Developing global managers’ competencies using the fuzzy DEMATEL method

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Abstract

Modern global managers are required to possess a set of competencies or multiple intelligences in order to meet pressing business challenges. Hence, expanding global managers’ competencies is becoming an important issue. Many scholars and specialists have proposed various competency models containing a list of required competencies. But it is hard for someone to master a broad set of competencies at the same time. Here arises an imperative issue on how to enrich global managers’ competencies by way of segmenting a set of competencies into some portions in order to facilitate competency development with a stepwise mode. To solve this issue involving the vagueness of human judgments, we have proposed an effective method combining fuzzy logic and Decision Making Trial and Evaluation Laboratory (DEMATEL) to segment required competencies for better promoting the competency development of global managers. Additionally, an empirical study is presented to illustrate the application of the proposed method.

Keywords: Global managers; Competency; Multiple intelligences; Decision Making Trial and Evaluation Laboratory (DEMATEL)

1. Introduction

In meeting the impact of existing and future globalization advancements, most companies have an ongoing need for competent global managers (Harvey, Novicevic, & Kiessling, 2002). Especially, the ability of organizations to effectively compete in the global marketplace is dependent on identifying and maintaining an adequate number of qualified global managers (Harvey & Richey, 2001; McKenna, 1998; Sinkovics, Bell, & Deans, 2004). To maintain an adequate staff of capable global managers, companies must effectively enforce global manager selection with multiple intelligences as specific competencies (Harvey & Richey, 2001; Harvey et al., 2002), and help global managers to identify and cultivate their competencies. It is now a leading company strategy to apply competency models to help global managers to develop their competencies.

The competency model is a set of competencies, namely success factors which include the key behaviors required for excellent performance in a particular role (Schoonover, Schoonover, Nemerov, & Ehly, 2000). In addition, the competency model can be used to identify the competencies which employees need to improve performance in their current job or to prepare for other jobs (Sinnott, Madison, & Pataki, 2002). Several surveys report that numerous modern enterprises are progressively adopting competency models as essential management technologies to enhance their competitiveness (JPC-SED, 2002; Schoonover et al., 2000). There are several useful manager competency models, such as: Boyatzis (1982), Hellriegel, Jackson, and Slocum (2002), Quinn, Faerman, Thompson, and McGrath (1996), and Spencer and Spencer (1993). However, each of these competency models contains too many competencies. It is hard for someone to master a broad set of competencies simultaneously. In order to be smart for...
launching competency applications effectively, it is a favorable way that focusing on some urgent competencies and implementing them with a stepwise mode (Wu, Lee, & Tzeng, 2005). Thus here arises the imperative issue of how to enrich global manager competencies by way of segmenting a set of competencies into some portions in order to effectively facilitate competency development. Unfortunately, few works discuss this issue.

To solve this issue, it is suitable to use the Decision Making Trial and Evaluation Laboratory (DEMATEL). The DEMATEL method (Gabus & Fontela, 1972, 1973) is a potent method that helps in gathering group knowledge for forming a structural model, as well as in visualizing the causal relationship of sub-systems through a causal diagram. However, in many cases, the judgments of decision-making are often given as crisp values, but crisp values are an inadequate reflection of the vagueness of the real world (Bellman & Zadeh, 1970; Zadeh, 1965). The fact that human judgment about preferences are often unclear and hard to estimate by exact numerical values, so that fuzzy logic is necessary for handling problems characterized by vagueness and imprecision (Chang, Yeh, & Cheng, 1998; Chen & Chiou, 1999). Hence, there has a need to extend the DEMATEL method with fuzzy logic for making better decisions in fuzzy environments.

Therefore, the aim of this paper is to develop the fuzzy DEMATEL method to segment required competencies for better promoting the competency development of global managers. Also, an empirical study of a high-tech company is presented as a test case to illustrate our proposed method and to demonstrate its usefulness. The rest of this paper is organized as follows. In Section 2, some of the prior literature relating to competencies and multiple intelligences is reviewed. In Section 3, the proposed method is described. In Section 4, an empirical study is illustrated. Finally, according to the findings of this research, conclusions and suggestions are presented.

