Application of grey theory approach to evaluation of organizational vision

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Abstract

Purpose – The purpose of the paper is to propose a quantitative approach for assessing the qualitative nature of organizational vision.

Design/methodology/approach – The paper uses grey systems method to rank and evaluate the vision of five top-ranked universities.

Findings – It is shown in the literature that qualitative consideration of organizational vision can be quantified using a mathematical method. This method can be used as a decision-making tool where the judgments of the decision maker are not exact.

Originality/value – This study expresses the qualitative nature of organizational vision into a quantified shape. It does it through a mathematical method called "grey systems theory". Moreover, it seems that the application of grey systems theory to the business context has rarely been examined.

Keywords Decision making, Systems theory, Universities, Strategic objectives

Paper type Research paper

1. Introduction

Vision formulation is the starting point for establishing an entity or organization. It is the vision which identifies the routes for further movement towards the ideals. It is necessary for organizations to formulate a vision that distinguishes them from others. This would not be achieved unless all related attributes are included in vision. Subjective evaluation of the vision's attributes is not enough. Therefore, quantitative methods are required for a vision to be evaluated and comparable with the best ones. This can be seen as a multiple attribute decision-making (MADM) problem in which the decision makers (DMs) always express their preferences on alternatives or on attributes of the options which can help ranking the visions or selecting the most desirable one (Li *et al.*, 2007).

As it is hardly possible to estimate the uncertain judgment of the DMs by the exact numerical value, thus, methods used to study uncertainty should be applied. Grey system theory (Deng, 1982) is one that copes with situations with uncertain information and uses grey numbers to describe this uncertainty. The grey number is a real number but we do not know its value (Li, 2009). The grey system puts stochastic variables as grey interval numbers that change within a given range. It does not rely on statistical method to deal with the grey quantity, but deals directly with the original data and searches the intrinsic regularity of the data (Hsu and Wang, 2009). The advantage of grey theory (GT) over fuzzy theory is that grey system theory considers the condition of the fuzziness (Zadeh, 1965; Li *et al.*, 2007). This theory has been widely studied in many fields, such as financial institutions, advertising agencies, management, etc. (Kung and Wen, 2007). There is a plenty of literature on different

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aspects of the higher education sector development (Rahimnia *et al.*, 2009). However, the higher education sector outside of east/west contexts, and in particular considering the organizational vision are rarely mentioned in the relevant literature.

In this paper, a GT approach is used to evaluate an organizational vision and to rank it in comparison to other organizational visions. To this aim, Section 2 presents a brief review of literature on vision. Section 3 describes grey systems theory which includes some basic definitions and grey relational analysis based on grey number. Section 4 introduces the applied grey approach and Section 5 considers the proposed approach by some examples of organizational vision. Lastly, a conclusion is provided in Section 6.

2. Vision

Rahimnia *et al.* (2005) believe that strategists should consider certain activities to achieve a suitable strategic decision. In their view, due to the significant importance of the main elements of strategic management such as vision, mission, values and long-term objectives, the situation of these elements must be determined.

Images of the future play an important role in our life. People look to the future when they create plans and goals. In this situation, they try to make links between their experiences and knowledge of the past and present (O'Brien and Meadows, 2001), and their decisions about the future (Ache, 2000; O'Brien and Meadows, 2001). One fundamental premise is that individuals and organizations equally need dreams if they are to survive and prosper (Kenny, 1994). Organizations that map the future would have a proactive reaction to the environment and can afford the changing nature of it. Generally, vision is important for strategic change in mature organization (Baum *et al.*, 1998).

Since the 1980s and throughout the 1990s, a great deal of interest has been focused on visions and envisioning approaches for making claims about and for the future (Helm, 2009). In a recent survey of 100 UK organizations conducted by O'Brien and Meadows (2000), 91 per cent reported that they had an organizational vision or were in the process of developing one.

There is not an agreement on the definition of a vision statement and the definitions vary in complexity. The term "vision" sometimes goes by terms such as "personal agenda, purpose, legacy, dream, goal, or vision". Other terms cited include long-term objective, long-term goal, image, doctrine, and core ideology (Price, 2001).

Vision is indicative of the core values and can distinguish organizations from each other. Vision is defined as:

> [...] a statement of purpose determined by management based on the organization's core values and beliefs that defines the organization's identity and combines an ideal manifestation of its direction together with a tangible prescription for realizing its goals (Ford and Pasmore, 2006).

To better understand the term "vision", it is necessary to single it out from other terms. Other terms like mission, strategy, philosophy, vision, and values are often used interchangeably (Kantabutra and Avery, 2007). Foster and Akdere (2007) and Rampersad (2001) emphasized the importance of values in the formation of visions; the content of the vision expresses and clarifies central organizational values. It differentiates the organization from other organizations. Kelly (2000) on the other hand, refers to the distinct differences between vision and strategy. Strategy is the path that an organization chooses to pursue its future, while vision should describe a future in which "goals and strategy are being successfully achieved in lockstep with the organization's guiding philosophy and values" (Foster and Akdere, 2007). McGivern and Tvorik (1998) argue that the traditional concept of organizational vision has been represented within two distinct contexts. In the first one, vision is seen as an approach that drives business strategy and the second one appreciates it as an approach that drives organizational culture. The emerging trend appears to identify organizational vision as interdependent with and preceding business strategy development (McGivern and Tvorik, 1998; Price, 2001).

