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Using Analytic Hierarchy Process Method and Technique for Order Preference by Similarity to Ideal Solution to Evaluate Curriculum in Department of Risk Management and Insurance

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ABSTRACT This work recommends and analyzes the most appropriate curricula for students in departments of risk management and insurance from the perspective of life insurance companies in Taiwan. The paper proposes a curriculum performance evaluation method combining the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The AHP is used in obtaining the relative weights of criteria, and then the TOPSIS approach is employed to rank how universities perform in using this curriculum. Research results find that experts select the most appropriate curricula in universities for life insurance companies based on the following rankings: personal insurance, insurance company operations and management, and insurance theory and legal. The results suggest that Shih Chien University (SCU) provides the most appropriate curriculum and its students are the most employable graduates by life insurance companies in Taiwan. The proposed AHP-based algorithm significantly helps faculty in departments of risk management and insurance to improve their curriculum design. The proposed algorithm, which is objective and systematic in selection procedures, can help human resources managers recruit highly qualified graduates for their companies.

INTRODUCTION

In an increasingly knowledge-and service-based economy, the labor market has changed dramatically over the past decade (Moreau and Leathwood 2006). Companies must be flexible, adaptable, and innovative while using cutting edge, information technology. The emergence of networking firms that collaborate to become more competitive has also contributed to new education and training demands (Delanty 2000).

The higher education system in the Taiwan has undergone a major transformation over the past two decades. The number of university graduates increased nearly tenfold from 1986 to 2006 (MOE 2006), and, with a 54 percent graduation rate, Taiwan is now well above the Organisation for Economic Co-operation and Development (OECD) average (OECD 2006). This is happening because the education system is doing better year on year at improving the employability of young people, but not by enough to match the increased demand for skilled employees (MOE 2006). Employers in Taiwan often report that university graduates lack business awareness and are poorly prepared for work. Indeed, in a technologically advanced economy, the search for talent becomes paramount.

In recent years, Taiwan has continued its privatization, liberalization and deregulation process (Kwon 2002), introducing the Financial Institutions Merger Law in 2000, the Financial Holding Company Law in 2001, and the Financial Supervisory Board Law in 2001. These laws established a legal basis for creating financial holding companies that offer banking, insurance, securities and financial services through their subsidiaries. The laws also permit joint marketing efforts among subsidiaries of financial holding companies (Kwon 2002). When Taiwan joined the World Trade Organization in 2002, domestic financial institutions encountered new and stronger competition from foreign institutions, which triggered a tremendous change in the finance market (Chiu 2000).

The insurance industry's new requirements for qualified employees have led to changes in education and training (Fan and Cheng 2006). According to reports by the Taiwan Insurance Institute (2006) and the Non-Life Insurance Association of the R.O.C. (2006), almost 94

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percent of insurance employees work for life insurance companies. It can take months, and possibly even years, before a firm can recoup its investment in training employees in life insurance companies (Fan and Cheng 2006). These data suggest that graduates of university departments of risk management and insurance will probably work for life insurance companies but they often are not well-prepared for their jobs.

Given the rapidly changing financial environment, life insurance companies are coping with lower employee productivity and increasing market competition. As a result, they have had to increase their training budgets to improve the competencies of their employees in the short term. To meet long term hiring needs, insurance companies hope to recruit highly qualified graduates who do not require such extensive training. Therefore, this paper proposes a curriculum performance evaluation method combining the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). First we use the AHP to determine the relative weights of criteria and then we apply the TOPSIS approach to rank university curricula based on educating the most employable, qualified graduates.

LITERATURE REVIEW

Employability

Employability reflects how the workforce acquires the knowledge, skills and capability for meaningful jobs (Hillage and Pollard 1998; CBI 2001; McQuaid and Lindsay 2005; Morrison 2007), but it is primarily determined by the labor market rather than the capabilities of individual. Employability varies according to economic conditions. During labor shortages, the long-term unemployed become "employable" but when labor is in great supply they become "unemployable." Employability cannot, therefore, be defined solely in terms of individual characteristics (McQuaid and Lindsay 2005) because whether graduates find employment depends on how many other more qualified or experienced people are looking for the same kinds of work. Employability depends not only on fulfilling the requirements for a specific job but also on how the candidate compares to other job seekers (Brown et al. 2003). Universities must take into account this expanded definition of employability when preparing students for jobs.