2. From competencies towards multiple intelligences

Successfully managing the challenges of globalization, companies need to possess enough capable global managers. For assessing a competent global manager, there has been a new shift away from the competency approach towards the multiple intelligences approach. Hence, competencies and multiple intelligences are discussed below.

2.1. Competencies and competency models

In view of the knowledge-based nature of competition, global managers need a broad range of managerial competencies. Especially, successful global management will think strategically in a worldwide context, but act like a local organization in each national market (Sheridan, 1997). According to McKenna (1998), identifying management competencies would enable managers to perform more effectively, and lead to develop the dimensions of effective management and leadership behavior. Moreover, Rosen and Digh (2001) indicate that global manager competencies are the new leadership competencies required for business success in today’s multicultural and global economy.

The concept of competency has been developed by McClelland and the McBer and Company in 1970s. Especially, McClelland’s paper, “Testing for Competence rather than Intelligence” (McClelland, 1973), started the competency movement in the 1970s. Schoonover et al. (2000) remark that competencies provide significant help with key problems such as: clarifying workforce standards and expectations; and aligning individuals with the organization’s business strategies. Generally, competencies are characteristics of people that differentiate performance in a specific job or role (Kelner, 2001; McClelland, 1973). Now competencies are commonly conceptualized as a measurable pattern of knowledge, skills, abilities, behaviors, and other characteristics (KSAOs) that differentiate high from average performance (Athey & Orth, 1999; Mirable, 1997; Rodriguez, Patel, Bright, Gregory, & Gowing, 2002). Regarding the notion of a competency model, Mansfield (1996) states that a competency model is a detailed description of behaviors and abilities which employees are required to have to be effective in a job. The competency model is useful to identify capabilities and attributes needed to meet current and future staffing needs, and to focus employee development efforts to eliminate the gap between capabilities needed and those available (Sinnott et al., 2002).

There are several notable manager competency models. Typically, Boyatzis (1982) suggests six clusters: goal and action management; leadership; human resource; directing subordinates; focus on others; and specialized knowledge. Moreover, Quinn et al. (1996) have grouped manager competency into eight clusters: mentor, facilitator, monitor, coordinator, director, producer, broker, and innovator. Further, Hellriegel et al. (2002) have developed six clusters of managerial competencies: self-management; strategic action; global awareness; teamwork; planning and administration; and communication. However, note that the above competency models usually contain many detailed competencies in each cluster. Dive (2004) suggests that it is better to implement the competency model gradually and to avoid involving too many competencies at a time.

2.2. Multiple intelligences and eight IQs

Regarding multiple intelligences, Gardner (1983) defines seven intelligences that differ greatly from the traditional view which usually recognizes as verbal or computational intelligence. Gardner’s seven intelligences are: logical–mathematical intelligence; linguistic intelligence; spatial intelligence; musical intelligence; bodily-kinesthetic intelligence; personal intelligences; and intrapersonal intelligence. Moreover, Sternberg (1997) stresses that multiple intelligences are effective in selecting individuals with different competencies, and categorizes multiple intelligences
into three groups based on the Triarchic Theory (Sternberg, 1985). These three groups all are the key to managerial intelligence, including: analytical intelligence; practical intelligence; and creative intelligence (Sternberg, 1997).

Recently, several works (Harvey & Richey, 2001; Harvey et al., 2002) suggest that multiple intelligences can be used as specific competences for the selection of global managers, owing to the rising significance of emotional competence (Boyatzis, Goleman, & Rhee, 1999). Emotional intelligence is the capacity for recognizing and managing our own feelings and those of others (Goleman, 1998). Motional competence is a learned capability based on emotional intelligence that contributes to effective performance in all aspects of life and in multiple environments (Boyatzis et al., 1999). Harvey and Richey (2001) emphasize that eight IQs have been identified to illustrate the heterogeneity of potential capabilities which global managers may possess.

According to their works (Harvey & Richey, 2001; Harvey et al., 2002), those different IQs are: (1) cognitive IQ involving the ability to reason, learn, and think analytically; (2) emotional IQ involving the ability to use one’s own affective state to tap the affective state of others to accomplish specific objectives; (3) political IQ involving the manager’s ability to use formal and informal power to accomplish objectives; (4) cultural/social IQ involving the extent to which one is adequately socialized into the cultural/social difference among organizations; (5) organizational IQ involving the ability of a manager to have a detailed and accurate understanding of how two organizations operate functionally; (6) network IQ involving the ability to get things done when working with multiple interrelated organizational units; (7) innovative IQ involving the ability to be innovative in thinking and create novel ideas and solutions to problems; and (8) intuitive IQ involving the ability to have quick insights into how to solve problems or to address situations without past experience with that particular problem and without actively or formally processing information. As per the above, there has been a recent shift away from the competency approach towards the multiple intelligences approach.

