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Developing Performance Indicators for Engineering Technology Programs in the Universities/Colleges of Technology in Taiwan

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Abstract

Highly expected to prepare quality engineering technology (ET) personnel, the ET programs in the universities/colleges of technology (UTs/CTs) in Taiwan have been anticipated to assure their performance. Performance indicators (PIs) are quantifiable measures that reflect whether you are successfully meeting or falling short of your goals. As for ensuring the performance of ET programs, performance indicators (PIs) are popular measures to monitor performance. The purpose of this study was to develop PIs for ET programs in the UTs/CTs in Taiwan. Literature review, panel discussion, and questionnaire survey were employed in order to achieve the purpose. With a valid return rate of 67% from

174 department heads in ET programs, the following conclusions are made: (1) The ET program heads in public and private institutions have the same point of views in the importance of PIs developed in this study; (2) There are 12 key performance indicators (KPIs) strongly recommended to be utilized in monitoring the performance of ET programs; (3) The 12 KPIs can be divided into three categories as satisfaction, enrolment, and revenues.

Keywords: performance indicators, key performance indicators, engineering technology programs.

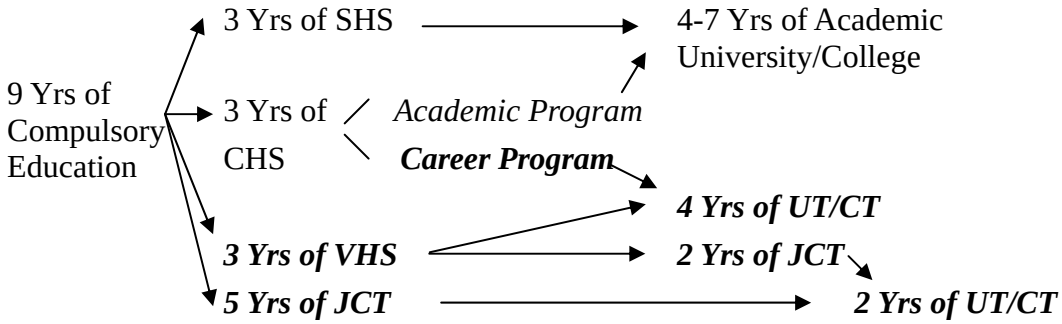
I. INTRODUCTION

During the past decades, Taiwan has created an economic miracle and its entire society has been going through rapid transformation. With the great impact from the transformation, Taiwan becomes a Green Silicon Island, where needs not only engineering (E) but also engineering technology (ET) workforce. At present, ET in Taiwan at least has the following concerns:

A. Engineering technology education (ETE) is highly expected to perform well

Beyond nine years of compulsory education, formal education in Taiwan is streamed into the following two tracks, which are like “two legs walking” to prepare the workforce: (1) General academic education (GAE)—mainly including three years of college-bound coursework in senior high schools (SHSs) as well as comprehensive high schools (CHSs), and four to seven years of coursework at the academic university/college level; (2) Technological and vocational education (TVE)—mainly including the institutions/programs highlighted in Figure 1. All universities/colleges and JCTs in both GAE and TVE systems, shown in Figure 1, are categorized as higher education institutions. In the past decade (school years 1995-2004), the number of these institutions increased by 25 (around 19%; from 134 to

159) (see Figure 2).



Legend: CHS-comprehensive high school CT-college of technology
JCT-junior college of technology SHS-senior high school
VHS-vocational high school UT-university of technology
Yrs-Years

