Understanding visitors' perception of tourism risks with fuzzy means-end chain analysis

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Abstract

Visitors' risk perceptions have been found to influence the on-site behavior of tourists and their intention to return to a destination or to recommend it to others. This study discusses how the uses of a means-end approach with fuzzy conceptualization in eliciting the perception of tourism risks in a better understanding of the visitors' perceptual orientation toward the tourism values. We provide a hierarchy value map that fuses the attribute-consequence-value (A-C-V) and fuzzy linguistics to effectively and efficiently understand vacation risks and risk characteristics. Fuzzy logic is also adopted to deal with the ill-defined nature of the tourist linguistic judgments required in the proposed means-end chain. This research findings suggest that additionally to managing the most likely risks, tourist resorts should be prepared to cope with worst case scenarios such as "Thunderstorm", "Bus accident", "Food poisoning" and "Cable car accident". From an overall risk perceptive, tourists are most concerned with dominant perceptual orientation of risk delivers being "Bus accident" → "Decrease of trust in the safety management as a result of the event of damage" → "Anger".

Keywords: Risk perception, Fuzzy conceptualization, Tourist destinations

1. Introduction

Travel research provides ample evidence for the fact that the tourism experience is associated with risk (Bentley et al., 2001; Phillip & Hodgkinson, 1994; Roehl & Fesenmaier, 1992). Previous travel decision-making research have carefully examined the various effects on traveler's value (Pizam et al., 2002), their subjective judgments (Benítez et al., 2007), decision-making process (Kozak, 2001), travel awareness and distinction preferences (Chen & Tsai, 2007), and various attitudes in different travel situations (de Rojas & Camarero, 2008). A common finding in tourism literature is that the presence of risk, no matter if real or perceived, influences the travel decision-making process (Mawby, 2000; Pizam et al., 1997; Sönmez & Graefe, 1998a).

Reisinger and Mavondo (2005) define risk perception in a tourism context 'as what is perceived and experience by the tourists during the process of purchasing and consuming traveling services and at the destination'. According to Moutinho (2000), 'perceived risk is a function of uncertainty and its consequences' experienced during the purchase decision. In detail, travelers have to deal with (1) the uncertainty of the product itself, (2) uncertainty regarding the place and the mode of purchase, (3) a certain degree of psychological and financial consequences, and (4) subjective uncertainty on behalf of the tourist. However, the outcome of the consume decision on travel-related products only can be evaluated thoroughly after their purchase, which adds more risks and ambiguous factors in their decision-making. To some degree, travelers perceive that they cannot complete their tourism purchase process because of risk cognition (Sönmez & Graefe, 1998b).

Besides, there are many research programs have focused on offering risk types that are relevant in the context of pleasure travel (Cheron & Ritchie, 1982; Lepp & Gibson, 2003; Roehl & Fesenmaier, 1992; Sönmez & Graefe, 1998a), few have provided travel risk-specific guidelines for how to present the humans' cognitive differences in risk perception. That is, the inherently subjective concept of risk framework developed primarily as a tool to diagnose the tourists' risk perceptions and to understand tourists' cognitive behavior, but these have not considered with how tourists perceive the risk consequences produced by the travel risk attributes, and what personal risk values the risk consequences reinforce.

The main objective in this research was to study the impact of different the scenarios of tourism risk attributes on consequence of risk characteristics and their relative effects on the cognitive behavior of visitors with regard to their values of risks. To be more specific, we wanted to find out what scenarios of risk descriptors tourists used to differentiate different consequence of risk characteristics, and how these descriptors help tourists achieve desired risk values. Beside, the inherent vagueness or impreciseness of tourists' preference for the relative risk descriptors can also be examined. In this research, fuzzy sets (Yager & Zadeh, 1992), means-end theory (Gutman, 1982) were used to link the scenarios of risk attributes—the means—to the abstract risk values—the ends—through the examining the consequences that tourists perceived form the risk attributes.

2. Literature review

2.1. The organization of risk evaluation: a means-end chain approach

Researchers in cognitive psychology have long used the notion of cognitive schema to understand how knowledge about objects, actions and events is stored in an individual' memory (Bartlett, 1932; Mandler, 1979). A schema is a hierarchical cognitive structure that contains individual knowledge about a domain, the attributes that pertain to that particular domain and the set of relationships among these attributes (Mandler, 1979; Fiske & Taylor, 1991).

However, schemata functions are not limited to information processing. Researchers (D'Andrade, 1992; Taylor & Crocker, 1981) have suggested that schemata also possess a motivational force in the sense that they are able to activate sequences of actual behaviors or expectations toward sequences of behaviors. This idea has been applied in motivational research starting form the pioneering work of Gutman (1982). According to Gutman (1982), individuals attach specific meanings to the objects they buy and use such meanings to reach personal goals. The process involves a cognitive structure organized as a means-end chain that starts form the attributes of a product or a service and establishes a sequence of links with the perceived benefits provided by those attributes until personal values are reached.

Means-end chain theory proposed that individual knowledge is hierarchically organized, spanning different levels of abstraction. The means-end chain theory involves people's cognitive structures of decision behavior. A means-end chain model results from the linkages between cognitive attributes, consequences or benefits produced by the objective, and personal values. Individual may "know" situations in terms of the attributes they possess, the personal consequences of getting into the situations, and the personal values they experience. The more abstract levels of knowledge stand for the more concrete levels of knowledge or meaning (Reynolds & Gutman, 1988; De Boer & McCarthy, 2003). Thus, personal consequences are more germane to the self than cognitive attributes, and personal values are more germane to the self than personal consequences.

Based on Gutman's (1982) definition, there are three levels of abstraction in a means-end chain. They are: (1) attributes—the means; (2) consequences; (3) psychological personal values—the ends. Means-end theory treats attribute-consequence-value (A-C-V) as the basic content of individual knowledge stored in memory. Attributes are features or aspects of products, services or scenarios. They can be physical, such as color, or abstract, such as quality, risk. Consequences (functional or psychosocial) accrue to people from experiencing products, services or events. Rokeach (1973) defined values as "an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct". The chain is connections or linkages between attributes, consequences, and values. These linkages or associations have a hierarchical quality in that they connect concepts at a more concrete level of meaning to concepts at a more abstract level (Grunert et al., 2001).

In this study, cognitive attributes have been defined as any scenarios of tourism risks that can be found in a tourist resort. Consequences are abstract meanings that reflect the perceived merits or demerits when a tourist resort has those specific risk attributes. They may be "man-made" or "natural" in nature. Last personal values, which are the end states of a means-end chain, are "highly abstract meanings" that an individual gains while perceiving through the attributes, with given consequences (Hofstede, et al., 1998). This set of linkage is called a means-end chain because individual consider the tourist resort and its risk attributes as a means to an end. Risk attitudes with self-relevant consequences and values result in the desired end.

2.2. The fuzzy concept of risk perception

Tourism researchers with an interest in tourists' risk perceptions on the one hand aimed at the identification of those risk types that are relevant in the context of pleasure travel. Building on evidence of consumer behavior research, earlier studies (Cheron & Ritchie, 1982; Lepp & Gibson, 2003; Roehl & Fesenmaier, 1992; Sönmez & Graefe, 1998a) identified at least seven types of vacation risk: (1) equipment risk, (2) financial risk, (3) physical risk, (4) psychological risk, (5) satisfaction risk, (6) social risk, and (7) time risk. Based on these risk types, Fuchs and Peters (2005) defined risks and hazards of tourist destinations. According to them, risks such as avalanches, illness or long distances to health care services are amongst physical risks of destinations, while snow and weather conditions are seen to pose a satisfaction risk. Language barriers or hostile attitudes towards tourism on behalf of the residents are mentioned as psychological risks. Mobile technology and hygiene of the sports infrastructure (i.e. cleanliness of the toilet facilities) are cited as examples for functional or equipment risks (Eitzinger & Wiedemann, 2007).

