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# Developmental Model of Strategic Alliance for Technological Education*

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Based on the value chain model of competition strategy theory, this paper explores the existing strategic alliances for technological education in Taiwan and uses the field of information management as an example to build a multiple developmental model for inter-school strategic alliances. The research methods include panel discussions and surveys. The paper can be divided into three major parts: Part one describes the status quo of strategic alliances for technological education in Taiwan; Part Two introduces a multiple developmental model formed by the teachers' professional development; Part Three uses an empirical investigation of schools of different levels to demonstrate the effects of the above-mentioned multiple developmental model. The contribution of such a developmental model lies in the construction of a cooperation value chain and the high efficacy of generating values for both teachers and students.

**Keywords:** strategic alliance; technological education; information management; model

## 1. Introduction

Proposed and promoted by Michael Porter [1], the term 'strategy' has come to the fore since the 1990s, and the strategic alliance has become one of the vital tools for multinational entrepreneurs when managing their enterprises [2]. The concept and implementation of strategic alliances have also influenced the management of schools amid the rapid changes in the situation both inside and outside the educational system. Only through strategic alliances and strengthened self-governance—under market-orientated policies—can school administrations prove that their managing ability does affect a school's prospects [3, 4].

Taiwan's vocational and technological education, or VTE, comprises three major levels: vocational high schools, vocational colleges, and universities of science and technology (including technical colleges of the same educational level). The first large-scale strategic alliance between vocational schools, implemented in 2006, was meant to group schools into different regional units based on their location; strengthen the interaction/partnership between vocational high schools, vocational colleges, and universities of science and technology; and establish vertical and horizontal ties between schools. Such a strategic alliance not only provides students with educational programmes at successive levels, and integrates the educational resources to great effect, but also extends the community's team spirit for vocational colleges and universities of science and technology. Moreover, students can choose a major—based on their interests—at the vocational and technological colleges or universities in their neighbourhood [5].

Currently Taiwan has five strategic-alliance regions, each comprising over ten vocational high schools and four to six vocational colleges (or universities of science and technology). The schools may choose to form an alliance within a specific region on a project basis, which means the allied schools propose tie-up plans to seek funding or other support from the Ministry of Education (MOE). Using the approach of management by objective, the allied schools set up a network management platform for instantaneous administration and evaluation. Given the characteristics of each school and the greater context in which they are, as well as the needs of industries, teachers and students, the regionally allied schools propose the projects and corresponding implementation approaches. At the end of each project year, the MOE will inspect these schools to assess the project implementations. What is worth noting is the manifold benefits of the vocational schools' regional strategic alliance: it encourages cooperation between vocational schools either of the same or of different levels; facilitates teachers' growth in expertise [17]; advances students' career prospects; contributes to resource sharing [15]; promotes

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**Table 1.** Schools that provide VTE programmes in Taiwan (Source: [6])

| | | Vocational and technological colleges or universities | | | |
|---|---|---|---|---|---|
| **Level** | **Vocational high schools** | **Vocational colleges** | **Technical colleges** | **Universities of science and technology** | **Total** |
| Number of schools | 156 | 15 | 37 | 41 | 93 |
| Number of graduates | 118 202 | 8430 | 48 039 | 94 689 | 151 158 |

partnerships between businesses and educational institutes; and solves the enrolment problems that plague some vocational and technological colleges or universities.

Table 1 shows the number of Taiwan-based schools that provide VTE programmes. In 2010, there are 156 vocational high schools and 118 202 vocational high school graduates. In total 151 158 students are eligible to enrol in the 93 vocational and technological colleges or universities, indicating a 128% admission rate. The enrolment issues facing Taiwan's vocational and technological colleges or universities stem from the recent decrease in student numbers at secondary-education institutes as well as the declining birth rate. The regional strategic alliance has therefore become one of the strategic responses to the trend toward enhanced school management and efficiency, which is a major concern for school managers and administrators.

The core of the problems facing vocational and technological schools is how to improve teachers' growth and students' career prospects. Continuing Professional Development, or CPD, on the teachers' part is actually ill-defined as to whether it should involve formal training and/or on-the-job services [7]. Kennedy [8] points out that CPD for teachers is meant to bolster their capabilities in terms of autonomy; therefore it makes sense to involve teachers' growth in the strategic alliances.

To meet the needs of VTE providers in Taiwan, this paper explores the status quo of the country's strategic alliances between schools that provide VTE programmes. The research uses the field of information management as an example to build a multiple developmental model for inter-school strategic alliances, which is then verified using empirical investigations. The major concern of the research lies in constructing a model of strategic alliance involving different schools at different levels to serve as a reference, or guideline, for strategic alliances in the five major strategic alliance regions of Taiwan.