The Changing Legitimating Idea of Higher Education

Higher education is being repositioned as an industry rather than a social institution (Gumport 2000). Education is being Japanised, with values and approaches to leadership coming directly from industrial processes (Morley and Rassool 1991). Higher education in Britain, for example, is viewed as a sub-system of the economy (Morley 2001). The UK government followed a supply-side strategy in an attempt to restructure the labor market by means of individual and collective skill development at the graduate level.

Ministry of Education (MOE) of Taiwan selected employability of graduates as one of the performance indicators for higher education (MOE 2007), implying that higher education institutions need to focus on better preparing graduates for new forms of employment in new economic areas. Universities must become more responsive to the needs and expectations of industry in order to ensure economic and social prosperity (Kruss 2004).

Collaboration between Universities and Industry

Many employers in Taiwan have expressed disappointment at the poor employability of university graduates. The failure of graduates to match industry demands results in an "employability gap" that higher education institutions and employers must work together to close (Philpott 2006). Reengineering the relationship between universities and industry can help graduates meet employer requirements (Mcgroddy 1995; Slotte and Tynjala 2003).

Over the past few years, developments in higher education have led to greater collaboration between universities and industry (Slotte and Tynjala 2003). The opportunities for cooperation between the two sectors range from education consulting to applied research to practices (Lukas 2003). According to research findings, university curricula continue to evolve in response to industry needs in a more effective way, improving the partnership between universities and industries.

Business should help universities develop curricula to meet their requirements (Deen 2005). Through regular consultation with employers, university faculty should ensure that the curricula

meet business needs for qualified graduates (Tener 1999). Industry has thus played a key role in designing the new curricula (Ronalds 1999), with larger employers dominating the debates about employability (Hesketh 2000). This raises the issue of how companies are redefining the skills and personal characteristics of the knowledge workers of the future (Brown et al. 2003). Universities working with large employers to design the curricula can effectively improve the employability of graduates.

Summary of the Literature Review

After reviewing the literature, this study concludes that

(1) Universities have become more responsive to educating and training students to satisfy the employment needs and expectations of industry.
(2) Universities and large employers are cooperating to develop curricula, an effective approach to better prepare qualified and competitive graduates for a changing workplace.

METHODOLOGY

Analytic Hierarchy Process

AHP is also a measurement theory that prioritizes the hierarchy and consistency of judgmental data provided by a group of decision makers. AHP incorporates the evaluations of all decision makers into a final decision, without having to elicit their utility functions on subjective and objective criteria, by pair-wise comparisons of the alternatives (Saaty 1990). AHP has thus been successfully applied to a diverse array of problems, with the calculation procedure as follows:

The hierarchy structure can be decomposed when dealing with a complex issue. Given the inability of humans to compare more than seven categories simultaneously, each element of the hierarchy must be assumed to not surpass seven elements. Under this limitation, a reasonable comparison can be made and consistency ensured as well (Saaty 1980). The first hierarchy of the structure is to achieve the goal. The final hierarchy involves selecting the projects or replacing the alternatives, while each middle hierarchy is either the appraisal factor or criteria.

Based on an element of the upper hierarchy is an evaluating standard, going on the pair-wise comparison to each elements.

If has Assume that the n elements must make n(n-1)/2 elements of the pair-wise comparison. Let $C_1, C_2, \ldots, C_n$ denote the set of elements, while a_{ij} represents a quantified judgment on a pair of elements C_i, C_j. The relative importance of two elements is rated using a scale with the values 1, 3, 5, 7, and 9, where 1 refers to "equally important", 3 denotes "slightly more important", 5 equals "strongly more important", 7 represents "demonstrably more important" and 9 denotes "absolutely more important". An n-by-n matrix A as follows:

$$A=\left[a_{ij}\right]=\begin{array}{c} \\ C_1 \\ C_2 \\ \vdots \\ C_n \end{array}\begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \end{array}, \qquad (1)$$