3. The fuzzy DEMATEL method

DEMATEL is a comprehensive method for building and analyzing a structural model involving causal relationships between complex factors. To lay the foundation for extending the DEMATEL method for making decisions in fuzzy environments, the essentials of the DEMATEL method and fuzzy logic are discussed below.

3.1. The DEMATEL method

The Battelle Memorial Institute conducted a DEMATEL method project through its Geneva Research Centre (Gabus & Fontela, 1972, 1973). The original DEMATEL was aimed at the fragmented and antagonistic phenomena of world societies and searched for integrated solutions. In recent years, the DEMATEL method has become very popular in Japan (Hori & Shimizu, 1999; Kamaike, 2001; Yamazaki et al., 1997; Yuzawa, 2002) because it is especially pragmatic to visualize the structure of complicated causal relationships.

Specifically, the DEMATEL method is based on digraphs, which can separate involved factors into cause group and effect group. Directed graphs, known as digraphs, are more useful than directionless graphs because digraphs can demonstrate the directed relationships of sub-systems. A digraph may typically represent a communication network, or some domination relation between individuals. Suppose a system contains a set of elements $S = \{s_1, s_2, \ldots, s_n\}$, and particular pair-wise relations are determined for modeling with respect to a mathematical relation $R$. Next, to portray the relation $R$ as a direct-relation matrix that is indexed equally on both dimensions by elements from the set $S$. Then, except the case that the number is 0 appearing in the cell $(i,j)$, if the entry is a positive integer that has the meaning of (1) the ordered pair $(s_i, s_j)$ is in the relation $R$, and (2) there has the sort of relation regarding that element $s_i$ causes element $s_j$.

The digraph portrays a basic concept of contextual relation among the elements of the system, in which the numeral represents the strength of influence. Hence, the DEMATEL method can convert the relationship between the causes and effects of factors into an intelligible structural model of the system. In order to apply the DEMATEL method smoothly, we refined the version used by Fontela and Gabus (1976) and make essential definitions as below.

**Definition 1.** The pair-wise comparison scale may be designated four levels, where the scores of 0, 1, 2, and 3 represent “No influence”, “Low influence”, “High influence”, and “Very high influence” respectively.

**Definition 2.** The initial direct-relation matrix $Z$ is a $n \times n$ matrix obtained by pair-wise comparisons in terms of influences and directions between criteria, in which $z_{ij}$ is denoted as the degree to which the criterion $i$ affects the criterion $j$, i.e., $Z = [z_{ij}]_{n \times n}$.

**Definition 3.** The normalized direct-relation matrix $X$, i.e., $X = [x_{ij}]_{n \times n}$ and $0 \leq x_{ij} \leq 1$ can be obtained through the formulas (1) and (2), in which all principal diagonal elements are equal to zero.

$$X = s \cdot Z,$$

$$s = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^{n} z_{ij}}, \quad i, j = 1, 2, \ldots, n.$$  \hspace{2cm} (1)

**Definition 4.** The total-relation matrix $T$ can be acquired by using the formula (3), in which the $I$ is denoted as the identity matrix.

$$T = X(I - X)^{-1}.$$  \hspace{2cm} (2)

$$T = X(I - X)^{-1}.$$  \hspace{2cm} (3)
Definition 5. The sum of rows and the sum of columns are separately denoted as $D$ and $R$ within the total-relation matrix $T$ through the formulas (4)–(6):

$$T = t_{ij}, \quad i, j = 1, 2, \ldots, n,$$

(4)

$$D = \sum_{j=1}^{n} t_{ij},$$

(5)

$$R = \sum_{i=1}^{n} t_{ij},$$

(6)

where $D$ and $R$ denote the sum of rows and the sum of columns respectively.

