The Exploration of Strategic Indicators of Promoting University Social Responsibility Using Hybrid Multi-Criteria Decision-Making Methods

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Keywords	Abstract.
University social responsibility University administration support Education for sustainable development Fuzzy modified DANP Modified VIKOR	In Taiwan, the Ministry of Education has been promoting University Social Responsibility (USR) since 2017. As every university differs in locations, specialties, features, and resources, how to choose and promote appropriate USR projects becomes an important issue. As stated above, this research has used hybrid multi-criteria decision-making methods to explore strategic indicators of USR promotion. First, based on the modified fuzzy Delphi Method, we conclude that 5 dimensions and 16 criteria are key factors for evaluation. Then through the fuzzy modified DEMATEL-based analytic network process, we construct the interactions and relationships between all key factors and discuss their priority weights. Finally, through modified VIKOR, we have evaluated 3 USRSs' performance from universities in northern Taiwan to find out key problems of the strategy execution so that we can assist in proposing better improving strategies for universities in the distribution and application of the teaching.

1. Introduction

With social development, colleges and universities have become the important cradle of cultivating talents, playing a vital role in academic research. However, with time passage, they are inclined to lose the function of solving social problems (see Chan [1]). To help teachers and students get rid of the thinking of the academic ivory tower and further understand social change and industrial transformation, higher education has started to be devoted to environmental protection and caring for local talent cultivation in order to catch up with the trend of the present world.

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It emerges as an international trend for the world to promote University Social Responsibility (USR). America and Canada have promoted USR since 2010 (see Nejati et al. [38]). European Union has presented the USR frame since 2012 (see EU-USR [11]). And since 2017, the Taiwanese Ministry of Education has used local connection and talent cultivation as a core value to lead higher education to help solve local problems based on local demand (see Kuo [23]). Promoting social responsibilities has been listed as a focal point of school development, hoping to inspire universities to share and shoulder social responsibilities. Furthermore, via the innovation of curriculum, teaching, multiple-service learning, the incentive system, and school management, the features of higher education can be developed (see Chen [5]).

In observation of the issues of promotion of university social responsibility programs in recent years at home and abroad, the descriptive statistics and content analysis methods are used to collect student learning outcomes and self-assessment scales, classroom records of teachers and teaching research assistants, and student questionnaires, to understand the effect of the university's promotion of social responsibility programs (see Chang et al., [4]; Lee and Chi [24]; Chen and Chiu [6]). However, few studies focus on the overall indicators that affect the universities' promotion of social responsibility projects, and universities must allocate key resources in the process of promoting projects. In addition, the DANP-mV model has been applied to research in various fields. Therefore, this study will adopt the Multiple Criteria Decision Making (MCDM) method. We discuss the strategic indexes of promoting the USR project, finding out the key factors of pushing for the project. In addition, through expert interviews and investigation, Fuzzy Modified DEMATEL-based ANP (Fuzzy Modified DANP) is adopted to find out the inter-relations and the weight sequencing of importance between every dimension and principle. And then, we connect Modified VIKOR to find out the strategic index for higher education to push for the project, which helps to promote the USR in the future.

2. Literature Review

This section will briefly introduce what is meant by universities' social responsibility, and what are the key factors that will influence universities to promote social responsibility programs in order to construct subsequent research frameworks.

2.1. University Social Responsibility

USR has been initiated in Chile at the beginning of 2001 (see Gomez [14]), and Romania also presented the idea of leading universities to take part in and solve social problems, establishing the co-existence of universities and the environment (see Vasilescua et al. [52]). And the universities of the UK, America, and Canada have pushed for Sustainable Development since 2010 (see Nejati et al. [38]). European Union presented the reference frame of university social responsibilities between 2012 and 2014, leading European universities to adopt transparent strategies and acts to impact societies and environments (see EU-USR [11]). And Japan listed the connection between local industries and universities as the priority item of social responsibility, making universities an important spot for promoting local knowledge (see Wu [60] and Yang [61]).

Taiwan Ministry of Education [36] has been promoting university social responsibility programs since 2017, with "local connection" and "talent cultivation" as the core. Starting from local needs, through the concept of humanistic care and with a view to solving local community problems, our goal is to fulfill social responsibility (see Kuo [23] and Sung [44]). At the same time, the important media "Commonwealth Magazine" also believes that universities should bear the responsibility of making societal progress and promoting social development. Therefore, starting in2019, the "World USR University Citizenship Selection" is conducted, and the university governance, teaching environment, social participation, teaching commitment, and environmental sustainability are the five aspects to review the social responsibility of universities. And "Global Views Monthly" encourages more universities to implement social practice action plans and promote universities' social responsibility. The first "USR Award" was held in 2020, with four aspects of sustainable policy (school governance), environmental policy (sustainable campus), social care (local participation), and academic teaching (SDGs-related research and courses) to fully observe the implementation status of universities from the angle sustainability (see Syong [46] and Global Views Monthly [13]).

2.2. The strategic indicators for promoting USR

The strategic indicators of constructing USR project have become a focal point of recent educational policies. In the past, universities used to use the achievement-oriented indicator to show the school's performance (see Fu [12]). In terms of promoting knowledge, they focus on academic research (see Wang [53])., and Chan [1] considers social responsibility the intrinsic gene of the university mission, holding that universities short of social participation are destined to be isolated in the academic ivory tower. So, universities should change educational types, adjust the curriculum of social practice, raising the opportunities for their students to enter the workplaces to learn and develop the consciousness of social responsibilities. Meanwhile, universities can establish local connection and then enhance the development of local communities (see Chen [8]). Therefore, in this study, we discuss the strategic indicators for the universities to establish the USR project, dimensions, and executive principles as shown below:

University Administration Support

Taiwan's Ministry of Education [36] points out that based on individual features of each university, the school surveys the demand of local communities, planning for the goals of practicing social responsibility, and should incorporate innovative teaching, multiple learning, teacher's incentive system, resources connection as the key factors into school affairs management. Chang [2] thinks that to enhance the teachers' teaching quality and promote students' learning effect, the universities should engage in resource incorporation in school affairs management including the dimensions of organizations, leading, teaching, curriculum, learning, environment, and administration systems. As stated above, in this research, we study the university administration dimensions of influencing the execution of the USR project including the incorporation of resources and organizations, and the teachers' incentive system as two executive principles.