As it is based on the core values and objectives, the vision has a strong power to change the organization. Thus, it is utilized as a pre-requisite for change and is the pivotal concept in leadership (Sosik and Dinger, 2007; Barnett and McCormick, 2003).

Vision content selection

Most of the literature on organizational vision is about how to produce a vision and what a vision should achieve, but few authors have explicitly described what should be included in a vision and very few studies examined the implications of vision content (Larwood *et al.*, 1995; Baum *et al.*, 1998; Kantabutra and Avery, 2007). Larwood *et al.* (1995) in their study of vision content, found ten items that received the highest average ratings. These items are as follows (starting with the highest mean score): action-oriented, responsive to competition, long-term, purposeful, bottom-line oriented, product of leadership, focused, strategic, flexible, and planned. Baum *et al.* (1998) highlight the importance of some attributes for an effective vision. These include: brevity, clarity, abstractness, challenge, future orientation, stability, and desirability or ability to inspire. Kantabutra and Avery (2007) also consider seven attributes of vision including brevity, clarity, challenge, stability, abstractness, future orientation, and desirability or ability to inspire.

In this paper, nine attributes have been selected for vision. These are:

(1) *Brevity*. Although some businesses offer very detailed visions (of the future), most business visions are limited to a short slogan, which states the ambition of the organization or company (Helm, 2009).

(2) *Clarity*. A vision statement should directly point at the prime goal it wants to achieve with a clearly indicated timeframe (Kantabutra and Avery, 2003, 2007).

(3) *Future orientation*. Organizations, through visioning, bridge their current situation to the desirable situation of the future (McGivern and Tvorik, 1998; Morden, 1997). Thus, a vision should focus on the long-term perspective of the organization and the environment in which it functions (Kantabutra, 2009).

(4) *Realistic*. A vision must be realistic about the market, competitive, economic, and regulatory conditions and reflect the values and aspirations of management, employees, and stakeholders. In uncertain and difficult times, visioning is vital to establish direction (Wilson, 1992). Visions have to go beyond the dreams we all foster for ourselves, our community, or for humanity as a whole, since there is an important difference between a dream and a vision (Helm, 2009).

(5) *Challenging*. By focusing attention on a meaningful vision, the leader operates on the emotional and spiritual resources of the organization, rather than on its physical resources (Dvir *et al.*, 2004). Kantabutra and Avery (2003) argue that

challenging a vision means the degree to which a vision statement motivates members to try their best to achieve a desirable outcome.

(6) *Ambitious*. Vision sets an ambitious target for the strategy at the highest organizational level (Kaplan *et al.*, 2008). It also creates a fundamental, ambitious sense of purpose, one to be pursued over many years (Kantabutra and Avery, 2010).

(7) *Provide a general sense of direction*. Vision is perceived as a direction for an organization and helps increase organizational success (Foster and Akdere, 2007). One of the most important underlying assumptions behind all visions is that a vision is needed in order (to help) to converge our actions into a desired direction (Helm, 2009).

(8) *Broad*. Vision must be comprehensive, touching all aspects of the business. An incomplete vision is likely to result in problems going unrecognized or unchallenged. Also, it must be inclusive, reaching both inside and outside the organization. A comprehensive, inclusive and dynamic vision can help lift an enterprise to a superior competitive position, avoiding in extremis the threat of corporate failure (Finkelstein *et al.*, 2008).

(9) *Motivating*. Vision statement defines an inspirational message to followers that expresses optimism about the future, confidence in achieving positive future challenges and opportunities, while highlighting the intrinsic needs that can be met and connecting this all to the core values of the organization (Sosik and Dinger, 2007).

3. Grey systems theory

GT was first proposed by Professor Julong Deng (1982) in order to cope with situations characterized by partially known and partially unknown information. Many kinds of systems, which exist in human society and nature, are classified into three types (white system, black system, and grey system). A system whose information is completely clear is called a white system. A system whose information is not clear at all is called a black system (a black box). And a system whose information is partly clear or partly unclear is called a grey system. In fact, incomplete information is the basic characteristic of the problems considered in grey systems theory (Lin *et al.*, 2004). These problems are of multi-attribute nature and the DMs' evaluation of the attributes would be subjective. In this paper, the aim of the grey systems theory is to rate quantitatively the desired visions in the presence of unknown and subjective evaluations.

A grey number, which is one of the inventions of GT, is "such a number whose exact value is unknown, but a range within which the value lies is known" (Lin *et al.*, 2004). The following are the three types of grey number:

(1) Grey numbers with only lower limits but not upper limits:

$$\otimes G \in [\underline{\alpha}, \infty) \rightarrow \otimes G(\underline{\alpha}) \tag{1}$$

where $\underline{\alpha}$, as a fixed real value, is the lower limit of the grey number $\otimes G$. One example is the weight of a tree while it is greater than zero.