On the other hand, previous research in the field of tourist risk perception sought to group or cluster travelers based on their risk perceptions as well as on various personal characteristics. Roehl and Fesenmaier (1992), for example, clustered tourists into different groups depending on which risks they perceive. Lepp and Gibson (2003) examined whether individual differences in the preference for novelty or familiarity allow for the explanation of differences in tourist risk perception. A number of studies provide further evidence for the fact that tourists can be grouped into novelty and familiarity seekers. Pearce (1985), for example, identified 15 types of international travelers based on the novelty－familiarity dimension. Similarly, Yiannakis and Gibson (1992), and more recently, Gibson and Yiannakis (2002) as well as Foo, McGuiggan and Yiannakis (2004), suggest that－based on the three dimensions (1) strangeness (novelty) vs. familiarity, (2) stimulating vs. tranquil, and (3) structure vs. independence－13 to 15 types of tourist roles differ in the degree to which they are characterized by these dimensions.

Besides the fact that tourism scholars analyse tourists' risk perceptions, risk perception research itself exists as an independent field of research. In psychological risk perception research, the term risk perception is used to describe intuitive judgments and attitudes toward risk, and thus goes beyond perception in a narrower sense (Slovic, 1992). In line with risk definitions in tourism research, risk perception is seen as an 'inherently subjective' concept (Slovic, 1987). It is argued that 'there is no such thing as "real risk" or "objective risk"' (Slovic, 1999). Each tourist has his or her own opinion about the meaning of the same subjective concept to risks. Thus, the risks judgments are highly subjective and this could be considered a lack of information in the objective sense (Lepp & Gibson, 2008). To represent the uncertainty and ambiguity arising in the assessment of the travel risk, the crisp results of the questionnaire are fuzzified by a fuzzy membership function, allowing varying degrees of memberships in a set.

In this paper, a further step has been provided respect to linguistic model. Selection of fuzzy logic as a means to represent a means-end chain methodology in the travel risk seems natural, in particular when we review Hisdal's (1988) proposition: "Fuzzy logic can handle inexact information and verbal variables in a mathematically well-defined way which simulates the processing of information in natural-language commutation."

3. Research methodoldogy

This research methodology is divided into two parts, part I: elicitation and laddering interview. part II: hierarchical value map.

3.1. Part I: elicitation and laddering interview

3.1.1. Elicitation

The first step in conducting a means-end approach research is to elicit choices from respondents in terms of different tourism risks. The main objective of elicitation is to dig deeper into tourists' decision-making process, and it is very important to identify the choices or alternatives that each tourist considers before making any decisions. For this project, these alternatives elicited have been used as scenarios of risks descriptors for the laddering process. There are five famous scenic areas in Taiwan (Sun Moon Lake, Yangmingshan, Taroko, Sitou, Alishan,) used as stimuli for the respondents to rank. These popular tourist resorts were chosen in a pilot study with tourists based on the popularity of these destinations with the aim of including all different kinds of attractions in different tourist resorts.

The elicitation could be divided into two phases. The first phase was "preference sorting" which followed the steps proposed by Bagozzi and Dabholkar (2000). Respondents were presented with the list of five tourist resorts and were asked to rank them in order of their awareness for the tourism risks. In order to prevent some respondents not knowing the tourist resorts, photos of the famous scenic spots were provided. Afterwards, they were asked to tell the reasons why they notice the first risk to the second, and then why they present the second to the third and so on.

The next phrase was to ask the respondents some open-ended questions. Olson and Reynolds (1983) stated that the use of open-ended questions can enable the researcher to gain insight about the proportion of each respondent's experience devoted to every tourist resort by asking: "Over the past year, what percentage of your experience would you say go to each tourist resort?" Having got the answers, the researcher elicited the respondents' choice criteria further by making comparisons: "When choosing between tourist resort A and resort B, what kinds of factors, in terms of tourism risks, do you consider?" After all the meaningful answers had been collected, they were content analyzed into a comprehensive list of the elicited distinctions and tourism risk attributes with any duplicate constructs eliminated. The scenarios of risk attributes were made bi-polar for the laddering interviews.

3.1.2. Laddering interview

Laddering is an in-depth, one-on-one interviewing technique used to help understand the ways tourist link the scenarios of tourism risk attributes to the perceived consequence of risk characteristics and also help link the attributes to self-personal risk values as indicated by the means-end theory. It also implies using the presence of lower-level answers to present the higher-level answers, so that linkages of attributes, consequences and values shall be discovered. The rationale behind this was to make respondents think critically about how the scenarios of tourism risk attributes aroused his/her personal risk values.

To do the laddering interview, the 40 respondents were presented with the list of the scenarios of tourism risk attributes. Below, the scenario for the risk *cable car accident is cited* exemplarily.

Cable car accident

> Just before dusk yesterday evening, the last cable car took 20 skiers on its last journey of the day up to the height of 2200m above sea-level. After 200m, the cable car suddenly crashed down into the gorge below and landed on a stream bed. Three people were killed and 17 were injured, several of them seriously.

Since damage scenarios describe a potential and not an actual harm, it is still risk perception and not damage perception that is analyzed. However, by the use of damage scenarios, we are focusing on one core element of risk, namely the potential harm and its evaluation by the participants. Afterwards, the respondents were asked to identify one distinction that they perceived the most, which was intended to be happened as the basis for asking interviewing questions in the laddering process. Primarily a line of "Why is that important influence to you?", "Why is that?" and "Why do you think so?" questions were asked continuously until respondents could no longer answer any "why" questions. These questions served to discover chains of attributes, consequences and values.

The content analysis attempted to analyze all elements elicited by the laddering procedures. It started by recording the entire set of ladders across all respondents on a separate coding form. The next step was to classify all responses into A-C-V levels, resulting in a summary content codes table. Initially 30 summary codes (Table 1) were classified so as to include every ladder mentioned by the respondents.

Table 1 The summary codes extracted form content analysis of respondents' ladders

The scenarios of tourism risk attributes	**Consequence of risk characteristics**	**Risk values**
A_1: Cable car accident	B_1: Dreadfulness of the event of damage	V_1: Grief
A_2: Derailing of a train	B_2: Memorability of the event of damage	V_2: Anger
A_3: Avalanche	B_3: Perceived media interest evoked by the event of damage	V_3: Fear
A_4: Bus accident	B_4: Search for perpetrators evoked by the event of damage	V_4: Sadness
A_5: Thunderstorm	B_5: Decrease of trust in the safety management as a result of the event of damage	V_5: Displeasure
A_6: Mass movement	B_6: Perceived economic consequences for the destination	V_6: Melancholy
A_7: Food poisoning	B_7: Negative impact on destination image	V_7: Hatred
A_8: Terrorist attack	B_8: Fears induced through the event of damage	
A_9: Fire in the hotel	B_9: Perceived crisis potential	
A_{10}: Electrical power outage		
A_{11}: Plan crash		
A_{12}: Rock fall on a village		
A_{13}: Potable water poisoning		
A_{14}: Breaking of an embankment dam		

To make the data extracted from the laddering interviewing process reliable and accurate, it followed the suggestions made by Bagozzi and Dabholkar (2000), "Care was taken to create a suitable interviewing environment in which respondents were sufficiently relaxed to be introspective and to relate their underlying motivations to the interviewer". Before starting the interview with the respondents, each of them was ascertained that "there are no right or wrong answers and the purposed of the exercise was to understand the way they saw different kinds of attributes".