Innovational Instruction Resources

Innovative teaching means that teachers make efforts to exceed tradition, persisting in innovation to help students to gain better learning effects (see Shin [42]). And they use innovative teaching methods, incorporate teaching resources, and develop multiple teaching materials to make the teaching methods more active and interesting, aiming to stir up students' interest in the teaching process, cause more teachers' involvement, and inspire students' thinking (see Chiu [9]). In this research, we sort out the dimensions of innovational instruction resources influencing the execution of the USR project including three executive principles—innovative teaching curriculum, innovative teaching methods, and career development.

Social Participation

Tsai [50] thinks that social participation stresses that organizations and individuals make a social connection via interactions with others, and at the same time embrace social norms and are willing to contribute to society, establishing social cultivation. Lin [34] points out that social participation means playing a social role and engaging in social activities and interactions including participation in leisure sports, political activities, and volunteer services. In this research, we sort out the dimensions of social participation in influencing the execution of the USR project including three executive principles—volunteer services, social incorporation, and international connection.

Locality Talent Cultivation

To become the promoter of local sustainable development, universities should take advantage of talent cultivation and local connections to make the schools get a better understanding of the problems of local development and connection, presenting a potentially innovative solution and then influencing society (see Sung [44]). At the same time, to respond to local innovation and solve the problem of negative population growth in remote areas, the universities should use teaching materials to help cultivate local talents, making students stay in the local areas to work or start a business after graduation (see Guo [15]). In this research, we sort out the local talent cultivation dimensions of influencing the execution of the USR project including four executive principles—community talent cultivation, local industrial talent, local culture innovation talent, and community long-term care talent.

Education for Sustainable Development

2007 international environmental education meeting declaration "the framework of commonly supporting environmental education and education for sustainable development" points out that sustainable development is the ultimate goal of environmental education (see Judy Chang [21]). In 2015, the United Nations presented four cores of sustainable development, that is, social inclusion, environmental protection, economic growth, and cultural preservation with an aim of sustainable development (see Yang [63] and Wang [55]). In this research, we sort out the education for sustainable development dimensions of influencing the execution of the USR project including four executive principles—the domain of society, the domain of environment, the domain of economy, and the domain of culture.

3. Research Methods

This section will discuss and describe Fuzzy Modified DEMATEL-based ANP to find out the weight sequence of influence and importance of each indicator and employ Modified VIKOR to evaluate the overall performance of the USR project executed by each university.

3.1. Proposed Fuzzy modified DANP-mV Model

The Fuzzy modified DANP-mV model used in this study is a hybrid research tool, including Modified Fuzzy Delphi Method, Fuzzy modified DANP and Modified VIKOR. The Modified Fuzzy Delphi Method is the important key factor of constructing the facets and criterion evaluation indicators, and then the Fuzzy Modified DANP is used to evaluate the interaction relationship and importance weight ranking. Finally, Modified VIKOR is used to select the best and ideal improvement strategy. Figure 1 shows that the complete operation process can be divided into four stages:

(1) Use the Modified Fuzzy Delphi Method to construct the dimension and criteria evaluation indicators.

(2) Through the pairwise comparison between the indicators judged by experts, the mutual influence relationship is constructed by the Modified DEMATEL method, and the mutual influence network relationship diagram (INRM) is drawn.

(3) Apply the Modified DANP model to derive the importance weights ranking of key factors of the indicators.

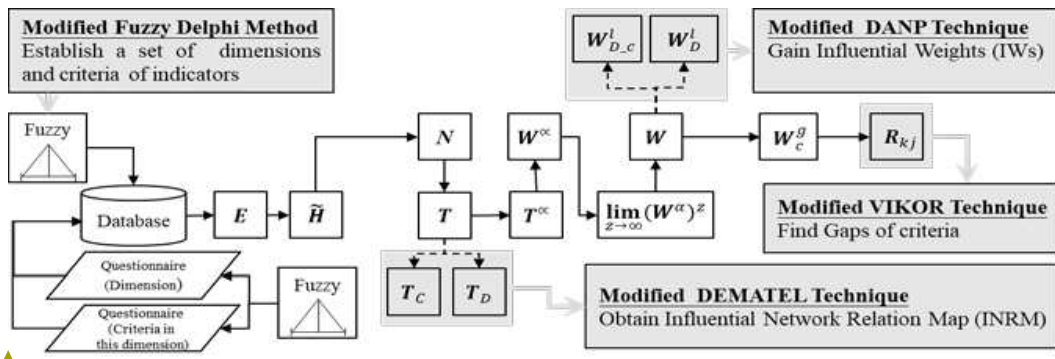(4) Use the Modified VIKOR method to select the best ideal improvement strategy.

Figure 1: The research procedure of the Fuzzy modified DANP-mV model.

3.2. Fuzzy Delphi Method

The main purpose of Fuzzy Theory is to use the Fuzzy Set mathematical method to solve semantic ambiguities (see Zadeh [65]). Because human beings more often than not are unclear of the subjective ideas, reasoning, and sensing about their surroundings, they have to use the logical concepts of Fuzzy Set to describe the ranking of the affairs,

making up for the insufficiencies of the traditional Binary Logic. Therefore, Fuzzy Theory is employed to help with high uncertainty, Fuzzy alternative projects, or Multi Criterion Decision Making (MCDM), certain complicated decision-making problems. In addition, Ishikawa et al. [19] present two methods of cumulative times allocation and Max-Min and Fuzzy Integration to sort out the experts' opinions to become Fuzzy Ranking. The dealing process is called the Fuzzy Delphi Method, which uses the concept of Fuzzy Ranking to deal with the Delphi Method, expecting to gain the experts' opinions to reach a consensus.