## 2. A Strategic Alliance model for VTE

### *2.1 The definition of Strategic Alliance*

'Strategy' is a responsive action taken by an administrator to deal with a problem. A Strategic Alliance can be defined as a formal relationship between two or more parties that either pursue a set of agreed-upon goals or strive to meet a critical business need while remaining independent organizations. Pansiri [9] states that:

> strategic alliances can be seen as purposive tactical arrangements between two or more independent organizations that form part of, and is consistent with participants' overall strategy, and contribute to the achievement of their strategically significant objectives that are mutually beneficial. These include cooperative arrangements such as joint ventures; licensing agreements; franchises; marketing and distribution agreements; production and manufacturing alliances; research and development contracts; technology development coalitions, production and manufacturing alliances and research and development contracts.

Unlike the aforesaid strategic alliances, a strategic alliance between vocational and technological schools is not formed to generate profits. The non-profit-oriented strategic alliances promoted by Taiwan's VTE institutes are planned, supported, and funded by the MOE. These alliances focus on three dimensions: the use and distribution of resources, the professional development growth of teachers, and the educational needs of students. Therefore, the strategic alliances promoted by VTE institutes can be defined as a formal, purposeful, and cooperative relationship between two or more vocational and technological schools that strive for common goals ranging from matters (and needs) related to teachers/students to the integration of resources.

### *2.2 Theory and model of the Strategic Alliance*

The theory of the strategic alliance for VTE is based on the concept of a value chain. Porter [1] indicates that an organization, in addition to evaluating the cost and profitability of each value activity, must coordinate and integrate all value activities to connect the activities in the most appropriate manner. Therefore, the key to strate-

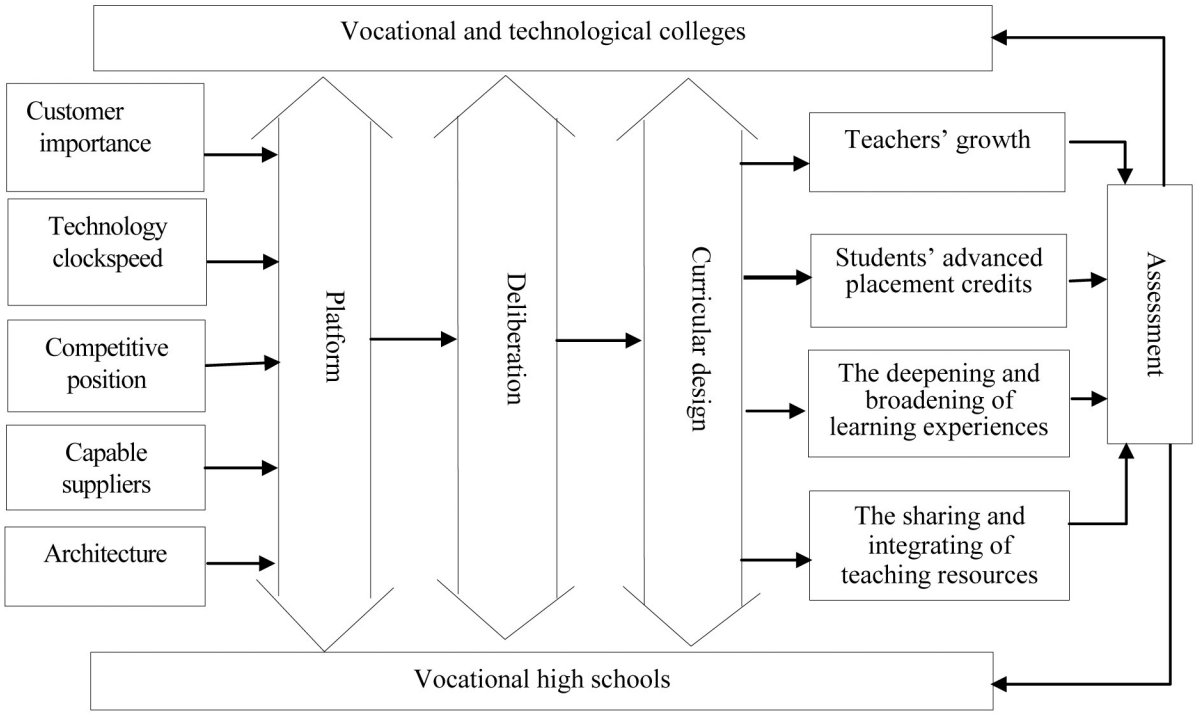



**Fig. 1.** A strategic alliance model for curriculum development.

gic alliances for VTE is to construct a value chain that involves the three levels of vocational high schools, vocational colleges, and universities of science and technology (including technical colleges). According to the concept of the value chain, a strategic alliance for VTE requires a reformed inter-school cooperative relationship, so that the allied schools can optimize their ties, establish a unique value chain for the regional alliance, and gain competitive advantages over schools in other regions

