

Full Length Research Paper

An application of Delphi method for eliciting criteria in personnel selection problem

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An important phase of human resource management is personnel selection, which is concerned with identifying an individual from a pool of candidates suitable for a vacant position. As with many decision problems, personnel selection problem is very complex in real life. Some of the techniques in decision making are multi criteria decision making (MCDM) which can be applied for personnel selection process. Although, many studies have investigated this problem, there are three missing links in existing studies: first, there is no systematic and valid method for specifying that the jobs requirements criteria have been presented. Second, group decision making (GDM) is a very important factor for solving the problem comprehensively. However, it has not been considered in the majority of the reviewed studies. The main objective of this paper is to develop a model for personnel selection problem in order to identify criteria for personnel selection by using the modified Delphi method and eliciting criteria hierarchy for personnel selection. In this model, after reviewing pertinent literature, the Delphi technique was used to seek best ideas from managers and experts for criteria selection. The models were validated using a case study of personnel selection criteria in a project based company for a project manager position. The results show that the proposed models perform very well in selection criteria and can improve efficiency in decision making process.

Key words: Personnel selection, criteria selection, Delphi, project management, decision making.

INTRODUCTION

An important phase of human resources management is personnel selection. When candidates apply for specific jobs in an organization, the basic purpose of personnel selection operations is to determine those that have the necessary knowledge, skill, and ability to perform the needs of the job successfully (Kaynak, 2002). Some multi criteria decision making (MCDM) techniques have been used for personnel selection processes, such as Analytic Hierarchy Process (AHP), Analytic Network Process (ANP) and TOPSIS concept (Kelemenis et al., 2011; Lin, 2010).

One of the initial steps in any personnel selection problem is to identify the selection criteria. Insight into

the relevant literatures reveals that majority of the reviewed studies do not provide a systematic method for criteria selection. A proper criteria selection method is the building block for successful personnel selection. Most scholars do not pay much attention to this step, as they only focus on giving some numerical examples to justify their personnel selection criteria. Some scholars have already talked about eliciting criteria through the use of experts' opinions (Kelemenis et al., 2011; Kelemenis and Askounis, 2010; Dagdeviren, 2010; Gibney and Shang, 2007). However, they again here do not specify their method in detail. Also, some other researchers just recently expressed that they have applied certain criteria selection methods (Jereb et al., 2005; Shih et al., 2005; Tavana et al., 1996) without any elaboration. Thus there is no systematic and valid method for specifying the job requirement criteria.

In the case of personnel selection decision making, the

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majority of developed models in literature focused more on the decision making tools rather than providing a valid method for criteria selection (Kelemenis et al., 2011). The neglect of an appropriate and systematic criteria selection technique might be presented inaccurately in the final decision and consequently, the validity of MCDM method will be reduced (Yeh, 2003). Thus, adding a systematic method for the criteria selection is required. Therefore, the aforementioned gap in literature indicates a need for further studies focused on criteria selection in personnel selection problem.

LITERATURE REVIEW IN PERSONNEL SELECTION CRITERIA AND METHODS USED

Personnel selection as one of the most important parts of human resources management is known. The input quality of personnel relates to personnel selection (Chien and Chen, 2008). Some multi criteria decision making (MCDM) techniques can be used for personnel selection process. Most of the contributors apply the analytic hierarchy process (AHP), analytic network process (ANP) and TOPSIS concept (Kelemenis et al., 2011; Lin, 2010).

There are some articles that have reviewed the literature related to personnel selection (Sackett and Lievens, 2008; Robertson and Smith, 2001). However, this paper is the only one that focuses on the multi criteria personnel selection problem approaches through a literature review and classification of the international journal articles. The literature review was done by an expansive search on such academic databases as Science Direct, Emerald, EBSCO, IEEE, Springer, Taylor and Francis, and Wiley-Blackwell.