3.2. Part II: hierarchical value map

3.2.1. Mathematical foundations of fuzzy set theory

Most of the mathematical tools for formal modeling, reasoning, and computing are crisp, deterministic, and precise in characteristic description. Precision assumes that the parameters of a model represent exactly either our perception of the phenomenon modeled or the features of the real system that has been modeled. However, tourist perception is an extremely complex process which involves certain degrees of uncertainty, imprecision or vagueness. Fuzzy sets are a generalization of crisp sets for representing imprecision or vagueness in everyday life, which were first introduced by Zadeh (1965). A fuzzy set can be defined mathematically by assigning a value to each possible individual in the universe of discourse for representing its grade of membership in the fuzzy set. This grade corresponds to the degree to which that individual is similar or compatible with the concept represented by the fuzzy set.

Fuzzy set theory is regarded as a powerful mathematical tool and has been widely used in present research fields, not only in science and engineering (Srino, et al., 2006; Lau et al., 2008) but in social and behavioral areas as well (Hsiao & Chou, 2006; Aluclu, et al., 2008). Taking the readability of this article into consideration for all journal readers, we elaborate the theoretical details on the definitions and mathematical operations of fuzzy set theory in Appendix A.

3.2.2. Calculating fuzzy association matrices

The summary content codes served for constructing AC (Attributes－Consequence) and CV (Consequence－Values) fuzzy association matrices. In the first, the attributes were listed in the columns and the consequences in the rows, resulting in a table of all combinations of attributes and consequences. Each column also contained an importance factor that allowed respondents to indicate the fuzzy perceived fatality of each attribute, with 9-point linguistic rating scale, ranging from *VU* (*Very Unfatal*) to *VF* (*Very Fatal*). The fuzzy scale is in Fig. 1.

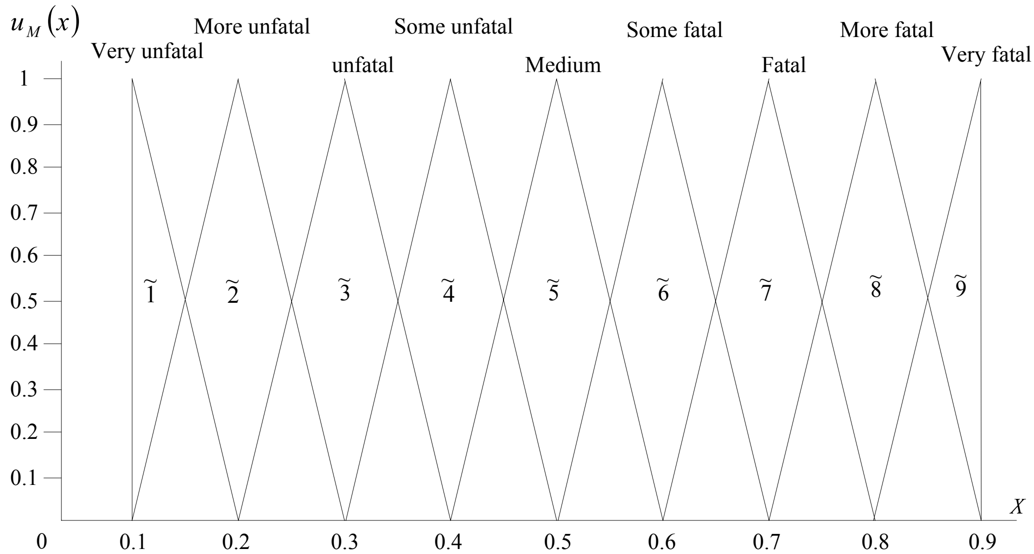

Fig. 1. Fuzzy sets form of the linguistic importance terms.

Suppose that q responders have been responded the A_i scenarios of tourism risk attributes and give fuzzy importance rating $\widetilde{a}_{iq}=(l_{iq}, m_{iq}, u_{iq})$, where l_{iq} refers to the lower limited values of fuzzy numbers on the *qth* responder evaluating the *ith* scenarios of tourism risk attributes. m_{iq}, u_{iq}, respectively, refers to the medium limited values and upper limited values of fuzzy numbers. By equation (1), we average these sets of importance ratings on A_j scenarios of tourism risk attributes $\widetilde{A}_i$,

$$\begin{aligned}\widetilde{A}_i &= \frac{1}{n}\sum_{q=1}^{n}\widetilde{a}_{iq} \\ &= \frac{1}{n}\left(\sum_{q=1}^{n} l_{iq},\ \sum_{q=1}^{n} m_{iq},\ \sum_{q=1}^{n} u_{iq}\right), \qquad i = 1,\ 2, \ldots, n.\end{aligned} \tag{1}$$

The position $\widetilde{R}_{ij}$ in the association weight matrix expresses the fuzzy relationship between the jth *consequence* with the ith *attribute*. The average fuzzy association rating $R\widetilde{I}_{ij}$ can be calculated applying equation (2).

$$R\widetilde{I}_{ij} = \frac{1}{n}\sum_{q=1}^{n}\widetilde{R}_{ij}, \qquad i = 1,\ 2, \ldots, n; \quad j = 1, 2, \ldots, m. \tag{2}$$

The process of constructing aggregate fuzzy association weight matrices was started by asking respondents to fill out a questionnaire that contained the AC and CV association matrices. Each respondent went through each column of the association matrices to indicate the linguistic association strengths, using linguistics ranging from strongly associated, more associated, some associated, not associated and symbols have been translated into fuzzy numbers, as shown in Table 2. The AC fuzzy association matrix included in the questionnaire is partially depicted in Fig. 2.

Table 2 Degree of association, graphic symbols and corresponding fuzzy numbers

Degree of association	Graphic symbol	Fuzzy number
Strongly associated	●	(0.7,0.8,0.9)
More associated	○	(0.5,0.6,0.7)
Some associated	□	(0.3,0.4,0.5)
Not associated	■	(0.1,0.2,0.3)

The scenarios of risk attributes

Consequences

	(0.5,0.6,0.7) Cable car accident	(0.2,0.3,0.4) Derailing of a train	. . .	(0.3,0.4,0.5) Food poisoning	(0.5,0.6,0.7) Terrorist attack
Dreadfulness of the event of damage	(0.7,0.8,0.9)	(0.5,0.6,0.7)		(0.5,0.6,0.7)	(0.3,0.4,0.5)
⋮					
Negative impact on destination image	(0.5,0.6,0.7)	(0.1,0.2,0.3)		(0.3,0.4,0.5)	(0.7,0.8,0.9)
Perceived crisis potential	(0.5,0.6,0.7)	(0.3,0.4,0.5)		(0.3,0.4,0.5)	(0.1,0.2,0.3)

Fig. 2. Part of the attribute-consequence fuzzy association matrix with importance factor.