Fine *et al.* [10] present a strategic value assessment, or SVA, for the value chain. SVA includes five key criteria: the customer importance, technology clock-speed, competitive position, capable suppliers, and architecture. High customer importance and fast clock-speed indicate high strategic value and argue for in-sourcing; in areas of strong competitive position, in-sourcing is indicated. Supply-base capability must be present for successful out-sourcing. A high degree of modularity in value-chain architecture significantly eases outsourcing. The SVA model also indicates such possible choices as whether to in-source, invest, partial out-source, partner/acquire, partial insource, spin off, develop suppliers, and outsource. By comparing the vocational and technological schools with such organizations, it is possible to apply the SVA model to inter-school strategic alliances.

### *2.3 Building a strategic alliance model for VTE*

Based on the value chain model, the strategic alliance for vocational and technological schools can be considered a system concept. Every vocational and technological school involved in the strategic alliance value chain is a component of the concept and sets a value in the resources, procedures, services, and every part of the administrative subsystem under the strategic alliance structure. The purpose of VTE is to educate students, and the curriculum is the most essential part of school education. The educational goals of vocational and technological schools of different levels can be achieved only by designing, planning and introducing the desired curricula that involve all the teachers, students and resources.

The cooperation between vocational high schools and vocational and technological colleges or universities has to focus on the curriculum, so as to form a value chain between the teachers and students at different levels. The naturalistic model proposed by Walker in 1971 can therefore help to complete the formation of a strategic alliance [16]. The naturalistic model of the curricular design is meant to present problems about curricular design in the most realistic way possible, and also to highlight the major features of traditional education. Unlike the objectives model that emphasizes its objectives as a guide to various learning activities [12, 13], the naturalistic model involves three

major elements: platform, deliberation and curricular design [11]. The platform element includes beliefs, values, assumptions, intentions, theories, purposes, and the procedures of action or decision-making; it offers guidance to the decision makers in an inter-school strategic alliance. The deliberation element identifies which facts are related to means and purposes, establishes the goals necessary for the cases to make alternative projects, analyses the possible outcomes of alternative projects, and evaluates the cost and profitability of projects, in order to make the best choice. The curricular design element determines whether the alternative projects are explicit or implicit designs (the implicit designs appear to be more spontaneous). Therefore, the strategic alliance for VTE needs to support its beliefs with empirical data. In this way, industry experts and teachers from the allied schools (including vocational high schools, vocational colleges, technical colleges and universities of science and technology) will attend group meetings and deliberate on how to avoid conflicting curricular platforms at participating schools and subsequently improve the platforms for the best project.

Such an alliance uses inter-school management methods to deepen and broaden students' learning experiences and help the teachers to form working groups. Schools can adopt the following model for strategic development [3]:

1. Develop a strategic approach
2. Implement the strategy effectively
3. Establish strategic roles in action
4. Review the strategic effectiveness.

Based on the model above and three group meetings attended by teachers from different schools, this paper creates a strategic alliance model, where inter-school cooperative efforts take place in areas such as teachers' growth, students' advanced placement credits, the deepening and broadening of learning experiences, and the sharing and integrating of teaching resources. The design of the model for strategic alliance is described below.

1. Group meetings help the schools from a regional strategic alliance reach agreements and find the common ground.
2. Schools set up goals for the strategic alliance and decide upon cooperative plans.
3. Schools identify the inter-school alliance's domains of cooperation.
4. Schools determine the strategies and cooperative approaches.
5. Schools assess the cooperative value of the strategic alliance.
6. Schools review and modify the cooperative plans on a continuous basis.

## 3. Methodology

The research adopts such methods as the analysis of literature and documents, consultation with experts, and a survey. The research is carried out in a three-stage process.

*Stage 1*

Stage 1 is the analysis of literature and documents. The purposes of this stage are to scrutinize how the curricula are connected between vocational high schools and vocational and technological colleges or universities; how different schools' resources are effectively integrated so as to meet the needs of teachers and students in their pursuit of further learning; and to compile a questionnaire on which the experts' group meetings are based.

*Stage 2*

Stage 2 is the three meetings of experts. The 45 experts who have attended such meetings include: teachers from vocational high schools; teachers from vocational and technological colleges or universities; and experts from the IT industry. They have researched and discussed the demands and specific essences of curriculum connection and have helped to revise the questionnaire for this research.