Definition 6. A causal diagram can be acquired by mapping the dataset of $(D + R, D - R)$, where the horizontal axis $(D + R)$ is made by adding $D$ to $R$, and the vertical axis $(D - R)$ is made by subtracting $D$ from $R$.

3.2. The fuzzy logic

In the real world, many decisions involve imprecision since goals, constraints, and possible actions are not known precisely (Bellman & Zadeh, 1970). When making decisions in a fuzzy environment, the result of decision-making is highly affected by subjective judgments that are vague and imprecise. The sources of imprecision include: unquantifiable information, incomplete information, non-obtainable information, and partial ignorance (Chen, Hwang, & Peters, 1997). In practice, linguistic values can be represented by fuzzy numbers, and the triangular fuzzy number is commonly used. In the following, we briefly review some essential definitions of fuzzy logic.

Definition 7. A fuzzy set $\widetilde{A}$ is a subset of a universe of discourse $X$, which is a set of ordered pairs and is characterized by a membership function $\mu_{\widetilde{A}}(x)$ representing a mapping $\mu_{\widetilde{A}} : X \rightarrow [0, 1]$. The function value of $\mu_{\widetilde{A}}(x)$ for the fuzzy set $\widetilde{A}$ is called the membership value of $x$ in $\widetilde{A}$, which represents the degree of truth that $x$ is an element of the fuzzy set $\widetilde{A}$. It is assumed that $\mu_{\widetilde{A}}(x) \in [0, 1]$, where $\mu_{\widetilde{A}}(x) = 1$ reveals that $x$ completely belongs to $\widetilde{A}$, while $\mu_{\widetilde{A}}(x) = 0$ indicates that $x$ does not belong to the fuzzy set $\widetilde{A}$.

$$\widetilde{A} = \{(x, \mu_{\widetilde{A}}(x))\}, \quad x \in X,$$

where $\mu_{\widetilde{A}}(x)$ is the membership function and $X = \{x\}$ represents a collection of elements $x$.

Definition 8. A fuzzy set $\widetilde{A}$ of the universe of discourse $X$ is convex if

$$\mu_{\widetilde{A}}(\lambda x_1 + (1 - \lambda)x_2) \geq \min(\mu_{\widetilde{A}}(x_1), \mu_{\widetilde{A}}(x_2)) \quad \forall x \in [x_1, x_2],$$

where $\lambda \in [0, 1]$.

Definition 9. A fuzzy set $\widetilde{A}$ of the universe of discourse $X$ is normal if

$$\max \mu_{\widetilde{A}}(x) = 1.$$

Definition 10. A fuzzy number $\widetilde{N}$ is a fuzzy subset in the universe of discourse $X$, which is both convex and normal.

Definition 11. The $x$-cut of the fuzzy set $\widetilde{A}$ of the universe of discourse $X$ is defined as

$$\widetilde{A}_x = \{x \in X | \mu_{\widetilde{A}}(x) \geq x\},$$

where $x \in [0, 1]$.

Definition 12. A triangular fuzzy number $\widetilde{N}$ can be defined as a triplet $(l, m, r)$, and the membership function $\mu_{\widetilde{N}}(x)$ is defined as:

$$\mu_{\widetilde{N}}(x) = \begin{cases} 
0, & x < l, \\
(x - l)/(m - l), & l \leq x \leq m, \\
(r - x)/(r - m), & m \leq x \leq r, \\
0, & x > r,
\end{cases}$$

where $l, m$, and $r$ are real numbers and $l \leq m \leq r$.

Further, in achieving a favorable solution, the group decision-making (GDM) is usually important to any organization. This is because that GDM is the process of arriving at a consensus based upon the reaction of multiple individuals, whereby an acceptable judgment may be obtained (Cheng & Lin, 2002). To deal with the problems of GDM in a fuzzy environment, an effective fuzzy aggregation method is required. Any fuzzy aggregation method always needs to contain a defuzzification method because the results of human judgments with fuzzy linguistic vari-
ables are fuzzy numbers. The term defuzzification refers to the selection of a specific crisp element based on the output fuzzy set, which may convert fuzzy numbers into crisp scores (Opricovic & Tzeng, 2003).

