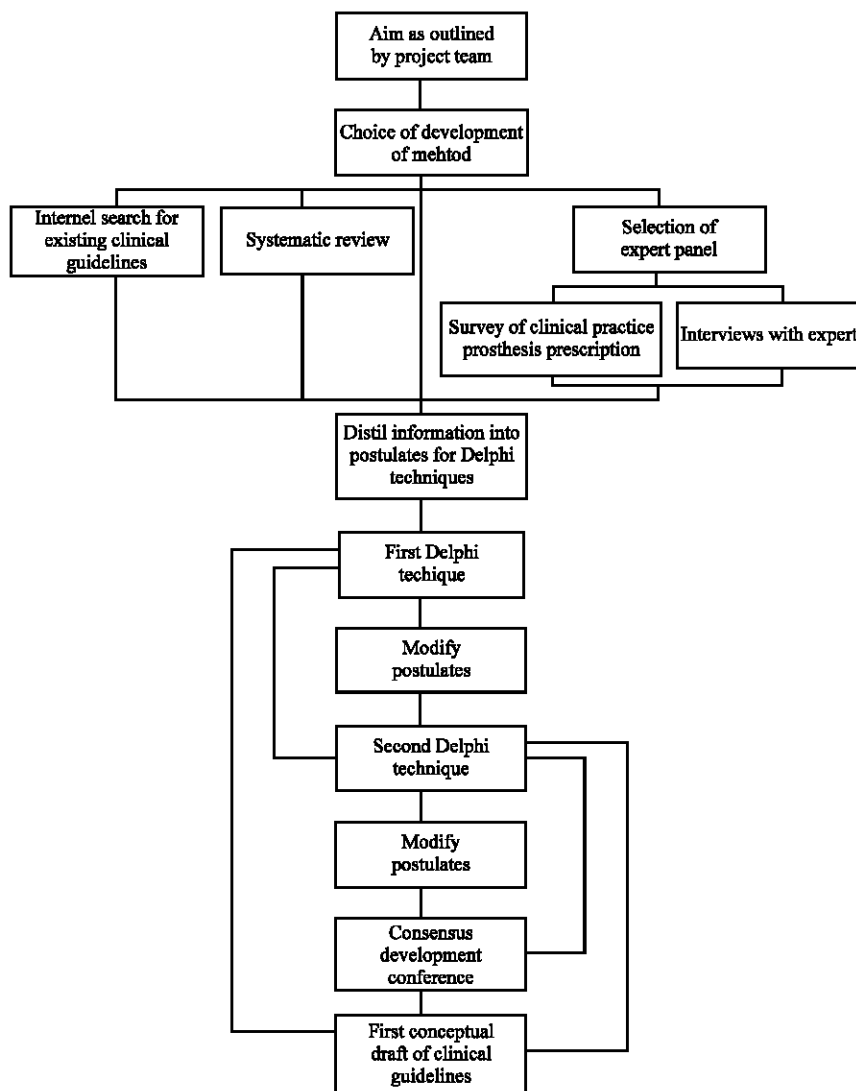


Fig. 2: Delphi Rounds Guidelines based on clinical procedures (Van Der Linde, 2005)

## MATERIALS AND METHODS

**Delphi operation:** Initially, if the research focus field has little previous research of if there are conflicting evidence in present time, Delphi became the method of choice (Hejblum *et al.*, 2008). It also would be an approach where practical restrictions exist such as not being able to gather those with required expertise together because of time and resources limitation (Vernon, 2009).

This approach actually the most suitable tools to driven the information from individual (Cavana *et al.*, 2001). Delphi method is a repetitive process since it often involved two or more rounds of interviews (Mullen, 2003). It is depends on the researcher to do as many rounds they want until the consensus is reached since Delphi is used to validate the consensus (Skulmoski *et al.*, 2007).