*Stage 3*

Stage 3 is the questionnaire survey. The content of the questionnaire content was based on the naturalistic model proposed by Walker as the theory for curricular design, and makes reference to the MOE's *Regulation for the Planning of School Departmentalism* and *Vocational High School Curricular Standards*, as well as the questionnaire compiled by Gu and Chang in 2009. In addition to the instruction for respondents, the definitions of key terms and the personal information, the main body of the questionnaire is based on the curricular content of the strategic alliance for vocational high schools and vocational and technological colleges or universities. The main body includes eight items on teachers' growth (the professional skill of the teacher being the most important, stated by Bryson and Hand [14]), seven items on the deepening and broadening of learning, five items on the students' advanced placement credits, and four items on the integrating and sharing of resources. As for the reliability and validity analyses, the first draft has been analysed, modified and revised, based on the group meetings of experts. The reliability analysis (Cronbach's $a$) examines the internal consistency of pre-test takers. The validity analysis was completed in three steps. The first step ensures that the substantial content has been examined for validity and

**Table 2.** Factorial validity statistics (137 items)

| | |
|---|---|
| KMO value | 0.916 |
| Bartlett's | 5415.463 ($p < 0.05$) |
| Level of statistical significance | 0.000 |

adequacy, based on the group meetings of experts (the experts include teachers from the strategic alliance schools and experts from the information industry). The second step is to conduct Bartlett's test of sphericity in order to ensure that the aspects of the questionnaire are close to the multivariate normal distribution; and to use a KMO (Kaiser–Meyer–Olkin) test—which measure the sampling adequacy—to determine whether the data are suitable for factor analysis. The third step is to conduct principal component analysis. The analytical tools used in the process include Varimax with Kaiser Normalization, with the factor analysis focusing on the factors with an eigenvalue greater than one.

The survey was conducted on a purposive sampling basis, with samples collected from:

1. academic circles: teachers from departments of information management of partner vocational colleges or high schools of Taiwan's regional strategic alliances;
2. industrial circles: experts selected by random sampling from the top 1000 businesses of information technology in Taiwan.

In the data analysis, descriptive statistics of percentile and standard deviation were used for the principal component analysis: a one-way Analysis of Variance (one-way ANOVA) was used to analyse the variance of the total score accounted for by independent variables; and an F-test was used to examine whether the opinions collected from different groups of teachers differ significantly.

## 4. Main results

### *4.1 The reliability and validity of the questionnaire*

The analysis of the reliability of the questionnaire shows a Cronbach Alpha of 0.929. The questionnaire as a whole reached a high standard of reliability. In the factorial validity test, a KMO test of goodness of fit was used according to Kaiser's criterion, and the factorial validity of this research turns out to be good (KMO > 0.9), indicating a high consistency of the questionnaire. Also, the result of Bartlett's test of sphericity indicates that the aspects of the questionnaire are

**Table 3.** Principal component analysis

| | **Components** | | | |
|---|---|---|---|---|
| **Component items** | **Inter-school alliances of teachers** | **Inter-school curricular proportions** | **Advanced placement of vocational high school students** | **Cooperation in special projects and resources** |
| A1 | **0.809** | 0.048 | 0.169 | 0.116 |
| A2 | **0.787** | −0.028 | −0.021 | 0.353 |
| A4 | **0.781** | 0.138 | 0.273 | 0.104 |
| A3 | **0.776** | 0.103 | 0.044 | 0.313 |
| A5 | **0.728** | 0.150 | 0.325 | 0.097 |
| A6 | **0.660** | 0.170 | 0.368 | −0.072 |
| A7 | **0.542** | 0.171 | 0.398 | −0.105 |
| B13 | 0.052 | **0.732** | 0.145 | 0.169 |
| B12 | 0.059 | **0.707** | 0.168 | 0.030 |
| B15 | 0.095 | **0.662** | 0.241 | 0.215 |
| B14 | 0.156 | **0.651** | 0.141 | 0.323 |
| B9 | 0.029 | **0.635** | 0.093 | 0.204 |
| B11 | 0.200 | **0.595** | −0.054 | 0.467 |
| D22 | 0.220 | 0.164 | **0.830** | 0.114 |
| D23 | 0.233 | 0.087 | **0.814** | 0.215 |
| D21 | 0.231 | 0.203 | **0.798** | 0.130 |
| D24 | 0.209 | 0.155 | **0.781** | 0.132 |
| C19 | 0.141 | 0.322 | 0.147 | **0.816** |
| C20 | 0.110 | 0.196 | 0.253 | **0.767** |
| C18 | 0.141 | 0.378 | 0.227 | **0.762** |
| C17 | 0.226 | 0.460 | 0.200 | **0.650** |
| C10 | 0.174 | 0.503 | −0.155 | **0.512** |
| Eigenvalue | 9.179 | 3.102 | 1.901 | 1.132 |
| Explained variance | 38.248% | 12.923% | 7.921% | 4.717% |
| Cumulative explained variance | 38.248% | 51.171% | 59.092% | 63.81% |

Factor extraction: Principal component analysis
Rotation method: Varimax with Kaiser normalization

close to multivariate normal distribution and therefore are fit for factor analysis.