Figure 1. Formal education structure in Taiwan

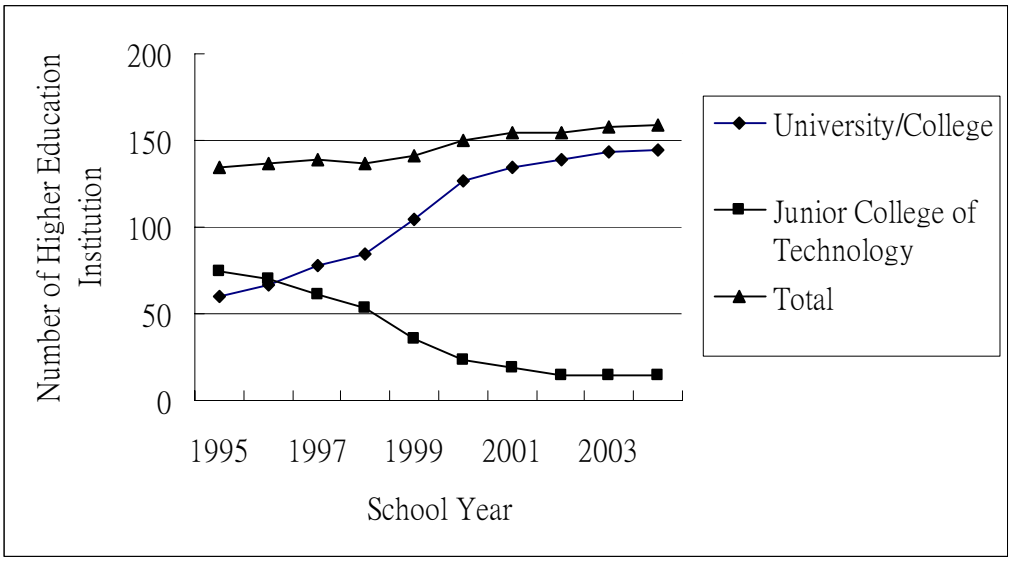


Figure 2. The number changes of higher education institutions [1]

B. Performance indicators (PIs) are measures to monitor performance

With the transformation to high-tech age, people can handle more and more things in their daily life. Accordingly, the need of high performance in organization of business is increasing. In order to measure the performance in organization of business, many business companies developed PIs in order to monitor their performance. Due to the trend of developing PIs in organization of business, concepts of accountable management in the

public sector have supported to include performance measurement on the improvement agenda of higher education institutions.

In the literature on the measurement of school performance in higher education, Cullen, Joyce, Hassal, and Broadbent [2] used a balanced scorecard (BSC) in order to ensure the quality in higher education and attempted to transfer from monitoring to management. In addition to the development of BSC, the development and application of performance indicators (PIs) have become an integral part of many western governments' approach to the management of the higher education system. In their push for PIs in higher education, the governments have made numerous claims about the benefits can be obtained from the applications of PIs, such as improved accountability and feedback on work performance [3, p.379]. Besides, Barnetson and Cutright argued that PIs in higher education are conceptual technologies that shape what issues we think about and how we think about those issues by embedding normative assumptions into the selection and structure of those indicators [4, p.277].

At the level of higher education, ET is one of the most important fields. Due to the needs of human resources in the field of ET, the performance of ET programs should be highly emphasized. In order to ensure the quality of ET programs, Accreditation Board for Engineering and Technology (ABET) is recognized by the Council on Higher Educational Accreditation and one of its major purposes is to develop standards for ensuring the quality of ET programs [5]. The spirit of accreditation standards developed by ABET is the same with PIs, both of them focus on monitoring the quality of ET programs. Therefore, it is important to develop PIs for ET programs in UTs/CTs in Taiwan, and this is also the major purpose of this study.

II. LITERATURE RIVEW

A. Methodological Approaches in Constructing PIs

In the literature on methodological approach in constructing PIs, Coombes, Raybould and Wong [6] advocate the use of a combined “top-down” and “bottom-up” approach characterized by the identification of indicators to assess the potential for urban regeneration. The major reason is that the ‘top–down’ approach requires a preliminary analysis of the concept, before breaking it down into a typology of factors. In contrast, the ‘bottom–up’ approach lists the factors that can be argued to be individually important, usually from grassroots level [7]. Besides, Hemphill, Berry and McGreal [8] use four phases methodological approach in constructing local area-specific indicators (Figure 3).

