



# Applying Fuzzy Preference Relations to Assess the Preference of Corporations for Sponsorship Projects

Tien-Chin Wang, Tsai-Yun Huang\*, Chien-Hui Lee

Institute of Management, National Kaohsiung University of Science and Technology, Taiwan

## Email address:

tcwang@nkust.edu.tw (Tien-Chin Wang), yun575999@gmail.com (Tsai-Yun Huang), chlee@nkust.edu.tw (Chien-Hui Lee)

\*Corresponding author

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**Abstract:** Nowadays, more and more corporations or organizations perceiving the change of the marketing trends begin to accept and conduct corporate sponsorship. Under such a choice of consideration for sponsorship projects, what type of projects that corporations may prefer become the major concerns, which can be advantageous or helpful for their business running. Therefore, this study proposes an analytic hierarchical model based on the reciprocal additive consistent fuzzy preference relations to help corporations assess the preference for sponsorship projects. 60 current executives or administrative managers of local and foreign companies are sampled as interviewed experts or evaluators, along with conducting questionnaire method. Pairwise comparisons are used to determine the priority weights of each sponsorship project, and the subjectivity and vagueness in the assessing procedures are dealt with using linguistic terms quantified in an interval scale 0 to 1. The empirical results show that the types of education, exercises and sports, and social welfare are the three most preferential for Taiwan companies, while the three most preferential project types for foreign companies appear partially different, noticing particularly on exercises and sports, culture and art, and social welfare. Furthermore, the results of difference analysis demonstrate that there is a significantly positive difference among these five project groups, and of the group differences, the positive cognition for education is the strongest, while research and development can be the weakest.

**Keywords:** Decision Analysis, Sponsorship Project, Fuzzy Preference Relations, Analytical Hierarchy Process

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## 1. Introduction

In recent decades, traditional methods of marketing deployment, such as advertising on radio, television and other mass media, have begun to forfeit efficiency gradually, for the severe conditions of market saturation and its subsequent fragmentation, along with the continuous progress of innovative technology. Enterprises and organizations perceiving the change of the marketing trends begin to accept and conduct different alternative tactics, in order to bring a stronger image to their target groups further for ensuring existent loyalty. One of these alternative techniques is to launch corporate sponsorship, which is obtaining popularity in the marketing mix. Sponsorship of sports, art, education, culture or social welfare has become an indispensable combination for promoting brands, as exposed by the IEG data for a global survey that about \$70.2 billion was injected in

corporate sponsorship in 2019, demonstrating an investment growth of 5.2% compared to 2018 [1].

As indicated by Meenaghan for corporate sponsorship, most corporations develop sponsorship for reaching three kinds of goals, including media goal that can create effective media benefit, and marketing goal that can help corporations closely contact target market, as well as extensive business goal that can build or maintain a trustable and popular company image [2]. In such consideration of reaching the goals, corporations will evaluate what type of sponsorship available or correspond with their current direction of business operation. And the evaluation for sponsorship types forms corporation's preference from choosing sponsorship projects which corporations may favor [2, 3]. Some scholars also argue that the measurement of sponsor-event fit may be the critical factor for corporations to choose their preferential projects of sponsorship, under the assessment for the fit of

functional-based similarity or image-based similarity in order to achieve successful effectiveness [4, 5].

Apparently, the evaluation of sponsorship goal, the consideration of sponsor-event fit, and even the measurement of effectiveness may be the relevant concerns for corporations, while making decision in choosing sponsorship projects. Therefore, to explore what type of projects corporations prefer will be involved in corporate sponsorship is the main purpose of the study. Meanwhile, for realizing the decision making on the preference of corporations for sponsorship projects, an effective and helpful decision approach is proposed in this study. The proposed model based on the fuzzy preference relations [6] can help corporations easily find out what they prefer in the choice of sponsorship projects, and simultaneously simplify the operations to improve the consistency while implementing the decision problem. This model application constitutes the other important research purpose.

The study is organized into five sections. The next section will explore literature review about corporate sponsorship and existing sponsorship projects. Research framework will be illustrated and interviewed experts will be presented in Section 3. In Section 4, the empirical analysis for the collected data will be expressed. Finally, discussion and conclusions are given in Sections 5.

## 2. Literature Review

### 2.1. Corporate Sponsorship

Sandler and Shani points out that corporate sponsorship is usually provided directly by enterprises, such as capital, staff, equipment, technique, etc., for improving activity implementation of the sponsored and further fulfilling their business target or marketing target [3]. Nader stresses that sponsorship can be a soft power tool which not only conducts a positive trend for business operation, but also creates a win-win situation for both the sponsors and the sponsored institutions [7].

Some scholars present that corporate sponsorship is concerned with cause-related marketing (CRM), which means that businesses operate not only for profit making, but also for taking responsibility of creating marketing activities for social issues [8, 9]. To select the related causes that target consumers take care can obtain more anticipated and positive feedbacks, especially when consumers perceive that the motive of sponsorship is constructive and not speculative. Therefore, developing better cause-related marketing can help consumers be greatly cognizant of business brand, and further trust the brand. And the choice of sponsorship projects becomes an essential and important issue in cause-related marketing [10].

In general, corporate sponsorship involves several various areas or projects, like sports, charity, culture and art, etc., which depend on what kind of interests will be advantageous for corporations under long term consideration [1]. Ukman analyzes that for individual effectiveness, sponsorship

projects include sports, culture and art, education, social business, festival events, charity, and community activity [11]. The scholars clearly point out that the classification of sponsorship projects can be mainly classified into five types: exercises and sports, culture and art, education, social welfare, and research and development [12, 13].

Therefore, in summary from discussion above, the types of sponsorship projects that enterprises or corporations may prefer can be generalized to be exercises and sports, culture and art, education, social welfare, and research and development. Each type of sponsorship projects will be explored in the following parts.

### 2.2. Corporate Sponsorship for Exercises and Sports

Stolar indicates that the preference of corporations for sports sponsorship may come from three important factors, including the image of sport project or event correspondent with the image of the sponsoring corporation, and the major consumer groups of sport project correspondent with the targeted consumers the sponsoring corporation locks on, as well as the advertising effect through sponsoring the sport project helpful to create greater advantages in future operation [14].