There are several useful defuzzification methods that may be divided into two classes by considering either the vertical or the horizontal representation of possibility distribution (Oussalah, 2002). However, a good defuzzification method needs to consider that a fuzzy number is characterized by its shape, spread, height, and relative location on the x-axis (Opricovic & Tzeng, 2003). The most commonly used defuzzification method is the Centroid (Center-of-gravity) method (Yager & Filev, 1994), but this does not distinguish between two fuzzy numbers which have the same crisp value in spite of different shapes. Therefore, we here adopt the CFCS (Converting Fuzzy data into Crisp Scores) defuzzification method for our fuzzy aggregation procedure. This is because the CFCS method can give a better crisp value than the Centroid method.

The CFCS method proposed by Opricovic and Tzeng (2003) is based on the procedure of determining the left and right scores by fuzzy min and fuzzy max, and the total score is determined as a weighted average according to the membership functions. Let \( z_{ij} = (l_{ij}, m_{ij}, r_{ij}) \) indicate the fuzzy assessments of evaluator \( k \) (\( k = 1, 2, \ldots, p \)) about the degree to which the criterion \( i \) affects the criterion \( j \). The CFCS method includes five-step algorithms described as follows:

1. **Normalization:**
   \[
   x_{ij}^k = (t_{ij}^k - \min t_{ij}^k) / A_{\text{max}},
   \]

2. **Compute left (ls) and right (rs) normalized value:**
   \[
   xls_{ij}^k = xm_{ij}^k / (1 + xm_{ij}^k - xl_{ij}^k),
   \]
   \[
   xrs_{ij}^k = x_{ij}^k / (1 + x_{ij}^k - xmr_{ij}^k).
   \]

3. **Compute total normalized crisp value:**
   \[
   x_{ij}^k = [xl_{ij}^k(1 - xls_{ij}^k)] + xrs_{ij}^k[xrs_{ij}^k] / [1 - xls_{ij}^k + xrs_{ij}^k].
   \]

4. **Compute crisp values:**
   \[
   z_{ij}^k = \min t_{ij}^k + x_{ij}^k A_{\text{max}}.
   \]

5. **Integrate crisp values:**
   \[
   z_{ij} = \frac{1}{p} (z_{ij}^1 + z_{ij}^2 + \cdots + z_{ij}^p).
   \]

**3.3. The procedure of fuzzy DEMATEL method**

To further the practicality of the DEMATEL method for group decision making in a fuzzy environment, the analytical procedure of our proposed method is explained as follows:

**Step 1: Identifying the decision goal and forming a committee.** Decision-making is the process of defining the decision goals, gathering relevant information, generating the broadest possible range of alternatives, evaluating the alternatives for advantages and disadvantages, selecting the optimal alternative, and monitoring the results to ensure that the decision goals are achieved (Hess & Siciliano, 1996; Opricovic & Tzeng, 2004). Thus, the first step is to identify the decision goal. Also, it is necessary to form a committee for gathering group knowledge for problem-solving.

**Step 2: Developing evaluation factors and designing the fuzzy linguistic scale.** In this step, it is necessary to establish sets of significant factors for evaluation. However, evaluation factors have the nature of causal relationships and are usually comprised of many complicated aspects. To gain a structural model dividing involved factors into cause group and effect group, the DEMATEL method must be used here. For dealing with the ambiguities of human assessments, the linguistic variable “influence” is used with five linguistic terms (Li, 1999) as {Very high, High, Low, Very low, No} that are expressed in positive triangular fuzzy numbers (\( l_i, m_i, r_i \)) as shown in Table 1.

**Step 3: Acquiring and aggregating the assessments of decision makers.** To measure the relationship between evaluation factors \( C = \{C_i|i = 1, 2, \ldots, n\} \), it is usually necessary to ask a group of experts to make assessments in terms of influences and directions between factors. Then, using the CFCS method, those fuzzy assessments are defuzzified and aggregated as a crisp value which is the \( z_{ij} \). Hence, the initial direct-relation matrix \( Z = [z_{ij}]_{n \times n} \) can be obtained by formulas (7)–(14).