Identifying, weighting, and evaluating the candidates against job requirements can be assumed to be a function of personnel selection. Personnel ability such as knowledge, skill and experience play an important role on organizations success. It is very difficult to correct the consequences from the wrong decision about hiring one person (Liao and Chang, 2009a). One of the main targets of organizations is the search for more powerful ways of evaluating and ranking of a set of personnel who have been evaluated in terms of different competencies. A suitable literature where attention was given for the selection of a suitable person among candidates (alternatives) and extensively presented review can be found is in Robertson and Smith (2001). A positive contribution to organizational performance can be achieved when, personnel selection strategies aligns with the organization's strategies (Stone, 2002).

Traditional personnel selection method uses an experimental and statistical techniques approach. After using the experimental approach, decision makers with their experience and understanding of the job specifications, select personnel. In the statistical techniques approach decision makers, make decisions through the arrangement of test scores and the measure

of accomplishment for the candidate. Interview with related candidates is one of the techniques related to the personnel selection.

Robertson and Smith (2001) present notable ability and availability of interviews to predict the performance of the personnel in the job. To make better personnel selection decisions in organizations, there are a number of studies in literature. These studies are based on interviews, work sample tests, assessment centres, resumes, job knowledge tests, and personality tests in human resource management (Chien and Chen, 2008), while multi criteria decision making (MCDM) techniques is used by only a few of them (Dursun and Karsak, 2010).

The objective of this review is to investigate selection criteria. Most of the scholars presented empirical application or case study for illustrating the applicability of their models. They formed a committee consisting of experts for determining selection criteria based on job position. Some systematic method for criteria selection also used include: NGT (Shih et al., 2005) and brainstorming (Jereb et al., 2005). There are 20 papers that applied their method to simple numerical example. Therefore they do not validate their methods in real life. Yeh (2003) and Liao and Cheng (2009a, 2009b) used the interview method for criteria selection. In the following the criteria selection method used for personnel selection is shown in the Table 1.

METHODOLOGY

In this paper, a systematic model for criteria selection was presented. The goal of the methodology is to form the panel of experts and determine the criteria hierarchy for personnel selection. In this method, the Delphi technique with some modifications was used to seek best ideas from managers and experts for criteria selection (Figure 1). The systematic method which consists of feedback was proposed over other methods because of the advantages it offers pertaining to the time available for respondents and researcher, convenience for respondents. This method is a Delphi based extension and an advantage of the Delphi is that it avoids direct conflict of the experts (Okoli and Pawlowski, 2004).

The new extension from modified Delphi method (Murry and Hammons, 1995) is used to extract the suitable criteria for personnel selection. The primary reason for modifying and applying Delphi for use in this study is that it has been used successfully for similar purposes within the criteria selection (Okoli and Pawlowski, 2004). The suggestion was made that group members working independently might be able to generate more innovative ideas; and such a process could reduce the diminution of the assessment capabilities of group members when there are face to face interactions. Then, a general consensus among experts can be reached to establish a hierarchical structure for criteria. Based on requirements of the specific job position and decision maker's opinions, criteria should be defined. For example, for salesman different criteria should be considered against IT systems developers or factory workers.

The primary Delphi method is an approach that uses panel experts for elicit experts' opinion in a special subject (Landeta, 2006). This method is done by written communication only and without face to face group discussion. This method includes an iterative process that usually needs three or four rounds of survey with the panel experts. By the end of every round, the data are

Table 1. Criteria selection method used for personnel selection.