### 4.2 Factor analysis—principal component analysis

The research uses principal component analysis and Promax with Kaiser Normalization for factor extraction. The factor analysis extracts four factors, and the cumulative explained variance is 63.81%. Eigenvalue > 1.0 recommends four factors. The factors are renamed, factor 1 being the 'inter-school alliances of teachers'; factor 2 being 'inter-school curricular proportions'; factor 3 being 'advanced placement of vocational high school students'; and factor 4 being 'cooperation in special projects and resources.'

### 4.3 Analysis of descriptive statistics

Eight hundred copies of the questionnaire were sent out and 367 copies (45.9%) of valid questionnaires were retrieved. The teachers from vocational high schools and vocational and technological colleges and universities, and experts from the information industry are divided into five strategic alliance groups, depending on their region. Table 4 shows the valid copies of the questionnaire retrieved from each group.

### 4.4 One-way ANOVA

The research uses one-way ANOVA of the variance of the total score and aspects to scrutinize whether the scores for different aspects are significantly different. The result is $F = 80.053$, $p < 0.01$, which shows that there are significant differences in the total scores and the four aspects of the teachers' growth, advanced placement credits, the deepening and broadening of learning experiences, and the integrating and sharing of resources. The Scheffé post hoc comparison indicates that there is no significant difference in the results, showing high homogeneity in the overall questionnaire responses.

The research further analyses whether there are significant differences in the respective regional strategic alliances' opinions concerning the four aspects. The F-values are not significant, which indicates that the four aspects of the teachers' growth, advanced placement credits, the deepening and broadening of learning experiences, and the integrating and sharing of resources are the domains of cooperation recognized by all regional alliances of schools.

### 4.5 Analysis of correlation

The analysis of correlation shows that the correlation between each aspect and the total score

**Table 4.** Analysis of the valid copies retrieved

| Items | Groups | Numbers of copies | Percentage (%) |
|---|---|---|---|
| Regional alliances | Northern | 82 | 22.4 |
| | Central | 72 | 19.6 |
| | Jia-nan | 71 | 19.3 |
| | Southern | 74 | 20.2 |
| | Eastern | 68 | 18.5 |
| Age | Below 30 | 27 | 7.4 |
| | 31 to 40 | 130 | 35.4 |
| | 41 to 50 | 153 | 41.7 |
| | Over 51 | 57 | 15.5 |
| Level of education | Bachelor's degree | 135 | 36.8 |
| | Master's degree | 184 | 50.1 |
| | Doctorate | 48 | 13.1 |
| Years of service | Below 5 | 51 | 13.9 |
| | 6 to 10 | 99 | 27.0 |
| | 11 to 15 | 48 | 13.1 |
| | 16 to 20 | 29 | 7.9 |
| | Over 21 | 140 | 38.1 |
| Attributes | Vocational high schools | 241 | 65.7 |
| | Technical colleges or universities of science and technology | 53 | 14.4 |
| | Industry | 73 | 19.9 |
| Positions | Full-time teachers | 160 | 43.6 |
| | Dean of a department | 21 | 5.7 |
| | Director of a division | 47 | 12.8 |
| | Director of an office | 53 | 14.4 |
| | School Principal/President | 13 | 3.6 |
| | Heads of a company (including presidents) | 25 | 6.8 |
| | Senior officers (VPs and assistant managers) | 18 | 4.9 |
| | Subordinate officers (managers) | 30 | 8.2 |