3.3. The Data Analysis Method

The Modified Fuzzy Delphi Method

This study initially adopts Modified Fuzzy Delphi Method to establish a set of frameworks of dimensions and criterion of strategic indicators influencing the universities to promote the USR project, sorting out the weight of the opinion evaluation of the experts to establish Triangular fuzzy number $(\tilde{A} = L, M, U)$ according to the formula of Equation (3.1) to solicit the experts' view of the dimensions and criteria to gain consensus. The parameter M has the maximum membership function value, that is $f_{\tilde{A}}(M) = 1$; it means that M is the data that can be most recognized as belonging to $\tilde{A}$ in the evaluation value, while L and U represent the lowest and highest possible data. (see Lee and Cheng [23]).

$$f_{\tilde{A}}(x) = \begin{cases} \dfrac{x-L}{M-L}, & L \leq x \leq M \\ 1, & x = M \\ \dfrac{x-U}{M-U}, & M \leq x \leq U \\ 0, & x \leq L; \ x \geq B \end{cases} \tag{3.1}$$

The Fuzzy Modified DEMATEL Method

This method is designed to find out the interrelation between each dimension and criterion. Lin and Wu [30] presented fuzzy theory to induce Modified DEMATEL in order to get a more objective understanding of the influence degree among variants. Through Defuzzification, Fuzzy Ranking is transformed into clear figures. The questionnaire contents for the interview of each expert are managed to establish the average direct-influence relation matrix of each indicator variant. And then via matrix counting, the direct/indirect relation matrix is formed. And then total influence relation matrix is counted to draw a figure of the executive steps of Influential Network Relation Map (INRM), Fuzzy Modified DEMATE (see Qu et al. [40]):

Step 1 : *Establish the direct influence relation matrix* $\boldsymbol{H}$

We ask N experts to rate the correlation between each index. The scale of the questionnaire is $0-4$: 0 means no influence, 1 means a low degree of influence, 2 means a moderate degree of influence, 3 means a high degree of influence, and 4 represents

a very high degree of influence. Thus, this matrix is an $n \times n$ nonnegative matrix. Then, the direct-influence relation matrix of the $\boldsymbol{H}$ experts can be obtained through the questionnaire as shown in Equation (3.2). The individual direct influence relation matrix H can be obtained by a survey.

$$
\boldsymbol{H} = \begin{bmatrix} h_{11} & \cdots & h_{1j} & \cdots & h_{1n} \\ \vdots & & \vdots & & \vdots \\ h_{i1} & \cdots & h_{ij} & \cdots & h_{in} \\ \vdots & & \vdots & & \vdots \\ h_{n1} & \cdots & h_{nj} & \cdots & h_{nn} \end{bmatrix}
\tag{3.2}
$$

Step 2: Calculate the average direct-influence relation matrix $\tilde{\boldsymbol{H}}$

Expert respondents have different evaluations on different dimensions and criteria, and there are differences in their recognition of semantic variables. After integrating the responses of N experts, where $z = L, M$, and U represent the left side value, middle value, and right side value of the triangular fuzzy number. In Equation (3.3), $\tilde{a}_{Dz}^{ij}(\tilde{a}_{Cz}^{ij})$ is the overall fuzzy value represented on the z side after the semantic variable of the fuzzy influence degree of the i-th aspect (criterion) on the j-th aspect (criterion) as converting into a triangular fuzzy number by N experts.

$$
\tilde{\boldsymbol{H}}_{Dz} = \begin{bmatrix} \tilde{a}_{Dz}^{11} & \cdots & \tilde{a}_{Dz}^{1j} & \cdots & \tilde{a}_{Dz}^{1n} \\ \vdots & & \vdots & & \vdots \\ \tilde{a}_{Dz}^{i1} & \cdots & \tilde{a}_{Dz}^{ij} & \cdots & \tilde{a}_{Dz}^{in} \\ \vdots & & \vdots & & \vdots \\ \tilde{a}_{Dz}^{n1} & \cdots & \tilde{a}_{Dz}^{nj} & \cdots & \tilde{a}_{Dz}^{nn} \end{bmatrix}, \qquad \tilde{\boldsymbol{H}}_{Cz} = \begin{bmatrix} \tilde{a}_{Cz}^{11} & \cdots & \tilde{a}_{Cz}^{1j} & \cdots & \tilde{a}_{Cz}^{1m} \\ \vdots & & \vdots & & \vdots \\ \tilde{a}_{Cz}^{i1} & \cdots & \tilde{a}_{Cz}^{ij} & \cdots & \tilde{a}_{Cz}^{im} \\ \vdots & & \vdots & & \vdots \\ \tilde{a}_{Cz}^{m1} & \cdots & \tilde{a}_{Cz}^{mj} & \cdots & \tilde{a}_{Cz}^{mm} \end{bmatrix}
$$

$$
\tilde{a}_{Dz}^{ij} = \frac{1}{n} \sum_{k=1}^{N} \tilde{a}_{Dz}^{ij} = \left(\frac{1}{n} \sum_{k=1}^{N} \tilde{a}_{DLk}^{ij}, \frac{1}{n} \sum_{k=1}^{N} \tilde{a}_{DMk}^{ij}, \frac{1}{n} \sum_{k=1}^{N} \tilde{a}_{DUk}^{ij} \right)
\tag{3.3}
$$

Step 3 : Formulate the normalized average direct influence relation matrix $\boldsymbol{N}$

The normalized average direct influence relation matrix H is acquired by normalizing the matrix $\tilde{\boldsymbol{H}}$. The matrix $\boldsymbol{N}$ is easily derived from Equations (3.4) and (3.5), in which all principal diagonal criteria are equal to 0:

$$
\boldsymbol{N} = \boldsymbol{u} \cdot \widetilde{\boldsymbol{H}_{\boldsymbol{D}z}}
\tag{3.4}
$$

$$
\min \left\{ \frac{1}{\max_{1 \leq i \leq n} \sum_{i=1}^{n} \tilde{a}_{Dz}^{ij}}, \frac{1}{\max_{1 \leq j \leq n} \sum_{i=1}^{n} \tilde{a}_{Dz}^{ij}} \right\}
\tag{3.5}
$$