Criteria selection method	Number	Citation
Experts opinion	19	Carlsson et al. (1997); Hooper et al. (1998); Taylor et al. (1998); McIntyre et al. (1999); Capaldo and Zollo (2001); Lazarevic (2001); Cho and Ngai (2003); Drigas et al. (2004); Huang et al. (2004); Jessop (2004); Chen and Cheng (2005); Gibney and Shang (2007); Boran et al. (2008); Zavadskas et al. (2008); Chien and Chen (2008); Celik et al. (2009); Dagdeviren (2010); Kelemenis and Askounis (2010); Kelemenis et al. (2011)
Numerical example	20	Gargano et al. (1991); Liang and Wang (1992); Lovrich (2000); Yaakob and Kawata (1999); Karsak (2001); Chen (2000); Butkiewicz (2002); Saghafian and Hejazi (2005); Seol and Sarkis (2005); Wang and Elhag (2006); Baykasoglu et al. (2007); Dagdeviren and Ydksel (2007); Golec and Kahya (2007); Shih et al. (2007); Mahdavi et al. (2008); Chen (2009); Güngör et al. (2009); Ayub et al. (2009); Dejiang (2009); Dursun and Karsak (2010).
Interviewing	3	Yeh (2003); Liao and Chang (2009a, 2009b)
Nominal group technique (NGT)	1	Shih et al. (2005)
Brainstorming	1	Jereb et al. (2005)

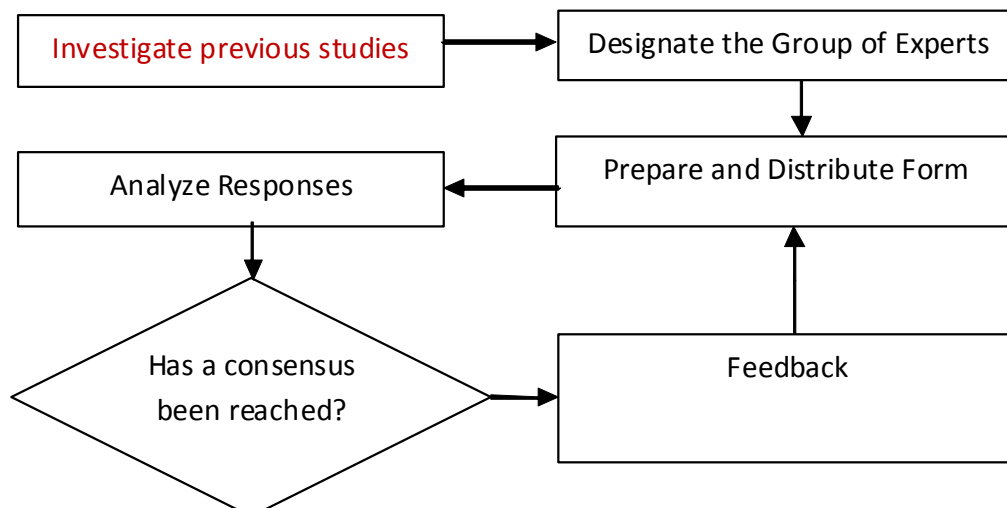


Figure 1. Research methodology.

analyzed and sent for the next round. The procedure will be finished after reaching a group consensus. As a contribution on the work of Murry and Hammons (1995) in the current study it was suggested that instead of open ended questionnaire in first round which is used in classic Delphi method, one additional task must be included. Thus, before disseminating forms for collecting experts' opinions, it is necessary to investigate the previous studies and/or expert interview to make a draft list of criteria. Therefore, this modified method will aid the process faster than the main Delphi method with more quality. In the following, the necessary steps for this stage will be described:

Procedure for selecting experts

The Delphi method is a group decision mechanism that requires qualified experts who have deep understanding of the problem.

Therefore, the selection of panel experts is one of the most critical requirements for criteria selection (Okoli and Pawlowski, 2004). A key step in the Delphi process is the identification and selection of the panel. It is the panel's opinions and judgments that determine the outcomes of the study. Following recommendations from Delphi literature, there will be 5 to 18 people in each panel.

Pertinent literature review for round one

In round one, a list that included examples of personnel selection criteria and competency developed by the researcher during the literature review pertaining to criteria for personnel selection problem, are sent to panel members along with an explanation of competency for review. Panel members are instructed to use the listing of personnel attributes and competency as a guide for creating their individual listing.