**Table 5.** ANOVA of different aspects

| | | Sum of square | Degree of freedom | Average sum of square | F-test |
|---|---|---|---|---|---|
| Teachers' growth | Between-classes | 17 954.191 | 87 | 206.370 | 10.174** |
| | Within-classes | 5659.466 | 279 | 20.285 | |
| | Sum | 23 613.657 | 366 | | |
| The deepening and broadening of learning experiences | Between-classes | 10 098.603 | 87 | 116.076 | 8.011** |
| | Within-classes | 4042.520 | 279 | 14.489 | |
| | Sum | 14 141.123 | 366 | | |
| Advanced placement credits | Between-classes | 8353.514 | 87 | 96.017 | 10.253** |
| | Within-classes | 2612.862 | 279 | 9.365 | |
| | Sum | 109 66.376 | 366 | | |
| Resource integration and sharing | Between-classes | 4821.863 | 87 | 55.424 | 5.677** |
| | Within-classes | 2724.012 | 279 | 9.763 | |
| | Sum | 7545.875 | 366 | | |

**$p < 0.01$

**Table 6.** ANOVA of opinions of different regional strategic alliances

| | | Sum of square | Degree of freedom | Average sum of square | F-test |
|---|---|---|---|---|---|
| Teachers' growth | Between-classes | 393.560 | 4 | 98.390 | 1.534 n.s |
| | Within-classes | 23 220.097 | 362 | 64.144 | |
| | Sum | 23 613.657 | 366 | | |
| The deepening and broadening of learning experiences | Between-classes | 114.111 | 4 | 28.528 | 0.736 n.s |
| | Within-classes | 14 027.012 | 362 | 38.749 | |
| | Sum | 14 141.123 | 366 | | |
| Advanced placement credits | Between-classes | 170.817 | 4 | 42.704 | 1.432 n.s |
| | Within-classes | 10 795.560 | 362 | 29.822 | |
| | Sum | 10 966.376 | 366 | | |
| Resource integration and sharing | Between-classes | 46.513 | 4 | 11.628 | 0.561 n.s |
| | Within-classes | 7499.362 | 362 | 20.716 | |
| | Sum | 7545.875 | 366 | | |

n.s. $p > 0.05$

**Table 7.** Summary table of the analysis of correlation between the total score and each aspect ($N = 367$)

| | Teachers' growth | The deepening and broadening of learning experiences | Advanced placement credits | Resource integration and sharing | Total score |
|---|---|---|---|---|---|
| Teachers' growth | 1 | 0.385** | 0.465** | 0.571** | 0.811** |
| The deepening and broadening of learning experiences | 0.385** | 1 | 0.715** | 0.388** | 0.781** |
| Advanced placement credits | 0.465** | 0.715** | 1 | 0.455** | 0.820** |
| Resource integration and sharing | 0.571** | 0.388** | 0.455** | 1 | 0.731** |
| Total score | 0.811** | 0.781** | 0.820** | 0.731** | 1 |

** $p < 0.01$ (two-tailed)

reaches a significant level ($p < 0.01$), which means that there is a significant correlation between the total score and the four aspects of the teachers' growth, advanced placement credits, the deepening and broadening of learning experiences, and the integrating and sharing of resources.

## 5. Discussion

1. The domains of cooperation depend on the schools of regional strategic alliances. The model in the research focuses on four domains of inter-school cooperation, namely the tea-

chers' growth, the deepening and broadening of learning experiences, students' advanced placement credits, and the integrating and sharing of resources. In fact, the regional strategic alliances are platforms for inter-school cooperation driven by the educational administration's external incentives. Such platforms will lead to cooperative efforts in students' learning activities or in multiple interaction/cooperative activities relating to teachers' lecturing, service and research. The model of the strategic alliance and the domains of cooperation will help establish mechanisms for cooperation, division of tasks and benign competition between schools, as well as major research/development projects jointly implemented with businesses.

2. The motive of cooperation is the key to a successful strategic alliance. Enormous differences exist in the resources at public and private schools in Taiwan, and schools of the same level are often in competition with one another. The success of a strategic alliance depends on how the allied schools can avoid egoism and sincerely share their resources with their partners, which is crucial to the establishment of a school's distinctive characteristics. Such characteristics include the teachers' specialties and well-integrated human and facility resources—that is the ideal of the value chain of VTE.
3. The subjects of the values generated by regional strategic alliance are teachers, students and industry, as shown in Fig. 2. There is an increasing number of cooperative efforts between teachers at universities of science and technology and technical colleges, and also an increasing number of services jointly offered by teachers from different vocational colleges and vocational high schools. Teachers at schools of different levels may team up for specific research projects, giving instructions to a student for a certain project or providing R&D services for regional industries.
4. The radar chart shows a lower-than-expected magnitude of approval for inter-school cooperation domains in the research. The magnitude of approval for each domain of cooperation is indicated by the measure of corresponding area in the radar chart. The research uses the example of the field of information management in the inter-school strategic alliances for vocational and technological schools in Taiwan. The research findings regarding the domains of cooperation (teachers' growth, advanced placement credits, the deepening and broadening of learning experiences, and the integrating and sharing of resources) are illustrated in a radar chart based on the averages, as Fig. 3 shows. When each domain is given the same weighting according to the rankings on the questionnaire (10 being the highest priority; 1 being the lowest priority), a triangle appears with any two of the rays representing the domains. The area of the triangle can be computed by the