As can be seen from the Fig. 2, attributes A_i, i=1, 2, 3,…, n affecting risk characteristics perception of consequences C_j, j=1, 2,…, m. Once the tourism risk attribute has been assed, viable consequences the tour operator can undertake in the tourism field to improve risk image have to be identified and ranked in terms of both effectiveness and efficiency. Those consequecnes of risk characteristics correspond to "hows" in the proposed tourism risk hierarchical value map.

3.2.3. Calculating the fuzzy importance weight of values and chains

In order to complete the assessment of attribute-consequece-value, the importance weight of values and chains should be considered. In this situation, fuzzy logic becomes a fundamental tool in dealing with ill-defined issues such as the evaluation of values. While responders may find objective difficulties in quantitatively assessing the values of tourism risk, he / she can more easily give a judgement on a linguistic scale, ranging for instance from *Very High* to *Very Low*. This is why a fuzzy parameter $\widetilde{V}_k$ has been added to consider the evaluating the importance weight of kth value. The equation (3) for calculating the fuzzy importanc weight of a value element is

$$\widetilde{V}_k = \sum_{j=1} \left(\sum_{i=1} \widetilde{RI}_{ij} \widetilde{A}_i \right) \cdot \widetilde{RI}_{jk} \qquad (3)$$

where $\widetilde{V}_k$ is the fuzzy importance weight of value element k; $\widetilde{A}_i$ the fuzzy importance weight of attribute element i; $\widetilde{RI}_{ij}$ the fuzzy association weight between the attribute element i and the consequence element j; and $\widetilde{RI}_{jk}$ the fuzzy association weight between the consequence element j and the value element k.

The equation (4) for calculating the fuzzy importance weight of a chain is

$$\widetilde{P}_{ijk} = \widetilde{A}_i(\widetilde{RI}_{ij} + \widetilde{RI}_{jk}) \quad (4)$$

where $\widetilde{P}_{ijk}$ is the fuzzy importance weight of the chain that connected attribute element *i*, consequence element *j* and value element *k*.

Suppose that the fuzzy number, $\widetilde{V}_k$, $\widetilde{P}_{ijk}$, can be normalized by diveded its upper bounds which means the fuzzy most marginal benefit, and furthermore, transform the normalized fuzzy number into the defuzzification and crisp number V_k, P_{ijk} by equation (5) (Vanegas & Labib, 2001):

$$\frac{FN_{\alpha} + 2 \cdot FN_{\beta} + FN_{\gamma}}{4} \quad (5)$$

These numbers are represented by triplets of the type $FN = (FN_{\alpha}, FN_{\beta}, FN_{\gamma})$, where FN_{α} and FN_{γ} are respectively the lower and upper limits of the fuzzy number considered, while FN_{β} is the element that denotes the closest fit.

4. Data analysis

In this paper, the means-end chain of fuzzy methodology developed is applied to a tourism industry. For part I, elicitation, 40 silver hair tourists and visitors aged 45-67 were interviewed individually, each for about 35-40 minutes. For part II, constructing hierarchical value map, a sample size of 40 tourists, half of whom were female and half male, were selected and each interview lasted fo about 20-30 minutes. Data collecting procedure consisted of two major activities: focus groups and survey. Analysis of the group discussion contents came form a set of attributes, consequences, and values, which served as the basis for developing the attribute-consequecne (AC) and consequence-value (CV) association matrix quesitonnaires. These codes were further aggregated into 21 master codes containing 10 attributes, 6 consequences and 5 values in order to show meaningful linkages.

The survey questionnaires were administered to subjects 3 months later to assess their opionion of the attributes, consequesces, and values. The sample population included subjects form different occupations and education levels so as to provide a broad spctrum of responses.

Care was taken in order to use appropriate wordings and atmosphere while conducting the interviews. The groups of respondednts were selected because the target respondents whithin this silver hair age group have the most powerful purchasing power and are the main patrons of Taiwan tourist business (Tourism Bureau, 2009). Moreover, based on the report by the Census and Statistiecs Department, this group or segment accounts for one third of the total population in Taiwan. Therefore, they are a large market in the tourism industry.

5. Results and discussion

5.1. Attributes

We used the data to construct aggregate AC and CV fuzzy association weight matrices (Table 3 and Table 4). The fuzzy association weight was calculated by equation (2), whereas the average association rating was calculated by adding all tourists' rating for each cell in the association matrices and dividing by the number of tourists. The algorithm for calculating fuzzy importance weight through equation (1) was the same as that of calculating fuzzy association weight.

The hierarchy value map in Fig. 3 consisted of all risk attributes, consequences, and values with the tourism sites. The 10 attributes being used in the hierarchy value map are very concrete in nature, and are all extracted from the summary risk elements table, such as "Cable car accident", "Derailing of a train", "Bus accident" and "Thunderstorm" etc. These elements are used to describe the scenarios of risk attributes that directly affected tourists' perception to consequences (such as Dreadfulness of the event of damage, Memorability of the event of damage,…) and risk values (such as Anger, Fear,…) in the tourism sites.

Table 3 The attribute-consequence fuzzy association weight matrix

Fuzzy importance factor weight / Fuzzy association weight		**Tourism risk attributes**									
		Cable car accident	Derailing of a train	Bus accident	Thunderstorm	Mass movement	Food poisoning	Terrorist attack	Fire in the hotel	Electrical power outage	Rock fall on a village
		(0.58,0.67,0.79)	(0.62,0.71,0.83)	(0.74,0.83,0.91)	(0.82,0.91,0.97)	(0.42,0.55,0.64)	(0.41,0.53,0.66)	(0.53,0.68,0.77)	(0.34,0.45,0.58)	(0.41,0.52,0.69)	(0.66,0.75,0.88)
Consequences	Dreadfulness of the event of damage	(0.77,0.85,0.97)	(0.11,0.23,0.34)	(0.12,0.23,0.34)	(0.58,0.69,0.75)	(0.74,0.89,0.96)	(0.56,0.69,0.76)	(0.72,0.81,0.91)	(0.15,0.26,0.38)	(0.17,0.28,0.33)	(0.33,0.45,0.51)
	Memorability of the event of damage	(0.31,0.42,0.52)	(0.54,0.65,0.78)	(0.54,0.65,0.76)	(0.16,0.27,0.39)	(0.57,0.64,0.76)	(0.55,0.67,0.79)	(0.35,0.47,0.56)	(0.76,0.86,0.94)	(0.35,0.47,0.52)	(0.34,0.46,0.55)
	Decrease of trust in the safety management as a result of the event of damage	(0.33,0.45,0.58)	(0.52,0.65,0.77)	(0.77,0.89,0.95)	(0.55,0.67,0.77)	(0.37,0.49,0.53)	(0.33,0.42,0.51)	(0.53,0.67,0.75)	(0.36,0.47,0.59)	(0.11,0.23,0.35)	(0.56,0.65,0.73)
	Negative impact on destination image	(0.52,0.64,0.76)	(0.32,0.41,0.57)	(0.54,0.65,0.77)	(0.54,0.66,0.79)	(0.53,0.64,0.77)	(0.71,0.84,0.95)	(0.52,0.65,0.76)	(0.14,0.26,0.36)	(0.16,0.27,0.36)	(0.72,0.84,0.90)
	Fears induced through the event of damage	(0.36,0.46,0.58)	(0.33,0.46,0.59)	(0.33,0.46,0.58)	(0.33,0.47,0.59)	(0.32,0.44,0.57)	(0.54,0.66,0.72)	(0.76,0.86,0.96)	(0.56,0.68,0.70)	(0.14,0.26,0.38)	(0.33,0.47,0.58)
	Perceived crisis potential	(0.72,0.81,0.91)	(0.30,0.44,0.57)	(0.55,0.67,0.71)	(0. 32,0.47,0.58)	(0.57,0.64,0.73)	(0.53,0.66,0.78)	(0.36,0.45,0.52)	(0.53,0.65,0.79)	(0.39,0.46,0.57)	(0.56,0.64,0.75)