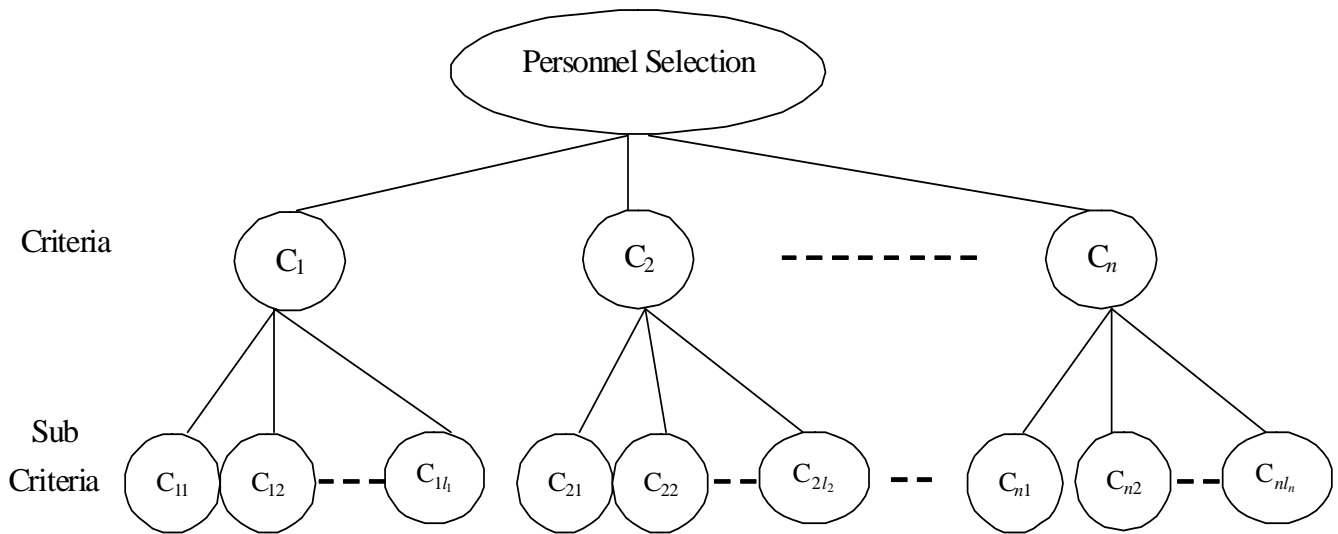


Figure 2. The criteria hierarchical for personnel selection.

Delphi round one for generate ideas

An example of personnel selection criteria developed by the researcher during the literature review is used in the first Delphi form and is sent to experts. They are determinants of key decision making criteria for personnel selection related to job position. First, the criteria mentioned in Section 3.2 were listed with their explanations and motivations in the first Delphi form. The respondents were asked to tick or cross before each criterion to show whether the criterion was relevant to their decision making on personnel selection or not. Second, the respondents were encouraged to submit as many extra missing criteria as possible. They were also asked to present the explanation and motivation of new criteria to avoid the confusion when the same criterion was raised by different terms.

Delphi round two for feedback

The data collected from a first Delphi round may not be exactly accurate. After proper analysis of its outcomes, the first round is typically followed by two more rounds that address more specific questions or provide more information or ideas, in order to achieve consensus between opinions (Hartman and Baldwin, 1995). Round two typically focuses on addressing major areas of concerns, whereas some additional information may be provided by the investigator in order to identify areas for improvement and attain consensus. During rounds two and three, each expert is allowed to review other experts' opinions and make comments or modify his or her original responses until consensus is reached at the end of round three.

After the first Delphi round, responses are grouped together for analysis. First, it is determined that each criterion has many advocates. Second, many of the proposals have similar and overlapping meanings. Duplicates criteria are removed and the experts are asked by form to verify the criteria list. Certainly, the second form that is used in round two contains consolidating of first round ideas. At the end of this round, the criteria with less than seventy percent of agreement (Polit et al., 2007; Polit and Beck, 2006) are omitted and offers about merging, add new criterion, separation, and edit of some criterion are applied.