Moreover, the effectiveness or advantage on sports sponsorship is also to be considered as another critical factor. In the research on baseball teams of rural primary schools sponsored by Herbalife Nutrition Taiwan (HNT), Lee demonstrates that the effectiveness displaying on HNT's sponsorship include promoting product values through sports sponsorship, performing corporate social responsibility (CSR) reliably to reinforce company image, and increasing the visibility of sponsorship while hosting a HNT Cup of national primary baseball championship annually [15]. Actually, CSR is an important factor for corporate sponsorship which will be demonstrated in the following parts, and is thought to be a form or manner of private businesses or corporations self-regulating which aims to make social contribution concerning the charitable or philanthropic nature by supporting or engaging in ethically-oriented or volunteering practices [16, 17].

The same result of obtaining effectiveness is also proven on the case of Emirates Airlines (EA). As analyzed by Hsu et al. for EA's sponsorship, EA, in the consideration of greatly increasing corporate image and brand awareness, chooses the sports teams which are with better popularity and performance and fit for corporate market scope and market segmentation as the major subjects sponsored [18]. And meanwhile, for contacting the potential customers of high business class, EA selects the items of sports like golf, tennis, and horse racing to launch sponsorship. Nowadays, more and more corporations keep affirmative for the projects of exercises and sports. As indicated by IEG report, over 60% of sponsored events focus on sponsorship for exercises and sports globally [1].

### 2.3. Corporate Sponsorship for Culture and Art

As analyzed by the scholars, the effectiveness on

sponsorship of culture and art can initiate the preference of corporations [19, 20]. The critical points lie in increasing the image of corporation, affirmation of the public for CSR, and enhancing the centripetal force of staff. Corporations supporting culture and art and participating related activities can procure the cognition of the public to the image and social responsibility. Simultaneously, the employees would feel honorable when their companies devote to sponsoring culture and art, increasing their centripetal forces in work.

Typically, culture and art sponsorship can be sorted out to be several different items or events, such as music, artistry, drama, dance, literature, folklore, lecture, etc., which are evaluated by the sponsors to invest for their separate benefits and effectiveness [19]. For example, Lund and Greyser, in their study on relationship building and collaborative marketing through artistry sponsorship for a museum, point out that the main benefits are created not only to develop relationship marketing for both to build a partnership, but also to integrate mutual resources to add values for both while interacting with mutual customers and audiences [21]. Wang and Holznagel also indicate that culture and art sponsorship can substantially promote corporate reputation through a beneficial interaction of cross-sector collaboration particularly as the culture and art sector is closely associated with contemporary lifestyle and civilization of consumers [22].

As previously mentioned, it can be seen that the preferential factors for culture and art sponsorship encompass promoting corporate reputation, building the affirmation of the public, enhancing the centripetal force of staff, and getting close to consumers to create relationship marketing.

#### **2.4. Corporate Sponsorship for Education**

With the charity appeals of the government for education, more and more local enterprises inject sponsorship into education, such as sponsoring scholarship and grants, school band funds or school activities funds, and even promoting “a firm to a school sponsorship”, especially for rural areas where educational resources are scarce [23]. Actually, education sponsorship can be regarded as a program or project of CSR as explored in the following project - social welfare, significantly and positively enhancing business brand, and further building the preference of corporations [24].

In addition to the reputation of CSR, another factor of preference is that education sponsorship may be a long-term investment to cultivate talents to fulfill the needs of corporations in human resources [25]. This can be observed particularly in the medical sector. Hirsch and Schumacher, taking the example of hospital sponsorship to nursing schools and faculty, discover that the direct answer is to fill nursing vacancies and reduce nursing shortages as nursing markets are more and more competitive [26]. And meanwhile, the sponsorship of nursing schools can shorten the vacancy gap which is widened by accelerating retirement of registered nurses and can enlarge nursing workforce to meet the increased demand for health care among new baby-boomers [27].

Actually, many large technology corporations also inject sponsorship into famous universities to absorb more talented

researchers for their future development as the sponsorship to nursing schools discussed above [28]. Therefore, we may realize that the preferential factors for education sponsorship mainly include creating better reputation of CSR and deploying better channels for human resources.

#### **2.5. Corporate Sponsorship for Social Welfare**

Social welfare is meant to provide the alternatives that can fulfill survival needs of the public, involving the events or activities on social security, people's health, and social services, and corporations for social welfare sponsorship may be engaged in offering living supplies, raising funds, relieving famine, assisting the elderly or the homeless, donating charities or charity foundations, etc. [29].

Similar to the sponsorship of sports, art, and education discussed above, the exposure effect on business brand is the critical factor for corporations to prefer the sponsorship of social welfare [30]. A meaningful sponsorship can not only improve the image while substantially fulfilling CSR, but also can satisfy the achievement of helping others, social sponsorship or charity activity wherein is to be particularly useful for changing social welfare and the attitude of the public to the total brand equity of the sponsors [31]. Chen also adds that if corporations intend to obtain the trust from the public, to genuinely implement CSR will be essential and necessary and the sponsorship of social welfare will be the best alternative in the performance of CSR [30].

Shen's study for public welfare sponsorship further shows that consumers' perception of public service sponsorship can strongly build a positive impact on the symbolic image of the brand while public welfare sponsorship is going on, and simultaneously the symbolic image will significantly and positively influence consumer brand identity [32]. In this part of discussion, it can be seen that the preferential factors for social welfare sponsorship may involve improving brand image, changing the attitude of the public to brand equity, and obtaining the achievement of helping others.

#### **2.6. Corporate Sponsorship for Technology Research and Development**

White presents that increasing the resources of R&D and previously deploying new product plans in the future are the most important factors for corporations preferring sponsoring technology research and development [33]. For example, many various research projects sponsored in university labs will help corporations build the concrete basis of R&D, and eventually may become new product development projects in the labs of corporations themselves. Besides, O'Connor et al. also analyze that sponsorship of technology research and development not only can be an enhancement of reputation in driving technology advance, but also can build an effective dependency relationship between corporations and the person or institution sponsored, which can potentially create possible talents to satisfy the needs of corporations in the future like sponsorship of education [34].

