International Journal of Agricultural Management and Development (IJAMAD)
Available online on: www.ijamad.iaurasht.ac.ir
ISSN: 2159-5852 (Print)
ISSN:2159-5860 (Online)

Achieving Consensus Deal with Methodological Issues in the Delphi Technique

Zahra Goodarzi [1], Enayat Abbasi [2] and Homayoun Farhadian [3]*

Received: 17 October 2016,
Accepted: 25 February 2017

Abstract

Delphi is a powerful technique used to seek answers to appropriate questions. The purpose of this paper is to provide an overview of the Delphi technique as a research method. This paper discusses the scientific merit of the Delphi technique by investigating on 41 studies of Journal of Agricultural Education from 1981 to 2013, and 2 studies of Journal of Agricultural Science and Technology. The results showed that there is no general agreement on using indexes in different rounds of Delphi technique; however, according to the frequencies of using indexes in different studies, the following suggestions are presented. The favourable number of panel of experts is between 10 to 20. Purposive sampling method is used for selecting the panel members. Usually a three rounds of Delphi method is used. One question is designed in round one. Mean and standard deviation indexes are used for passing from round two to round three and agreement level of 70 present is used for achieving expert's consensus in round three.

Keywords:
consensus level, Delphi technique, methodological criticism

[1] PhD. Student of Agricultural Extension and Education, Tarbiat Modares University, Tehran, Iran
[2] Assistants Professor, Department of Agricultural Extension and Education, Tarbiat Modares University, Tehran, Iran
[3] PhD. Department of Agricultural Extension and Education, Tarbiat Modares University, Tehran, Iran
** Corresponding author's email: Enayat.abbasi@modares.ac.ir*

INTRODUCTION

Delphi method is a qualitative research method that provides a reliable group opinion using expert judgment (Landeta, 2006). A number of different types of 'Delphi' studies have been identified. Van Zolingen and Klaassen (2003) described four categorizations: Classical Delphi, policy Delphi, decisions Delphi, and fuzzy Delphi. The classical Delphi is characterised by five features including anonymity, iteration, controlled feedback, statistical group response, and stability in responses among those with expertise on a specific issue. The aim of policy Delphi in this situation is to generate policy alternatives by using a structured public dialogue, and not to reach stability in responses among those with expertise. The decision Delphi is used for decision making on social developments and reality is created by a group of decision-makers. Fuzzy Delphi is a combination of the traditional Delphi method with fuzzy set theory in order to address some of the ambiguity of the Delphi panel consensus (Ishikawa et al., 1993). The fuzzy Delphi is a more advanced version of the Delphi method in that it utilizes triangulation statistics to determine the distance between the levels of consensus within the expert panel.

Due to the nature of the Delphi design, there are some critical methodological issues that force the prudent researcher to view Delphi results with caution (Woudenberg, 1991).

Accordingly, it is difficult to show clear conclusions about paradigmatic assumptions underpinning all Delphi studies, and it is necessary to define a new framework for using this technique.

What is Delphi method?

Delphi method is a structured technique, originally developed as a systematic, interactive forecasting method which relies on a panel of experts (Brown, 1968; Delbecg, et al., 1975; Dalkey & Helmer, 1963; Linstone & Turoff, 1975; Sackman, 1974). According to the old rule that "two heads are better than one" (Dalkey, 1972), the Delphi is a structured group communication process (Delbecg et al., 1975; Linstone & Turoff, 1975; Powell, 2003), designed to obtain a consensus from a group of experts. The technique has the benefits of group decision making while preventing the limitations of group decision-making and undesirable interaction effects (Cline, 2000). The Delphi judgment is arrived through sequential questionnaires or 'rounds', interspersed with summary and feedback derived from previous panels responses (Delbecg et al., 1975; Linstone & Turoff, 1975; Witkin & Altschuld, 1995). Participants in Delphi panel are stimulated to produce new ideas, which they consider more suitable to solve a problem. The experts answer questionnaires in at least two or more rounds. After each round, the primary researcher provides a summary of the experts' forecasts from the previous round and also the reasons that they provided for their judgments. Therefore, with responses obtained from other panel's members, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. During this process, the range of separate answers will decrease and leads to the group coverage of the correct answer. Finally, the process is stopped after a predefined stop criterion (e.g. achievement of consensus, number of rounds, and stability of results).

The purpose of this study was to demystify Delphi methodology and update knowledge in order to inform future debate. The objectives of the study were as follows:

1. Achieving favourable number of rounds and panellists.
2. Describe favourable indexes for reaching agreement in Delphi studies.
3. Describe favourable Delphi panellists' level of agreement with the generated competency statements.
4. Describe how to achieve validity and reliability in Delphi studies.

MATERIALS AND METHODS

This research is a kind of content analysis, which gives an extensive review of all the studies that had employed the Delphi method and were published in the Journal of Agricultural Education from 1981 to 2013 as well as Journal of Agricultural Science and Technology (two studies). The researchers calculated the total

number of research studies that had employed the Delphi method (43 studies). In each study, the researchers elicited all number of rounds, number of questions in the first round, the sampling method and size, as well as how to define consensus and validity and reliability of the questionnaire. After gathering this information, the result for each section was shown in a table and a summary of that section is presented under the table.