Step 4 : Construct the total influence relation matrix $\boldsymbol{T}$

A continuous decrease of the indirect effects of problems moves with the powers of the matrix

$$
\boldsymbol{N}^q = [0]_{n \times n} \text{ for } \lim_{q \to \infty} (\boldsymbol{I} + \boldsymbol{N}^2 + \boldsymbol{N}^3 + \cdots + \boldsymbol{N}^q) = \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N}^{q-1}) = \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N})^{-1},
$$

where $\boldsymbol{I}$ is an $n \times n$ unit matrix. The total influence relation matrix $\boldsymbol{T}$ is an $n \times n$ matrix $\boldsymbol{T}$ is a $n \times n$ matrix and is defined by $\boldsymbol{T} = [t_{ij}]_{n \times n}$ for $i, j = 1, 2, \ldots, n$, as shown in Equation (3.6):

$$\begin{aligned} \boldsymbol{T} &= \boldsymbol{N}^1 + \boldsymbol{N}^2 + \boldsymbol{N}^3 + \cdots + \boldsymbol{N}^q = \boldsymbol{N}(\boldsymbol{I} + \boldsymbol{N} + \cdots + \boldsymbol{N}^{q-1}) \\ &= \boldsymbol{N}(\boldsymbol{I} + \boldsymbol{N} + \boldsymbol{N}^2 + \cdots + \boldsymbol{N}^{q-1})(\boldsymbol{I} - \boldsymbol{N})(\boldsymbol{I} - \boldsymbol{N})^{-1} \\ &= \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N})^{-1}, \text{ when } \lim_{q \to \infty} \boldsymbol{N}^q = [0]_{n \times n}. \end{aligned} \quad (3.6)$$

Step 5 : *Illustrate the total INRM from the INRM of dimensions and criteria*

The total influence relation matrix T of the INRM can be acquired using Equations (3.7) and (3.8) to generate each row sum and column sum, respectively, in the matrix $\boldsymbol{T}$, respectively.

$$o = [o_i]_{n \times 1} = \left[\sum_{j=1}^{n} t_{ij} \right]_{n \times 1} = (o_1, \ldots, o_i, o_n)' \quad (3.7)$$

$$r = [r_j]_{n \times 1} = [r_j]'_{1 \times n} = \left[\sum_{i=1}^{n} t_{ij} \right]'_{1 \times n} = (r_1, \ldots, r_j, r_n)' \quad (3.8)$$

The Fuzzy Modified DANP Method

Fuzzy Modified DANP is designed to find out the importance level of each dimension and criterion, using Fuzzy Modified DEMATEL as a foundational analysis to apply the total influence relation matrix, to the Super matrix of Analytic Network Process method, and then via the feature of weight change of the Super matrix to change the influenced figure of the total influence relation matrix to the influenced weight figure to gain the influence weight of each dimension and criterion. And then the partial weight of the criteria and the local weight of the dimension are multiplied to gain the global weight of each criterion. The steps of executing Fuzzy Modified DANP are as follows:

Step 1 : *Transpose and normalize the total influence-relation matrix*

We use Equation (3.9) to normalize the total influence matrix $\boldsymbol{T}$ to obtain the normalized total influence-relation matrix $\boldsymbol{T}^\alpha$, and then use Equation (3.10) to transpose $\boldsymbol{T}^\alpha$ to obtain $\boldsymbol{W}^\alpha$.

$$\boldsymbol{T}^\alpha = [t_{ij}]_{n \times n} / o \quad (3.9)$$
$$\boldsymbol{W}^\alpha = (\boldsymbol{T}^\alpha)^{-1} \quad (3.10)$$

Step 2 : *Calculate the local weights*

We perform Self-Multiplying on $\boldsymbol{W}^\alpha$ to get the limiting supermatrix $\lim_{z \to \infty}(\boldsymbol{W}^\alpha)^z$, where z is the integer 1. Then we use Equation (3.11) to calculate the influence weight until the supermatrix converges to the Steady-State supermatrix, then the area influence weight of Fuzzy Modified DANP for each dimension and criterion can be obtained.

$$\boldsymbol{W} = \lim_{z \to \infty}(\boldsymbol{W}^\alpha)^z \quad (3.11)$$

Step 3 : *Calculate the global weights*

Global weights of all criteria W_c^g are obtained by integrating the local weights of dimensions with criteria, as shown in Equation (3.12).

$$\boldsymbol{W}_c^g = \boldsymbol{W}_{D_c}^l \times \boldsymbol{W}_D^l \tag{3.12}$$

The Modified VIKOR method

According to the Modified VIKOR method presented by Liou et al. [35], we conducted the performance evaluation of the USR projects executed by three universities. This method can be categorized as the Multi Criterion Decision Making (MCDM) method mainly aiming to find out each dimension and criterion of executing the cases and the gap value of the aspiration level. And then according to the gap value, we suggest the improvement directions of the project execution. The steps of the analysis are explained as follows:

Step 1 : *Normalize the performance of k alternatives, and calculate the gap*

In this study, in the Performance Matrix $[r_{kj}]_{m \times n}$, the desired level f_j^* and the worst level f_j^- are used to calculate all criterion equations $i = 1, 2, \ldots, m$, and the option is $j = 1, 2, \ldots, n$, the performance of each criterion can be surveyed using a questionnaire on a scale from 0 (completely dissatisfied) to 10 (completely satisfied). Therefore, the desired level is $f_j^* = 0$ and the worst level is $f_j^- = 0$. In this study, we set $f_j^* = 10$ as the desired level value and $f_j^- = 0$ as the worst value for standardization, so as to avoid choosing the best solution from the poor options, then the solution is still poor, as shown in Equation (3.13).

$$[r_kj]_{m \times n} = [(|f_j^* - f_ij|)/(|f_j^* - f_i^-|)]_{m \times n} \tag{3.13}$$

Step 2 : *Determine the group utility S_j and largest gap Q_j*

Through Equation (3.14), S_j (also known as the minimum group utility average or minimum average gap) can be obtained, which represents the majority decision index. The smaller the value, the more the majority of decision-makers agree with this criterion plan; through Equation (3.15), Q_j can be obtained, which represents the largest gap of all criteria or individual regrets, which is the object of priority for each aspect of the criteria to be improved. The smaller the value is, the more it means that a few decision-makers oppose this criterion plan and the symbol W_i is the obtained influence weights after criterion DANP calculation.