Table 4 The consequence-value fuzzy association weight matrix

Risk values	Consequences					
	Dreadfulness of the event of damage	Memorability of the event of damage	Decrease of trust in the safety management as a result of the event of damage	Negative impact on destination image	Fears induced through the event of damage	Perceived crisis potential
Grief	(0.72,0.84 ,0.96)	(0.73,0.85 ,0.92)	(0.17,0.24 ,0.36)	(0.56,0.64 ,0.78)	(0.15,0.27 ,0.39)	(0.74,0.86 ,0.97)
Anger	(0.35,0.46 ,0.52)	(0.34,0.45 ,0.57)	(0.53,0.64 ,0.72)	(0.38,0.49 ,0.56)	(0.37,0.44 ,0.56)	(0.36,0.45 ,0.56)
Fear	(0.51,0.67 ,0.78)	(0.55,0.68 ,0.79)	(0.15,0.27 ,0.38)	(0.75,0.83 ,0.92)	(0.36,0.47 ,0.59)	(0.54,0.65 ,0.76)
Displeasure	(0.38,0.47 ,0.56)	(0.35,0.42 ,0.54)	(0.39,0.47 ,0.54)	(0.34,0.45 ,0.57)	(0.74,0.85 ,0.96)	(0.38,0.47 ,0.55)
Melancholy	(0.33,0.45 ,0.52)	(0.35,0.46 ,0.58)	(0.76,0.87 ,0.95)	(0.78,0.87 ,0.95)	(0.55,0.62 ,0.73)	(0.17,0.24 ,0.35)

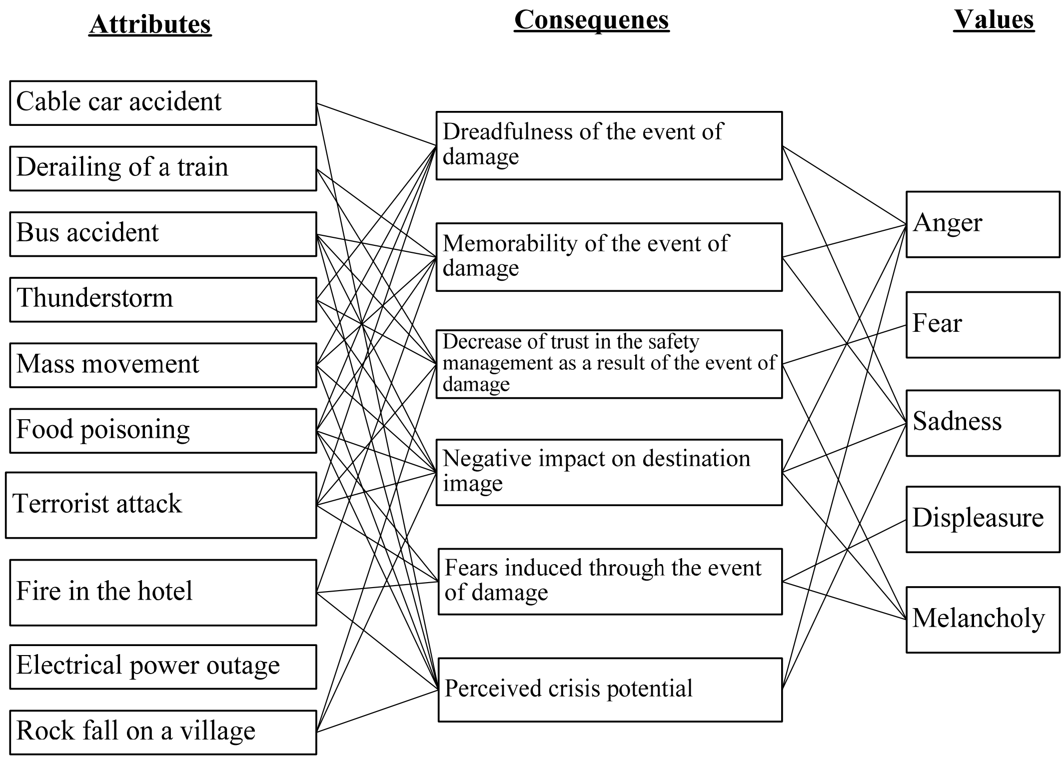

Fig. 3. The hierarchy risk value map in tourists' perception to the tourism resort.

5.2. Consequences

One distinction of the means-end chain was to see how risk attributes affect tourists' choice criteria and to relate the relative criteria to tourists' personal relevance, which was named as consequences and risk values. In this study, 6 consequences were found, "Dreadfulness of the event of damage", and "Fears induced through the event of damage", were feelings aroused during traveling at the tourist resorts; "Negative impact on destination image", and "Memorability of the event of damage" were more related to tourists' self image after purchasing the travel products; others, such as "Perceived crisis potential", and "Decrease of trust in the safety management as a result of the event of damage", were mainly concerned with psychology risks. Within the data, "Negative impact on destination image", and "Memorability of the event of damage" were the dominating consequences.

5.3. Values

5 risk values were finally be used in the hierarchy value map, with the largest proportion devoted to "Melancholy", and the second largest to "Fear". These were followed by "Anger", "Grief" and "Displeasure". The most fatal risk value was Melancholy with using the sample system, since its defuzzied importance weight (V_6=4.52) through equation (5) was the highest (Table 5). These findings are also similar to those of previous researchers including Sönmez and Graefe (1998a), del Bosque (2008), that risk values such as "Melancholy" and "Fear" were the most fatal risk values to tourism visitors.

Table 5 Defuzzied importance weights of all chains and risk value elements

Chain	Weight	Chain	Weight	Value	Weight
$P_{1.1.1}$	1.97	$P_{7.7.2}$	3.34	V_1	2.43
$P_{1.5.1}$	1.91	$P_{7.9.5}$	1.78	V_2	3.67
$P_{2.2.2}$	1.04	$P_{12.8.3}$	1.88	V_3	4.06
$P_{2.5.2}$	1.17	$P_{12.9.6}$	1.61	V_5	1.71
$P_{4.8.3}$	1.63			V_6	4.52
$P_{4.5.2}$	3.89				
$P_{5.9.6}$	3.13				

5.4. Constructing hierarchy value map

To construct the hierarchy value map with a reduced data display and perceptual orientations, we chose a higher cutoff level for the fuzzy importance weights of the attributes to screen out less important attributes, their associated consequences and values, and the linkage among them. The hierarchy value map in Fig. 4 consisted of attributes with fuzzy importance weights above the chosen cutoff fuzzy value, (0.5, 0.6, 0.7). An attribute with fuzzy importance weight above the cutoff value meant that the attribute was important. Then, the hierarchical value map in Fig. 4 was gradually built up by connecting all the chains that were formed by selecting the linkages whose fuzzy association weights were above the chosen cutoff fuzzy value of (0.7, 0.8, 0.9). A linkage whose association weight was above the cutoff fuzzy value had a strong association.