Methodological considerations

While there are different Delphi studies that report answers to specific questions about Delphi method, there are less studies dealt with methodological issues such as selecting the panel, survey administration, and other challenges as well as use in evaluation studies (H.-L. Hung et al., 2008). Some researchers give recommendations for improvement and more efficient use of the Delphi (Hasson et al., 2000; Keeney et al., 2006; Lang, 1994; Skulmoski et al., 2007). The following observations are based on a number of concerns founded in the literature.

Sample size/panel size

The size and participant dropout and selection of experts for the panel affect most Delphi studies. Panel selection is vital to the success of the study (Moore, 1987).

There is no established rule for determining the appropriate sample size (Williams & Webb, 1994). Like other research methods, the more participants, the better; however, Powell (2003) points out that the numbers of experts vary according to the nature of the problem and resources available to researchers and as would be expected with larger samples as well as more heterogeneous ones, the complexity of the research would tend to be higher. Gordon (1994) notes that most panels have 15–35 respondents; however, there have been studies with groups ranging from four to 345 experts. Witkin and Altschuld (1995) suggest that panels should be less than 50 in size with some occasionally being larger. Skulmoski et al. (2007) observe that a homogeneous group needs a smaller sample (10–15); however, heterogeneous ones (such as in an international study) may require up to several hundred subjects. The number of panel size and its frequency is summarized in Table 1.

As shown by the Table 1, although there is little agreement on the ideal number of panellists for a Delphi study, it seemed that the panel size between (10-20) is very common.

The sampling method

The fact that must be given consideration by researchers is that Delphi does not use a random sample which is representative of the target population; but rather, it employs `experts' (McKenna, 1994). A judicious and purposeful selection of experts is a critical factor to the reliability of data collected (Clayton, 1997). Skulmoski et al. (2007) recommend using purposive sampling with 'snowballing' for expert re-

Table 1
Panel size using in Delphi studies

Panel size	Results in	n
≤ 10	-	0
10-20	Ludwig & Barrick, 1996; Boyd, 2003; Dyer & Breja, 2003; Dyer et al., 2003; Martin et al., 2006; Roberts, 2006; Shinn et al, 2008; Warner & Washburn, 2009; Harder et al., 2010; Rayfield & Croom, 2010; Smalley & Retallick, 2010; Franklin, 2011; Ramsey & Edwards, 2011; Conner and Roberts, 2013.	14
20-30	Park & Rudd, 2005; Simon et al., 2005; Mantooth & Fritz, 2006; Myers & Thompson, 2009; Nistler et al., 2011; Saucier et al., 2012; Wooten et al., 2013.	7
30-40	Varnadore & Iverson.1991; Buriak & Shinn,1993; Camp et al., 2000; Dobbins & Camp,2003; Roberts & Dyer, 2004; Trexler et al., 2006; Jenkins & Kitchel,2009; Rasouli et al., 2009; Jenkins et al., 2010; Slusher et al., 2011; Namdar & Sadighi, 2013.	9
≥ 40	Sutphin & Newcomb,1983; Lawrence & Mallilo,1989; Buriak & Shinn,1989; Johnson & Schumacher, 1989; Frick et al., 1991; Shih & Gamon, 1997; Connors, 1998; Murphy&Terry,1998; Mundt & Connors,1999; Akers et al., 2003; Myers et al., 2005.	11

Table 2
The Sampling Method Using in Delphi Studies

Sampling method	Results in	N
Snowball sampling	-	0
Purposeful sampling	Sutphin & Newcomb,1983; Buriak & Shinn, 1989; Fricket al, 1991; Varnadore & Iverson, 1991; Buriak & Shinn, 1993; Ludwig & Barrick,1996; Shih & Gamon,1997; Connors,1998; Murphy & Terry,1998; Akers et al., 2003; Boyd,2003; Dyer & Breja, 2003; Dyer et al., 2003; Dobbins & Camp,2003; Myers et al.,2005; Park & Rudd, 2005; Martin et al.,2006; Mantooth & Fritz,2006; Trexler et al., 2006; Shinn et al., 2008; Rasouli et al. 2009; Myers & Thompson,2009; Jenkins & Kitchel, 2009; Warner & Washburn, 2009; Harder et al., 2010; Jenkins et al.,2010; Rayfield & Croom,2010; Smalley & Retallick,2010; Franklin, 2011; Nistler et al., 2011; Slusher et al., 2011; Conner and Roberts, 2013; Wooten et al., 2013; Namdar & Sadighi, 2013.	32
Systematic sampling	-	0
Non sampling	Johnson & Schumacher, 1989; Lawrence & Mallilo, 1989; Mundt & Connors, 1999; Roberts & Dyer, 2004; Simon et al., 2005; Roberts, 2006; Saucier et al., 2012.	7

cruitment. Purposive sampling (judgment, selective or subjective sampling) is a sampling method in which the researcher handpicks the cases to be included in the sample. Creswell (2005) defined purposeful sampling as "a qualitative sampling procedure that researchers intentionally select individuals and sites to learn or understand the main phenomenon".

Well-defined principles for selection objectives are needed; however, guidelines are in little supply (Keeney et al., 2006). Mitchell (1991) advise that it is important to avoid selection bias.

Different sampling methods are summarized in Table 2. As shown by the Table, Purposeful sampling was used to select members for most studies' expert panel.

Number of rounds

The Delphi method applies a number of rounds in which questionnaires are sent and used until a consensus is reached (Beretta, 1996; Green et al., 1999). In each round, by the panel members, a summary of the results of the previous round is included and evaluated.