Where $a_{ij}=1$ and

$$a_{ij}=1/a_{ij},\ i,\ j=1,\ 2,\ \ldots,\ n.$$

In matrix A, the problem becomes one of assigning to the n elements $C_1, C_2, \ldots, C_n$ a set of numerical weights $W_1, W_2, \ldots, W_n$ that reflects the recorded judgments. If A is a consistency matrix, the relations between weights W_i and judgments a_{ij} are simply given by (for $i, j=1,\ 2,\ \ldots,\ n.$) and matrix A as follows:

$$A=\begin{array}{c} \\ C_1 \\ C_2 \\ \vdots \\ C_n \end{array}\begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\ \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n \end{bmatrix} \end{array}, \qquad (2)$$

Matrix A multiply the elements weight vector ( ) equal to , that is ($-nI)x=0$, the x is the Eigenvalue ( ) of Eigenvector. Due to be makers' subjective judgment give comparison and appraisal, with the truly value (W_i/W_j) have the some level degree difference, so that $Ax=n.x$ can not to be set up. Satty (1990) suggested that the largest eigenvalue be:

(3)

$$\lambda_{\max}=\sum_{j=1}^{n} a_{ij}\frac{W_j}{W_i},$$

If A is a consistency matrix, eigenvector X can be calculated by

(4)

Saaty (1990) proposed utilizing consistency index (*C.I.*) and consistency ratio (*C.R.*) to verify the consistency of the comparison matrix. *C.I.* and *R.I.* are defined as follows:

(5)

(6)

Where *RI* represents the average consistency index over numerous random entries of same order reciprocal matrices. If , the estimate is accepted: otherwise, a new comparison matrix is solicited until .

TOPSIS methodology

Developed by Hwang and Yoon in 1981, TOPSIS attempts to define the ideal solution and the negative ideal solution. The ideal solution maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. The optimal alternative is the closest to the ideal solution and the farthest from the negative ideal solution. Alternatives in TOPSIS are ranked based on 'the relative similarity to the ideal solution', which avoids having the same similarity for both ideal and negative ideal solutions. The method is calculated as follows:

(I) Establishing the performance matrix

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{array} \begin{bmatrix} X_{11} & X_{12} & \cdots & \cdots & X_{1j} & X_{1n} \\ X_{21} & X_{22} & \cdots & \cdots & X_{2j} & X_{2n} \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots \\ X_{i1} & X_{i2} & \vdots & \vdots & X_{ij} & X_{in} \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots \\ X_{m1} & X_{m2} & \cdots & \cdots & X_{mj} & X_{mn} \end{bmatrix}, \quad (7)$$

where X_{ij} is the performance of attribute X_j for alternative A_i, for i=1, 2, ..., m, j=1, 2, ..., n.

(II) Normalize the performance matrix.

Normalizing the performance matrix is an attempt to unify the unit of matrix entries.

(8)

where X_{ij} is the performance of attribute i to criterion j.

(III) Create the weighted normalized performance matrix

TOPSIS defines the weighted normalized performance matrix as $\forall i, j$,

(9)

where w_j is the weight of criterion j.

(IV) Determine the ideal solution and negative ideal solution

The ideal solution is computed based on the following equations:

$$| \ j \in J), \ (\min V_{ij} \mid$$
$$j \in J'), \ i = 1, 2, \ ..., \ m\} \ , \quad (10)$$

$$| \ j \in J), \ (\min V_{ij} \mid$$
$$j \in J'), \ i = 1, 2, \ ..., \ m\} \ , \quad (11)$$

where

$$\mid$$
$$j' = \{ j = 1, 2, \ ..., \ n$$
$$\mid$$

(V) Calculate the distance between idea solution and negative ideal solution for each alternative, using the n-dimensional Euclidean distance.

$$S_i^* = \sum_{j=1}^{n} (V_{ij} - V_j^*)^2 \qquad i = 1, \ 2, \ ..., \ m \ , \quad (12)$$

$$S_i^- = \sum_{j=1}^{n} (V_{ij} - V_j^-)^2 \qquad i = 1, \ 2, \ ..., \ m \ , \quad (13)$$

(VI) Calculate the relative closeness to the ideal solution of each alternative

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-} \qquad i = 1, \ 2, \ ..., \ m \ . \quad (14)$$

where $0 \le C_i^* \le 1$. That is, an alternative i is closer to A^* as C_i^* approaches to 1.