On the other hand, Fabbri et al. indicate that R&D

sponsorship in which stirs corporations' interest lie in developing corporate potential to influence public debate and policymaking by affecting the research agenda that they prioritize on possible products or processes which can be commercialized, further influencing the choice of research priorities [35]. This influential factor is also proved by Legg et al. that R&D funding can be used to influence the conduct and publication of research to form powerful evidence bases in industry's favor [36]. And meanwhile, R&D funding can model industry-friendly policymaking environments to shape the use of research policy in industry's favor, further maximizing favorable research and minimizing unfavorable research.

As discussed above, it can be realized that the preferential factors for technology research and development sponsorship may encompass increasing R&D resources, deploying new product plans, building dependency relationship for adding talents, and influencing the choice of research priorities.

In respect of the exploration for the preference of these five sponsorship projects, it can be seen that each project is with its specific factors of preference. Therefore, in this study, the preference of corporations for these five projects will be examined through pairwise comparisons to further realize which project will be the highest priority of preference amongst all the interviewed experts.

### 3. Methodology

#### 3.1. Research Framework of Preference for Sponsorship Projects

This study mainly explores the research on the preference of corporations for sponsorship projects, and through above-discussed literature review, adopts the following five sponsorship projects to build the framework, shown as figure 1, along with utilizing expert questionnaire to collect data.

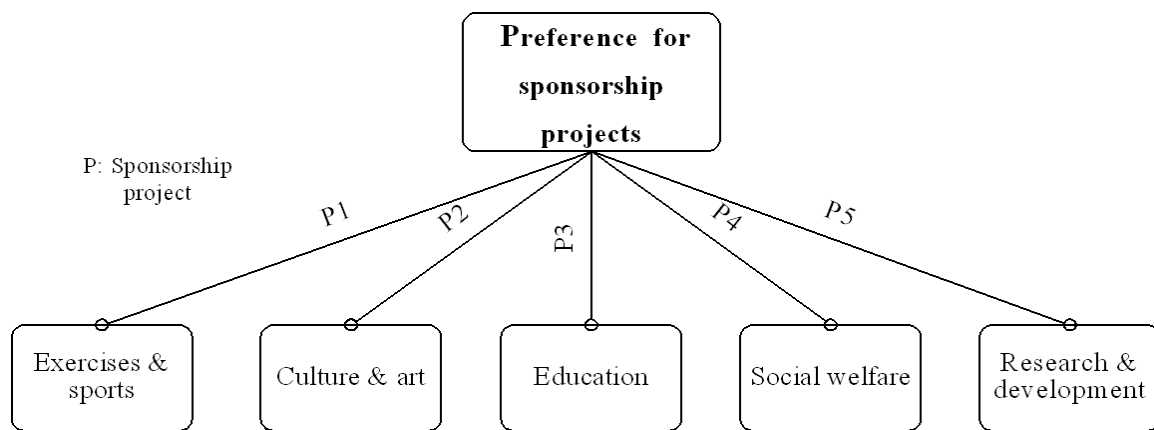


Figure 1. Framework of preference for sponsorship projects.

For the interviewed experts who can better understand the meaning of sponsorship projects while making preference judgment, these five projects are defined as follows:

P<sub>1</sub>- Exercises and sports: This means the interviewed experts favor or support the sport-related sponsorship, including the sponsorship on various sport items, any kind of athletic contests, particular sport events, etc.

P<sub>2</sub>- Culture and art: This means the interviewed experts favor or support the culture-related sponsorship, including the sponsorship on the areas of artistry, drama, dance, literature, folklore, lecture, festival, etc.

P<sub>3</sub>- Education: This means the interviewed experts favor or support the education-related sponsorship, including the sponsorship on scholarship and grants, school band funds, school activities funds, providing educational equipment, etc.

P<sub>4</sub>- Social welfare: This means the interviewed experts favor or support the charity-related sponsorship, including the sponsorship on all social events, such as offering living supplies, raising funds, relieving famine, assisting the elderly or the homeless, donating charities or charity foundations, etc.

P<sub>5</sub>- Research and development: This means the interviewed experts favor or support the R&D-related sponsorship, including the sponsorship on research projects in universities

or research institutes, donation to R&D seminars or forums, providing research funds for new technologies, etc.

#### 3.2. The Approaches of Decision Making for Preference

So far as preference decision making is concerned, the AHP approach is presented earlier, but nevertheless, several preference approaches are subsequently discovered for amending or modifying the drawbacks of AHP while making judgment, such as Fuzzy AHP [37, 38], multiplicative preference relations [39, 40], fuzzy preference relations [6, 41], linguistic preference relations [42], incomplete fuzzy preference relations [43, 44], incomplete multiplicative preference relations and incomplete linguistic preference relations [45, 46].

Though these amending approaches can successfully overcome some certain shortcomings of AHP which will be explained in the following part, most of these approaches use the essence of AHP theory including pairwise comparison and assessment criteria as the basis of modification. Whereas, the basic concept and evaluation method of AHP will need to be discussed first, which can be cohesive to the approach of fuzzy preference relations this study mainly utilizes.

### 3.3. Analytic Hierarchy Process (AHP)

Prior to introducing the method of fuzzy preference relations, the Analytic Hierarchy Process (AHP), a conventional pairwise comparison method, will be explained in advance for the formation of judgments in decision making. AHP is a method of decision making invented by Saaty, adopting a hierarchical approach to organize assessment criteria for making decisions [47]. Its major solution is to decompose a complex decision problem into a measurable hierarchy and apply quantified criteria to allow evaluators to clearly resolve the problem, along with selecting the most suitable alternative. In the meantime, AHP utilizes pairwise comparisons with a 1-9 ratio scale to analyze the relative importance of a criterion to other criteria. In the matrices of pairwise comparisons developed, eigenvalue and eigenvector can be calculated for obtaining local priority and total priorities while checking consistency, further for finding out the highest priority as the best alternative [47, 48].