The number of rounds depends on the available time and what the experimenter commenced the Delphi sequence with one broad question or with several questions. The process raises the question of how many rounds it takes to reach consensus. The classical Delphi used 4 rounds originally (Young & Hogben, 1978). Though to suit individuals, this has been modified by many research aims and in some cases, it has been

Table 3
Number of Rounds Used in Delphi Studies

Number of rounds	Results in	n
1	-	0
2	Frick et al., 1991; Varnadore & Iverson, 1991; Buriak & Shinn, 1993.	3
3	Sutphin & Newcomb, 1983; Buriak & Shinn, 1989; Johnson & Schumacher, 1989; Ludwig & Barrick, 1996; Mundt & Connors, 1999; Akers et al., 2003; Boyd, 2003; Dobbins & Camp, 2003; Myers et al., 2005; Park & Rudd, 2005; Simon et al., 2005; Mantooth & Fritz, 2006; Roberts, 2006; Trexler et al., 2006;Myers & Thompson, 2009; Rasouli et al., 2009; Rayfield & Croom, 2010; Smalley & Retallick, 2010; Nistler et al., 2011; Robinson & Edwards, 2011; Conner and Roberts, 2013; Wooten et al., 2013; Namdar & Sadighi, 2013.	
4 or more	Connors, 1998; Camp et al., 2000; Dyer & Breja, 2003; Dyer, Breja, & Ball, 2003; Shinnet al., 2008; Kitchel & Hains, 2010; Harder et al., 2010; Saucier et al., 2012.	21 8

Table 4
Number of Questions Used in the First Round of Delphi Studies

Number of questions in the first round	Results in	n
No questions (statements, based on literature)	Sutphin & Newcomb, 1983; Johnson & Schumacher, 1989; Varnadore & Iverson.1991; Ludwig & Barrick, 1996; Dobbins & Camp, 2003.	5
1	Lawrence & Mallilo, 1989; Fricket al., 1991; Connors, 1998; Mundt & Connors,1999; Dyeret al., 2003; Dyer & Breja, 2003; Roberts & Dyer, 2004; Myerset al., 2005; Roberts,2006; Martin et al., 2006; Mantooth & Fritz, 2006; Trexleret al., 2006; Shinn, et al., 2008; Rasouliet al., 2009; Warner & Washburn, 2009; Myers & Thompson, 2009; Harderet al., 2010; Nistleret al., 2011; Ramsey & Edwards, 2011; Slusheret al., 2011; Saucieret al., 2012; Conner and Roberts, 2013; Wootenet al., 2013; Namdar & Sadighi, 2013.	22
2	Shih & Gamon, 1997; Park & Rudd, 2005; Rayfield & Croom, 2010.	3
3	Buriak & Shinn, 1989; Akers et al., 2003; Boyd, 2003; Jenkins & Kitchel, 2009; Jenkins et al., 2010; Franklin, 2011; Smalley & Retallick, 2011.	7
4 or more	Murphy & Terry, 1998; Campet al., 2000.	2

shorted to two or three rounds (Beech, 1997; Green et al., 1999).

The number of rounds in the modified technique may be decreased to as few as two if panellists have been provided with an event list, and if early group consensus is achieved (Snyder- Halpern, 2002).

Other authors have focused on participant's burden as a problem and suggested that when the number of rounds exceeds four, the response rates can be very low (Linstone & Turoff, 1975).

Three rounds of iterations (as it is shown in Table 3) are commonly viewed as sufficient for arriving at a high-level of the agreement. Although the possibility of more than three rounds is offered, there is a need to balance time, cost and possible participant fatigue. As noted by McCampbell and Stewart (1992), most Delphi studies reach consensus at the third round. However, failing to achieve consensus on a majority of the items, a fourth round was initiated.

Round one

Round one of the classical Delphi starts with one or several open-ended questions, thereby allowing the panel members to enjoy great freedom in their responses. Round one is used to generate opinions, and the panel members are asked for their responses to or comments about a subject (Keeney et al, 2006). Franklin and Hart (2007) expressed that researchers develop the initial questionnaire based on a perfect literature review. The questionnaire, thus, can be a summary of previous research theories and findings postulated by scholars. The first questionnaire gives a way to structure ideas around a set of common statements to panellists. Researchers use content analysis to identify the main themes from the open-ended questions of the first round (Powell, 2003) in order to form items for future researches (Keeney et al., 2006).

Open-ended questions are used to collect an array of views or issues to be addressed in later rounds. Using broad questions in the first round of a Delphi survey may discourage experts with time constraints to participate in a study, which was indicated by the dropout rate of some participants in the first Delphi study accommodate. Less broad survey questions should be considered to stimulate expert participation in a Delphi study. In Table 4 the number of questions in the first round and its frequency is presented. As shown in Table 4, in 22 studies, the Delphi started with only one question.