$$S_j = \sum_{i=1}^{n} W_i(f_j^* - f_{ij})/(f_j^* - f_i^-) \tag{3.14}$$

$$Q_j = \max_i \{W_i(f_j^* - f_{ij})/(f_j^* - f_i^-)\} \tag{3.15}$$

Step 3 : *Establish a comprehensive integration indicator and rank the criteria*

Through Equation (3.16), the viewpoints of S_j and Q_j are integrated, and a comprehensive performance value R_j is established to sort the merits and demerits. Among

them, S^* is the ideal solution for the group benefit of the plan, S^- is the non-ideal solution of the group benefit of the plan; Q^* is the ideal solution to individual regrets, Q^- is the non-ideal solution of individual regrets; in this method, v is the decision weight value to the decision maker. And to find the largest gap and largest performance v weight value signifies the more decision makers agree; the smaller the v weight value, the less opposition.

$$
\begin{aligned}
S^* &= \min\{S_j \mid j = 1, 2, \ldots, n\}, & S^- &= \max\{S_j \mid j = 1, 2, \ldots, n\}, \\
Q^* &= \min\{Q_j \mid j = 1, 2, \ldots, n\}, & Q^- &= \max\{Q_j \mid j = 1, 2, \ldots, n\}, \\
R_j &= v(S_j - S^*)/(S^- - S^*) + (1 - v)(Q_j - Q^*)/(Q^- - Q^*), & v &\in [0, 1].
\end{aligned}
\tag{3.16}
$$

4. Empirical Analysis

In order to understand the strategic indicators of universities' promotion of social responsibility plans, this study begins to collect and analyze data based on the above-mentioned Fuzzy modified DANP and Modified VIKOR research methods, and at the same time, conducted the performance analysis and advanced strategy suggestions for the promotion of USR for sample universities.

4.1. Description of the Problem

In recent years, various universities have adopted different strategies to actively promote the USR project, and each university has invested relevant teaching and research resources according to its characteristics. Participants in the USR program include administrative unit directors or staff, teaching unit directors or teachers and students, and partners from industry or NPO organizations, and they not only have to evaluate the priority or proportion of teaching or administrative resources in the promotion process, but also need to have a very deep experience and feeling of participating in or assisting in promoting the USR plan. And through the implementation of the USR plan, it also helps a university build a teaching, research, or sustainability profile. Therefore, according to the Modified DANP-mV proposed by Qu et al. [40], and in order to achieve the consistency of expert opinion, this study will introduce the fuzzy set theory, so that the research results can be more objective and real.

4.2. Building Evaluation Indicators for Promoting USR

Based on the literature, this research explores and constructs the strategic evaluation indicators of the university's promotion of social responsibility plans, which are mainly divided into 5 major dimensions and 16 criteria, as shown in Table 1.

4.3. Research Framework

According to the documental research, we carve out the strategic indicators for the universities to promote the USR project, sorting out five dimensions, that is, University

Table 1: The constructed evaluation framework.

Dimensions/Criteria	Descriptions	References
University Administration Support (D_1)	Through well-functioning organizations and structures, the University conducts appropriate resource allocation and employs effective management systems.	
Incorporation of resources and organizations (C_{11})	The university establishes an organizational system, integrates and allocates various resources, and invests appropriate resources for the development of school affairs.	Wen [57]; Tsai [49]; Yu [64]
Teachers' incentive system (C_{12})	The university provides teachers with a specific incentive mechanism to activate teachers' enthusiasm and innovation for their work, and allow teachers to implement plans and develop their expertise.	Hsieh & Weng [16]; Li [26]
Innovational Instruction Resources (D_2)	The university introduces teaching resources such as new teaching concepts, methods, or strategies.	
Innovative teaching curriculum (C_{21})	The university integrates its own characteristics and resources such as industry, local or community, and designs innovative teaching courses.	Wen [57] Wang [54]
Innovative teaching methods (C_{22})	University teachers use innovative teaching methods such as problem-oriented learning teaching, flipped teaching, and inquiry-based teaching in teaching courses.	Pan and Tsai [39] Ku [22]; Ju [20]
Career development (C_{23})	The university incorporates the content of the plan into career exploration, workplace functions, and professional functions, etc., to strengthen the industrial connection with local industries and attract talents.	Wu [59] Chen et al. [7]
Social Participation (D_3)	Universities engage in social responsibilities such as environmental protection or local ecosystems in different ways.	
Volunteer services (C_{31})	University teachers cultivate students' citizenship and social responsibility by participating in community service, volunteering, service learning and international volunteering.	Lin [33] Tian et al. [48]
Social incorporation (C_{32})	Universities and industries, communities, schools or NPO organizations integrate resources and give full play to the overall characteristics and advantages of the community.	Wang [56] Lian [27]
International connection (C_{33})	The university and overseas partner schools or NPO organizations participate in local development, enhance the international vision of teachers and students, attach importance to various resource advantages, and enhance international influence and academic reputation.	Yang [62] Roy et al. [4]
Locality Talent Cultivation (D_4)	The university strengthens the connection with the local area, assists the local area to solve problems, and cultivates local talents at the same time.	
Community talent cultivation (C_{41})	The University bears the responsibility of promoting the revitalization of local communities. Through the participation of teachers and students, they can build community awareness, demonstrate local vitality, and promote the talents cultivation and employment of the community.	Chang et al. [3] Lian et al. [28]
Local industrial talent (C_{42})	Through visiting local development characteristics and regional industrial links, university teachers and students help local professional industries transform and enhance their competitiveness, and promote the cultivation and employment of local industrial talents.	Chuang [10] Hu [18]
Local culture innovation talent (C_{43})	University teachers and students assist in the preservation and promotion of local unique cultural industries, and promote the cultivation and employment of local cultural innovation talents.	Lin [32]; Su [43]; Lin et al. [31]
Community long-term care talent (C_{44})	University teachers and students actively promote community integrated care services, implement local aging and local nursing policies, and promote the cultivation and employment of community long-term care talents.	Ueng et al. [51] Lin and Yu [29]
Education for Sustainable Development (D_5)	Universities are nurtured through environmental sustainability education.	
Domain of social (C_{51})	The university uses teaching and research resources to achieve sustainable development towards the educational goals of disadvantaged care, local care, long-term care and urban and rural education development.	Ministry of Education [36]; Wang [55]
Domain of environment (C_{52})	The university uses teaching and research resources to achieve sustainable development towards educational goals such as the conservation of environmental resources, climate change, marine ecology, and terrestrial ecology.	Ministry of Education [36]; Wang [55]
Domain of economy (C_{53})	The university uses teaching and research resources to achieve sustainable development towards the educational goals of industrial development, improving labor productivity and the production mode of disadvantaged groups.	Ministry of Education [36]; Wang [55]
Domain of culture (C_{54})	The university uses teaching and research resources to achieve sustainable development towards educational goals such as cultural asset preservation, aboriginal culture, and multiculturalism.	Ministry of Education [36]; Wang [56]