(2) Grey numbers with only upper limits but not lower limits:

$$\otimes G \in [-\infty, \bar{\alpha}) \rightarrow \otimes G(\bar{\alpha}) \tag{2}$$

where $\bar{\alpha}$, as a fixed real value, is the upper limit of the grey number $\otimes G$. The maximum amount of the annual budget for a company is an example of the grey number with upper limit.

(3) Interval grey numbers:

$$\otimes G \in [\underline{\alpha}, \bar{\alpha}] \tag{3}$$

where $\underline{\alpha}$ and $\bar{\alpha}$ represent the lower and upper limits of the interval grey number, respectively.

Operations of interval grey numbers

The main operations of interval grey numbers are defined as follows:

- If $\otimes G_1 \in [a, b]$, $a < b$ and $\otimes G_2 \in [c, d]$, $c < d$, then the sum of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 + \otimes G_2 \in [a + c, b + d]. \tag{4}$$

- If $\otimes G_1 \in [a, b]$, $a < b$ and $\otimes G_2 \in [c, d]$, $c < d$, then the difference of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 - \otimes G_2 \in [a - d, b - c]. \tag{5}$$

- If $\otimes G_1 \in [a, b]$,$a < b$ and $\otimes G_2 \in [c, d]$, $c < d$, then the product of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 \cdot \otimes G_2 \in [\min\{ac, ad, bc, bd\}, \max\{ac, ad, bc, bd\}]. \tag{6}$$

- If $\otimes G_1 \in [a, b]$, $a < b$ and $\otimes G_2 \in [c, d]$, $c < d$, then the quotient of $\otimes G_1$ divided by $\otimes G_2$ is defined as:

$$\frac{\otimes G_1}{\otimes G_2} \in \left[\min\left\{\frac{a}{c}, \frac{a}{d}, \frac{b}{c}, \frac{b}{d}\right\}, \max\left\{\frac{a}{c}, \frac{a}{d}, \frac{b}{c}, \frac{b}{d}\right\}\right] \tag{7}$$

or:

$$\otimes G_1 \div \otimes G_2 \in [a, b] \times \left[\frac{1}{c}, \frac{1}{d}\right]$$

- If k is a positive real number, then the scalar multiplication of k and $\otimes$G is defined as:

$$k.\otimes \mathrm{G} \in [ka, kb] \tag{8}$$

Examples can be constructed to present that interval grey numbers cannot in general be canceled additively or multiplicatively. More specifically, the difference of any two grey numbers is generally not zero, except in the case that they are identical. The division of any two grey numbers is generally not 1, except in the case when they are identical (Lin and Liu, 2007).

- The length of grey number ⊗G is defined as:

$$\ell(\otimes G) = [b - a]. \quad (9)$$

Comparison of grey numbers

A degree of grey possibility (Li *et al.*, 2007) is used to compare the ranking of grey numbers. In order to calculate the possibility degree of $\otimes G_1 \leq \otimes G_2$ for two grey numbers $\otimes G_1 = [a, b]$ and $\otimes G_2 = [c, d]$, the following equation is expressed:

$$p\{\otimes G_1 \leq \otimes G_2\} = \frac{\max(0, \ell^* - \max(0, \mathrm{b} - \mathrm{c}))}{\ell^*} \quad (10)$$

where $\ell^* = \ell(\otimes G_1) + \ell(\otimes G_2)$.

For the position relationship between $\otimes G_1$ and $\otimes G_2$, there exist four possible cases on the real number axis. The relationship between $\otimes G_1$ and $\otimes G_2$ is determined as follows:

(1) If $a = c$ and $b = d$, it is said that $\otimes G_1$ is equal to $\otimes G_2$, denoted as $\otimes G_1 = \otimes G_2$. Then $P\{\otimes G_1 \leq \otimes G_2\} = 0.5$.

(2) If $c > b$, it is said that $\otimes G_2$ is larger than $\otimes G_1$, denoted as $\otimes G_2 > \otimes G_1$. Then $P\{\otimes G_1 \leq \otimes G_2\} = 1$.

(3) If $d < a$, it is said that $\otimes G_2$ is smaller than $\otimes G_1$, denoted as $\otimes G_2 < \otimes G_1$. Then $P\{\otimes G_1 \leq \otimes G_2\} = 0$.

(4) If there is an intercrossing part in them, when $P\{\otimes G_1 \leq \otimes G_2\} > 0.5$, it is said that $\otimes G_2$ is larger than $\otimes G_1$, denoted as $\otimes G_2 > \otimes G_1$. When $P\{\otimes G_1 \leq \otimes G_2\} < 0.5$, it is said that $\otimes G_2$ is smaller than $\otimes G_1$, denoted as $\otimes G_2 < \otimes G_1$.