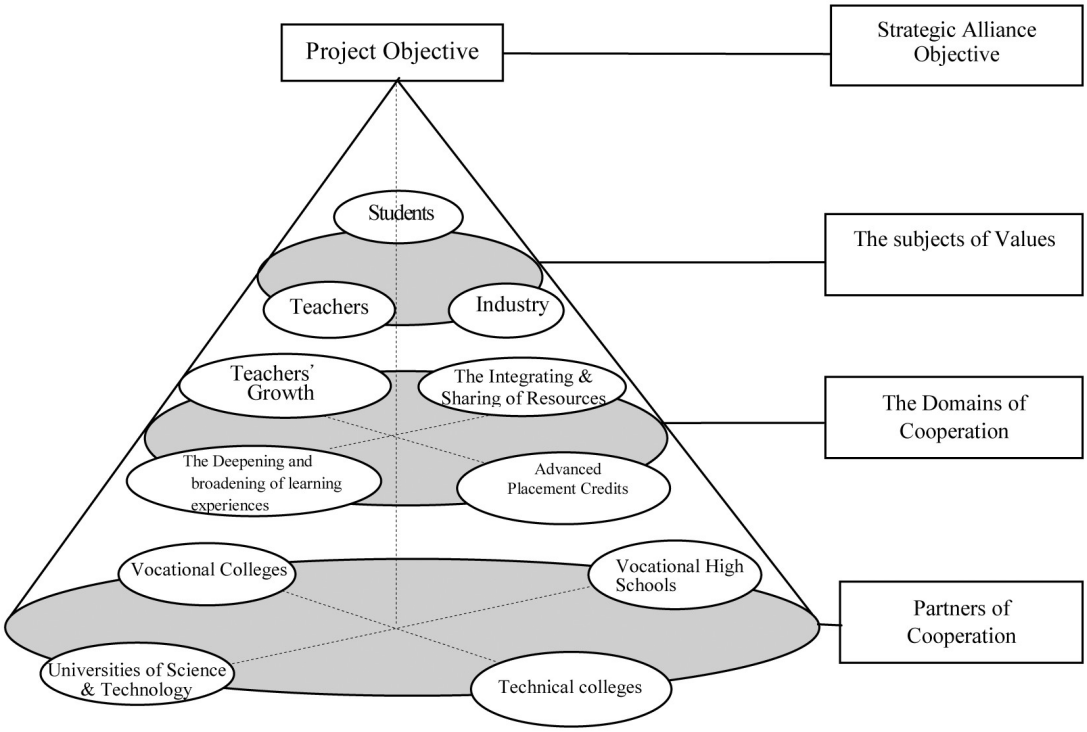
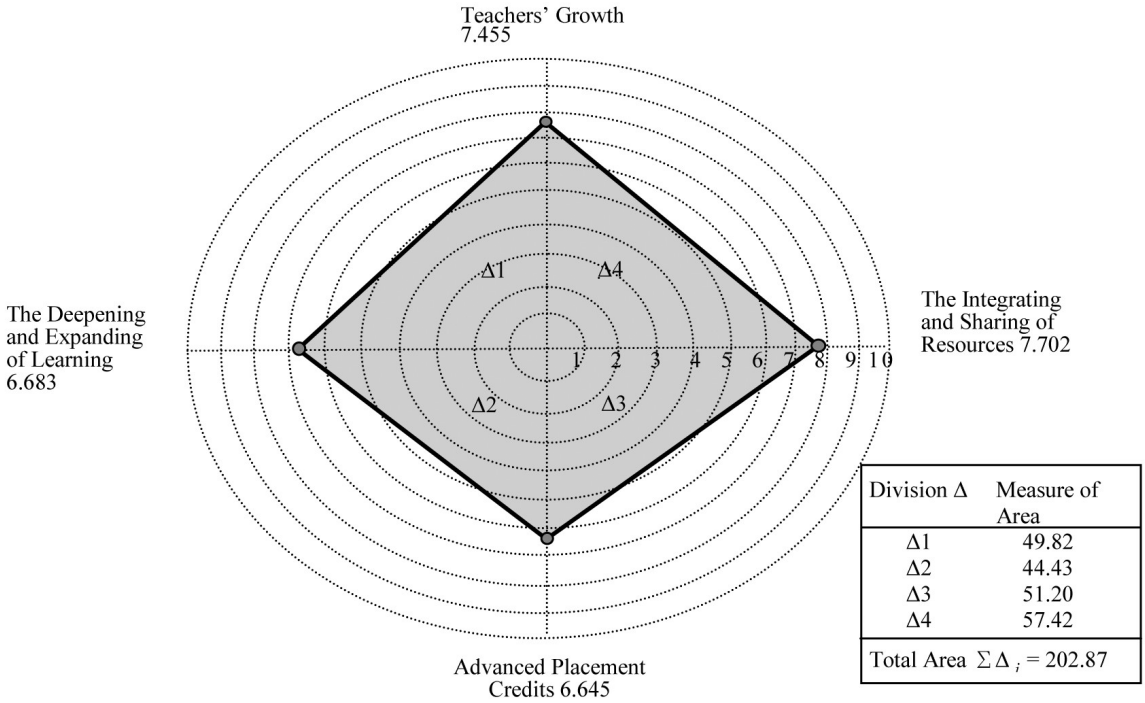