And as indicated by the scholars [49, 50] for the shortcomings of AHP, these drawbacks mainly involve the followings: (1) This approach is subject to resolving crisp decision problems; (2) This approach will occur unbalanced scale of judgments while making choices; (3) Ranking method is not accurate enough; (4) The selection and subjectivity of decision makers for preference will influence the consistency. In addition, the evaluators have to make  $n(n-1)/2$  judgments as shown in Figure 2, if there are  $n$  elements in the decision matrix. This leads evaluators to conduct a series of calculation procedures, including computing eigenvector, maximum eigenvalue, consistency index, and consistency ratio for examining the inconsistency of decision matrix.

$$\begin{bmatrix} 1 & a_{12} & a_{13} & \cdots & a_{1n} \\ 1/a_{12} & 1 & a_{23} & \cdots & a_{2n} \\ 1/a_{13} & 1/a_{23} & 1 & \cdots & a_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & 1/a_{3n} & \cdots & 1 \end{bmatrix}$$

Figure 2. A decision matrix example of AHP.

### 3.4. Pairwise Comparison Matrix (Fuzzy Preference Relations)

For AHP or Fuzzy AHP method, evaluators always provide  $n(n-1)/2$  judgments for a preference matrix with  $n$  elements as mentioned above. To reduce the judgment times, the additive consistent fuzzy preference relation is employed in this study, requiring only  $n-1$  judgments from a set of  $n$  elements. The consistent fuzzy preference relation is proposed by Herrera-Viedma *et al.* [6] for establishing pair-wise comparison preference decision matrices using the so-called reciprocal additive transitivity property. This method not only enables decision makers to express their degree of preference for a set of attributes or alternatives, but also avoids checking the inconsistency in the decision

making process.

#### 3.4.1. Definitions of Reciprocal Additive Transitivity Fuzzy Preference Relation

The major basic definitions below are utilized in this study, described as follows:

Definition 1 Assume a fuzzy preference relation  $P$  on a set of alternatives  $X$  is denoted by a matrix  $P \subset X \times X$ , which is meant by a membership function:  $\mu_p : X \times X \rightarrow [0,1]$ ,  $P = (p_{ij})$ ,  $p_{ij} = \mu_p(x_i, x_j) \quad \forall i, j \in \{1, \dots, n\}$ .  $p_{ij}$  is explained as the preference degree of the alternative  $x_i$  over  $x_j$ . If  $p_{ij} = 1/2$ , this demonstrates that there is no difference between  $x_i$  and  $x_j$  ( $x_i \sim x_j$ );  $p_{ij} = 1$  indicates  $x_i$  is absolutely preferred to  $x_j$ ; similarly  $p_{ij} = 0$  indicates  $x_j$  is absolutely preferred to  $x_i$ ;  $p > 1/2$  indicates that  $x_j$  is preferred to  $x_i$  ( $x_j > x_i$ ).  $P$  is assumed to be additive reciprocal, that is:

$$p_{ij} + p_{ji} = 1 \quad \forall i, j \in \{1, \dots, n\} \quad (1)$$

Definition 2 Suppose there is a set of alternatives  $X = \{x_1, \dots, x_n\}$ , which is associated with a multiplicative preference relation  $A = (a_{ij})$  with  $a_{ij} \in [1/9, 9]$ . Then the corresponding reciprocal additive fuzzy preference relation  $P = (p_{ij})$  with  $p_{ij} \in [0,1]$  to  $A = (a_{ij})$  is defined as follows:

$$p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_9 a_{ij}) \quad (2)$$

Definition 3 For a reciprocal additive fuzzy preference relation  $P = (p_{ij})$ , the following statements are equivalent:

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \quad \forall i < j < k;$$

$$p_{i(i+1)} + p_{(i+1)(i+2)} + \cdots + p_{(j-1)j} + p_{ji} = \frac{j-i+1}{2} \quad \forall i < j$$

If the preference matrix contains any values that are not in the interval  $[0,1]$ , but in an interval  $[-a, 1+a]$ , a linear solution is required to preserve the reciprocity and additive transitivity, that is preference of sponsored project -  $P: [-a, 1+a] \rightarrow [0,1]$ . Based upon the above statements, a consistent fuzzy preference relation can be constructed by using the following equation:

$$p_{ji} = \frac{j-i+1}{2} - p_{ii+1} - p_{i+1i+2} \cdots - p_{j-1j} \quad (3)$$

#### 3.4.2. Procedures of Obtaining the Priorities of the Preference for Sponsorship Projects

The following describes the procedures of the reciprocal additive consistent fuzzy preference relation for obtaining the priorities of the preference for sponsorship projects.

- (1) Constructing pairwise comparison matrices amongst the preference of projects  $P_i (i=1,2,\dots,n)$ . The evaluators (interviewed experts)  $E_k (k=1,2,\dots,m)$  then are inquired to select which is more important of each two preferential projects for a set of  $n-1$  preference values  $\{a_{12}, a_{23}, \dots, a_{n-1n}\}$ , for example illustrated below:

$$A^k = \begin{matrix} & P_1 & P_2 & P_3 & \dots & P_n \\ \begin{matrix} P_1 \\ P_2 \\ P_3 \\ \vdots \\ P_n \end{matrix} & \begin{bmatrix} 1 & a_{12}^k & \times & \times & \times \\ \times & 1 & a_{23}^k & \times & \times \\ \times & \times & 1 & a_{34}^k & \times \\ \vdots & \vdots & \vdots & \ddots & a_{n-1n}^k \\ \times & \times & \times & \times & 1 \end{bmatrix} \end{matrix}$$

The  $a_{ij}^k$  denotes the preference intensity toward projects  $i$  and  $j$  assessed by  $k$ th evaluator,  $a_{ij}^k = 1$  means indifference between projects  $i$  and  $j$ ,  $a_{ij}^k = 3, 5, 7, 9$  expresses that project  $i$  relatively important to project  $j$ , while  $a_{ij}^k = 3^{-1}, 5^{-1}, 7^{-1}, 9^{-1}$  indicates that project  $i$  is less important than project  $j$ . The sign “x” means the remaining  $a_{ij}^k$  which can be evaluated by inverse comparison methods.