4. The applied grey method

The approach used in this paper based on a grey possibility degree is adopted from Li *et al.* (2007) for supplier selection problem. According to Li *et al.* (2007) this approach is very suitable for solving the group decision-making problem in an uncertain environment. Assume that $V = \{V_1, V_2, \ldots, V_m\}$ is a discrete set of m possible vision alternatives. $Q = \{Q_1, Q_2, \ldots, Q_n\}$ is a set of n attributes of visions. The attributes are additively independent. $\otimes w = \{\otimes w_1, \otimes w_2, \ldots, \otimes w_n\}$ is the vector of attribute weights. The attribute weights and ratings of visions are considered as linguistic variables. These linguistic variables are expressed in grey numbers by the 1-7 scale (Table I). The attribute ratings ⊗G can also be expressed in grey numbers by the 1-7 scale (Table II). The remainder of this section presents the procedures in eight steps:

- *Step 1*. Ask a committee of DMs to identify the attribute weights of visions. Assume that this committee has k decision members, then the attribute weight of attribute Q_j can be calculated as:

$$\otimes w_j = \frac{1}{\mathrm{k}}\left[\otimes w_j^1 + \otimes w_j^2 + \cdots + \otimes w_j^k\right] \quad (11)$$

  where $\otimes w_j^k (j = 1, 2, \ldots, n)$ is the attribute weight of kth DMs and can be described by grey number $\otimes w_j^k \left[a_j^k, b_j^k\right]$.

- *Step 2*. Use linguistic variables for the ratings to make an attribute rating value. Then, the rating value can be calculated as:

$$\otimes G_{ij} = \frac{1}{k}\left[\otimes G_{ij}^{1} + \otimes G_{ij}^{2} + \cdots + \otimes G_{ij}^{k}\right] \quad (12)$$

where $\otimes G_{ij}^{k}(i = 1, 2, \ldots, m;\ f = 1, 2, \ldots, n)$ is the attribute rating value of kth DMs and can be described by grey number $\otimes G_{ij}^{k} = \left[\alpha_{ij}^{k}, \beta_{ij}^{k}\right]$.

- *Step 3*. Establish the grey decision matrix:

$$D = \begin{bmatrix} \otimes G_{11} & \otimes G_{12} & \cdots & \otimes G_{1n} \\ \otimes G_{21} & \otimes G_{22} & \cdots & \otimes G_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \otimes G_{m1} & \otimes G_{m2} & \cdots & \otimes G_{mn} \end{bmatrix} \quad (13)$$

where ⊗G are linguistic variables based on the grey number.

- *Step 4*. Normalize the grey decision matrix:

$$D^{*} = \begin{bmatrix} \otimes G_{11}^{*} & \otimes G_{12}^{*} & \cdots & \otimes G_{1n}^{*} \\ \otimes G_{21}^{*} & \otimes G_{22}^{*} & \cdots & \otimes G_{2n}^{*} \\ \vdots & \vdots & \ddots & \vdots \\ \otimes G_{m1}^{*} & \otimes G_{m2}^{*} & \cdots & \otimes G_{mn}^{*} \end{bmatrix} \quad (14)$$

Scale	$\otimes w$
Very low (VL)	[0.0. 0.1]
Low (L)	[0.1, 0.3]
Medium low (ML)	[0.3, 0.4]
Medium (M)	[0.4, 0.5]
Medium high (MH)	[0.5, 0.6]
High (H)	[0.6, 0.9]
Very high (VH)	[0.9, 1.0]

Table I. The scale of attribute weights $\otimes w$

Scale	⊗G
Very poor (VP)	[0, 1]
Poor (P)	[1, 3]
Medium poor (MP)	[3, 4]
Fair (F)	[4, 5]
Medium good (MG)	[5, 6]
Good (G)	[6, 9]
Very good (VG)	[9, 10]

Table II. The scale of attribute weights ⊗G where for a benefit attribute, $\otimes G_{\mathrm{ij}}^{*}$ is expressed as:

$$\otimes G_{ij}^{*} = \left[\frac{\alpha_{ij}}{G_j^{max}}, \frac{\beta_{ij}}{G_j^{max}}\right], \tag{15}$$

$$G_j^{max} = max_{1\le i\le m}\{\beta_{ij}\}$$

and for a cost attribute, $\otimes G_{\mathrm{ij}}^{*}$ is expressed as:

$$\otimes G_{\mathrm{ij}}^{*} = \left[\frac{G_j^{min}}{\beta_{\mathrm{ij}}}, \frac{G_j^{min}}{\alpha_{ij}}\right], \tag{16}$$

$$G_j^{min} = min_{1\le i\le m}\{\alpha_{\mathrm{ij}}\}.$$

The normalization method mentioned above is to preserve the property that the ranges of the normalized grey number belong to [0, 1].

- *Step 5*. Establish the weighted normalized grey decision matrix. Considering the different importance of each attribute, the weighted normalized grey decision matrix can be established as:

$$D^* = \begin{bmatrix} \otimes N_{11} & \otimes N_{12} & \cdots & \otimes N_{1n} \\ \otimes N_{21} & \otimes N_{22} & \cdots & \otimes N_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \otimes N_{m1} & \otimes N_{m2} & \cdots & \otimes N_{mn} \end{bmatrix} \tag{17}$$

where $\otimes N_{\mathrm{ij}} = \otimes G_{\mathrm{ij}}^{*} \times \otimes w_{\mathrm{j}}$.