Validating of the first round question

Table 5
The Indexes for Reaching Agreement in Delphi Studies

Index	Results in	n
Mean/mean & standard deviation	Buriak & Shinn,1989; Johnson & Schumacher,1989; Johnson & Schumacher,1989; Lawrence & Mallilo,1989; Ludwig & Barrick,1996; Connors,1998; Dyer & Breja, 2003; Dyer, Breja, & Ball, 2003; Roberts & Dyer, 2004; Myers, Dyer, & Washburn, 2005; Park & Rudd, 2005; Fritzsche, & Ball, 2006; Roberts, 2006; Trexler et al., 2006; Myers & Thompson, 2009; Warner & Washburn, 2009; Smalley & Retallick, 2010; Slusher et al, 2011; Franklin, 2011; Saucier et al., 2012; Wooten, Rayfield & Moore, 2013; Namdar & Sadighi, 2013.	21
Standard deviation	Dobbins & Camp, 2003; Mantooth & Fritz, 2006.	2
Frequencies, percentages, and ranks	Sutphin & Newcomb,1983; Frick et al.,1991; Varnadore & Iverson,1991; Murphy & Terry,1998; Mundt & Connors,1999; Akers et al., 2003; Boyd, 2003; Simon et al., 2005; Rasouli et al.,.2009; Kitchel, & Hains,2010; Ramsey & Edwards,2011.	10
Inter-quartile range	-	0
Cronbach's alpha	-	0

The questions of the first round were validated for content regarding their appropriateness for the objectives of the studies by external experts that could be a panel of faculty and graduate students or a jury of agricultural educators (Akers et al.,2003; Dobbins & Camp, 2003; Dyer & Breja,2003; Dyer et al.,2003; Myers et al., 2005) or a panel of internal expert was asked to validate the round one questions (Buriak & Shinn,1989; Rayfield & Croom, 2010; Saucier et al., 2012; Simon et al., 2005; Camp et al., 2000; Wooten et al., 2013);accordingly, it is recommended that any questions of first round is validated by a panel of experts.

Data analysis

The instruments that was used in the second and third rounds contained items on which a predetermined level of consensus was not achieved during the panel of the previous round. The researchers determined a priori that only those competencies receiving the percent level of agreement would be used for the inclusion in the investigation.

In round 2, the jury was asked to rate their strength of agreement for each statement on a Likert-type scale. Those statements that received a five or six points (agree or strongly agree in a six point Likert type) from at least two-thirds of the jury responding in round 2 were kept for the third round. This would ensure a true consensus of the entire group. With a mean cut–off score, one could have a high mean score, yet have one or more panellists mark half of a Likert scale or below, which does not indicate agreement of an item to be included as, in this case, a quality indicator. Thus, this use of the method is a more stringent approach to item selection.

How to reach an agreement

Because of the disparate nature of the panel, the lack of a clear agreement on how to define consensus in the Delphi presented a minor challenge. In practical Delphi studies, investigators should be more transparent about their choice of agreement index and report the value of the selected index within every round. Hasson et al., (2000) argued that statistical aggregation of responses to scaled items are measures of central tendency like mean, median, and mode, and dispersion like standard deviation and inter quartile range.

In a systematic review of the literature on Delphi method, different descriptive statistics were used. These statistics included mean, median, mode, percentages for each event, ranks, upper and lower quartile ranges, regression weights or induced (if-then) rules, as well as the statistical average of points for each factor. Stone, Fish, and Busby (2005) suggested analysing Delphi data using median and inter-quartile ranges to identify rates of group agree-

Table 6
Percent of Agreement To be Needed for Round Two in Delphi Studies

Percent of agreement needed for round2	Results in	n
≥25	Frick et al., 1991.	1
≥50	Buriak & Shinn, 1989; Johnson & Schumacher, 1989; Shih & Gamon, 1997; Mantooth & Fritz, 2006; Fritzsche, & Ball, 2006; Ramsey & Edwards, 2011.	6
≥60	Sutphin & Newcomb,1983; Varnadore & Iverson.1991; Connors,1998; Murphy & Terry,1998; Mundt & Connors,1999; Camp et al., 2000; Trexler et al., 2006; Shinn et al., 2008; Conner and Roberts, 2013.	9
≥70	Lawrence, L & Mallilo, 1989; Akers et al,, 2003; Boyd, 2003; Dyer & Breja, 2003; Dyer et al.,2003; Myers et al.,2005; Jenkins & Kitchel,2009; Myers & Thompson, 2009; Warner & Washburn, 2009; Kitchel, & Hains, 2010; Smalley & Retallick, 2010; Franklin, 2011; Nistler et al., 2011; Slusher et al., 2011; Namdar & Sadighi, 2013.	13
≥ 80	Ludwig & Barrick,1996; Roberts & Dyer, 2004; Park & Rudd, 2005; Simon et al., 2005; Roberts, 2006; Rasouli et al,. 2009; Rayfield & Croom, 2010; Wooten et al., 2013.	7

ment for consensus. The use of inter-quartile ratings (IQR) provides the researcher with information "… about the variability in the data without being affected by extreme scores" (Sprenkle & Piercy, 2005). The usual indexes of reaching agreement are shown in Table 5. As can be seen, comparing different indexes mean and standard deviation was more used.

The percent of agreement required for round two in Delphi studies was more than 70% that is shown in Table 6.

The purpose of round 3 is to begin the process of developing consensus among the jury.

Used similar benchmarks for consensus in round 2. The percent of consensus required in round three in Delphi studies was more than 60 as is shown in Table 7.

If 100% of the respondents had chosen "agree", it would have been included as a quality indicator.

Loughlin and Moore (1979) recommended that consensus would be at least 51% of agreement among respondents, Ulschak (1983) suggests 80%, and Green (1982) desires at least 70%. Mitchell (1991) views 75% as the lowest level. Since limiting the number of rounds could prevent total consensus, 75% agreements were chosen as the consensus level. It means that if 75% or less agreed an item should be included as a quality indicator, that item was dismissed as a possible quality indicator and removed from the study. Powell (2003) advocates deciding upon criteria for consensus before conducting the research.