(VIII) Rank the preference order

A set of alternatives can be preferentially ranked according to the descending order of C_i^*.

Decision Model Application and Results

The satisfactory courses which are used to establish an estimate model for curriculum designed in the department of risk management and insurance was formed by experts after three

rounds of questionnaire surveys and following steps:

Step 1: Here, the experts who satisfy characteristics as showed in Table 1 are applied to select and define the evaluation criteria and sub-criteria. Finally, according to six experts from model life insurance companies confirm three evaluation criteria and eleven evaluation sub-criteria (see Table 2).

Step 2: Based on the modified Delphi method (Murry and Hammons, 1995), a general consensus among experts can be reached to establish a hierarchical structure. The most appropriate curriculums designed can be selected and evaluated based on three evaluation criteria, eleven evaluation sub-criteria and, finally, the alternatives (Fig. 1).

Step 3: Base on the weighted value that experts finally assign, the geometry mean value is used to compute decision-making community scores of all experts in order to formulate the weighted values selected for training program fitness. For instance, the main criteria as the sample, such as in Table 3. Eq. (1) and (2) are used to calculate the aggregate pair-wise comparison matrix.

Step 4: Using the comparison matrix (such as in Table 3), the eigenvectors were calculated by Eq. (3) and (4). Table 4 summarizes the results of the eigenvectors for criteria and sub-criteria.

Step 5: According to Eq. (5) and (6) the criteria comparison matrix of consistency for each criterion is calculated, as shown in Table 3. Results of the consistency test and the *CR* of the comparison matrix from each of the training administrators or human resource managers are all < 0.1, indicating "consistency". Furthermore, the *CR* of the aggregate matrix is also < 0.1, also indicating "consistency".

Step 6: Aggregated scores provided by all decision makers are aggregated showed in Table 5. Table 5 summarizes the relative weight of the elements for each level.

Step 7: Normalize the decision matrix.

Calculate the normalized performance matrix and calculate the weighted normalized

Table 1: Expert's bable 1: Expert's Background

Experts	*Employers*	*Years of working experience in H.R.*	*Title*
NO. 1	Model company A	12	Vice President for Human .Resources.
NO. 2	Model company B	18	C. E. O.
NO. 3	Model company C	14	Senior Manager for Human .Resources
NO. 4	Model company D	11	Vice Assistant President of Human Resources Department
NO. 5	Model company E	10	Senior Manager for Human .Resources
NO. 6	Model company F	12	Vice President for Human .Resources.

Table 2: The most appropriate curriculum formed by experts in the department of risk management and insurance

Categories	*Courses*	*References*
Insurance Theory and Legal	Principle of InsuranceInsurance Law Regulation of Insurance Contract	Opinions from the group of experts
Personal Insurance	Life InsuranceHealth and Accident Insurance Annuity Insurance Unit-Linked life Insurance	Opinions from the group of experts
Insurance Company Operation and Management	DerivatesInsurance MarketingProduct Design for Life Insurance Personal financial Planning and Insurance	Opinions from the group of experts

Table 3: Aggregation of the pairwise comparison matrix for criteria of main criteria

Level 2 criteria	*Insurance theory and legal*	*Personal insurance*	*Insurance company operation and management*
Insurance Theory and Legal	1.0000	0.7937	1.0000
Personal Insurance	1.2599	1.0000	1.0000
Insurance Company Operation and Management	1.0000	1.0000	1.0000