- *Step 6*. Make the ideal alternative as a referential alternative. For m possible vision alternatives set $V = \{v_1, v_2, \ldots, v_m\}$, the ideal referential vision alternatives $V^{max} = \left\{\otimes G_1^{max}, \otimes G_2^{max}, \ldots, \otimes G_n^{max}\right\}$ can be obtained by:

$$\begin{aligned} V^{max} = \{&[max_{1\le i\le m}\alpha_{i1}, max_{1\le i\le m}\beta_{i1}], [max_{1\le i\le m}\alpha_{i2}, max_{1\le i\le m}\beta_{i2}], \ldots, \\ &[max_{1\le i\le m}\alpha_{in}, max_{1\le i\le m}\beta_{in}]\}. \end{aligned} \tag{18}$$

- *Step 7*. Calculate the grey possibility degree between compared visions alternatives set $S = V = \{v_1, v_2, \ldots, v_m\}$ and ideal referential vision alternative V^{max}:

$$P\{V_i \le V^{max}\} = \frac{1}{n}\sum_{j=1}^{n} P\left\{\otimes N_{ij} \le \otimes G_j^{\max}\right\}. \tag{19}$$

- *Step 8*. Rank the order of vision alternatives. When $P\{V_i \le V^{max}\}$ is smaller, the ranking order of v_i is better. Otherwise, the ranking order is worse.

According to the above procedures, the ranking order of all vision alternatives can be determined and the best from among a set of feasible visions can be selected.

5. Application

In this paper, five visions of five different 2008 top-ranked Asian universities have been selected to be evaluated and compared using GT approach. The ranking has been done by Times Higher Education which is the UK's most authoritative source of information about higher education. These universities are the first top-ranked universities in each of the Asian countries to make their vision available on their web sites. The universities and their visions have been presented in Table III.

These five visions $V_i (i = 1, 2, \ldots, 5)$ are selected as alternatives against seven attributes $Q_j (j = 1, 2, \ldots, 7)$. For all the attributes, the greater values are better. Figure 1 shows the selection structure. The calculation procedures are as follows:

- *Step 1*. Assess the weights of attributes $Q_1, Q_2, \ldots, Q_7$. To rank the visions, a committee of eight DMs, $D_1, D_2, \ldots, D_8$, has been formed to express their preferences. According to equation (11), the evaluation of attribute weights from

University	Country	Vision	Address
1. The University of Hong Kong	Hong Kong	The University of Hong Kong, as a pre-eminent international university in Asia, seeks to sustain and enhance its excellence as an institution of higher learning through outstanding teaching and world-class research so as to produce well-rounded graduates with lifelong abilities to provide leadership within the societies they serve	www.hku.hk/about/vision.html
2. National University of Singapore	Singapore	Towards a Global Knowledge Enterprise and a leading global university centred in Asia, influencing the future	www.nus.edu.sg/aboutus/vision.php
3. Tokyo Institute of Technology	Japan	Knowledgeable, skilled, ambitious, peace-minded and harmony-seeking scientific creators of the times	www.titech.ac.jp/english/about/activity/vision.html
4. Pohang University of Science and Technology	South Korea	POSTECH will pursue a university 1) to train and educate creative scientists and engineers with global leadership 2) to create economic value by conducting academically and industrially high impact research and 3) to develop into a world top 20 research-oriented university	www.postech.ac.kr/e/
5. University of Malaya	Malaysia	To be an internationally renowned institution of higher learning in research, innovation, publication and teaching	www.um.edu.my/discover_um/mission_vision.php?intPrefLangID = 1&

Table III.
The selected universities and their visions

four DMs are shown in Table IV. In order to remove the unnecessary attributes (attributes which are not important from the experts' point of view), those with lower limits less than 0.5 have not been taken into account in the calculation procedure. Therefore, two of the attributes, i.e. broadness and challenging, have been removed from the list.

- *Step 2*. Assess attribute-rating values for five vision alternatives. According to equation (12), the results are presented in Table V.
- *Step 3*. Establish the grey decision matrix of the visions (according to equation (13)).
- *Step 4*. Establish the grey normalized decision table based on equation (14) (Table VI).
- *Step 5*. Establish the grey weighted normalized decision table. According to equation (17), the grey weighted normalized decision matrix is shown in Table VII.
- *Step 6*. Obtain the ideal vision V^{max} a referential alternative. According to equation (18), the ideal vision V^{max} is shown as follows:

$$V^{max} = \{[0.46, 0.70], [0.54, 0.86], [0.61, 0.96], [0.41, 0.71], [0.54, 0.82], [0.69, 1], [0.68, 1]\}.$$

- *Step 7*. Calculate the grey possibility degree between the compared alternatives of five visions $V_i = (i = 1, 2, \ldots, 5)$ and the ideal referential vision alternative