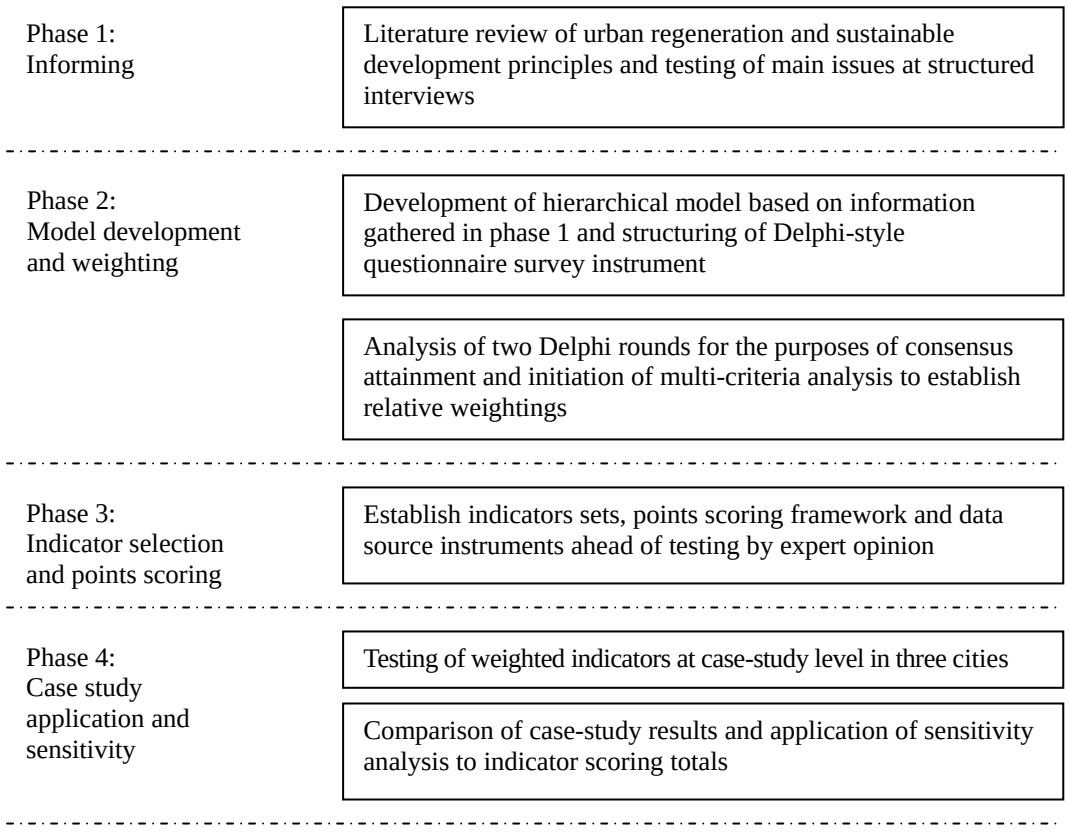


Figure 3. Methodological Approach [8, p.729]

According to the methodological approach mentioned by Hemphill, Berry, and McGreal [8], the methodological approach can be revised with better research approach. On the hand of top-down, PIs in ET programs can be developed by the following five steps: literature review, PIs selection, criteria for selecting PIs, constructing a draft set of PIs, and panel discussion. These steps are explained as follows:

1) Literature review: In order to develop the draft of PIs in any research topics, literature review of research topics and sustainable development principles should be conducted firstly.

2) PIs selection: After the review of literature, the PIs selection should follow Coombes and Wong's [9] four-step procedure in determining the selection of indicators as follows: (a) Conceptual consolidation: clarifying the basic concept to be presented in the analysis; (b) Analytical structuring: providing a structure within which the indicators can be collated; (c) Indicator identification: translation of the structure developed in Step 2 into specific measurable indicators; (d) Index creation: process of synthesizing the proposed indicators into a single/composite measure.

3) Criteria for selecting PIs: The development and selection of indicators is a long and complex process, where the selection of some may be obvious, but in other situations either it is not clear which indicators are the most appropriate, or the data to evaluate the preferred indicator are not available [8, p.729]. Therefore, there is no doubt that when we want to select PIs in UTs/CTs, the setting of criteria is necessary.

Hatry, Blair, and Fisk [10] suggested that the following criteria to frame the selection of performance measures: (a) appropriateness and validity; (b) uniqueness, accuracy and reliability; (c) completeness and comprehensibility; (d) controllability; (e) cost and feedback time. And Kaufman [11] pointed that useful performance indicators best related to valid ends: results, consequences, performance, and payoffs. However, Shavelson, McDonnell, and Oakes [12] assumed that indicators should: (a) reflect the central features; (b) provide

information pertinent to current or potential problems; (c) measure factors that policy can influence; (d) measure observed behavior rather than perceptions; (e) be reliable and valid; (f) provide analytical links; (g) be feasible to implement; and (h) address a broad range of audiences.

On the other hand, the Association of Universities and College of Canada [13] mentioned that the key features of performance indicators were as follows: (a) are goal or result oriented- related to missions or outcomes; (b) have a reference point- a target, performance over time or comparison across institutions; (c) provide strategic information about the condition, health or functioning of the institution/system; (d) are evaluative- the purpose is to assess, judge; (e) are strategic, specific, policy-oriented and issue-driven; (f) connect outcomes to structure and process, taking inputs into account; (g) are used for improvement, enhancement, positive reform.