**Step 4: Establishing and analyzing the structural model.** On the base of the initial direct-relation matrix \( Z \), the normalized direct-relation matrix \( X \) can be obtained through formulas (1). Then, the total-relation matrix \( T \) can be acquired by using formula (3). According to Definitions 5 and 6, a causal diagram can be acquired through formulas (4)–(6). The causal diagram is constructed with the horizontal axis \( (D + R) \) named “Prominence” and the vertical axis \( (D - R) \) named “Relation”. The horizontal axis “Prominence” shows how much importance the factor has, whereas the vertical axis “Relation” may divide factors into cause group and effect group. Generally, when the \( (D - R) \) axis is plus, the factor belongs to the cause

<table>
<thead>
<tr>
<th>Linguistic terms</th>
<th>Triangular fuzzy numbers</th>
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<tbody>
<tr>
<td>Very high influence (VH)</td>
<td>(0.75,1.0,1.0)</td>
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<td>High influence (H)</td>
<td>(0.5,0.75,1.0)</td>
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<td>Low influence (L)</td>
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group. Otherwise, the factor belongs to the effect group if the \((D - R)\) axis is minus. Hence, causal diagrams can visualize the complicated causal relationships of factors into a visible structural model, providing valuable insight for problem-solving. Further, with the help of a causal diagram, we may make proper decisions by recognizing the difference between cause and effect factors.

4. Empirical study and discussions

Facing global competition, all companies need to enrich the required competencies for their global managers. In this section, an empirical study shows how a high-tech company applied our proposed method to segment the eight IQs for promoting competency development successfully.

4.1. Problem descriptions

The case Company P is a Taiwan firm with more than USD 860 million turnover and over 1428 employees. The company is one of the world’s leading manufacturers in the RAID (Redundant Array of Inexpensive Disks) market, offering high-capacity storage products and data protection solutions. Due to the worldwide challenge posed by the trend toward shorter product cycles and lower costs for consumer electronics, Company P requires production, human resource, and information technology departments. The following shows how Company P adopted our proposal and set up a competency development committee consisting of the General Manager, and several managers representing the marketing, financial, production, human resource, and information technology departments. The following shows how Company P utilized our proposed fuzzy DEMATEL method to evaluate and segment the eight IQs for better implementing the competency development of their global managers.

4.2. Applications of proposed method

The committee followed our proposed method with the four-step procedure. First, they defined the decision goals for segmenting the eight IQs into portions in order to promote the competency development of their global managers step by step. In step 2, the committee adopted the eight IQs as evaluation factors, including: cognitive IQ \((C_1)\); emotional IQ \((C_2)\); political IQ \((C_3)\); cultural/social IQ \((C_4)\); organizational IQ \((C_5)\); network IQ \((C_6)\); innovative IQ \((C_7)\); and intuitive IQ \((C_8)\). Also, they decided to use a fuzzy linguistic scale (Table 1) for making assessments. In step 3, once the relationships between those factors were measured by the committee through the use of the fuzzy linguistic scale, the data from each individual assessment could be obtained. For example, the assessment data of the General Manager are shown in Table 2. Then, using the CFCS method to aggregate these assessment data, the initial direct-relation matrix (Table 3) was produced.

In step 4, based on the initial direct-relation matrix, the normalized direct-relation matrix (Table 4) was obtained by formula (1) and (2). Next, the total-relation matrix (Table 5) was acquired by using formula (3). Then, using formulas (4)–(6), the causal diagram (Fig. 1) could be acquired by mapping a dataset of \((D + R, D - R)\). Looking at this causal diagram, it is clear that evaluation factors were visually divided into the cause group, including \(C_1, C_2, C_7\) and \(C_8\) while the effect group was composed of such factors as \(C_3, C_4, C_5\) and \(C_6\).

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<td>0.327</td>
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<tr>
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<td>0.400</td>
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<td>0.400</td>
<td>0.633</td>
<td>0.000</td>
</tr>
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</table>

4.3. Problem descriptions

The committee followed our proposed method with the four-step procedure. First, they defined the decision goals for segmenting the eight IQs into portions in order to promote the competency development of their global managers step by step. In step 2, the committee adopted the eight IQs as evaluation factors, including: cognitive IQ \((C_1)\); emotional IQ \((C_2)\); political IQ \((C_3)\); cultural/social IQ \((C_4)\); organizational IQ \((C_5)\); network IQ \((C_6)\); innovative IQ \((C_7)\); and intuitive IQ \((C_8)\). Also, they decided to use a fuzzy linguistic scale (Table 1) for making assessments. In step 3, once the relationships between those factors were measured by the committee through the use of the fuzzy linguistic scale, the data from each individual assessment could be obtained. For example, the assessment data of the General Manager are shown in Table 2. Then, using the CFCS method to aggregate these assessment data, the initial direct-relation matrix (Table 3) was produced.