After constructing the hierarchy value map, the relative responses of tourists aroused by the five risk attributes, how these attributes directly affected the tourists' perceptions of the tourist resort, and finally, the ultimate feelings and values that tourists attained through the five scenarios of risk elements were shown. The dominant perceptual orientation was Bus accident → Decrease of trust in the safety management as a result of the event of damage → Anger since its defuzzied importance weight P_{ijk} was the highest (see Table 5). Other important perceptual orientations included Food poisoning → Negative impact on destination image → Anger; Thunderstorm → Perceived crisis potential → Melancholy; Cable car accident → Decrease of trust in the safety management as a result of the event of damage → Grief. The hierarchy value maps implied that, for a tourism risk management, subjects were most concerned with being "Anger" from an overall perspective, while they were aware of the importance of "Melancholy" and "Grief".

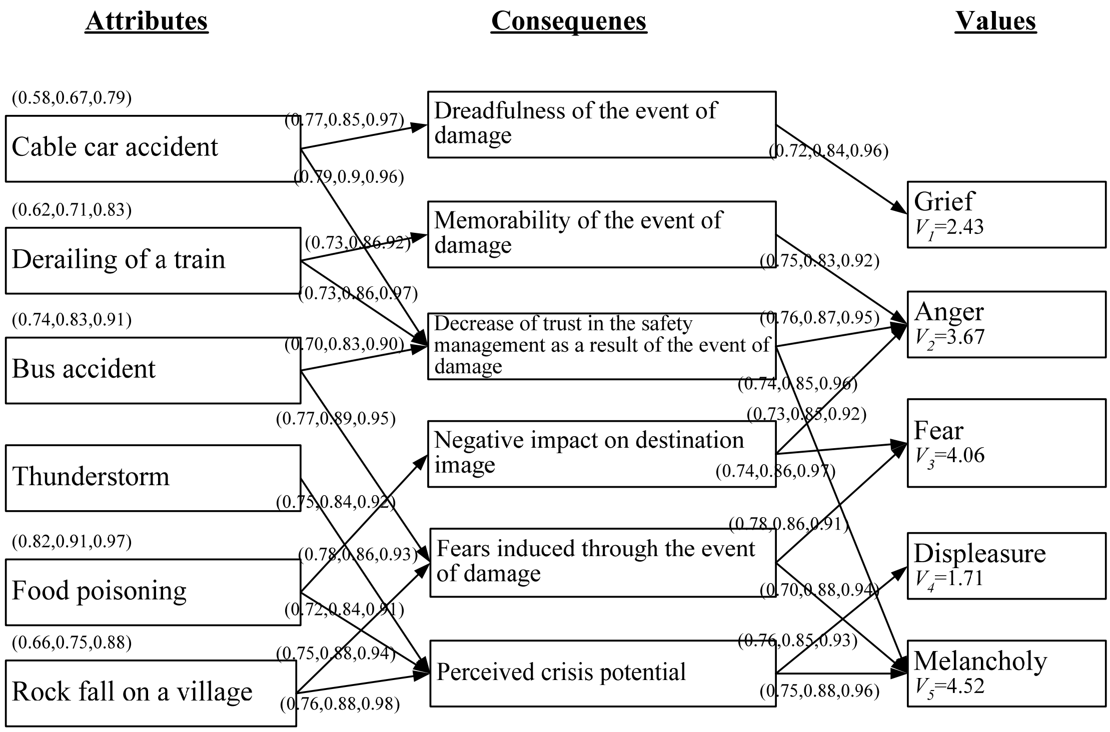

Fig. 4. The hierarchy risk value map with cutoff fuzzy value for fuzzy importance weight and fuzzy association weights.

5.5. The means-end chain delivers in the tourism risk

It is very useful to note some distinctive an dominant chains, which include Bus accident — Decrease of trust — Anger, Food poisoning — Negative image — Anger, Thunderstorm — Perceived crisis potential — Melancholy and Cable car accident — Decrease of trust — Grief. This shows (Fig. 5) how tourists achieve the risky end-states by the relative attributes. It also means that tourists perceived tourism sites that “Bus accident”, “Food poisoning”, “Thunderstorm” and “Cable car accident” as scenarios of risk elements, and that made them “Decrease of trust”, “Negative image”, as a result, there would be a “Perceived crisis potential” for risk perception in the tourism sites and finally, the tourists would feel either “Anger”, “Melancholy” or “Grief” to that travel.

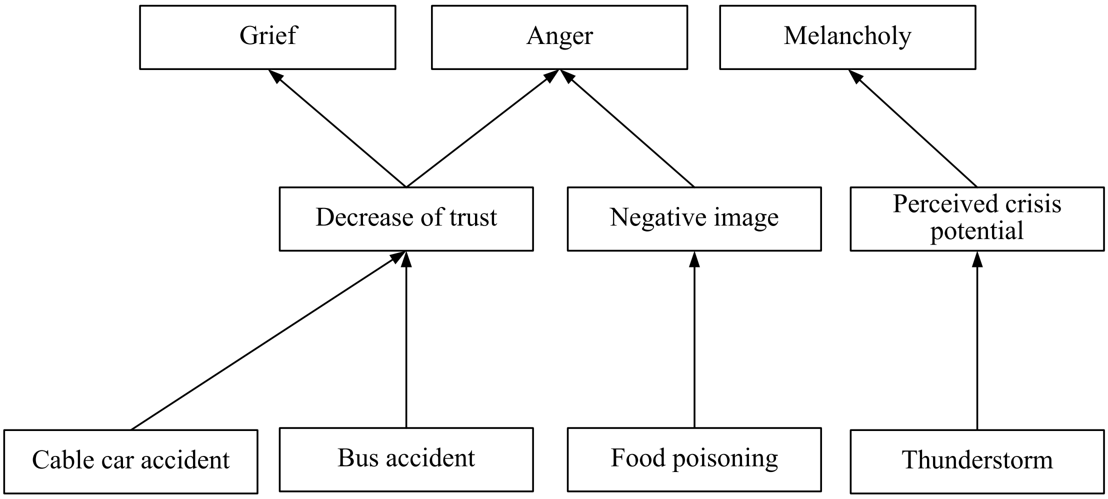

Fig. 5. Dominant means-end chain in tourism risk perceptions.

There are 10 scenarios of tourism risk elements (attributes) elicited from the elicitation process by the 40 subjects, we shall see that these risk attributes were in line with the definition of Sjöberg et al. (2004), in which they stated that risk display should include two risk extracted factors: *event-related appraisals*, *consequences of event-related appraisal on a destination level*. In this study, we depict the location of 10 scenarios of risk attributes on the two extracted factors. Fig. 6 demonstrates that the scenarios “Bus accident”, “Terrorist attack”, “Derailing of a train” and “Cable car accident” receive the highest scores on the *event-related appraisals* factor. On the factor *consequences of event-related appraisals on a destination level*, the scenario “Food poisoning”, “Mass movement”, “Electrical power outage”, “Rock fall on a village” and “Fire in the hotel” receive the highest factor scores. Risk scenarios that score high on both, the *event-related appraisals* factor and the *consequences of event-related appraisals on a destination level* factor, are those located in the upper right quadrant, namely “Thunderstorm”, “Bus accident”, “Food poisoning” and “Cable car accident”.