Validity and reliability considerations

Van Zolingen and Klaassen (2003) suggested that compromises to the reliability and validity

Table 7
Percent of Consensus Needed in Round Three in Delphi Studies

Percent of consensus	Results in	n
≥50	Shih & Gamon, 1997; Mantooth & Fritz, 2006.	2
≥60	Sutphin & Newcomb,1983; Murphy & Terry,1998; Connors,1998; Mundt & Connors,1999; Camp et al.,2000; Boyd, 2003; Dobbins & Camp, 2003; Myers, Dyer, & Washburn, 2005 Fritzsche, & Ball, 2006; Trexler et al., 2006; Shinn et al., 2008; Nistler et al., 2011.	12
≥70	Akers et al., 2003; Dyer & Breja, 2003; Dyer et al., 2003; Jenkins & Kitchel, 2009; Myers & Thompson, 2009; Warner & Washburn, 2009; Kitchel, & Hains, 2010; Harder et al., 2010; Smalley & Retallick, 2010; Franklin, 2011; Ramsey & Edwards, 2011; Slusher et al., 2011; Namdar & Sadighi, 2013.	12
≥ 80	Ludwig & Barrick, 1996; Roberts & Dyer, 2004; Simon et al., 2005; Park & Rudd, 2005; Roberts,2006; Rasouli et al., 2009; Rayfield & Croom, 2010; Conner and Roberts,2013; Wooten et al., 2013.	8

of the study arise from the value led nature of feedback and the instability of responses and consensus. These areas are, in turn, influenced by the number of experts, their average expertise and the average inter-correlation of their judgments. Content validity of the questionnaire can be determined by piloting. Few `Delphi' researchers report undertaking pilot tests before implementation (eg: Akers, Vaughn, & Haygood, 2003; Simon et al., 2005), it is unclear how many pilot tests should be undertaken when using this method. For example, should there be one for every round or only one for the initial round? (Keeney et al., 2001).

Ludwig and Starr (2005) point that "the validity of a Delphi study depends not on the number of participant survey, but rather on the expertise of the panel who participate". Content and Face validity of the initial instrument was confirmed through a panel of experts (e.g. Ludwig & Barrick, 1996; Dyer et al., 2003; Jenkins & Kitchel, 2009; Kitchel, & Hains, 2010; Mundt & Connors, 1999; Mantooth & Fritz, 2006; Rayfield & Croom, 2010; Saucier et al., 2012; Robinson, & Edwards, 2011; Varnadore & Iverson, 1991) These authors argue for setting specific guidelines for each area, so the reliability of the study (or whether a replication of the study would give the same results with a different panel) can be judged.

Estimates of the internal consistency reliability of each questionnaire obtained using Cronbach's alpha analysis. In often studies, researchers follow Dalky (1969). He found that when the size of the jury was greater than 13, mean correlations were greater than 0.80, satisfying questions of process reliability (e.g. Boyd, 2003; Buriak & Shinn, 1989; Dyer & Breja, 2003; Franklin, 2011; Harder et al., 2010; Fritzsche, & Ball, 2006; Myers et al., 2005; Ramsey & Edwards, 2011; Rayfield & Croom, 2010; Roberts & Dyer, 2004; Saucier et al., 2012; Smalley & Retallick, 2010; Shinn et al., 2008; Robinson, & Edwards, 2011; Murphy & Terry, 1998; Warner & Washburn, 2009). Given the nature of the Delphi technique, additional types of validity and reliability estimates were not appropriate for the instrument (Dalkey et al., 1972).

CONCLUSIONS AND RECOMMENDATIONS

By searching through and reviewing the literature, the researchers were able to confirm that the Delphi method continues to be used and is a valid method for forecasting and supporting decision-making. There are inherent characteristics or weaknesses in the methodology or its application that have not been completely corrected. Delphi does not call for expert panels to be representative samples for statistical purposes. Representativeness is assessed on the qualities of the expert panel rather than its numbers. The Delphi method showed satisfactory reliability and validity indexes. The method should be used judiciously and only after careful preparation. Measurements of the main trend were obtained. The experiences provided evidence of the present and potentiality of the Delphi method in the areas of input for quantitative models by means of expert opinion. Based on the findings of the present study, the researchers recommend a Delphi study with the size ranging between 10-20, the purposeful sampling method for selecting the panel of expert, three rounds, one open-ended question in the first round, using Mean/Mean and Standard Deviation for reaching agreement in round two and 60% or more for consensus in round three for future studies.

ACKNOWLEDGEMENTS

In particular, we want to thank the editors of IJAMAD, for their valuable help and suggestions and for providing stimulating feedback that helped us to reinforce our arguments.

REFERENCES

Akers, C.L., Vaughn, P.R., & Haygood, J.D. (2003). High school agricultural communications competencies: A national Delphi study. *Journal of Agricultural Education, 44*(4), 1-10.

Akers, C., Vaughn, P.R., & Lockaby, J.D. (2001). High school agricultural communications competencies: a national Delphi study. *Journal of Southern Agricultural Education Research, 51*(1), 124-137.

Beech, B. (1997). Studying the future: a Delphi survey of how multi-disciplinary clinical

staffs view the likely development of two community mental health centers over the course of the next two years. *Journal of Advanced Nursing, 25*(2), 331-338.

Beretta R. (1996) A critical review of the Delphi technique. *Nurse Researcher 3*(4), 79-89.