**Fig. 2.** The value chain of the regional strategic alliance.




| Division Δ | Measure of Area |
|---|---|
| Δ1 | 49.82 |
| Δ2 | 44.43 |
| Δ3 | 51.20 |
| Δ4 | 57.42 |
| Total Area $\Sigma\Delta_i$ = 202.87 | |

**Fig. 3.** The measure of area of the magnitude of approval of inter-school cooperation domains.

proportion method using the formula: $\Delta = \frac{1}{2} ab \sin\theta$, where $a$ and $b$ represent the respective lengths of the two legs (e.g., in $\Delta 1$, $a = 7.455$, $b = 6.683$). Therefore, the triangular area (i.e., the magnitude of the cooperation domain) is $\Sigma\Delta_i = 202.87$, only 50.72% of the optimal value of $\Sigma\Delta = 400$. This indicates that the responding teachers and experts from industrial and academic circles fail to reach the acceptable target of 60% for strategic alliances to establish a value chain of education and industry—in terms of the research results involving teachers' growth, advanced placement credits, the deepening and broadening of learning experiences, and the integrating and sharing of resources.

## 6. Conclusion

The panel discussion, the analyses of responses to the questionnaire, and the research in Taiwan's five major strategic alliance regions all support the model for what it represents. In other words, this paper proposes a multiple developmental model that is highly applicable to the strategic alliances between different schools at different levels (i.e., vocational high schools, vocational colleges, and universities of science and technology/technical colleges). That is, according to the 'value chain concept' in the model, the strategic alliance between schools of different levels requires that the lower-level vocational high schools and the higher-level vocational and technological colleges consider their own platforms (primarily including customer importance, technology clock-speed, competitive position, capable suppliers, and architecture); deliberation (i.e., discussions between experts from industrial and academic circles for a solution to the conflicting curricula); curricular design (i.e., determining the major areas of cooperation in the strategic alliance, and also the most appropriate projects); and assessment (i.e., evaluating the cost and profitability of a project). The process not only enables the allied schools to play their assigned roles in the value chain, but also enables each of Taiwan's regional alliances to establish a value chain with distinguishable features, so as to make such alliances effective.

The multiple developmental model proposed by this research is based on the 'value chain' concept of business management and focuses on the discourse of the strategic alliance between schools of different levels. The limitations of the study include: how the strategic alliance patterns for businesses are applied to educational institutes, taking into consideration the conspicuous differences in goal and nature between business and educational institutes. The second limitation of this study is that, while a strategic alliance is meant to combine multiple schools' efforts to greater effect, how an inter-school strategic alliance would affect the accumulation of social capital and the nurturing of talents at participating schools. The third limitation is how to

enhance the efficacy of inter-school strategic alliances through an inter-organization administrative mechanism. The fourth limitation is how to apply the 'Supply Chain Management' theory to optimize the teachers' training programmes (as well as the students' advanced placement credits programmes), deepen and broaden the learning experiences, and share/integrate the teaching resources between different schools. The above-mentioned issues are not explored in this paper but would serve as good subject matter for further research projects.

The multiple developmental model proposed by the research serves as a reference for the promotion and development of strategic alliances of vocational high schools and vocational and technological colleges. The assistance and support from allied schools help each school to create distinctive characteristics while building a value chain of inter-school cooperation. Also, an administrative mechanism for strategic alliances between schools of different levels should be established, so as to boost the benefits for the three targets of cooperation—teachers, students and resources—and to manifest vocational and technological schools' values for external customers (e.g. local businesses and communities) and internal customers (e.g. teachers and students).

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