Delphi round three for developing hierarchy

Second round responses are analysed, categorized, and returned to the experts for developing a hierarchical structure of the assessment criteria. The purpose of round three is to obtain consensus among experts for hierarchy of criteria. Verification of the criteria hierarchy can be done by interaction with the decision maker. After this round and the final analysis, the hierarchical structure for personnel selection criteria is determined according to the one shown in Figure 2. In this study, the hierarchy shows the criteria for selecting personnel. The top level is the selection goal which is personnel selection in general case and for example project manager selection. And following this are the criteria (the second level) and finally sub criteria (the third level).

CASE STUDY

To validate the model, a case study was conducted in an Iranian company. MAPNA is a large multi disciplinary power holding organization. It is located in Tehran, and it has 371 employees who are organized in five main organizational units. 14 of these persons have acquired international certificates in Professional Project Management (PMP). This section discusses the results, analysis and findings from using Delphi method for developing selection criteria hierarchy for the project manager. A critical task for a project based organization is project managers' selection.

The selection criteria should specifically be defined to cover the decision maker's requirements and correspond to the specific job characteristics. For diverse job description varied criteria should be taken into consideration, for example, system analyst, and project experts, etc. To specify the most suitable assessment criteria, the modified Delphi method has been exploited. A list consisting of selection criteria extracted from related literature and interviews with experts were designed and sent to some experts.

Designate the group of experts

A group of nine experts were chosen to form an expert panel. Then these experts were asked to specify the project manger selection

Table 2. Project manager selection criteria in literature review.

Citation criteria	Figueira et al. (2005)	Collins (1998)	Lord and Brown (2001)	Adobor (2004)	Lievens et al. (2003)	Haynes and Love (2004)	Chen et al. (2008)	El-Sabaa (2000)	Ogunlana et al. (2002)	Ling (2003)	Mustapha and Naoum (1998)
Education	•			•				•			•
Planning and control							•		•		•
Communication		•		•		•	•	•	•		•
Experience	•		•	•	•	•	•			•	•
Leadership		•				•					
Negotiation skills						•	•		•		
General management									•		•
Team development		•				•			•		
Resource management		•						•			
Time management		•	•		•	•	•		•		
Human skills		•				•					•
Technical skills		•		•	•			•			
Computer			•					•			•
Problem solving				•				•			•
Quality management	•				•	•					

criteria. The respondents were all among the company managers with relevant knowledge and more than five years of experience in project administration. Management had selected a panel consisting of procurement deputy, engineering deputy, executive deputy, administrative and financial deputy, planning deputy, quality and systems deputy, inspection manager, HSE manager, contracts manager, and the HR Department. The expert panel was responsible for eliciting the most relevant criteria for a project manager position. The experts were asked to give their supposed selection criteria in an anonymous confidential form.

RESULTS

Results of pertinent literature review

Investigating existing literatures for project manager selection demonstrate some criteria which require evaluation by the organization experts.

Most of the times, a project is confined by limited resources which result in the amplification of project manager selection importance (Gabriel et al., 2006).

For different projects, project managers with different skills and capabilities are needed. Based on the literature review (Zavadskas et al., 2008) and discussions with the experts, the selection criteria were defined and presented for Delphi rounds as shown in Table 2.

Results of the Delphi round one

After step 2 of the proposed methodology, 15 potential criteria from literatures in project manager selection evaluation were selected. For elicitation criteria, Delphi technique was used. Consequently, the first potential criteria for

evaluating project managers identified from literature can be presented in a form. That list includes all criteria which have been identified within the grouping of selected criteria. Then in the first round expert panels determine the importance or relevance of each criterion. All of the respondents agreed with the ten criteria. The form requested the experts to consider the criteria and the definitions. While some wording was modified, overall the decision makers endorsed the operational definitions.

Results of the Delphi round two

According to the group interest about the criteria, the experts corrected their interest in the second Delphi round. Finally, the criteria that have more importance will be selected after a few

Table 3. The results of Delphi model.