Furthermore, Department of the Environment, Transport and the Regions [14] also mentioned that indicators must be capable of satisfying various criteria in terms of being scientifically sound, technically robust, easily understood, sensitive to change, measurable and capable of being regularly updated. In addition, Lee and Lai [15] identified KPIs for ET programs according to the following criteria: (a) alignment with UTs/CTs missions; (b) linkage to overall ET program objectives; (c) access to specific information regarding program problems; (d) measurement of observed behavior rather than perceptions; (e) reliability and validity; (f) access to analytical links; (g) feasibility of implementation; and (h) addresses a broad range of audiences.

In order to generate the most appropriate criteria for selecting PIs, a two dimension table was utilized to check if each possible PI meets the following adapted criteria: (a) alignment with UTs/CTs missions; (b) linkage to overall objective; (c) connecting outcomes to structure and process, taking inputs into account; (d) strategic, specific, policy-oriented and

issue-driven; (e) reliability and validity; (f) accessing to analytical links; (g) feasibility of implementation; and (h) addressing a broad range of audiences.

4) Constructing a draft set of PIs in ET programs: Kaufman [11] suggested an optional template for including internal and external usefulness in deriving PIs as figure 4. Therefore, through the process of selecting PIs in ET programs, Kaufman's template can be used to construct a set of PIs.

	Inputs	Processes	Products	Outputs	Outcomes
Example	goals, objectives	teaching, learning	competency	job placement, certified licenses	safety of outputs
Scope	Internal（Organizational）				External（Societal）
Cluster	Organizational Efforts		Organizational Results		Societal Results/Impact

Figure 4. An optional template for including internal and external usefulness in deriving PIs [11, p.81]

5) Panel discussion: In order to confirm the appropriate of the draft of PIs in ET programs, panel discussion should be conducted in order to develop a serious draft from the viewpoints of top-down approach.

In order to make the PIs practicable, the following steps of bottom-up approach should also be adopted in this study:

1) Field interview: For the purpose of understanding the viewpoints of ET department heads, field interview should be conducted in order to revise the draft of PIs for ET programs.

2) Questionnaire survey: After revise the set of PIs for ET programs by field interview, the last and most important work is conducting the questionnaire survey. Through the questionnaire survey, the opinions of ET department heads can be collected and utilized in refining the PIs.

B. PIs for Departments of ET

The purpose of this study was to develop PIs for ET programs, so fore, literature review of PIs in higher education, Accreditation Board for Engineering and Technology (ABET) are necessary. Meanwhile, the criteria of selecting PIs were also reviewed.

1) PIs in Higher Education

PIs have grown in popularity in higher education institutions around the world. For example, the Oregon University System (OUS) in the United States implemented PIs in the late 1990's. The OUS's 12 KPIs are as follows: (a) total credit enrolment, (b) new undergraduate enrolment, (c) freshman persistence, (d) six-year graduation rates, (e) total degree production, (f) degrees in shortages areas, (g) philanthropy, (h) recent graduates, (i) graduate success, (j) faculty compensation, (k) research and development (R&D), as well as (l) internships [16]. Johnes and Taylor [17, p.174] also mentioned five PIs in higher education as follows: (a) the non-completion rate, (b) the percentage of graduates, obtaining a first or upper second class honours degree, (c) the percentage of graduates obtaining permanent employment, (d) the percentage of graduates proceeding to further education or training, and (e) the average research rating obtained by each university in the UFC's 1989 Research Selectivity Exercise.

Besides, High Education Funding Council for England [18] also suggested five PIs in higher education as follows: (a) access to higher education, (b) non-completion rates for students, (c) outcomes and efficiencies for learning and teaching in universities and colleges, (d) employment of graduates, and (e) research output. Furthermore, there were also three different categories of PIs proposed in Jarratt Report including of "internal performance indicators," "external performance indicators," "operational performance indicators [19]."

On the other hand, Burke [20, p.24] suggested 13 core indicators in higher education: (a) State operating appropriations for public higher education per student; (b) Tuition and fees as

a percent of state median family income; (c) Pass rates on teacher certification exams; (d) Percent of baccalaureate freshmen with college preparatory curriculum in high school; (e) College going rate; (f) Percent of 25-44 year olds enrolled part-time in post-secondary education; (g) Transfer rates of two- and four-year institutions; (h) Graduation rates of two-year (3yrs) and four-year campuses (6yrs); (i) Degrees attainment; (j) Degrees attainment critical fields, i.e., science, engineering, technology and teacher education; (k) Job placement rates for graduates; (l) Dollar volume of externally sponsored research; (m) Alumni survey on the knowledge and skills developed in college.