- (2) Transforming the preference value  $a_{ij}^k$  into  $p_{ij}^k$  in an interval scale  $[0,1]$ , then calculating the remaining  $p_{ij}^k$  by using the reciprocal transitivity property, which is illustrated as follows:

$$A^k \xrightarrow{\frac{1}{2}(1+\log_9 a_{ij})} P^k = \begin{matrix} & P_1 & P_2 & P_3 & \dots & P_n \\ \begin{matrix} P_1 \\ P_2 \\ P_3 \\ \vdots \\ P_n \end{matrix} & \begin{bmatrix} 0.5 & P_{12}^k & \times & \times & \times \\ 1-P_{12}^k & 0.5 & P_{23}^k & \times & \times \\ \times & 1-P_{23}^k & 0.5 & P_{34}^k & \times \\ \vdots & \vdots & \vdots & \ddots & P_{n-1n}^k \\ \times & \times & \times & \times & 0.5 \end{bmatrix} \end{matrix}$$

The  $p_{ij}^k = 1/2$  denotes indifference between projects  $i$  and  $j$ ,  $p_{ij}^k = 1$  indicates that project  $i$  is absolutely important to project  $j$ ,  $p_{ij}^k = 0$  represents that project  $i$  is absolutely less important to project  $j$ , and  $p_{ij}^k > 1/2$  further demonstrates that project  $i$  is preferred to project  $j$ . If this transforming matrix contains any values that are not included in the interval  $[0,1]$ , but in an interval  $[-a, 1+a]$ , then a transformation function is required to retain the reciprocity and additive transitivity. The transformation function is calculated by the following equation:

$$f(P_{ij}^k) = \frac{P_{ij}^k + a}{1 + 2a} \quad (4)$$

In this equation, “ $a$ ” refers to the absolute value of the minimum in this transformation preference matrix.

- (3) Drawing out the judgments from evaluators to procure the aggregated weights of preferential projects, and conducting  $P_{ij}^k$  to denote the transformed fuzzy preference value of evaluator  $k$  in the process of assessing the projects  $i$  and  $j$ . The average value equation is used to integrate the judgment values of  $m$  evaluators, which is shown below:

$$P_{ij} = \frac{1}{m} (P_{ij}^1 + P_{ij}^2 + \dots + P_{ij}^m) \quad (5)$$

- (4) Normalizing the aggregated fuzzy preference relation matrices, and using  $r_{ij}$  to denote the normalized fuzzy preference values of each preferential project. The calculation equation is shown below:

$$r_{ij} = \frac{P_{ij}}{\sum_{i=1}^n P_{ij}} \quad (6)$$

- (5) Given that the  $\varpi$  denotes the priority weight of preferential project  $i$ , the priority weight of each project can be obtained, which is demonstrated below:

$$\varpi_i = \frac{\sum_{j=1}^n r_{ij}}{\sum_{i=1}^n \sum_{j=1}^n r_{ij}} \quad (7)$$

### 3.5. Definition of Linguistic Variables

Nine linguistic terms, namely “absolutely more important”, “very strongly more important”, “strongly more important”, “weakly more important”, “equally important”, “less weakly more important”, “less strongly more important”, “less very strongly more important”, and “less absolutely more important”, are provided for comparing neighboring preferential sponsored projects corresponding to a real number (see Table 1).

Table 1. Linguistic terms for priority weights of sponsorship projects.

Definition	Intensity of importance
Absolutely more important (AB)	9
Between AB and VS - Intermediation (AV)	8
Very strongly more important (VS)	7
Between VS and ST - Intermediation (VT)	6
Strongly more important (ST)	5
Between ST and WK - Intermediation (SW)	4
Weakly more important (WK)	3
Between WK and EQ - Intermediation (WE)	2
Equally important (EQ)	1
Between EQ and LWK - Intermediation (ELW)	$1/2$
Less weakly more important (LWK)	$1/3$
Between LWK and LST - Intermediation (LWLS)	$1/4$
Less strongly more important (LST)	$1/5$
Between LST and LVS - Intermediation (LSLV)	$1/6$
Less very strongly more important (LVS)	$1/7$
Between LVS and LAB - Intermediation (LVLA)	$1/8$
Less absolutely more important (LAB)	$1/9$

### 3.6. Examination of Difference Analysis

This study also uses one-way analysis of variance (ANOVA) to examine whether there are any statistically significant differences between the means of these five independent groups, with respect to the groups showing preference priority on these five different projects, including the groups of exercises and sports, culture and art, education, social welfare, and research and development.

Meanwhile, Post Hoc analysis, also known as multiple comparisons, will be used to test which project groups are significantly different from other project groups, exploring the strength of the relationship between these five project groups. In this study, the tool of Duncan will be used for Post Hoc

analysis.

## 4. Data Collection and Analysis

### 4.1. Data Collection

#### (1) Research subject

This study conducts questionnaire method, sampling current executives or administrative managers of local and foreign companies as interviewed expert, along with collecting back 60 valid copies of questionnaires, including 40 samples of local companies and 20 samples of foreign companies.

#### (2) Background of interviewed experts (evaluators)

The background of interviewed experts is shown as Table 2.

**Table 2.** Background of interviewed experts.

Taiwan companies: 40 (T1 ~ T40)		Foreign companies: 20 (F1 ~ F20)	
Industry	Number	Industry	Number
Travel agency	10	Retailing	9 (USA:5, Japan:2, France:1, UK:1)
Metal & steel-related	7	Semi-conductor	4 (USA:3, Korea:1)
Farming & aquatic product	5	Direct selling	3 (USA)
Construction & building materials	5	Motor trade	2 (Japan)
Medical & environmental	3	Pharmaceutical	1 (UK)
Chemical	3		
Logistics	2	Cleaning supplies	1 (Japan)
Other services	5		

### 4.2. Questionnaire Design

Based upon research framework and the major research method (Fuzzy Preference Relations), this study designs the questionnaire as shown on Table 3, in light of the five sponsorship projects.