Project manager selection criteria (Results of literature review)	Criteria (Results of Delphi round 2)	Criteria Groups (Results of Delphi round 3)
Education	Education	Basic Requirements
Planning and control	Planning	Management Skills
	Controlling	Management Skills
Communication	Communication Skills	Basic Requirements
Experience	Past Experience	Basic Requirements
Leadership		
Negotiation skills		
	Decision making	Interpersonal Skills
General management	Organizing	Management Skills
Team development	Team development	Interpersonal Skills
Resource management	Resource management	Project Management Skills
Time management	Time management	Project Management Skills
	Cost management	Project Management Skills
Human skills		
Technical skills		
Computer	Computer skills	Basic Requirements
Problem solving	Problem solving	Interpersonal Skills
Quality Management	Quality Management	Project Management Skills

discussion. Nine members of the expert team considered the results of first Delphi round and edited their opinions according to feedback. Consequently, 14 project manager selection criteria were selected in this step that was shown in Table 3. During this step (second round of Delphi), the nine experts were asked to the decision about the two un-consensus criteria (Human skills, Technical skills). Eight of them agreed to delete these criteria because they believed that they were seen as integral parts of other criteria and no need to repeat.

Results of the Delphi round three

In this step, based upon the similarities among the skills, experts must group their selected criteria in a hierarchical structure. Then, hierarchy of the criteria must be structured. Another form was used to develop a hierarchy of the hiring criteria for project manager selection. The form asked the experts separate their criteria into related groups, and to suggest names for the groups of criteria. When this form was completed by all 10 experts, the individual responses were aggregated into separate comprehensive lists for the four sub criteria: Basic requirements, Management skills, Project management skills, and Interpersonal skills.

At this stage, there were substantial differences among the experts regarding the ways to group related criteria. Therefore, the facilitators met with each group to synthesize the responses to these form. Some experts expressed concerns about, for example, the difficulty of separating project managerial skills from management

skills. Table 3 shows the hierarchies of evaluation criteria that were synthesized during the meetings between the facilitators and the experts.

After the third round of Delphi, the 14 criteria were structured into four main groups: Basic Requirements, Project Management Skills, Management Skills, and Interpersonal Skills. The final criteria structure for project manager selection in this study is shown in Figure 3. The top level describes the main objective, which is project manager selection. To do that, four major criteria are considered, namely Basic Requirements, Project Management Skills, Management Skills, and Interpersonal Skills. These criteria are then divided into a total 14 sub criteria.

DISCUSSION

In this paper, one hierarchical structure consisting of selection criteria and sub criteria, by the help of Delphi method is created. In this way, experts are encouraged to focus on proper criteria, rather than to use inappropriate criteria. The methods such as Delphi are useful for unstructured problems. The Delphi method solves disagreements of experts by feedback. Utilizing this framework as a group decision making for aggregating, by providing feedback to the experts about their ideas, will increase their integration. Overall, this systematic criteria selection will help to increase the depth of analysis and finally will provide a decision making with more quality.