Lee and Lai [15] completed a questionnaire survey to identify 22 KPIs for ET programs in taiwan, which are outcome-based and compatible with ABET's accreditation criteria as follows: (a) Number of admitted freshman; (b) Percentage of freshmen to all admission applicants; (c) Percentage of enrolled freshman to admitted freshman; (d) Percentage of freshman who advance to become sophomores; (e) Percentage of graduates from the previous school year to the quantity of the initial enrolment; (f) Percentage of graduates of the previous school year who participated in work-based practicum; (g) Cooperative institutions' satisfaction with students participating in work-based practicum; (h) Average graduation credits earned by graduates of the previous school year; (i) Percentage of selective credits to average graduation credits earned by graduates of the previous school year; (j) Average academic grading of graduates of the previous school year; (k) Average behavioral conduct grading of graduates of the previous school year; (l) Percentage of graduates of the previous school year employed within three months after graduation; (m) Employed graduates' satisfaction with their ETE learning at six months after graduation; (n) Employed graduates' satisfaction with their compensation at six months after graduation; (o) Employers satisfaction with ETE graduates; (p) Percentage of graduates of the previous school year immediately continuing postgraduate education; (q) Continuing study graduates' satisfaction

with their ETE learning at six months after graduation; (r) Continuing study institutions' satisfaction with ETE graduates; (s) Ratio of students to full-time faculty; (t) Current revenues per ETE student in the previous fiscal year; (u) Capital revenues per ETE student in the previous fiscal year; and (v) Rating from the recent evaluation administered by the Ministry of Education (MOE).

2) PIs for ET Programs

In order to select the PIs for ET programs, in this study a two dimension table was used to select the PCorrespond with eight criteria. After the selection of PIs, 25 PIs were selected and adapted to 21 PIs finally.

3) The Set of PIs for ET Programs

After the selection of PIs for ET programs, Kaufman's [11] template was used to develop the set of PIs for ET programs. However, this study focused on developing the internal ET programs' PIs, and external ET programs' PIs was neglected. The set of PIs in ET programs is described in Figure 5.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1. ET Programs' Effort	1-1 Input	1-1-1 Objectives	1-1-1-1 Programs' educational objectives are consistent with the mission of the institution.
			1-1-1-2 Programs' educational objectives are applicable with the ABET criteria
		1-1-2 Enrolment	1-1-2-1 Percentage of freshmen to all admission applicants
			1-1-2-2 Percentage of enrolled freshman to admitted freshman
		1-1-3 Unit costs	1-1-3-1 Current revenues per ETE student in the previous fiscal year
			1-1-3-2 Capital revenues per ETE student in the previous fiscal year
	1-2 Process	1-2-1 Learning	1-2-1-1 Percentage of freshman who advance to become sophomores
			1-2-1-2 Percentage of graduated from the previous school year to the quantity of the initial enrolment
		1-2-2 Practicum	1-2-2-1 Percentage of graduates of the previous school year who participated in work-based practicum
			1-2-2-2 Cooperative institutions' satisfaction with students participating in work-based practicum
		1-2-3 Courses	1-2-3-1 Average graduation credits earned by graduates of the previous school year
			1-2-3-2 Percentage of selective credits to average graduation credits earned by graduates of the previous school year
2. ET Programs' Result	2-1 Products	2-1-1 Learning Performance	2-1-1-1 Average academic grading of graduates of the previous school year
		2-1-2 Further Job/Study Performance	2-1-2-1 Percentage of graduates of the previous school year employed within three months after graduation
			2-1-2-2 Percentage of graduates of the previous school year immediately continuing postgraduate education
	2-2 Outputs	2-2-1 Learning Satisfaction	2-2-1-1 Continuing study graduates' satisfaction with their ETE learning at six months after graduation
			2-2-1-2 Continuing study institutions' satisfaction with ETE graduates
		2-2-2 Job Satisfaction	2-2-2-1 Employed graduates' satisfaction with their ETE learning at six months after graduation
			2-2-2-2 Employed graduates' satisfaction with their compensation at six months after graduation
			2-2-2-3 Employers satisfaction with ETE graduates
		2-2-3 Appraisal	2-2-3-1 Rating from the recent evaluation administered by the Ministry of Education (MOE)

Figure 5. The set of PIs for ET programs

III. METHODOLOGY

In order to develop the PIs in ET programs, this study uses both “top-down” and “bottom-up” approaches as follows:

A. Literature review

In order to develop a draft of PIs, literature review and sustainable development principles were conducted firstly.

B. Panel discussion

In order to confirm the appropriateness of the draft PIs for ET programs, a panel discussion was conducted in order to develop draft PIs from the viewpoints of top-down approach.