The interviewed expert will be invited to fill in the questionnaire, according to the sequence of priority that is

evaluated by individual judgment. And the interviewed expert will be asked to select an important priority among 1-9 ratio scales between left side and right side, along with pair-wise comparisons to each project. For example, if the interviewed expert thinks “ST 5” on the left side is the best priority between “1.exercises and sports” and “2.culture and art”, she or he can mark a “●” in the blank of the “ST 5” row on the left side.

**Table 3.** Questionnaire of preference of corporations for sponsorship projects.

Projects	AB 9	8	VS 7	6	ST 5	4	WK 3	2	EQ 1	2	WK 3	4	ST 5	6	VS 7	8	AB 9	Projects
1.exercises and sports																		2.culture and art
2.culture and art																		3.education
3.education																		4.social welfare
4.social welfare																		5.R & D

EQ 1: Equally important; WK 3: Weakly more important;

ST 5: Strongly more important; VS 7: Very strongly more important

AB 9: Absolutely more important

Intermediate values used to present compromise 2, 4, 6, 8.

### 4.3. Data Analysis

#### 4.3.1. Weighting Calculation of the Preference for Sponsorship Projects

- (1) For clearly explaining the computational process, the assessment of evaluator 1 (T1) is extracted as an example for data analysis. The original fuzzy preference pairwise comparison matrix of evaluator 1 is listed in Table 4, and the linguistic terms of evaluator 1 can be further transferred into corresponding numbers as listed in Table 5.

**Table 4.** Original fuzzy preference pairwise comparison matrix of evaluator 1 (T1).

T1	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	1	VS	X	X	X
P <sub>2</sub>	LVS	1	LAB	X	X
P <sub>3</sub>	X	AB	1	AB	X
P <sub>4</sub>	X	X	LAB	1	LST
P <sub>5</sub>	X	X	X	ST	1

T1: denotes the first interviewed expert (evaluator) of Taiwan companies.

**Table 5.** Translated linguistic terms into corresponding numbers of evaluator 1.

T1	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	1	7	X	X	X
P <sub>2</sub>	1/7	1	1/9	X	X
P <sub>3</sub>	X	9	1	9	X
P <sub>4</sub>	X	X	1/9	1	1/5
P <sub>5</sub>	X	X	X	5	1

(2) Subsequently, Eq.(2) is used to transform the elements which are listed in Table 5 into an interval [0, 1], yielding the following values:

$$P_{12} = \frac{1}{2}(1 + \log_9 7) = 0.9428,$$

$$P_{23} = \frac{1}{2}(1 + \log_9 \frac{1}{9}) = 0.0000,$$

$$P_{34} = \frac{1}{2}(1 + \log_9 9) = 1.0000,$$

$$P_{45} = \frac{1}{2}(1 + \log_9 \frac{1}{5}) = 0.1338.$$

The remaining values then can be calculated by Eqs. (1) and (3). For  $P_{21}$ ,  $P_{31}$  and  $P_{52}$  as examples:

$$P_{21} = 1 - P_{12} = 1 - 0.9428 = 0.0572,$$

$$P_{31} = \frac{3-1+1}{2} - P_{12} - P_{23} = 1.5 - 0.9428 - 0.0000 = 0.5572$$

$$P_{52} = \frac{5-2+1}{2} - P_{32} - P_{34} - P_{45} = 2 - 0.0000 - 1.0000 - 0.1338 = 0.8662.$$

The fuzzy preference relation matrix of the preference for five sponsorship projects assessed by evaluator 1 can be built in Table 6. Table 6 expresses that all elements list in the interval [0, 1], and for ensuring the reciprocity and additive transitivity of the preference relation matrix, a linear transformation stated in Eq.(4) is employed to calculate the transformation matrix as listed in Table 7.

**Table 6.** Transformed fuzzy preference values of evaluator 1.

T1	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	0.5000	0.9428	0.4428	0.9428	0.5766
P <sub>2</sub>	0.0572	0.5000	0.0000	0.5000	0.1338
P <sub>3</sub>	0.5572	1.0000	0.5000	1.0000	0.6338
P <sub>4</sub>	0.0572	0.5000	0.0000	0.5000	0.1338
P <sub>5</sub>	0.4234	0.8662	0.3662	0.8662	0.5000

**Table 7.** Preference values transformed by linear solution for evaluator 1.

T1	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	0.5000	0.9428	0.4428	0.9428	0.5766
P <sub>2</sub>	0.0572	0.5000	0.0000	0.5000	0.1338
P <sub>3</sub>	0.5572	1.0000	0.5000	1.0000	0.6338
P <sub>4</sub>	0.0572	0.5000	0.0000	0.5000	0.1338
P <sub>5</sub>	0.4234	0.8662	0.3662	0.8662	0.5000

(3) Likewise, the same computational procedures (1)–(2) demonstrated above can calculate the fuzzy preference relation matrices of the other 59 evaluators; therefore,

using Eq.(5), the aggregated pairwise comparison matrix of 60 evaluators can be obtained as listed in Table 8.

(4) Eq.(6) is used to normalize the aggregated pairwise comparison matrix. Taking  $r_{21}$  as an example:

$$r_{21} = 0.4489 / 0.5000 + 0.4489 + 0.5149 + 0.4595 + 0.3467 = 0.1978$$

**Table 8.** Aggregated pairwise comparison matrices of 60 evaluators.

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	0.5000	0.5511	0.4851	0.5405	0.6533
P <sub>2</sub>	0.4489	0.5000	0.4340	0.4894	0.6022
P <sub>3</sub>	0.5149	0.5660	0.5000	0.5554	0.6682
P <sub>4</sub>	0.4595	0.5106	0.4446	0.5000	0.6128
P <sub>5</sub>	0.3467	0.3978	0.3318	0.3872	0.5000
Total	2.2700	2.5255	2.1955	2.4725	3.0365

(5) The priority weight of each sponsorship project can then be obtained by Eq.(7). The priority weight and rank of each sponsorship project assessed by 60 evaluators are listed in Table 9. Therefore, the rank of weight for each sponsorship project is illustrated as:

$$P_3(0.2247) \succ P_1(0.2186) \succ P_4(0.2022) \succ P_2(0.1980) \succ P_5(0.1565)$$

The results demonstrate that the three most preferential sponsorship projects are education (0.2247), exercises and sports (0.2186), social welfare (0.2022); meanwhile, the two least preferential sponsorship projects are culture and art (0.1980) and research and development (0.1565).