Administration Support (D_1), Innovational Instruction Resources (D_2), Social Participation (D_3), Locality Talent Cultivation (D_4) and Education for Sustainable Development (D_5) and sixteen criteria, and the hierarchical framework of the research goals, dimen-
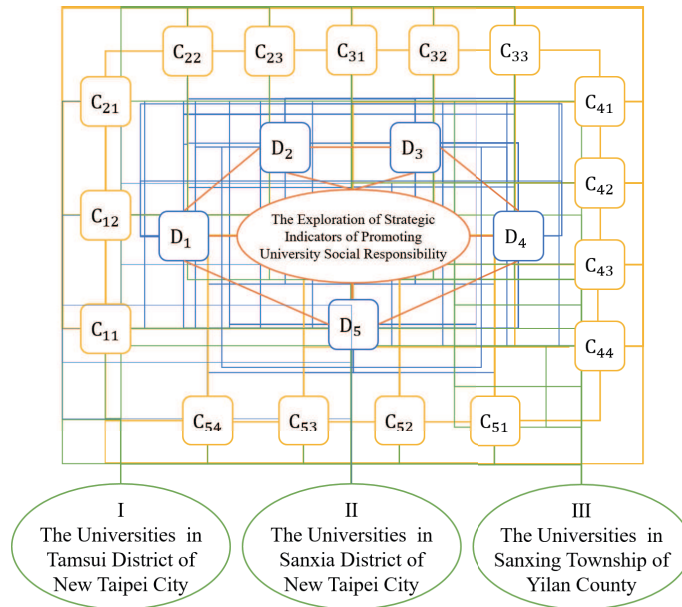
sions, and criteria is shown in Figure 2.

Figure 2: The hierarchy structure to determine the best Exploration of Strategic Indicators to Promote University Social Responsibility.

4.4. Data Collection, Analysis, and Results

The objects of this research are centered on the experts of the industrial sector and the academic circle who executed the USR project. And the investigations can be divided into two stages. In the first stage, the survey was conducted from November 16th to December 07th, 2020, mainly focusing on experts from the industry and academia who implement the university's social responsibility program, all of whom are senior executives, academic directors, and industry directors, a total of 10 experts. 10 experts were invited to conduct the questionnaire investigation of the Modified Fuzzy Delphi Method to ensure whether the contents of the dimension and criterion of the strategic indicators fit or not. And on the second stage, The survey was conducted from March 16th to April 13th, 2021, mainly from the industry and academic experts who implement the university's social responsibility plan. At this stage, the executive director, academic director, and industry executive who actually promote the university's social responsibility plan were selected. a total of 11 experts. 11 experts were invited to conduct the questionnaire investigation of Fuzzy Modified DEMATEL to find out the inter-relations between the dimensions and criteria of the strategic indicators. Furthermore, based on Murry and Hammons [37], we think that the fittest number of the chosen experts is supposed to be more than 10 persons. Wheeller et al. [58] suggests that the number should be 10 to 12 or 15 to 20. Hsu [17] points out that the experts of the same quality should be 10 to 15.

The three chosen universities have conducted the USR projects for years showing diverse professional features. For example, the schools in Tamsui District of New Taipei

City were awarded by CommonWealth Magazine between 2019 and 2020. And the schools in Sanxia District of New Taipei City are mainly concerned about the issues of sustainable development and were awarded by Corporate Sustainability Award. And the schools in Sanxing Township of Yilan County took advantage of the profession of medical and nursing health to connect with local communities.

Influence relation of all variables

According to the data analysis method discussed above, via the Fuzzy Modified DEMATEL method, the average direct-influence relation matrix ($\hat{\boldsymbol{H}}$) and total influence relation matrix ($\boldsymbol{T}$) are obtained. Dimension analysis results are shown in Table 2.

Table 2: Average direct-influence relation matrix and total influence relation matrix of each dimension.

$\hat{\boldsymbol{H}}$	D_1	D_2	D_3	D_4	E	$\boldsymbol{T}$	D_1	D_2	D_3	D_4	D_1
D_1	0	0.826	0.742	0.750	0.848	D_1	1.522	1.817	1.761	1.803	1.886
D_2	0.712	0	0.485	0.538	0.705	D_2	1.422	1.310	1.412	1.456	1.543
D_3	0.606	0.576	0	0.818	0.689	D_3	1.490	1.562	1.376	1.617	1.643
D_4	0.515	0.682	0.765	0	0.742	D_4	1.473	1.585	1.570	1.412	1.654
D_5	0.811	0.758	0.765	0.742	0	D_5	1.691	1.767	1.731	1.766	1.637

The column summation and row summation in the above total influence relationship matrix (T) are used to obtain the sum of the influence and the influenced dimensions and criteria (Table 3) It can be seen that the five dimensions, the school affairs support ($D_1 = 1.192$) and sustainable development education ($D_5 = 0.227$), the reason degree ($L_j - Q_i$) values are greater than 0, indicating that this dimension is biased towards "cause factors", while innovative teaching resources ($D_2 = -0.898$), social participation ($D_3 = -0.162$) and local talent cultivation ($D_4 = -0.360$), the cause degree ($o_j - r_i$) values are all less than 0, which means that this dimension is biased towards the "result factor". Take the total influence relationship matrix (T) to obtain the values of significance ($o_j + r_i$) and cause degree ($o_j - r_i$), etc., and draw the influence relationship diagram (INRM) between dimensions and criteria (Figure 2.), and the complex influence relationships are simplified into easy-to-understand structures that provide insight into problems and provide solutions.