C. Questionnaire survey

For the purpose of understanding the viewpoints from ET department heads, questionnaire survey was conducted in order to refine the draft from the viewpoints of bottom-up. Besides, the ET department heads also ranked the importance of PIs by using the five-point scale from “very unimportant—1” to “very important—5”. Results of the study were based on responses received from 174 ET department heads, with a return rate of 67%.

IV. RESULTS AND DISCUSSION

A. The correlation of ranking PIs between earlier reply and later reply

Due to the non-response is likely to bias survey results, it is necessary to understand the relationship between response and non-response [21]. Broadly speaking, the reply of questionnaire survey can be divided into two periods. The first peak of reply can be called earlier reply, and the second peak of reply can be called later reply, which could be considered as the non-response. The rank of PIs in different periods is shown in table 1, and

the Spearman correlation of ranking between earlier-reply and later-reply is .803 with significance level .05 (table 2). That is to say, statistically there is no difference between response and non-response in this study, so all responses in this study could be generalized to population.

Table 1. The rank of PIs in earlier and later reply

PIs	Earlier Reply			Later Reply		
	M	SD	RANK	M	SD	RANK
1-1-1-1	4.28	0.69	21.0	4.40	0.66	21.0
1-1-1-2	3.49	0.97	5.5	3.41	0.89	3.0
1-1-2-1	4.02	1.03	14.0	4.14	0.90	18.5
1-1-2-2	3.99	1.02	12.5	4.14	0.98	18.5
1-1-3-1	3.98	0.85	11.0	3.72	0.87	9.0
1-1-3-2	4.04	0.89	15.5	3.83	0.89	11.0
1-2-1-1	3.67	1.01	10.0	4.12	0.89	17.0
1-2-1-2	3.57	0.91	7.0	3.81	0.85	10.0
1-2-2-1	3.66	0.94	9.0	3.49	0.96	6.0
1-2-2-2	4.05	0.84	17.0	4.04	0.63	14.0
1-2-3-1	3.43	0.81	3.0	3.71	0.78	8.0
1-2-3-2	3.47	0.84	4.0	3.52	0.82	7.0
2-1-1-1	3.32	0.90	2.0	3.44	0.69	4.0
2-1-2-1	3.61	1.11	8.0	3.47	1.04	5.0
2-1-2-2	3.49	0.87	5.5	3.32	1.07	1.5
2-2-1-1	4.13	0.78	20.0	3.91	0.85	12.0
2-2-1-2	3.31	0.81	1.0	3.32	0.70	1.5
2-2-2-1	4.09	0.91	19.0	4.09	0.71	16.0
2-2-2-2	4.04	0.81	15.5	4.05	0.72	15.0
2-2-2-3	3.99	0.80	12.5	3.93	0.75	13.0
2-2-3-1	4.07	1.06	18.0	4.19	0.94	20.0

Note: The PI's codes correspond with those in Figure 5.

Table 2. The Spearman test of ranking between previous and later reply

	Rank of Earlier Reply	Rank of Later Reply
Rank of Period 1	-	0.80^{*}
Rank of Period 2	0.80^{*}	-

$^{*}p < .05$.

B. The correlation of ranking PIs between public and private institutions

In order to avoid the different point of views in ranking PIs between public and private

institutions, a Spearman test of ranking between public and private institutions was done in this study. Consequently, the rank of PIs in public and private institutions is shown in table 3, and the Spearman correlation of ranking between public and private institutions is .815 with significance level (table 4.). That is to say, statistically there is no difference between public and private institution's responses.

Table 3. The rank of PIs in public and private institutions

PIs	Public Institutions			Private Institutions		
	M	SD	RANK	M	SD	RANK
1-1-1-1	4.33	0.59	19.5	4.34	0.70	21.0
1-1-1-2	3.49	1.07	2.5	3.45	0.89	4.0
1-1-2-1	3.97	0.99	12.0	4.10	0.97	19.0
1-1-2-2	4.13	1.06	15.0	4.04	0.99	18.0
1-1-3-1	3.92	0.82	11.0	3.85	0.89	10.0
1-1-3-2	4.03	0.82	13.0	3.93	0.91	13.0
1-2-1-1	3.82	0.94	9.5	3.88	0.99	11.5
1-2-1-2	3.68	0.84	7.5	3.67	0.90	9.0
1-2-2-1	3.38	1.02	1.0	3.64	0.92	8.0
1-2-2-2	4.16	0.75	16.0	4.02	0.75	16.5
1-2-3-1	3.68	0.70	7.5	3.51	0.83	7.0
1-2-3-2	3.58	0.64	4.5	3.47	0.87	5.5
2-1-1-1	3.58	0.68	4.5	3.31	0.84	2.0
2-1-2-1	3.82	0.98	9.5	3.47	1.10	5.5
2-1-2-2	3.66	0.91	6.0	3.34	0.97	3.0
2-2-1-1	4.28	0.65	18.0	3.95	0.85	14.5
2-2-1-2	3.49	0.72	2.5	3.26	0.77	1.0
2-2-2-1	4.33	0.74	19.5	4.02	0.84	16.5
2-2-2-2	4.37	0.71	21.0	3.95	0.76	14.5
2-2-2-3	4.26	0.60	17.0	3.88	0.80	11.5
2-2-3-1	4.11	0.96	14.0	4.13	1.03	20.0