In step 4, based on the initial direct-relation matrix, the normalized direct-relation matrix (Table 4) was obtained by formula (1) and (2). Next, the total-relation matrix (Table 5) was acquired by using formula (3). Then, using formulas (4)–(6), the causal diagram (Fig. 1) could be acquired by mapping a dataset of \((D + R, D - R)\). Looking at this causal diagram, it is clear that evaluation factors were visually divided into the cause group, including \(C_1, C_2, C_7\) and \(C_8\) while the effect group was composed of such factors as \(C_3, C_4, C_5\) and \(C_6\).

<table>
<thead>
<tr>
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<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
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</thead>
<tbody>
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<td>0.084</td>
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</tr>
<tr>
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<td>0.054</td>
<td>0.104</td>
<td>0.059</td>
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<td>0.099</td>
</tr>
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<tr>
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<td>0.059</td>
<td>0.094</td>
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</tbody>
</table>
found decisions from the causal diagram (Fig. 1). For follows:

derive several implications about business management as the eight IQs. According to the evaluation results, we can enhance the competencies of their global managers through 4.3. Discussions

<table>
<thead>
<tr>
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<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
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<tbody>
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<tr>
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<td>0.157</td>
<td>0.117</td>
<td>0.139</td>
<td>0.169</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Secondly, training and development (T&D) attempt to increase employees’ competencies in order to make them work better with high performances. However, training is mainly used to provide required knowledge and skills to employees for improving performance, whereas development focuses on ways to expand employees’ mental ability and brain power. This implies that the effect group IQs (political IQ, cultural/social IQ, organizational IQ, and network IQ) can be improved by training, while the cause group IQs (cognitive IQ, emotional IQ, innovative IQ, and intuitive IQ) need more efforts of development.

Thirdly, a competency model usually contains a list of required competencies, in which some are easier to be changed through training but others are not so. Referring to the five types of competency characteristics (Spencer & Spencer, 1993), knowledge and skills are relatively easy to develop through training, while motive, trait and self-concept are more difficult to assess and develop. In this sense, the cause group IQs is difficult to be changed, so that it can be used as the critical criteria for recruiting the right global managers.

5. Conclusions

In the current borderless economy, companies have the continual need to be globally efficient and competitive by integrating activities and resources across national borders. To this end, companies need to pay careful attention to select the right global manager and to expand their managerial competencies through using competency models. However, a competency model often contains a list of numerous competencies. It is difficult for anyone to master a broad set of competencies simultaneously. There arises an important issue in terms of segmenting a set of competencies into some meaningful portions in order to effectively facilitate competency development. Additionally, to handle this issue, it is also necessary to solve the matter of integrating group decision-making in fuzzy environments.

Hence, we proposed the fuzzy DEMATEL method to achieve segmentation of required competencies for better implementing the competency development of global managers. Our proposed method successfully extends the DEMATEL method by applying both linguistic variables and a fuzzy aggregation method, so that it can effectively deal with vague and imprecise judgments. In particular, this proposed method can also successfully divide a set of complex factors into a cause group and an effect group, and produce a visible causal diagram. Through the causal diagram, the complexity of a problem is easier to capture, whereby profound decisions can be made.

As concerns our empirical study, the proposed fuzzy DEMATEL method worked smoothly in tackling the issue of segmenting the eight IQs into meaningful portions. According to the analysis results, these IQs (the cognitive IQ, emotional IQ, innovative IQ, and intuitive IQ) are difficult to be changed through training but must be expanded by development. This implies that it is an effective way to expand global managers’ competencies by these four IQs with high priority. Further, these IQs can be regarded as the critical criteria in recruiting the right global managers.
Our proposed fuzzy DEMATEL method is comprehensive and applicable to all companies facing problems that require group decision-making in a fuzzy environment to segment complex factors. As for future research, one possible direction may be to research a more satisfying fuzzy aggregation method.

References