Boyd, B. L. (2003). Identifying competencies for volunteer administrators for the coming decade: a national Delphi study. *Journal of Agricultural Education, 44*(4), 47-56.

Brown, B. B. (1968). *Delphi process: A methodology used for the elicitation of opinions of experts* (No. RAND-P-3925). Rand Corp Santa Monica CA.

Buriak, P., & Shinn, G. C. (1989). Mission, initiatives, and obstacles to research in agricultural education: A National Delphi Using External Decision-Makers. *Journal of Agricultural Education, 30*(4), 14-23.

Camp, W. G., Clarke, A., & Fallon, M. (2000). Revisiting supervised agricultural experience. *Journal of Agricultural Education, 41*(3), 13-22.

Clayton, M. J. (1997). Delphi: a technique to harness expert opinion for critical decision-making tasks in education. *Educational Psychology, 17*(4), 373-386.

Cline, A. (2005). Prioritization process using Delphi technique. Carolla Development 2000, Retrieved March, 8. 2005.

Conner, N., & Roberts, T. G. (2013). Competencies and experiences needed by pre–service agricultural educators to teach globalized curricula: A modified Delphi study. *Journal of Agricultural Education, 54*(1), 8-17.

Connors, J. J. (1998). A regional Delphi study of the perceptions of NVATA, NASAE, and AAAE members on critical issues facing secondary agricultural education programs. *Journal of Agricultural Education, 39,* 37-47.

Creswell, J. W. (2005). Educational research: Planning, conducting, and evaluating quantitative and qualitative research (2nd Ed.). Upper–Saddle River, NJ: Pearson Education.

Dalkey, N. (1969). An experimental study of group opinion: the Delphi method. *Futures, 1*(5), 408-426.

Dalkey, N. C. (1972). *The Delphi method: An experimental study of group opinion.* In: N. C. Dalkey, D. L. Rourke, R. Lewis, & D. Snyder (Eds.). Studies in the Quality of Life: Delphi and Decision-making (Pp. 13-54). Lexington, MA: Lexington Books.

Dalkey, N. C., Rourke, D. L., Lewis, R., & Snyder, D. (1972). *Studies in the quality of life*. Lexington. DC Heath and Company.

Dalkey, N., & Helmer, O. (1963). An experimental application of the Delphi method to the use of experts. *Management science, 9*(3), 458-467.

Delbecq, A. L., Van de Ven, A. H., & Gustafson, D. H. (1975). *Group techniques for program planning: A guide to nominal group and Delphi Processes1975, Glenview.* IL: Scott, Foresman.

Dobbins, T. R., & Camp, W. G. (2003). Clinical experiences for agricultural teacher education programs in North Carolina, South Carolina, and Virginia. *Journal of Agricultural Education, 44*(4), 11-21.

Dyer, J. E., & Breja, L. M. (2003). Problems in recruiting students into agricultural education programs: A Delphi study of agriculture teacher perceptions. *Journal of Agricultural Education, 44*(2), 75-85.

Dyer, J. E., Breja, L. M., & Ball, A. L. (2003). A Delphi study of agriculture teacher perceptions of problems in student retention. *Journal of Agricultural Education, 44*(2), 86-95.

Franklin, E.A. (2011). Greenhouse facility management experts' identification of competencies and teaching methods to support secondary agricultural education instructors: a Modified Delphi study. *Journal of Agricultural Education, 52*(4), 150-161.

Franklin, K. K., & Hart, J. K. (2007). Idea generation and exploration: Benefits and limitations of the policy Delphi research method. *Innovative Higher Education, 31*(4), 237–246.

Frick, M.J. Kahler, A.A., & Miller, W.W. (1991). A definition and the concepts of agricultural literacy. *Journal of Agricultural Education, 32*(2),49-57.

Gordon, T. J. (1994). The Delphi Method. Futures Research Methodology, 2. Retrieved July 6, 2007, from /http://www.futurovenezuela.org/_curso/5-delphi.pdfS.

Green, B., Jones, M., Hughes, D., & Willimas, A. (1999) Applying the Delphi technique in a study of GP's information requirements. *Health and Social Care in the Community 7*(3), 198-205.

Green, P. (1982). *The content of a college-level outdoor leadership course*. 3572-3572. Paper presented at the Conference of the Northwest District Association for the American Alliance for Health, Physical Education, Recreation, and Dance, Spokane, WA.

Harder, A., Place, N.T., & Scheer, S.D. (2010). Towards a competency-based extension education curriculum: A Delphi Study. *Journal of Agricultural Education, 51*(3): 44.

Hasson, F., Keeney, S. & McKenna, H. (2000). Research Guidelines for the Delphi Survey Technique. *Journal of advanced Nursing, 32*(4): 1008-1015.

Hung, H.L., Altschuld, J.W. & Lee, Y.F. (2008). Methodological and Conceptual Issues Confronting a Cross-country Delphi Study of Educational Program Evaluation. *Evaluation and Program Planning, 31*(2), 191-198.

Ishikawa, A., Amagasa, M., Shiga, T., Tomizawa, G., Tatsuta, R., & Mieno, H. (1993). The max-min Delphi method and fuzzy Delphi method via fuzzy integration. *Fuzzy sets Sets and Systems, 55*(3), 241-253.

Jenkins III, C. C., & Kitchel, T. (2009). Identifying Quality Indicators of SAE and FFA: A Delphi Approach. *Journal of Agricultural Education, 50*(3), 33-42.