Note: The PI's codes correspond with those in Figure 5.

Table 4. The Spearman test of ranking between public and private institutions

	Rank of Public Institutions	Rank of Private Institutions
Rank of Period 1	-	0.82^{*}
Rank of Period 2	0.82^{*}	-

$^{*}p < .05$.

C. The t-test between the means of PIs and 3

For the purpose of understanding the ranking of importance in PIs, the t-test between the means of PIs and 3 (theoretical mean) is shown in table 5. As the results of table 5, the t-test between the means of PIs and 3 shows all with the significance level. Therefore, the members in ET programs are agreeing with the importance of 21 PIs developed by this study.

Table 5. The t-test between the means of PIs and 3

PIs	M	SD	t
1-1-1-1	4.31	0.76	22.21*
1-1-1-2	3.44	0.97	5.88*
1-1-2-1	4.05	1.02	13.66*
1-1-2-2	4.03	1.04	13.10*
1-1-3-1	3.84	0.91	12.18*
1-1-3-2	3.92	0.94	12.94*
1-2-1-1	3.85	1.02	10.97*
1-2-1-2	3.65	0.93	9.22*
1-2-2-1	3.56	0.98	7.49*
1-2-2-2	4.02	0.81	16.40*
1-2-3-1	3.53	0.85	8.11*
1-2-3-2	3.47	0.87	7.10*
2-1-1-1	3.35	0.85	5.32*
2-1-2-1	3.53	1.11	6.22*
2-1-2-2	3.39	0.99	5.18*
2-2-1-1	4.01	0.87	15.10*
2-2-1-2	3.29	0.80	4.77*
2-2-2-1	4.07	0.88	15.93*
2-2-2-2	4.02	0.83	16.11*
2-2-2-3	3.94	0.83	14.72*
2-2-3-1	4.10	1.06	13.21*

Note:1. The PI's codes correspond with those in Figure 5.

2.* $p < .05$.

D. The selection of KPIs

The purpose of KPIs is to be utilized in monitoring the performance of organization of business rapidly. The KPIs are those PIs having means higher than the average of all means (Ma). The t-test between the means of PIs and the average of all means was done and shown in table 6. Finally, 12 PIs were selected as the KPIs that can be utilized in monitoring the

performance of ET programs. The 12 KPIs are: (1) Programs' educational objectives are consistent with the mission of the institution, (2) Percentage of freshmen to all admission applicants, (3) Percentage of enrolled freshman to admitted freshman, (4) Current revenues per ET student in the previous fiscal year, (5) Capital revenues per ET student in the previous fiscal year, (6) Percentage of freshman who advance to become sophomores, (7) Cooperative institutions' satisfaction with students participating in work-based practicum, (8) Continuing study graduates' satisfaction with their ET learning at six months after graduation, (9) Employed graduates' satisfaction with their ET learning at six months after graduation, (10) Employed graduates' satisfaction with their compensation at six months after graduation, (11) Employers satisfaction with ET graduates, (12) Rating from the recent evaluation administered by the Ministry of Education (MOE).

Table 6. The selection of KPIs

PIs	M	M_a	t
1-1-1-1	4.31	3.78	9.00*
1-1-2-1	4.05	3.78	3.53*
1-1-2-2	4.03	3.78	3.22*
1-1-3-1	3.84	3.78	0.94
1-1-3-2	3.92	3.78	2.03*
1-2-1-1	3.85	3.78	0.85
1-2-2-2	4.02	3.78	3.90*
2-2-1-1	4.01	3.78	3.39*
2-2-2-1	4.07	3.78	4.32*
2-2-2-2	4.02	3.78	3.83*
2-2-2-3	3.94	3.78	2.52*
2-2-3-1	4.10	3.78	3.83*

Note:1. The PI's codes correspond with those in Figure 5.