In a group decision environment, deference of opinions

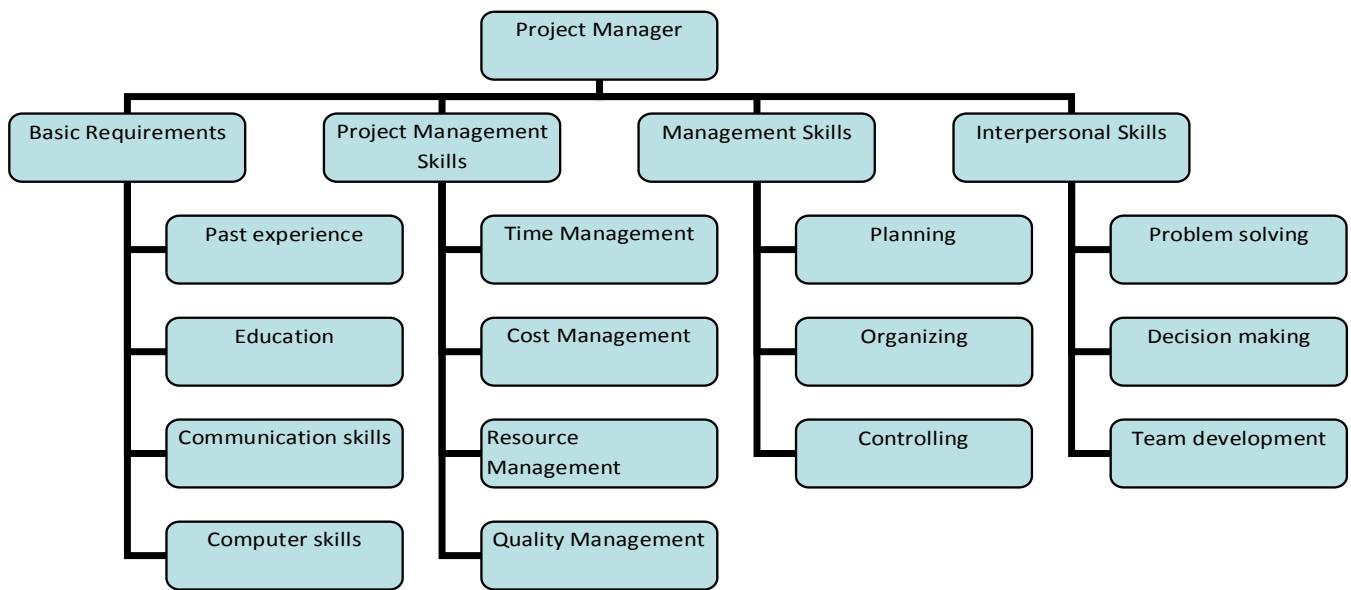


Figure 3. The hierarchical structure for project manger selection.

is normal and usual. Each expert has a different background and different knowledge and experience. Accordingly, each expert suggests different sets of criteria and preference. This difference is intensified with using the Delphi method. It is true that Delphi generates conflict, but it is also true that Delphi manages this conflict with feedback property. In the first steps of the first stage, experts contribute a diversity of viewpoints about producing selection criteria. However, in the next steps they consider other comments, and they find an opportunity for rethinking their ideas.

What distinguishes this research, relates to criteria selection method. Most of the previous researches did not provide the clear method for eliciting criteria (Kelemenis et al., 2011). This is the first study that employs a systematic method for this stage in personnel selection and has used the Delphi methods with some modifications. As a contribution to the knowledge, this study extended the classical Delphi technique for saving time and expenses, by using the results of relevant literature review and discussion with experts to identify the selection criteria. Thus, this systematic method consists of three elements: review of pertinent literature, the Delphi technique and discussion with experts. This synergy increases the quality and quantity of the personnel selection process.

Another thing that requires discussion here is the number of expert panel. Usually in the Delphi method between 5 and 20 experts should be used in the experts panel (Anderson et al., 2004). For the reason that the panel size influences the effectiveness of decision processes some researchers believe that the number of expert panels should not be too large, a minimum of 5 to

a maximum of about 9 (Delbecq et al., 1975). Therefore, in this study nine experts were suggested for the formation of the group of expert panellist.

Conclusion

From the scientific decision making point of view, many scholars have dealt with the personnel selection problem. To handle this decision making problem, they combined techniques from operational research with artificial intelligence fields. Expert systems, fuzzy linguistic variables, neural networks and multi criteria decision making techniques used as methodology. According to previous studies in literature, there is no systematic method that can help companies in preparing and choosing personnel selection criteria. However, this research has showed that the Delphi method can be used as guidelines for companies and that can enable each company to determine the essential criteria of each job position based on expert's opinion. This study selected the criteria for draft list in Delphi method, from pertinent literature. Review of pertinent literature and discussion with experts and using Delphi method, this three together increase the efficiency of criteria selection stage. The proposed model can also be applied to problems such as project selection, material selection and many other areas of management decision problems or strategy selection problems.

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