Jenkins III, C.C., Kitchel, T., & Hains, B. (2010). Defining Agricultural Education Instructional Quality. *Journal of Agricultural Education, 51*(3), 53-63.

Jenkins III, C.C., Kitchel, T., & Hains, B. (2010). Defining agricultural education instructional quality. *Journal of Agricultural Education, 51*(3), 53-63.

Johnson, D. M., & Schumacher, L. G. (1989). Agricultural Mechanics Specialists Identification and Evaluation of Agricultural Mechanics Laboratory Management Competencies: A Modified Delphi Approach. *Journal of Agricultural Education, 30*(3), 23-28.

Keeney, S., Hasson, F., & McKenna, H. (2006). Consulting the Oracle: Ten Lessons from Using the Delphi Technique in Nursing Research. *Journal of Advanced Nursing, 53*(2), 205–212.

Keeney, S., Hasson, F., & McKenna, H.P. (2001). A critical review of the Delphi technique as a research methodology for nursing. *International Journal of Nursing Studies, 38*(2), 195-200.

Landeta, J. (2006). Current validity of the Delphi method in social sciences. *Technological Forecasting and Social Change, 73*(5), 467-482.

Lang, T. (1994). *An Overview of Four Futures Methodologies*. Retrieved July 6, 2007, from http://www.soc.hawaii.edu/future/j7/LANG.html.

Lawrence, L. D., & Mallilo, A. T. (1981). Identification of Specific Areas of Vocational Agriculture Teaching in Need of the Greatest Improvement: A Modified Delphi Approach. *Journal of the American Association of Teacher Educators in Agriculture, 22*(1), 24-28.

Linstone, H. A., & Turoff, M. (1975). (Eds.) The Delphi Method: Techniques and applications, 29, Reading, MA: Addison-Wesley Publishing Company.

Linstone, H.A., Turoff, M., & Helmer, O. (2002). *The policy Delphi. The Delphi method: Techniques and applications*. Reading, MA: Addison-Wesley Publishing Company, Pp. 80-97.

Loughlin, K.G., & Moore, L.F. (1979). Using Delphi to achieve congruent objectives and activities in a pediatrics department. *Academic Medicine, 54*(2), 101-6.

Ludwig, B.G., & Barrick, R.K. (1996). Internationalization of extension: What does it mean? *Journal of Agricultural Education, 37*, 40-46.

Ludwig, L., & Starr, S. (2005).Library as place: Results of a Delphi study. *Journal of the Medical Library Association, 93*(3), 315.

Mantooth, L. J., & Fritz, C. A. (2006). Challenges of service-learning in tennessee 4-H Youth Development: A Delphi Study. *Journal of Agricultural Education, 47*(3), 94-104. DOI: 10.5032/jae.2006.03094.

Martin, M.J., Fritzsche, J.A., & Ball, A.L. (2006). A Delphi study of teachers' and professionals' perceptions regarding the impact of the no child left behind legislation on secondary

agricultural education programs. *Journal of Agricultural Education, 47*(1), 100-109.

McCampbell, W. H., & Stewart, B. R. (1992). Career ladder programs for vocational educators: Desirable characteristics. *Journal of Vocational Education Research, 17*(1), 53-68.

McKenna, H. P. (1994). The Delphi technique: a worthwhile research approach for nursing? *Journal of Advanced Nursing, 19*(6), 1221-1225.

Mitchell, V. W. (1991). The Delphi Technique: An exposition and application. *Technology Analysis & Strategic Management, 3*(4), 333–358.

Moore, G. E. (1987). *A day late and a dollar short: Doctoral research in agricultural education. Presented to the National Agricultural Education.* Research Meeting. Las Vegas, NV.

Mundt, J.P., & Connors, J.J. (1999). Problems and challenges associated with the first years of teaching agriculture: A framework for pre-service and in-service education. *Journal of Agricultural Education, 40*, 38-48.

Murphy, T. H., & Terry, H. R. (1998). Opportunities and obstacles for distance education in agricultural education. *Journal of Agricultural Education, 39,* 28-36.

Myers, B. E., & Thompson, G. W. (2009). Integrating academics into agriculture programs: A Delphi study to determine perceptions of the national agriscience teacher ambassador academy participants. *Journal of Agricultural Education, 50*(2), 77-88.

Myers, B.E., Dyer, J.E., & Washburn, S.G. (2005). Problems facing beginning agriculture teachers. *Journal of Agricultural Education, 46*(3), 47-55.

Namdar, R. & Sadighi, H. (2013). Investigation of major challenges of rural development in Iran utilizing Delphi technique. *Journal of Agricultural Science and Technology, 15*(3), 445-455.

Nistler, D.L., Lamm, A.J., & Stedman, N. (2011). Evaluating the influences on extension professionals' engagement in leadership roles. *Journal of Agricultural Education, 52*(3), 110-121.

Park, T. D., & Rudd, R. (2005). A description of the characteristics attributed to students' decisions to teach agriscience. *Journal of Agricultural Education, 46*(3), 82-91.

Powell, C. (2003). The Delphi technique: Myths and realities. *Journal of Advanced Nursing, 41*(4), 376–382.

Ramsey, J. W., & Edwards, M. C. (2011). Entry-Level technical skills that agricultural industry experts expected students to learn through their supervised agricultural experiences: A Modified Delphi study. *Journal of Agricultural Education, 52*(2), 82-94.