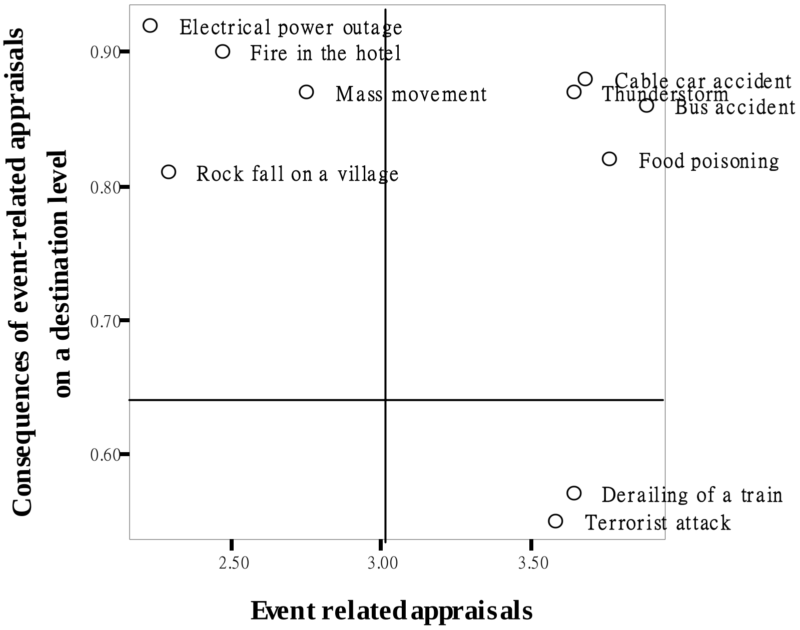

Fig. 6. Location of the scenarios of tourism risk attributes.

6. Conclusion

Thomas and Thomas (1928), two famous American sociologists of the last century, have stressed the power of perception in what is now known as Thomas-Theorem. It says "If men define situations as real, they are real in their consequences". This corner pillar of modern sociology should be acknowledged in risk management as well as in tourist management, because "What is social today, is political tomorrow and economic in costs and consequences the day after" (Coates et al., 1986). Transferred to our context, it means: risk perception creates reality, sometimes troublesome reality that will trigger reputation damages and economic losses.

Tourism risk managers, in their daily practice, seem still to restrict themselves to the identification and management of so-called factual risks that are measured by likelihood and severity of harm. Of course, likelihood and severity of harm are important risk characteristics, but in addition, perceived risks should be taken into account too. It is worth considering that perceived risks research offers reliable methods and plenty of insights that are useful for scanning, indexing and prioritizing risks for proactive risk management. In particular, risk perception research allows identifying those risks that evoke public outage before and in case of a loss-incurring event (Sunstein, 2003).

This research applies the psychometric paradigm to the analysis of travel risk perception. This approach allows the identification of those risks within the tourist destination that are supposed to evoke public outrage in an event of damage. Methodologically, the current study overcomes some of the critiques on previous risk perception studies (Sjöberg, Moen & Rundmo, 2004), in so far as risk items in our questionnaire were not presented by a single key phrase but in the form of a richer scenario description. Since all the information relevant for the risk judgments is provided within these scenario descriptions, it seems reasonable to conclude that all risk judgments are based on the same information. As consequence, we assume the risk judgments to better be comparable with each other than when risks are just presented in note form.

Besides, the applicability of the means-end chain theory with fuzzy conceptualization has been addressed. The proposed methodology developed could be rightly considered as a useful tool for selecting the efficient and effective A-C-V leverages to reach tourist risk perceptions. In particular, the methodology allows the identification of attributes that are perceived to affect risk values from the tourists' point of view, enabling the assessment of possible gaps between tourists' and tourism managers' perception of the tourism risk delivery. As a matter of fact, this is why tourism manager' perception should not be considered as the starting point in developing risk aversion strategies, while direct interviews with tourists are required.

Since tourists judgments are required when building the hierarchy risk value map of tourist resorts, fuzzy logic has been adopted as a useful tool. Through fuzzy logic linguistic judgments, tourists give to weights and associations have been appropriately translated into triangular fuzzy numbers. Moreover, fuzzy logic has allowed coping well with uncertainties and incomplete understanding of the associations between risk "attributes" and "consequences", "consequence" and "values". In addition, fuzzy logic becomes fundamental to dealing with several parameters that seem difficult to express in a quantitative measure. For example, detailed information about risk values conceptualization for tourism are usually not available, while linguistic judgments on values can be easily obtained.

Based on previous findings of Brun (1992) and Fischhoff et al. (1978), it was further hypothesized that perceptions for man-made risk scenarios and for events with fatalities should be higher. Consistent with this hypothesis, the study results show higher appraisals for man-made events on all of the nine evaluation risk characteristics. This finding indicates that Jungermann and Slovic's (1993) notion, according to which "…risks of human origin are seen as voluntary, controllable and hence ultimately avoidable—and thus as more severe than risks from nature" also hold true in the context of tourism risks.

Finally, with respect to risk management, it stresses the importance of being prepared to handle cope especially with man-made risks, since mismanagement of these avoidable risks seems to be particularly prone to evoke public outrage in case of a loss-incurring event. From the viewpoint of a resort's risk management, highest priority should be given to those damage events with high ratings on both factors, that is on the event-related appraisals (i.e. dread factor) and on the consequence of event-related on a destination level factor (i.e. ripple effects). Amongst these damage events are "Cable car accident", "Bus accident" and "Food poisoning". These risks should be taken into account by the resort's risk management, since these are the risks that can be supposed to evoke strong public concern and outrage if they result in an event of damage.

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Appendix A

A.1. Fuzzy sets and fuzzy number

A fuzzy set is defined by its membership function. Let *X* denotes a universal set. The membership function u_A by which a fuzzy set *A* can be defined and expressed as follows (Klir and Folger, 1988):

$$u_A : X \rightarrow [0, 1] \qquad \text{(A.1)}$$

where [0, 1] denotes the interval of real number from 0 to 1, inclusive.

As shown in Fig. A1, a fuzzy set *A* in the observed space *X* is characterized by a triangular membership function that associates each element *x* of *X* with a real number, $u_A(x)$, in the interval [0, 1]. The value of membership grade, $u_A(x)$, indicates the degree of the element *x* belonging to fuzzy set *A*, which is defined as a collection of ordered pairs and can be expressed by the following notations:

$$\begin{aligned} A &= \{(x_1,\ u_A(x_1)),\ (x_2,\ u_A(x_2)),\ldots,(x_n,\ u_A(x_n))\} \\ &= \{x_i,\ u_A(x_i) \mid i = 1,2,\ldots,n\}, \\ &= \frac{u_A(x_1)}{x_1} + \frac{u_A(x_2)}{x_2} + \cdots + \frac{u_A(x_n)}{x_n} = \sum_{i=1}^{n} \frac{u_A(x_i)}{x_i}. \end{aligned} \qquad \text{(A2)}$$

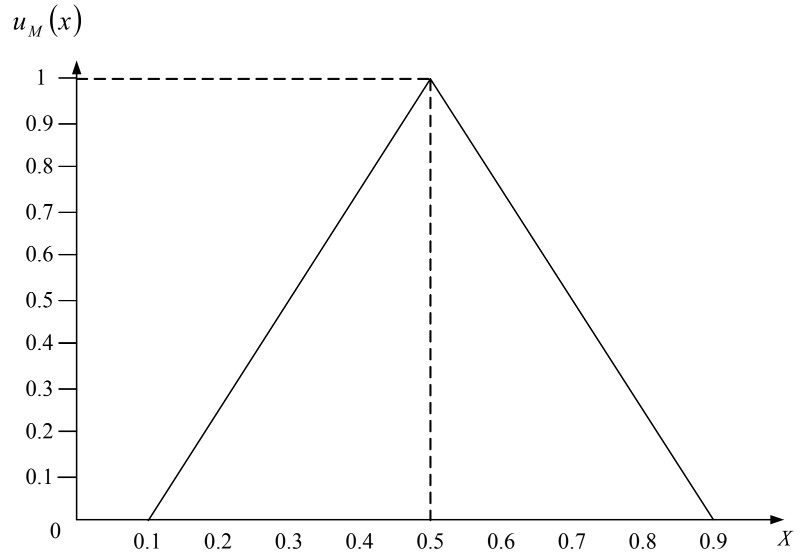

Fig. A1. A triangular membership function of a fuzzy set of real numbers close t 0.5.