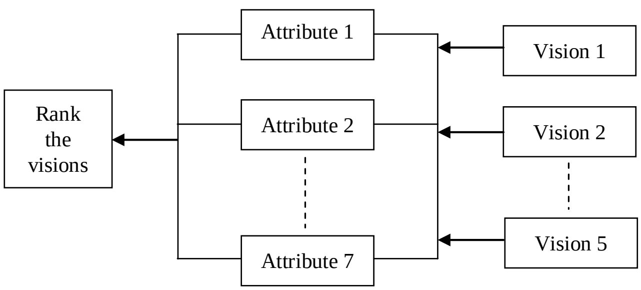

Figure 1.
The selection procedure of visions

Table IV.
Attribute weights for five visions

Q_j	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	$\otimes w_j$
Q_1	VH	M	M	MH	H	MH	VH	M	[0.57, 0.70]
Q_2	MH	H	M	VH	VH	H	VH	VH	[0.71, 0.86]
Q_3	VH	VH	H	VH	H	H	VH	VH	[0.78, 0.96]
Q_4	M	MH	MH	MH	MH	H	VH	H	[0.56, 0.71]
Q_5	ML	H	MH	MH	M	M	MH	MH	[0.46, 0.58]
Q_6	VH	H	MH	MH	MH	VH	VH	H	[0.67, 0.82]
Q_7	VH	VH	VH	VH	VH	VH	VH	VH	[0.90, 1.00]
Q_8	M	MH	MH	MH	MH	M	H	M	[0.47, 0.60]
Q_9	VH	VH	VH	VH	VH	VH	VH	VH	[0.90, 1.00]

V_i	Q_j	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	$\otimes G_{ij}$
V_1										
	Q_1	F	MP	F	G	F	P	P	MP	[3.25, 4.75]
	Q_2	MG	MG	MG	VG	MG	MG	F	F	[5.25, 6.25]
	Q_3	G	F	G	G	MG	MG	F	F	[5.00, 6.75]
	Q_4	F	F	F	MG	MG	MG	F	MG	[4.50, 5.50]
	Q_5	VG	G	F	G	G	F	F	MP	[5.25, 7.00]
	Q_6	MG	MG	MG	G	G	F	F	F	[4.87, 6.37]
	Q_7	MG	G	G	G	F	F	F	F	[4.87, 6.62]
V_2										
	Q_1	MG	G	MG	VG	G	F	MG	MG	[5.62, 7.12]
	Q_2	MP	MG	F	F	MP	MP	MP	F	[3.62, 4.62]
	Q_3	MG	F	F	G	F	MP	MP	MG	[4.25, 5.37]
	Q_4	MP	MG	F	MG	F	F	F	MG	[4.25, 5.25]
	Q_5	VG	G	MG	G	MG	MP	MG	F	[5.37, 6.87]
	Q_6	F	G	F	MG	F	MP	MP	F	[4.12, 5.37]
	Q_7	F	G	F	MG	MG	MP	MP	F	[4.25, 5.50]
V_a										
	Q_1	G	VG	G	VG	VG	MG	MG	MG	[6.75, 8.25]
	Q_2	F	G	F	G	F	F	MG	MG	[4.75, 6.25]
	Q_3	F	G	F	G	G	F	F	MG	[4.87, 6.62]
	Q_4	F	MG	F	G	MG	F	F	F	[4.50, 5.75]
	Q_5	VG	G	F	G	G	F	F	F	[5.37, 7.12]
	Q_6	F	G	MG	G	MG	F	F	F	[4.75, 6.25]
	Q_7	F	G	MG	MG	MG	F	F	MG	[4.75, 6.00]
V_4										
	Q_1	F	F	MG	G	G	MP	MP	MP	[4.25, 5.75]
	Q_2	G	G	MG	VG	G	MG	MG	MG	[5.87, 7.62]
	Q_3	MG	G	MG	VG	G	F	F	MG	[5.50, 7.00]
	Q_4	G	MG	G	G	MG	F	F	F	[5.00, 6.75]
	Q_5	MG	VG	MG	VG	G	F	F	F	[5.75, 7.00]
	Q_6	G	VG	G	VG	G	F	F	F	[6.00, 7.75]
	Q_7	MG	G	G	VG	G	F	F	MG	[5.62, 7.37]
V_5										
	Q_1	G	G	MG	VG	G	F	F	MP	[5.37, 7.12]
	Q_2	F	G	MP	G	F	MG	MP	MP	[4.25, 5.75]
	Q_3	MG	MG	F	G	MG	F	F	F	[4.62, 5.87]
	Q_4	F	F	F	G	MG	F	F	F	[4.37, 5.62]
	Q_5	MG	MG	MG	G	G	MP	F	MP	[4.62, 6.12]
	Q_6	F	F	F	G	MG	MG	F	F	[4.50, 5.75]
	Q_7	F	MG	F	G	G	MP	MP	F	[4.37, 5.87]