According to the result of the overall analysis, in terms of Overall INRM (Figure 3.), the dimension of influential relations considers University Administration Support (D_1) and Education for Sustainable Development (D_5) to be reason elements and takes Innovational Instruction Resources (D_2), Social Participation (D_3) and Locality Talent Cultivation (D_4) as result elements, and thinks Innovational Instruction Resources (D_2), Social Participation (D_3) and Locality Talent Cultivation (D_4) as strategic directions, using University Administration Support (D_1) and Education for Sustainable Development (D_5) as strategic cores to form the main structure with Social Participation (D_3), and working with Locality Talent Cultivation (D_4) and Innovational Instruction Resources

Table 3: Fuzzy Modified DEMATEL Dimensions and Criteria Influence Degree Relation Table.

Dimensions/Criteria	O_j	r_i	$O_j + r_i$	$O_j - r_i$
University Administration Support (D_1)	**8.789**	**7.596**	**16.385**	**1.192**
Incorporation of resources and organizations (C_{11})	100.000	99.000	199.000	1.000
Teachers' incentive system (C_{12})	99.000	100.000	199.000	-1.000
Innovational Instruction Resources (D_2)	**7.142**	**8.040**	**15.182**	**-0.898**
Innovative teaching curriculum (C_{21})	17.118	16.387	33.505	0.731
Innovative teaching methods (C_{22})	17.210	17.058	34.268	0.152
Career development (C_{23})	15.154	16.037	31.191	-0.883
Social Participation (D_3)	**7.688**	**7.850**	**15.538**	**-0.162**
Volunteer services (C_{31})	0.910	0.921	1.831	-0.010
Social incorporation (C_{32})	0.957	0.947	1.904	0.010
International connection (C_{33})	0.767	0.767	1.534	0.001
Locality Talent Cultivation (D_4)	**7.693**	**8.053**	**15.747**	**-0.360**
Community talent cultivation (C_{41})	12.045	11.661	23.707	0.384
Local industrial talent (C_{42})	11.560	11.882	23.442	-0.321
Local culture innovation talent (C_{43})	11.334	11.676	23.010	-0.341
Community long-term care talent (C_{44})	9.919	9.641	19.560	0.279
Education for Sustainable Development (D_5)	**8.591**	**8.364**	**16.955**	**0.227**
Domain of social (C_{51})	19.273	18.732	38.005	0.540
Domain of environment (C_{52})	19.706	19.590	39.296	0.116
Domain of economy (C_{53})	18.919	18.525	37.443	0.394
Domain of culture (C_{54})	17.885	18.936	36.821	-1.050

(D_2) to form the planning level to promote the result of the USR project executed by the universities.

Importance of all dimensions and criterion

To find out the importance of each dimension and weight, we conduct the data analysis of fuzzy modified DANP to gain the global and local weight of each dimension and weight. The analysis result is shown in Table 4. Among all the importance weight of all dimensions, the importance weight of Education for Sustainable Development (D_5 = 0.210) is the highest. Locality Talent Cultivation (D_4 = 0.202) is the second and then followed by Innovational Instruction Resources (D_2 = 0.201), Social Participation (D_3 = 0.197), and University Administration Support (D_1 = 0.191).

Performance of implementing USR plans

Via the analysis result of Modified VIKOR, the overall performance and total gap of each dimension and criterion in the USR projects implemented by three universities located in Tamsui District, Sanxia District of New Taipei City, and Sanxing Township of Yilan County are shown in Table 5. The university situated in Sanxia District has the best overall performance (II = 7.982). And the university in Tamsui District (I = 7.770) is the second. And the third is the university in Sanxing Township of Yilan County (III = 7.418). Besides the overall performance, Gap represents the gap between each evaluation dimension and the best performance for the three universities. And the result
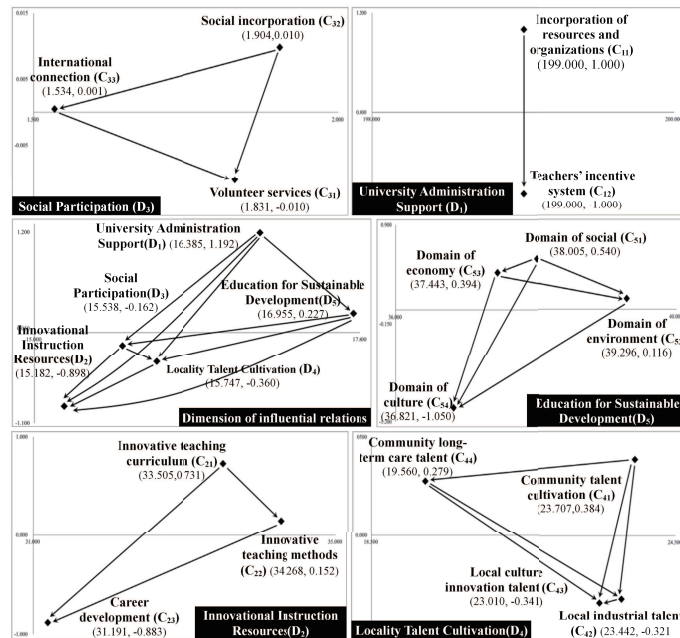
Figure 3: OVERALL INRM (Influential Network Relation Map).

shows that the university located in Sanxia District (II = 0.000) has the smallest gap. And the second is the university in Tamsui District (I = 1.098) and then the university in Sanxing Township of Yilan County (III = 1.740) embraces the biggest gap.

Using Modified VIKOR to count the gap figure, we find out the improvement directions for the three universities to push for the USR project. And the result finds that the university in Sanxia District needs to make an improvement in the dimension of Education for Sustainable Development. And the university in Tamsui District and the university in Sanxing Township of Yilan County need improvements in the dimension of University Administration Support to raise the effect of implementing the USR project.

4.5. Managerial Implications

It is a future trend for universities to promote social responsibility programs. Our research points out that schools' mastery of administrative support and the development of sustainable education are the two most critical strategic indicators for the success of the program. The integration of campus resources and organizations is also a key criterion for the administrative support dimension of school affairs. Therefore, before promoting social responsibility projects, universities should make an inventory of the key teaching and research resources on the campus that can assist the development of the community, school, or industry. To effectively promote the social responsibility plan, we suggest that the highest decision-making level of the university social responsibility plan promotion committee and project office should be established first, which is responsible for integrating various promotion resources in the school, communication channels of the school

Table 4: Global and local weights of dimensions.