2.* $p < .05$.

E. The factor analysis of KPIs

According to the KPIs which are selected in table 6, the factor analysis of KPIs was conducted in order to reset the framework. Therefore, the principal components analysis, which shows that three factors account for 65% of the variance among the inter-correlations

of the 12 KPIs (table 7).

Table 7. Total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
component	total	% of variance	cumulative	total	% of variance	cumulative	total	% of variance	cumulative
1-1-1-1	5.23	43.58	43.58	5.23	43.58	43.58	3.19	26.56	26.56
1-1-2-1	1.36	11.36	54.94	1.36	11.36	54.94	2.46	20.50	47.06
1-1-2-2	1.20	9.97	64.91	1.20	9.97	64.91	2.14	17.85	64.91
1-1-3-1	.94	7.87	72.78						
1-1-3-2	.73	6.09	78.87						
1-2-1-1	.62	5.15	84.02						
1-2-2-2	.57	4.72	88.74						
2-2-1-1	.38	3.15	91.89						
2-2-2-1	.32	2.69	94.58						
2-2-2-2	.27	2.25	96.83						
2-2-2-3	.25	2.06	98.89						
2-2-3-1	.13	1.11	100.00						

Note: The PI's codes correspond with those in Figure 5.

In table 8, all variables with loadings of .60 or larger with a factor are in Italic font. Besides, all loading lower than .30 were deleted in order to clarify the structure. Finally, three clusters of variables were generated from 12 PIs, which are named as "Satisfaction," "Enrolment," and "Revenues."

Table 8. The component matrix and rotated component matrix

Com-ponent	Component Matrix (Unrotated factors)			Rotated Component Matrix		
	1	2	3	1	2	3
1-1-1-1	0.52	0.24	0.00		0.47	
1-1-2-1	*0.60*	0.56	0.21		*0.82*	
1-1-2-2	*0.69*	0.47	0.25		*0.81*	
1-1-3-1	*0.66*	-0.42	0.52			*0.90*
1-1-3-2	*0.64*	-0.48	0.51			*0.91*
1-2-1-1	0.47	0.52	0.03		*0.68*	
1-2-2-2	*0.67*	0.07	-0.10	0.51		
2-2-1-1	*0.74*	-0.23	-0.33	*0.80*		
2-2-2-1	*0.81*	-0.13	-0.22	*0.75*		
2-2-2-2	*0.76*	-0.15	-0.36	*0.81*		
2-2-2-3	*0.77*	-0.13	-0.45	*0.87*		
2-2-3-1	0.50	0.00	0.25			0.42
Meaning attached to rotated factors				Satisfaction	Enrollment	Revenues

Note: The PI's codes correspond with those in Figure 5.

V. CONCLUSIONS AND SUGGESTIONS

According to the results and discussion above, the conclusions and suggestions are made as follows:

A. The ET program heads in public and private institutions have the same viewpoints in the importance of PIs developed in this study

The ET program heads in public and private institutions have the same point of views in the importance of PIs developed in this study. Therefore, the 21 PIs developed in this study can be utilized in monitoring the performance of ET programs in public and private UTs/CTs.

B. There are 12 key performance indicators (KPIs) strongly recommended to be utilized in monitoring the performance of ET programs

In order to monitor the performance of ET programs quickly, 12 KPIs are selected in this study. These 12 KPIs are: (1) Programs' educational objectives are consistent with the mission of the institution, (2) Percentage of freshmen to all admission applicants, (3) Percentage of enrolled freshman to admitted freshman, (4) Current revenues per ET student

in the previous fiscal year, (5) Capital revenues per ET student in the previous fiscal year, (6) Percentage of freshman who advance to become sophomores, (7) Cooperative institutions' satisfaction with students participating in work-based practicum, (8) Continuing study graduates' satisfaction with their ET learning at six months after graduation, (9) Employed graduates' satisfaction with their ET learning at six months after graduation, (10) Employed graduates' satisfaction with their compensation at six months after graduation, (11) Employers satisfaction with ET graduates, (12) Rating from the recent evaluation administered by the Ministry of Education (MOE).

C. The 12 KPIs can be divided into three categories as satisfaction, enrolment, and revenues

According to the result of factor analysis, the 12 KPIs can be divided into three categories as satisfaction, enrolment, and revenues. That is, if educational authorities or ET programs wants to monitor the performance of ET programs, the fastest approach will be the utilization of 12 KPIs.

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