Table V. Attribute rating values for visions

V_i	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7
V_1	[0.40, 0.57]	[0.69, 0.82]	[0.71, 0.96]	[0.67, 0.81]	[0.73, 0.98]	[0.63, 0.82]	[0.66, 0.90]
V_2	[0.68, 0.86]	[0.47, 0.60]	[0.60, 0.76]	[0.63, 0.78]	[0.75, 0.96]	[0.53, 0.70]	[0.57, 0.74]
V_3	[0.81, 1.00]	[0.62, 0.82]	[0.70, 0.94]	[0.67, 0.85]	[0.75, 1.00]	[0.61, 0.80]	[0.64, 0.81]
V_4	[0.51, 0.70]	[0.77, 1.00]	[0.78, 1.00]	[0.74, 1.00]	[0.80, 0.98]	[0.77, 1.00]	[0.76, 1.00]
V_5	[0.65, 0.86]	[0.56, 0.75]	[0.66, 0.84]	[0.65, 0.84]	[0.65, 0.86]	[0.58, 0.74]	[0.59, 0.80]

Table VI. Grey normalized decision table

V^{max}. According to equation (19), the results are shown as follows:

$$P(V_1 \leq V^{max}) = 0.615,$$

$$P(V_2 \leq V^{max}) = 0.700,$$

$$P(V_3 \leq V^{max}) = 0.569,$$

$$P(V_4 \leq V^{max}) = 0.493,$$

$$P(V_5 \leq V^{max}) = 0.659.$$

- *Step 8*. Finally, rank the order of five visions $V_i = (i = 1, 2, \ldots, 5)$, as shown as follows:

$$V_4 > V_3 > V_1 > V_5 > V_2.$$

Based on the results, the vision of Pohang University of Science and Technology (POSTECH) is ranked as the best one. The vision of Tokyo Institute of Technology follows it and then, the visions of the University of Hong Kong, University of Malaya and National University of Singapore, respectively.

6. Conclusion

Vision is something mostly qualitatively dealt with in the literature. If vision statements are to guide strategy development, they must be not only aspirational and inspirational, they must also be measurable (Kaplan *et al.*, 2008). This paper proposed a grey-based approach to rate visions. It not only identifies a vision's rank against the attributes declared in the literature, but also makes it possible to rate and compare visions amongst each other. The main contribution of the grey approach for measuring visions is that it converts the uncertain judgments of DMs into quantitative expressions, which could not be possible through conventional MADM methods. The experimental results of this paper show that the proposed approach is reliable and reasonable.

Table VII. Grey weighted normalized decision table

V_i	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7
V_1	[0.23, 0.40]	[0.49, 0.70]	[0.56, 0.92]	[0.37, 0.57]	[0.49, 0.80]	[0.56, 0.82]	[0.59, 0.90]
V_2	[0.39, 0.60]	[0.33, 0.51]	[0.47, 0.73]	[0.35, 0.55]	[0.50, 0.79]	[0.47, 0.70]	[0.51, 0.74]
V_3	[0.46, 0.70]	[0.44, 0.70]	[0.55, 0.90]	[0.37, 0.60]	[0.50, 0.82]	[0.55, 0.80]	[0.57, 0.81]
V_4	[0.29, 0.49]	[0.54, 0.86]	[0.61, 0.96]	[0.41, 0.71]	[0.54, 0.80]	[0.69, 1.00]	[0.68, 1.00]
V_5	[0.37, 0.60]	[0.40, 0.64]	[0.52, 0.80]	[0.36, 0.60]	[0.43, 0.70]	[0.52, 0.74]	[0.53, 0.80]

References

Ache, P. (2000), "Vision and creativity: challenge for city regions", *Futures*, Vol. 32 No. 5, pp. 435-49.

Barnett, K. and McCormick, J. (2003), "Vision, relationships and teacher motivation: a case study", *Journal of Educational Administration*, Vol. 41 No. 1, pp. 55-73.

Baum, I.R., Locke, E.A. and Kirkpatrick, S.A. (1998), "A longitudinal study of the relation of vision and vision communication to venture growth in entrepreneurial firms", *Journal of Applied Psychology*, Vol. 83 No. 1, pp. 43-54.

Deng, J.L. (1982), "Control problems of grey systems", *Systems and Control Letters*, Vol. 1 No. 5, pp. 288-94.

Dvir, T., Kass, N. and Shamir, B. (2004), "The emotional bond: vision and organizational commitment among high-tech employees", *Journal of Organizational Change Management*, Vol. 17 No. 2, pp. 126-43.

Finkelstein, S., Harvey, C. and Lawton, T. (2008), "Vision by design: a reflexive approach to enterprise regeneration", *Journal of Business Strategy*, Vol. 29 No. 2, pp. 4-13.

Ford, J.D. and Pasmore, W.A. (2006), "Vision: friend or foe during change?", *The Journal of Applied Behavioral Science*, Vol. 42 No. 2, pp. 172-6.

Foster, R.D. and Akdere, M. (2007), "Effective organizational vision: implications for human resource development", *Journal of European Industrial Training*, Vol. 31 No. 2, pp. 100-11.