CI =0.00 ; CR = 0.00 < 0.1

Table 4: Weights of the criteria and sub-criteria

Criteria	*Criteria weight*	*Sub-criteria*	*Sub-criteria weight*	*Weights of overall levels*
Insurance Theory and Legal	0.308	Principle of Insurance	0.448	0.138
		Insurance Law	0.196	0.060
		Regulation of Insurance Contract	0.356	0.110
Personal Insurance	0.359	Life Insurance	0.353	0.127
		Health and Accident Insurance	0.195	0.070
		Annuity Insurance	0.150	0.054
		Unit-Linked Life Insurance	0.302	0.108
Insurance Company Operation and Management	0.333	Derivates	0.108	0.036
		Insurance Marketing	0.431	0.144
		Product Design for Life Insurance	0.253	0.084
		Personal Financial Planning and Insurance	0.207	0.069

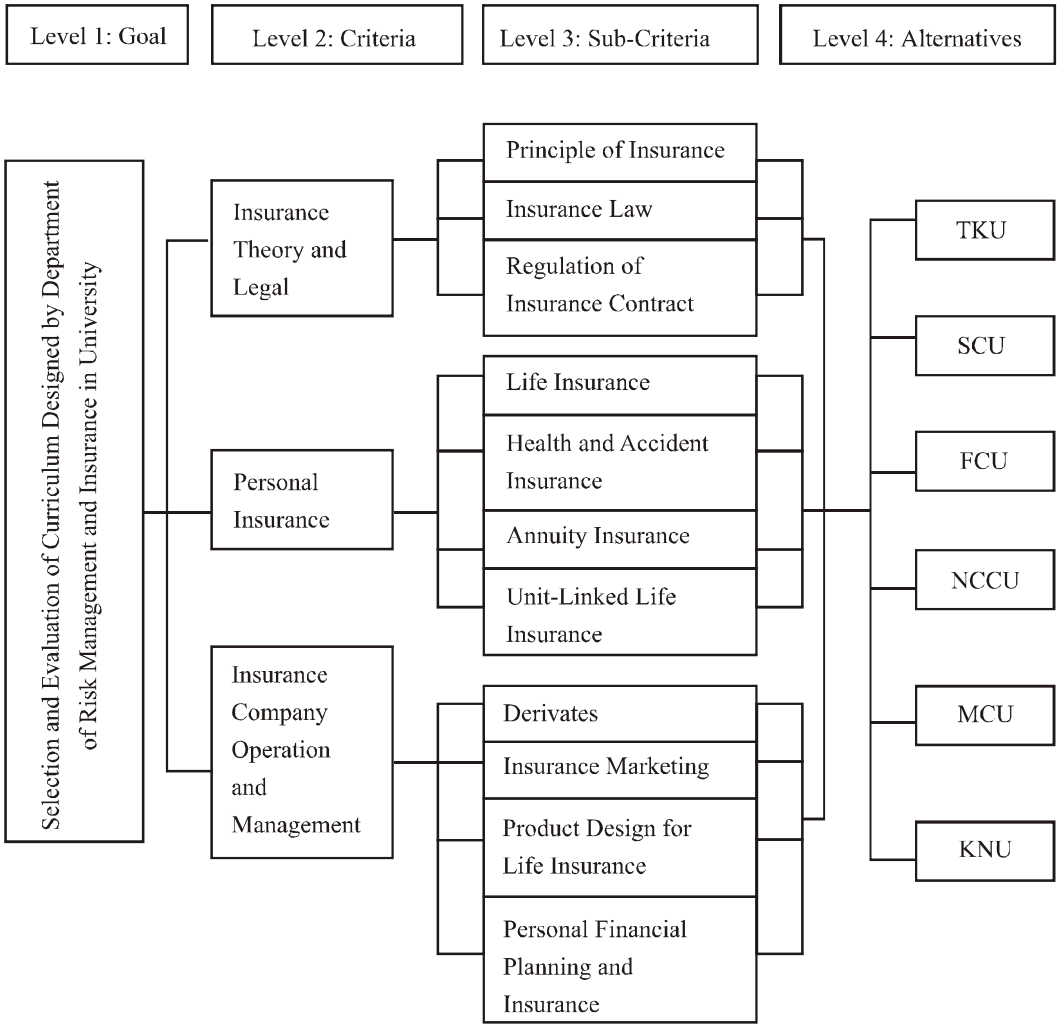

Fig. 1. Hierarchical structure to select and evaluate the curriculum

performance matrix, using formulae (8) and (9). Table 6 summarizes those results.