Rasouli, F., Sadighi, H., & Minaei, S. (2009). Factors affecting agricultural mechanization: A Case study on sunflower seed farms in Iran. *Journal of Agricultural Science and Technology, 11*, 39-48.

Rayfield, J., & Croom, B. (2010). Program needs of middle school agricultural education teachers: A Delphi study. *Journal of Agricultural Education, 51*(4), 131-141.

Roberts, T. G. (2006). Developing a model of cooperating teacher effectiveness. *Journal of Agricultural Education, 47*(3), 1-13.

Roberts, T. G., & Dyer, J. E. (2004). Characteristics of effective agriculture teachers. *Journal of Agricultural Education, 45*, 82-95

Sackman, H. (1974). *Delphi assessment: Expert Opinion, Forecasting, and Group Process* (No. Rand-R-1283-Pr), Rand Corp Santa Monica California.

Saucier, P. R., McKim, B. R., & Tummons, J. D. (2012). A Delphi Approach to the preparation of early-career agricultural educators in the curriculum area of agricultural mechanics: Fully qualified and highly motivated or status quo? *Journal of Agricultural Education, 53*(1), 136-149.

Shih, C. C., & Gamon, J. A. (1997). Using the Delphi Technique to assess educational needs related to extension's 4-h beef program. *Journal of Agricultural Education, 38*(1), 14-20.

Shinn, G. C., Briers, G., & Baker, M. (2008). Forecasting Doctoral-Level Content in Agricultural Education: Viewpoints of Engaged Scholars in the United States. *Journal of Agricultural Education, 49*(1), 121-131.

Simon, L. A., Haygood, J. D., Akers, C. L., Doerfert, D. L., & Davis, C. S. (2005). Master's level agricultural communications curriculum: A

National Delphi study. *Journal of Agricultural Education, 46*(3), 56.

Skulmoski, G., Hartman, F., & Krahn, J. (2007). The Delphi Method for graduate research. *Journal of Information Technology Education: Research, 6*(1), 1-21.

Slusher, W. L., Robinson, J. S., & Edwards, M. C. (2011). Assessing the animal science technical skills needed by secondary agricultural education graduates for employment in the animal industries: A Modified Delphi study. *Journal of Agricultural Education, 52*(2), 95-106.

Smalley, S.W., & Retallick, M.S. (2011). Purposes, activities, and documentation of early field experience in agricultural teacher education: A National Delphi study. *Journal of Agricultural Education, 52*(3), 100-109.

Snyder-Halpern, R. (2002). Indicators of organizational readiness for clinical information technology/ systems innovation: a Delphi study. *International Journal of Medical Informatics, 63*, 179-204.

Sprenkle, D. H., & Piercy, F. P. (Eds.). (2005). *Research methods in family therapy*. Guilford Press. New York City, NY.

Sutphin, H. D., & Newcomb, L. H. (1983). Positions held by teachers, teacher educators, and state supervisors about selected national issues in agricultural education. *Journal of the American Association of Teacher Educators in Agriculture, 24*(2), 53-63.

Trexler, C. J., Parr, D. M., & Khanna, N. (2006). A Delphi study of agricultural practitioners' opinions: Necessary experiences for inclusion in an undergraduate sustainable agricultural major. *Journal of Agricultural Education, 47*(4), 15.

Ulschak, F. L. (1983). *Human resource development: The theory and practice of need assessment.* Reston Publishing Co, United States.

Vamadore, W.L. & Iverson, M.J. (1991). Projecting meat industry characteristics in the 21st century using Delphi: Extrapolating curriculum content in agricultural education. *Journal of Agricultural Education, 32*(2), 29-33.

Van Zolingen, S. J., & Klaassen, C. A. (2003). Selection processes in A Delphi study about key qualifications in senior secondary vocational education. *Technological Forecasting and Social Change, 70*(4), 317-340.

Warner, W. J., & Washburn, S. G. (2009). Issues facing urban agriscience teachers: A Delphi study. *Journal of Agricultural Education, 50*(1), 105-115.

Williams, P.L., & Webb, C. (1994). The Delphi Technique: A Methodological Discussion. *Journal of Advanced Nursing, 19*(1), 180-186.

Witkin, B. R., & Altschuld, J. W. (1995). *Planning and Conducting Needs Assessment: A Practical Guide.* Thousand Oaks, CA: Sage Publications, Inc.

Wooten, K., Rayfield, J., & Moore, L.L. (2013). Identifying STEM concepts associated with junior livestock projects. what a degree in agricultural leadership really means: exploring student conceptualizations. *Journal of Agricultural Education, 54*(4), 31-44.

Wooten, K., Rayfield, J., & Moore, L.L. (2013). Identifying STEM concepts associated with junior livestock projects. *Journal of Agricultural Education, 54*(4), 31-44.

Woudenberg, F. (1991). An evaluation of Delphi. *Technological Forecasting and Social Change, 40*(2), 131-150.

Young, W.H. & Hogben, D.O.N.A.L. D. (1978). An experimental study of the Delphi technique. *Education Research Perspective, 5*, 57-62.

How to cite this article:
Goodarzi, Z., Abbasi, E., & Farhadian, H. (2018). Achieving consensus deal with methodological issues in the Delphi technique. *International Journal of Agricultural Management and Development, 8(2), 219-230.*
URL: http://ijamad.iaurasht.ac.ir/article_540498_e5b9a16dbf24954c307c2228c2786d01.pdf