Helm, R.V. (2009), "The vision phenomenon: towards a theoretical underpinning of visions of the future and the process of envisioning", *Futures*, Vol. 41 No. 2, pp. 96-104.

Hsu, L.C. and Wang, C.H. (2009), "Forecasting integrated circuit output using multivariate grey model and grey relational analysis", *Expert Systems with Applications*, Vol. 36 No. 2, pp. 1403-9.

Kantabutra, S. (2009), "Toward a behavioral theory of vision in organizational settings", *Leadership and Organization Development Journal*, Vol. 30 No. 4, pp. 319-37.

Kantabutra, S. and Avery, G.C. (2003), "Enhancing SME performance through vision based leadership: an empirical study", *Proceedings of the 16th Annual Conference, 2003 Small Enterprise Association of Australia & New Zealand, Ballarat*.

Kantabutra, S. and Avery, G.C. (2007), "Vision effects in customer and staff satisfaction: an empirical investigation", *Leadership and Organization Development Journal*, Vol. 28 No. 3, pp. 209-29.

Kantabutra, S. and Avery, G.C. (2010), "The power of vision: statements that resonate", *Journal of Business Strategy*, Vol. 31 No. 1, pp. 37-45.

Kaplan, R.S., Norton, D.P. and Barrows, E.A. Jr (2008), *Developing the Strategy: Vision, Value Gaps, and Analysis*, Harvard Business School, Boston, MA, Article Reprint No. B0801A.

Kelly, D. (2000), "Using vision to improve organizational communication", *Leadership and Organization Development Journal*, Vol. 21 No. 2, pp. 92-101.

Kenny, T. (1994), "From vision to reality through values", *Management Development Review*, Vol. 3 No. 7, pp. 17-20.

Kung, C.Y. and Wen, K.L. (2007), "Applying grey relational analysis and grey decision making to evaluate the relationship between company attributes and its financial performance: a case study of venture capital enterprises in Taiwan", *Decision Support Systems*, Vol. 43 No. 3, pp. 842-52.

Larwood, L., Falbe, C.M., Kriger, M.P. and Miesing, P. (1995), "Structure and meaning of organizational vision", *Academy of Management Journal*, Vol. 38 No. 3, pp. 740-69.

Li, G.D., Yamaguchi, D. and Nagai, M. (2007), "A grey-based decision-making approach to the supplier selection problem", *Mathematical and Computer Modelling*, Vol. 46 Nos 3/4, pp. 573-81.

Li, Q.X. (2009), "Grey dynamic input-output analysis", *Journal of Mathematical Analysis and Applications*, Vol. 359 No. 2, pp. 514-26.

Lin, Y. and Liu, S. (2007), "National economic strength as evaluated using grey systems theory", *Kybernetes*, Vol. 36 No. 1, pp. 89-97.

Lin, Y., Chen, M. and Liu, S. (2004), "Theory of grey systems: capturing uncertainties of grey information", *Kybernetes*, Vol. 33 No. 2, pp. 196-218.

McGivern, M.H. and Tvorik, S.J. (1998), "Vision driven organizations: measurement techniques for group classification", *Management Decision*, Vol. 36 No. 4, pp. 241-64.

Morden, T. (1997), "Leadership as vision", *Management Decision*, Vol. 59 No. 9, pp. 668-76.

O'Brien, F. and Meadows, M. (2000), "Corporate visioning: a survey of UK practice", *Journal of the Operational Research Society*, Vol. 51 No. 1, pp. 36-44.

O'Brien, F. and Meadows, M. (2001), "How to develop visions: a literature review, and a revised CHOICES approach for an uncertain world", *Journal of Systemic Practice and Action Research*, Vol. 14 No. 4, pp. 495-515.

Price, W.H. (2001), "Vision and change: the relationship between vision statement and strategic change in organizations", Dissertation, Submitted to School of Business and Entrepreneurship Nova Southeastern University, Davie, FL.

Rahimnia, F., Castka, P. and Sharp, J.M. (2005), "Towards understanding the impeders of strategy implementation in higher education (HE): a case of HE institutes in Iran", *Quality Assurance in Education*, Vol. 13 No. 2, pp. 132-47.

Rahimnia, F., Polychronakis, Y. and Sharp, J.M. (2009), "A conceptual framework of impeders to strategy implementation from an exploratory case study in an Iranian university", *Education, Business and Society: Contemporary Middle Eastern Issues*, Vol. 2 No. 4, pp. 246-61.

Rampersad, H.K. (2001), "A visionary management model", *The TQM Magazine*, Vol. 13 No. 4, pp. 211-23.

Sosik, J.J. and Dinger, S.L. (2007), "Relationships between leadership style and vision content: the moderating role of need for social approval, self-monitoring, and need for social power", *The Leadership Quarterly*, Vol. 18 No. 2, pp. 134-53.

Wilson, I. (1992), "Realizing the power of strategic vision", *Long Range Planning*, Vol. 25 No. 5, pp. 18-28.

Zadeh, L.A. (1965), "Fuzzy sets", *Information and Control*, Vol. 8 No. 3, pp. 338-53.

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