Dimensions/Criteria	Local Weight	Local Rank	Global Weight	Global Rank
Education for Sustainable Development (D_5)	**0.210**	**1**		
Domain of social (C51)	0.247	3	0.052	14
Domain of environment (C52)	0.259	1	0.054	9
Domain of economy (C53)	0.244	4	0.051	15
Domain of culture (C54)	0.250	2	0.052	13
Locality Talent Cultivation (D_4)	**0.202**	**2**		
Community talent cultivation (C41)	0.260	2	0.052	11
Local industrial talent (C42)	0.265	1	0.053	10
Local culture innovation talent (C43)	0.260	3	0.052	12
Community long-term care talent (C44)	0.215	4	0.043	16
Innovational Instruction Resources (D_2)	**0.201**	**3**		
Innovative teaching curriculum (C21)	0.331	2	0.067	6
Innovative teaching methods (C22)	0.345	1	0.069	4
Career development (C23)	0.324	3	0.065	7
Social Participation (D_3)	**0.197**	**4**		
Volunteer services (C31)	0.349	2	0.069	5
Social incorporation (C32)	0.360	1	0.071	3
International connection (C33)	0.291	3	0.057	8
University Administration Support (D_1)	**0.191**	**5**		
Incorporation of resources and organizations (C11)	0.498	2	0.095	2
Teachers' incentive system (C12)	0.502	1	0.096	1

administration and academic units, and formulating the implementation plan. Now, the world regards ESG as the key direction to promote sustainable development. We believe that society should be listed as the most critical criterion for promoting sustainable education in universities, such as workplace issues, industrial relations, reciprocity and equality, gender equality, and racial discrimination. These are all important issues that universities should integrate into sustainable education.

5. Conclusions

Implementing the USR project is an important way for Taiwanese universities to fulfill their social responsibilities. However, the effect of implementation is influenced by many intrinsic and outside factors within the universities. Via the literature reviews, we construct a set of strategic indicators including five dimensions and sixteen criteria in pushing for the USR project. And then, we use the MCDM method to find out the influential relations and importance among these dimensions and criteria to serve as important references for the universities to implement the USR project and design strategies for implementing the USR project. The research results show that the key factors for the universities to push for the USR project are the two vital dimensions of University Administration Support and Education for Sustainable Development. And the key point of pushing University Administration Support to support the USR project is to

Table 5: The performance and gap evaluation of the case study using the Fuzzy Modified DANP-mV model.

Dimensions/Criteria	Local Weight	Global Weight	Performance			Gap		
			I	II	III	I	II	III
University Administration Support (D_1)	**0.191**		**7.591**	**8.000**	**7.045**	**0.046**	**0.038**	**0.056**
Incorporation of resources and organizations (C_{11})	0.498	0.095	7.636	8.091	7.273	0.022	0.018	0.026
Teachers' incentive system (C_{12})	0.502	0.096	7.545	7.909	6.818	0.024	0.020	0.031
Innovational Instruction Resources (D_2)	**0.201**		**7.485**	**7.879**	**7.030**	**0.050**	**0.042**	**0.060**
Innovative teaching curriculum (C_{21})	0.331	0.067	7.818	8.182	7.273	0.015	0.012	0.018
Innovative teaching methods (C_{22})	0.345	0.069	7.545	8.273	7.273	0.017	0.012	0.019
Career development (C_{23})	0.324	0.065	7.091	7.182	6.545	0.019	0.018	0.022
Social Participation (D_3)	**0.197**		**7.818**	**8.030**	**7.242**	**0.043**	**0.039**	**0.053**
Volunteer services (C_{31})	0.349	0.069	7.455	7.818	8.000	0.017	0.015	0.014
Social incorporation (C_{32})	0.360	0.071	7.909	8.091	7.273	0.015	0.014	0.019
International connection (C_{33})	0.291	0.057	8.091	8.182	6.455	0.011	0.010	0.020
Locality Talent Cultivation (D_4)	**0.202**		**7.318**	**7.614**	**7.909**	**0.053**	**0.047**	**0.042**
Community talent cultivation (C_{41})	0.260	0.052	7.818	8.000	8.000	0.011	0.010	0.010
Local industrial talent (C_{42})	0.265	0.053	7.545	7.818	7.818	0.013	0.012	0.012
Local culture innovation talent (C_{43})	0.260	0.052	7.545	7.818	7.909	0.013	0.011	0.011
Community long-term care talent (C_{44})	0.215	0.043	6.364	6.818	7.909	0.016	0.014	0.009
Education for Sustainable Development (D_5)	**0.210**		**7.977**	**8.000**	**7.886**	**0.042**	**0.042**	**0.044**
Domain of social (C_{51})	0.247	0.052	7.909	7.909	8.273	0.011	0.011	0.009
Domain of environment (C_{52})	0.259	0.054	7.909	8.091	8.000	0.011	0.010	0.011
Domain of economy (C_{53})	0.245	0.051	8.091	8.091	7.273	0.010	0.010	0.014
Domain of culture (C_{54})	0.250	0.052	8.000	7.909	8.000	0.010	0.011	0.010
Total Performance			**7.770**	**7.982**	**7.418**			
Total Gap						**1.098**	**0.000**	**1.740**

first establish related organizations and integrate the school resources. And the key point of pushing for Education for Sustainable Development is to first develop environmental education within on campus.

After making a comparison on the implementation effect of the USR project among the three universities, we know that the university in Sanxia District of New Taipei City stresses comprehensive influences including school management, education for sustainable development, partnership, and financial performance in pushing for the USR project, and gains the award of comprehensive effects for implementing the USR project. It is shown that since it promotes sustainable education, sustainable environment, and social cohesion in recent years, its performance gains societal recognition (see Taiwan Institute for Sustainable Energy [47]). And the university in Tamsui District of New Taipei City gains the university citizen award for implementing the USR project in terms of four dimensions, that is, university management, sustainable environment, social participation, and teaching promises (see Syong [45]). According to these two indicator schools, we figure out that when the universities push for the USR project, if they want to win societal recognition, they have to uphold the importance of two dimensions, that is, University Administration Support and Education for Sustainable Development. Future research

suggestions can include dimensions such as international cooperation, industry-university cooperation, etc., and it is suggested that the average number of interview experts from the government, industry, and academia will be selected, hoping to make more or more objective research findings and results.

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