The definitions of normalization and convexity play a vital role in fuzzy set theory. A fuzzy set *A* is called normalized when at least one of its elements attains the maximum possible membership grade (i.e., $\max_{x \in X}\ u_A(x) = 1$), and if the membership function $u_A(x)$ is a monotone increasing function for $x < m$ and a monotone decreasing function for $x > m$, where $u_A(m)=1$, it can be considered as a convex fuzzy set (i.e., $u_A(\lambda x_1+(1-\lambda)x_2)\geq \min(u_A(x_1),\ u_A(x_2)),\ \forall x_1,\ x_2\in X,\quad \lambda\in[0,\ 1]$). If a convex and normalized fuzzy set whose membership function is piecewise continuous is defined on *R*, it can be classified as a fuzzy number. A fuzzy number is a special case of a fuzzy set, which can be though of as containing the real numbers within some interval to varying degrees. The example in Fig. A1 is a classification of fuzzy numbers.

A.2. Algebraic operations

A fuzzy number $\widetilde{A}$ on $\Re$ to be a TFN (triangular Fuzzy Numbers) if its membership function $u_{\widetilde{A}}(x):\Re\rightarrow[0,\ 1]$ is equal to

$$u_{\widetilde{A}}(x)=\begin{cases}(x-l)/(m-l)\ , & l\leq x\leq m,\\ (u-x)/(u-m)\ , & m\leq x\leq u\ ,\\ 0,\ \mathit{oterwise}. & \end{cases} \tag{A.3}$$

where *l* and *u* represent the lower and upper bounds of the fuzzy number $\widetilde{A}$, respectively, and *m* is the median value. The TFN is denoted as $\widetilde{A}=(l,\ m,\ u)$ and the following is the operational laws of two TFNs $\widetilde{A}_1=(l_1,\ m_1,\ u_1)$ and $\widetilde{A}_2=(l_2,\ m_2,\ u_2)$, as shown (Kaufmann and Gupta, 1991):

Fuzzy number addition $\oplus$:

$$\widetilde{A}_1\oplus\widetilde{A}_2=(l_1,\ m_1,\ u_1)\oplus(l_2,\ m_2,\ u_2)=(l_1+l_2,\ m_1+m_2,\ u_1+u_2)\,. \tag{A.4}$$

Fuzzy number subtraction Θ:

$$\widetilde{A}_1\,\Theta\,\widetilde{A}_2=(l_1,\ m_1,\ u_1)\,\Theta\,(l_2,\ m_2,\ u_2)=(l_1-l_2,\ m_1-m_2,\ u_1-u_2)\,. \tag{A.5}$$

Fuzzy number multiplication $\otimes$:

$$\widetilde{A}_1\otimes\widetilde{A}_2=(l_1,\ m_1,\ u_1)\otimes(l_2,\ m_2,\ u_2)\cong(l_1\times l_2,\ m_1\times m_2,\ u_1\times u_2)\quad \text{for } l_i>0,\ m_i>0,\ u_i>0. \tag{A.6}$$

Fuzzy number division Ø:

$$\widetilde{A}_1\,Ø\,\widetilde{A}_2=(l_1,\ m_1,\ u_1)\,Ø\,(l_2,\ m_2,\ u_2)=(l_1/u_2,\ m_1/m_2,\ u_1/l_2)\quad \text{for } l_i>0,\ m_i>0,\ u_i>0. \tag{A.7}$$

Fuzzy number logarithm:

$$\log_n(\widetilde{A})\cong(\log_n l,\ \log_n m,\ \log_n u)\qquad n \text{ is base.} \tag{A.8}$$

Fuzzy number reciprocal:

$$(\widetilde{A}_1)^{-1}=(l,\ m,\ u)^{-1}\cong(1/u,\ 1/m,\ 1/l)\qquad \text{for } l, m, u>0. \tag{A.9}$$

A.3. Fuzzy weighted average and linguistic variables

The FWA (Fuzzy Weighted Average) is a combination of extended algebraic operations to be used in the evaluation of alternatives when their corresponding importance (weights) and ratings of criteria are represented by fuzzy numbers. The operation of FWA can be formularized as follows (Vanegas and Labib, 2001):

$$D = \frac{\sum_{j=1}^{m} w_j r_j}{\sum_{j=1}^{m} w_j}, \tag{A.10}$$

where D represents the overall desirability of an evaluated alternative; r_j represents the rating of the *jth* criterion; w_j represents the importance (weight) of the *jth* criterion.

The variables D, r_j, and w_j are fuzzy numbers, and the operations performed are addition, multiplication and division as defined by Eqs. (A.4), (A.6) and (A.7), respectively.

In retreating from precision in the face of overpowering complexity, as well as to easily evaluate alternative, r_j and w_j are expressed linguistically with appropriate triangular fuzzy numbers. Nine linguistic sets, "very unimportant" (VU), "more unimportant" (MU), "unimportant" (U), "some unimportant" (SU), "Medium" (M), "some important" (SI), "important" (I), "more important" (MI), and "very important" (VI), are allowable to describe with respondent's subjective judgment. Moreover, these linguistic sets can be quantified with corresponding triangular fuzzy numbers as shown in Table A1.

Table A1 Linguistic variables for the ratings and the importance (weights)

Linguistic variable	Triangular fuzzy number
Very unimportant (VU)	(0.1, 0.1, 0.2)
More unimportant (MU)	(0.1, 0.2, 0.3)
Unimportant (U)	(0.2, 0.3, 0.4)
Some unimportant (SU)	(0.3, 0.4, 0.5)
Medium (M)	(0.4, 0.5, 0.6)
Some important (SI)	(0.5, 0.6, 0.7)
Important (I)	(0.6, 0.7, 0.8)
More important (MI)	(0.7, 0.8, 0.9)
Very important (VI)	(0.8, 0.9, 0.9)

Through the operation of equation (A.10), the resultant membership function of the evaluated alternative can be presented in a membership function curve, and it also can be classified as a fuzzy number. In order to obtain a quantitative value of the resultant membership function, the center-of-gravity method known as "defuzzification" is used in this study. The equation of the center-of-gravity method can be expressed as below:

$$\bar{x} = \frac{\int_a^b m(x)x\,dx}{\int_a^b m(x)\,dx}. \tag{A11}$$

where *m(x)* represents the degree of membership of the (crisp) variable *x*; *a* and *b* are, respectively, the lower and upper limits of the support of the fuzzy number.