Next important phase is expert selection, expert should posses an expertise from basic professional level, to the level of international leadership in the research field. Delphi researchers should define their experts criteria and panel size for the experts required in their research. The list of potential experts and recruitment strategies should be prepared then, the researchers can invite participation before commencing the Delphi (Vernon, 2009; Nworie, 2011). According to Adler and Ziglin suggest that Delphi panels should meet these requirements:

- Experience or knowledge at the aims of the problem statement
- Willing to participate
- Willingness to use their time to participate in Delphi process
- Good communications skills

Consideration on time and resources scarcity, available experts number and their location should be revised to chosen the form of Delphi for example face to face approach or computer-based Delphi. Enough information on research should be provided to remove ambiguity and contact details also need to provide for any clarification (Vernon, 2009).

There are no definite standard of sampling size for Delphi methods as stated by Loo (2002) but it is because of carefully selected experts, this method enables a researchers used a small size of panels. In deciding sample size process, researcher should determine the relevant sample size for optimum results of feedback. According to Dalkey (1972) suggest that for heterogeneous population, 15-30 selected panels could be used which for a homogeneous population as 5-10 experts can be used but Phillips (2000) states that the optimum size of the panels of experts is from 7-12 members.

## RESULTS AND DISCUSSION

According to Skulmoski *et al.* (2007) stated that two or three rounds of Delphi method should be sufficient for most qualitative research project. The rounds of interviews also need to be decided when conducting the Delphi method. Delphi technique can be iterated as many times as necessary to achieve research consensus since opinions are always subjective. Some researchers suggest that Delphi method had four rounds but currently this technique appear to have either two or three rounds are more preferred. Below are the guidelines in doing the Delphi rounds.

**Round one:** In traditional Delphi, it start with the first round with an open ended questions which serves as the cornerstone of specific information about research area for the Delphi experts (Custer *et al.*, 1999). After receiving experts responses, researcher need to designed a structural questionnaire to use in round two.

**Round two:** Experts need to review the items summarized by researcher based on their own responses in the first round via questionnaire. Delphi subjects may need to rank the items to established primary list of items priorities using likert scale (Ludwig, 1997). In second round, consensus begins to forms and outcomes can be presented to the experts.

**Round three:** Using the responses from the panels in round two a new structured questionnaire that includes the items and rating summary will be designed. The questionnaire will then distribute to panel of experts and they needed to revise their previous judgment. The panels get the opportunity to make further clarifications of both from the information and judgment from the previous results. The list of remaining items and their rating, minority opinions and items achieving consensus will be included in the questionnaire (Hsu and Sandford, 2007).

After the consensus is achieved, the Delphi rounds will be terminated. The number of Delphi rounds were depends on the degree of consensus sought by the researchers (Ludwig, 1997). The final summary of reports from the interviews and consensus statement will be distributed to all panels of expert that participate in the study for their comments.

**Advantages and disadvantages of Delphi:** The Delphi Technique is a qualitative approach, not a quantitative approach but the result might be quantitative (Grisham, 2009). There are flaws even for the most used technique but it all depends for the researcher to take the risk. These are the advantage and also disadvantages of Delphi method (Table 1).

Table 1: Advantages and disadvantages of Delphi method compatibility with qualitative research (Elnasr *et al.*, 2012)

Advantages	Disadvantages
Systematic and flexible utilizes expert judgments	Very sensitive towards design characteristic, example: panels expertise level
An iterative process	Panel's willingness to allow others re-formed their judgments
Anonymity of panels	The panels suffer high-rate of attrition
Eliminates the influence of personality	
Combines advantages of both single and group	Potential for researcher bias
Produce reliable and valid	Risk of specious consensus
Can use modern communication method, example: e-mails, phone calls	Problems in determining what actually constitutes consensus
Controlled feedback	Used more time and costly because of its iterative rounds
well-established and insightful	

## CONCLUSION

When, there are limited sources of information or previous research, Delphi is seen as one of the alternative method to achieved consensus since Delphi is a qualitative technique that well suited for the research that covers complex issues. Implementation of Delphi will be needed a careful consideration on subject selections and the time frames of the study upon construction of the research. Delphi will and always be the one of the research methodology to collect data within wide area of application in management science.

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