Step 8: Calculate the separation measures.

Determine the distance of the *i*th alternative from the ideal and negative-ideal solutions, using formulae (12) and (13). Table 7 displays those results.

Step 9: Calculate the relative closeness to the ideal solution and rank the preference order.

Step 10: Calculate the relative closeness to the ideal solution of each alternative, , using formulae (14) and rank the preference order (Table 8). Thus, SCU designs the most appropriate curriculum based on the opinion of the experts from the viewpoint of employability.

CONCLUSION

Recruiting employable and qualified graduates from departments of risk management and insurance in universities is a complex issue and often depends on the subjective assessments of decision-makers. Human resources managers in the life insurance industry, however, lack objective decision-making procedures and clearly-defined evaluation criteria. Therefore, this study presents an AHP and TOPSIS algorithm to determine employability factors in order to identify the most appropriate curricula design for departments of risk management and insurance. The proposed AHP-based algorithm significantly contributes to efforts to help faculty in departments of risk management and insurance to improve curriculum design. The proposed algorithm, which is objective and uses systematic selection, can help human resource managers recruit more qualified graduates for their companies.

Table 5: Evaluations of six universities under sub-criterions in relation to each criterion as averaged

Universities	*Principle of insurance*	*Insurance law*	*Regulation of insurance contract*	*Life insurance*	*Health and accident insurance*	*Annuity insurance*	*Unit-linked life insurance*	*Derivates*	*Insurance marketing*	*Product design for life insurance*	*Personal financial planning and insurance*
NCCU	0.170	0.108	0.421	0.132	0.125	0.147	0.117	0.117	0.310	0.098	0.142
TKU	0.215	0.293	0.116	0.263	0.241	0.256	0.279	0.120	0.103	0.248	0.260
SCU	0.215	0.212	0.116	0.216	0.245	0.178	0.232	0.120	0.278	0.243	0.182
MCU	0.108	0.151	0.116	0.099	0.093	0.106	0.090	0.269	0.103	0.093	0.089
FCU	0.222	0.157	0.116	0.225	0.222	0.243	0.210	0.122	0.103	0.247	0.256
KNU	0.070	0.080	0.116	0.065	0.074	0.071	0.072	0.252	0.103	0.070	0.070

Table 6: Summary of the weighted normalized data

Universities	*Principle of insurance*	*Insurance law*	*Regulation of insurance contract*	*Life insurance*	*Health and accident insurance*	*Annuity insurance*	*Unit-linked life insurance*	*Derivates*	*Insurance marketing*	*Product design for life insurance*	*Personal financial planning and insurance*
NCCU	0.393	0.244	0.851	0.297	0.282	0.334	0.260	0.266	0.667	0.217	0.318
TKU	0.497	0.661	0.235	0.591	0.543	0.581	0.620	0.273	0.222	0.548	0.582
SCU	0.497	0.478	0.235	0.486	0.552	0.404	0.515	0.273	0.598	0.537	0.408
MCU	0.250	0.341	0.235	0.223	0.209	0.241	0.200	0.612	0.222	0.206	0.199
FCU	0.513	0.354	0.235	0.506	0.500	0.551	0.466	0.278	0.222	0.546	0.574
KNU	0.162	0.181	0.235	0.146	0.167	0.161	0.160	0.573	0.222	0.155	0.157

Table 7: Resultant of S_i^* and S_i^-

Universities	S_i^*	S_i^-
NCCU(i=1)	0.07509	0.10238
TKU(i=2)	0.09390	0.10881
SCU(i=3)	0.07431	0.10464
MCU(i=4)	0.13069	0.02370
FCU(i=5)	0.09778	0.09250
KNU(i=6)	0.14405	0.01106

Table 8: Summary of the TOPSIS C_i^*

Universities	C_i^*	*Rank*
NCCU(i=1)	0.57688	2
TKU(i=2)	0.53677	3
SCU(i=3)	0.58474	1
MCU(i=4)	0.15351	5
FCU(i=5)	0.48615	4
KNU(i=6)	0.07128	6

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