**Table 9.** Normalized matrix of priority weight and rank of projects for total evaluators.

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	Total	Weight	Rank
P <sub>1</sub>	0.2203	0.2182	0.2210	0.2186	0.2151	1.0932	0.2186	2
P <sub>2</sub>	0.1978	0.1980	0.1977	0.1979	0.1983	0.9897	0.1980	4
P <sub>3</sub>	0.2268	0.2241	0.2277	0.2246	0.2201	1.1233	0.2247	1
P <sub>4</sub>	0.2024	0.2022	0.2025	0.2022	0.2018	1.0111	0.2022	3
P <sub>5</sub>	0.1527	0.1575	0.1511	0.1566	0.1647	0.7826	0.1565	5
						4.9999	1.0000	

(6) Likewise, the same computational procedures (3)–(5) stated above can calculate the fuzzy preference relation matrices of 40 evaluators for Taiwan companies. The aggregated pairwise comparison matrices are listed in Table 10, and the normalized matrix of priority weight and rank of preferential projects are listed in Table 11.

**Table 10.** Aggregated pairwise comparison matrices of T companies (40 evaluators).

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	0.5000	0.5584	0.4092	0.5140	0.6459
P <sub>2</sub>	0.4416	0.5000	0.3508	0.4557	0.5876
P <sub>3</sub>	0.5908	0.6492	0.5000	0.6049	0.7368
P <sub>4</sub>	0.4860	0.5443	0.3951	0.5000	0.6319
P <sub>5</sub>	0.3541	0.4124	0.2632	0.3681	0.5000
Total	2.3725	2.6643	1.9183	2.4427	3.1022



**Table 11.** Normalized matrix of priority weight and rank of projects for *T* companies.

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	Total	Weight	Rank
P <sub>1</sub>	0.2107	0.2096	0.2133	0.2104	0.2082	1.0522	0.2104	2
P <sub>2</sub>	0.1861	0.1877	0.1829	0.1866	0.1894	0.9327	0.1865	4
P <sub>3</sub>	0.2490	0.2437	0.2606	0.2476	0.2375	1.2384	0.2477	1
P <sub>4</sub>	0.2048	0.2043	0.2060	0.2047	0.2037	1.0235	0.2047	3
P <sub>5</sub>	0.1493	0.1548	0.1372	0.1507	0.1612	0.7532	0.1507	5
						5.0000	1.0000	

The rank of weight for each sponsorship project evaluated by Taiwan companies is illustrated as:

$$P_3(0.2477) > P_1(0.2104) > P_4(0.2047) > P_2(0.1865) > P_5(0.1507)$$

The results analyzed from Taiwan companies demonstrate that the three most preferential sponsorship projects are education (0.2477), exercises and sports (0.2104), social welfare (0.2047); meanwhile, the two least preferential sponsorship projects are culture and art (0.1865) and research and development (0.1507).

(7) Likewise, the same computational procedures (3)–(5) stated above can calculate the fuzzy preference relation matrices of 20 evaluators for foreign companies. The aggregated pairwise comparison matrices are listed in Table 12, and the normalized matrix of priority weight and rank of preferential projects are listed in Table 13.

**Table 12.** Aggregated pairwise comparison matrices of *F* companies (20 evaluators).

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
P <sub>1</sub>	0.5000	0.5366	0.6369	0.5934	0.6680
P <sub>2</sub>	0.4634	0.5000	0.6003	0.5569	0.6314
P <sub>3</sub>	0.3631	0.3997	0.5000	0.4565	0.5311
P <sub>4</sub>	0.4066	0.4431	0.5435	0.5000	0.5745
P <sub>5</sub>	0.3320	0.3686	0.4689	0.4255	0.5000
Total	2.0651	2.2480	2.7496	2.5323	2.9050

**Table 13.** Normalized matrix of priority weight and rank of projects for *F* companies.

	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	Total	Weight	Rank
P <sub>1</sub>	0.2421	0.2387	0.2316	0.2343	0.2299	1.1766	0.2353	1
P <sub>2</sub>	0.2244	0.2224	0.2183	0.2199	0.2173	1.1023	0.2205	2
P <sub>3</sub>	0.1758	0.1778	0.1818	0.1803	0.1828	0.8986	0.1797	4
P <sub>4</sub>	0.1969	0.1971	0.1977	0.1974	0.1978	0.9870	0.1974	3
P <sub>5</sub>	0.1608	0.1640	0.1705	0.1680	0.1721	0.8354	0.1671	5
						4.9999	1.0000	

The rank of weight for each sponsorship project evaluated by foreign companies is illustrated as:

$$P_1(0.2353) > P_2(0.2205) > P_4(0.1974) > P_3(0.1797) > P_5(0.1671)$$

The results analyzed from foreign companies demonstrate that the three most preferential sponsorship projects are exercises and sports (0.2353), culture and art (0.2205), social welfare (0.1974); meanwhile, the two least preferential sponsorship projects are education (0.1797) and research and development (0.1671).

#### 4.3.2. Difference Analysis Among Five Sponsorship Project Groups

The ANOVA test, as shown in Table 14, demonstrates that *F* value is 8.6219 ( $p < 0.001$ ) and is also greater than critical value (CV), where

$$CV = F_{\alpha}(k-1, n-k) = F_{0.05}(4, 295) = 2.4022,$$

which indicates that the preference of these five project groups appears very significantly different, namely there is a significantly positive difference in preference for sponsorship projects among these five project groups.

**Table 14.** ANOVA for different project groups.

	SS	DF	MS	F	P-value	CV
Between Groups	0.1606	4	0.0401	8.6219	0.000***	2.4022
Within Groups	1.3734	295	0.0046			
Total	1.5340	299				

\*\*\*:  $p < 0.001$

In addition, in Post Hoc analysis as shown in Table 15, the results show that the positive cognitions of P<sub>2</sub>, P<sub>4</sub>, P<sub>1</sub> and P<sub>3</sub> project groups are all higher than P<sub>5</sub> project group, and meanwhile, the positive cognition of P<sub>3</sub> project group is also higher than P<sub>2</sub> project group. This result indicates that the positive cognition of preference for P<sub>3</sub> education group is the strongest, while the P<sub>5</sub> group of research and development can be the weakest.

**Table 15.** Post Hoc analysis.

Project	N	Mean	Std. Deviation	Duncan
P <sub>1</sub> Exercises and sports	60	0.2178	0.0848	
P <sub>2</sub> Culture and art	60	0.1975	0.0562	
P <sub>3</sub> Education	60	0.2242	0.0618	P <sub>3</sub> < P <sub>2</sub> , P <sub>4</sub> ,
P <sub>4</sub> Social welfare	60	0.2024	0.0593	P <sub>1</sub> , P <sub>3</sub>
P <sub>5</sub> Research and development	60	0.1580	0.0748	P <sub>2</sub> < P <sub>3</sub>

## 5. Conclusion

The aim of the study was to estimate what type of projects corporations prefer will be involved in corporate sponsorship, as well as to apply the model of fuzzy preference relations to find out the most preferential sponsorship projects. Based upon research findings, the types of education, exercises and sports, and social welfare are the three most preferential for total 60 evaluators. Additionally, the types of education, exercises and sports, and social welfare are also the three most preferential for 40 evaluators of Taiwan companies, while the three most preferential project types for 20 evaluators of foreign companies appear partially different, noticing particularly on exercises and sports, culture and art, and social welfare. Furthermore, the results of difference analysis demonstrate that there is a significantly positive difference among these five project groups, and of the group differences, the positive cognition for education is the strongest, while research and development can be the weakest.

Considering the research results, the main contribution of this study is to utilize the advantage of the reciprocal additive consistent fuzzy preference relation approach to construct more appropriate pairwise comparison matrices, rather than using conventional multiplicative preference relation. And this proposed approach uses only  $n-1$  judgments, whereas the traditional analytic hierarchy approach adopts  $n(n-1)/2$  judgments in a preference matrix with  $n$  attributes or alternatives, providing a faster way to execute and analyze the priorities of the preference for sponsorship projects. Furthermore, comprehensive data collection is conducted from various industries including 40 Taiwan companies and 20 foreign companies, providing more sufficient preference opinions and judgments which can be analyzed more objectively to present more effective evidences.

## 6. Discussion and Suggestion

The results of previous analysis demonstrate that the most preferential sponsorship projects for Taiwan companies and foreign companies are different. Taiwan companies notice on the project of education most, and in contrast, foreign companies prefer the project of exercises and sports most. This difference may come from the backgrounds of various industries. For Taiwan companies, around 20 firms participating in this survey belong to service sector, and the other 20 firms are associated with manufacturing sectors. As analyzed by Chen, most of domestic companies are small and medium scales, and prefer to focus on the reputation of CSR, like the sponsorship of education and social welfare [30]. On the other hand, Benson argues that education sponsorship may be a long-term investment to cultivate talents to fulfill the needs of corporations in human resources, which may be the other factor that Taiwan companies prefer first [25].

For foreign companies, the 20 samples in this survey actually are all multinational corporations. As indicated by IEG report [1], most of multinational corporations tend to choose the project of exercises and sports most as the important sponsorship item. This is similar to the analysis of Stolar that sports sponsorship can promote company image quickly like the large sport event – Olympic Games [14]. It is also certain that sports sponsorship can help companies lock on the targeted consumers they hope [15, 18].

In addition, the project of social welfare is simultaneously listed by Taiwan companies and foreign companies, as well as total evaluators as the third preferential. Apparently, all evaluators still take account of social welfare as an important item of sponsorship. As emphasized by the scholars [31, 32], social welfare sponsorship can improve the image while substantially fulfilling CSR, change the attitude of the public to brand equity of corporations, and obtain the achievement of helping others to create a meaningful sponsorship, which should be the concerns of total evaluators for social welfare sponsorship.

Finally, the least preferential sponsorship project - research and development deserves to be discussed. For all evaluators

including Taiwan companies and foreign companies, the priorities of the preference for research and development project are all the least preferential, which indicates that the effectiveness of R&D project in this survey is beyond anticipation for evaluators. This result explains that the evaluators from different industries are unwilling to pay much attention to R&D project, given that R&D sponsorship project can increase R&D resources, deploy new product plans, build dependency relationship for adding talents, and influence the choice of research priorities as stressed by the scholars [33-36]. Besides, the evaluators covering many kinds of industries may disperse the allocation of preference weights for each project. If the participating subjects are sampled from technology industries, the result of R&D project may appear different.

The major limitation observed in this study relates to the limits of neglecting to conduct the assessment of precise factors or motives that inspire or influence the evaluators on the choice of sponsorship project. Apparently, the limitation can serve as an encouragement for future researchers. Therefore, the study suggests that future researchers can also use the method of consistent fuzzy preference relation to proceed with the survey of preference weights for practical factors or motives, further to construct pairwise comparison matrices amongst the preference of factors or motives and obtain the priorities of the preference for factors or motives. The application of fuzzy preference relation model to explore the factors or motives for separate preferential project may provide another contribution to the academia.

## Appendix: Basic Data

Basic data of the interviewed corporation

1. Name of Company:
2. Industry:
3. Capital:
4. Establishment:
5. Location:
6. Number of employees:
7. Company category:
8. Job title of the interviewee:

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