Strategic Planning of Engineering Educational Programs in Ministry of Education, Taiwan

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Abstract：The aim of this paper is to outline the measures of pioneering specific engineering educational programs, taken by Science & Technology Advisory Office (STAO), Ministry of Education, Taiwan. In order to sustain the competitive edge of emerging high-tech industries, STAO was institutionalized to steer universities and colleges carrying out respective engineering educational programs. Traditionally, these engineering educational programs, such as developing integrated programs, planning curricula, compiling instructional multimedia, holding technological workshops and establishing specific theme teaching laboratories, are designed predominantly in light of industrial-academic cooperation. Science the life cycle of technical knowledge is getting shortened and much of it is under explorations, learning capacities of students should be strengthened rather than being infused with mountains of information. How to construct value-added knowledge flows challenged the revolution of industrial-academic cooperation. However, this collaborative task can not be accomplished within one college or university. STAO has driving the inter-campus strategic alliances established, which were teamed up based on the shared core disciplines. The alliances were constituted to integrate and amplify the knowledge flows of engineering educational programs among departments. The key successful factors of strategic alliances are organizational consensus on shared visions, systematic knowledge value-added flows, and tangible cooperative accomplishments. The ultimate goal for constituting strategic alliances is to build inter-campus learning communities for fostering human resources of core industrial development.

Keywords：strategic alliance, internet community learning, industrial-academic cooperation on education

1. Government roles on Engineering Education

The 3rd industry revolution is riding on the wave of knowledge-base economy. How to acquire, amplify and make great uses of knowledge flow through discontinuous innovation are the main issues of 4th R & D [1]. The pioneering theoretical knowledge usually stems form universities. Therefore, how to commercialized the embryo outcome from campus research is challenging governmental regulations. Recently, it was pointed out that the qualified engineers of core industries, such as semi-conductor and telecommunication, do not meet the industrial needs neither in quality nor in quantity at Taiwan. Domestically, the collage students would be decreased from 1.6 million at 1999 to 1.3 million at 2009. The population of high-tech experts coming abroad is decreasing gradually and competition for head hunting is getting rigorously in Asia. Flourishing high-tech human resources once had made "Taiwan economical miracle" during the past decade. In Taiwan's "Cross-Century National Development Plan" and "Science & Technology White Paper", the Executive Yuan outlines the national development goals and core industries in the next decade. In the emerging high-tech industries, such as semi-conductor, consumer electronics, multimedia, precision machinery and automation, aerospace, pollution control, biotechnology, health care, special chemicals, advanced materials and related new products, are all identified as core industries. In dealing with the crisis of high-tech human resource, the Ministry of Education has launched plenty of measures to strengthen fostering the high-tech human resources, such as encouraging the establishment of E-related departments, funding the national scale research projects, and subsidizing engineering educational programs.

In order to meet the needs of human resources for developing core industries, STAO, established since 1979, takes the responsibility to steer universities and colleges carrying out respective educational programs based on the core industrial development. STAO is constituted of administrative personnel and consultants from respective disciplines, such as electrical engineering, biotechnology, aerospace technology and mechanical engineering. and so on. In the past two decades, STAO launched a variety of engineering educational programs in coordination with the mid- and long-term Science and Technology Development Plan, Economic Development Plan and National Industry Strategic Plan promoted by various ministries (e.g. national telecommunications plan and national disaster

mitigation plan). The current programs are manufacture-business integration, materials, chemical engineering, disaster mitigation in relation to civil constructions, VLSI and system design, telecommunications, 3C integration, mech-eletronic integration, precision machinery, aerospace, biotechnology, and medical engineering. Committees of STAO with respect to the aforesaid programs are teamed up from the industry, government, academia and research institutions. Those include members from the National Science Council (NSC), Ministry of Economic Affairs (MOEA), Council of Labor Affairs, Council of Agriculture, Industrial Technology and Research Institute (ITRI), Metal Industry Development Center (MIDC), Biotechnology Development Center, various universities, and private sectors. In undertaking its assignment of fostering human resources for the mid- and long-term development of various core industries, STAO put emphasis on the cultivation of quality people through interdisciplinary curricula and MOEA and Council of Labor Affairs focus on professional training. In the long run, the incubation of talent engineers and further professional training is relayed, which is the benchmark of upgrading the industrial technology of the country.

The annual budget of STAO is 400 million dollars. The subsidiary funding for each educational improvement projects ranges from 150,000 to 30,000 dollars. Usually, the first priority is given to the projects working on inter-disciplinary integration. In order to outspread the outcomes of specific education improvement projects, the complementary measures, like specific programs or curriculum planning, development of instructional multimedia, and industrial-academic cooperation, are commissioned to carry out around the country. To date, a plenty of special theme teaching laboratories and specific teaching resources centers are set up in universities and colleges. However, the STAO budget can not meet the needs of colleges and universities, which are increasing in numbers within years. Therefore, how to broaden the marginal utility of educational improvement projects with limited funding will challenge STAO regulations.

2. Reflections on Industrial-academic cooperation

From the viewpoint of knowledge economy, current issues of revolutionizing engineering educational programs are all about what should be instructed and how the systematic knowledge should be learned. It is acknowledged that establishing learning processes makes the most profits out of industrial-academic cooperation since finding the ways to acquire knowledge is more important than being aware of technological information. Worldwide attentions have been focused on improving engineering education through industrial-academic cooperation in light of knowledge-based economy. The tasks for fostering engineering college students is to enable them to learn actively rather then infuse them with practical information passively. The planning and funding of engineering educational programs must be efficiently pioneered in respect of development for core industries. Lester C., Thurow, professor at Sloan School; Massachusetts Institute Of Technology predicted that knowledge global economy will supersede all current economies at the 2000 World Congress of Information Technology. Thurow said the power in the 21st century comes form information and knowledge. The decayed phase of knowledge is getting shorter. What have learned at collages or universities could be turned less applicable in years. What should be learned and how to instruct students are main issues of national education revolution.

The engineering educational programs steered by STAO are in line with the development of core industries identified by central bureaus. The industrial-academic cooperative projects are usually predominant in engineering educational programs. "Knowledge makes profits". How to acquire knowledge from industrial-academic cooperation makes a decisive contribution for development of industry. Traditionally, the cooperative projects are research-orientated for industrial interests. On educational stands, practical training programs are usually arranged for students. However, the exchanges of explicit resources for complementary interest between industries and academies may contribute less without knowledge flows established. The current wave of strategic alliances among corporations illustrates that the greatest profits usually come out of knowledge acquisition from partnerships [2-3]. In respect of fostering high-tech human resources, the industrial-academic cooperation should be focused to enable students with learning capacities at schools rather then infuse with mountains of "practical" information. The learning process begins with the interpretation of data through "filters" embedded on students' recognition[1]. The data is filtered to be as information, further accompanied with theories and experiences, which leads to knowledge. Knowledge will lead to decisions and actions. The ways of filtering data and integrating information to knowledge are core learning processes. Therefore, in terms of engineering education, the methodologies to acquire knowledge are more important then what kind of information is aware through industrial-academic cooperation. The value-added knowledge flows should be constructed, as industrial-academic cooperation programs are carries out.

3. Strategic management of inter-campus partnership for revolution of engineering educational programs

3.1 Factors promoting inter-campus strategic alliances

Government should concentrate efforts on core industries to sustain competitive edge. The infrastructures of fostering human resources for core industries are being strategically constructed. STAO, once a year, called for proposals of engineering educational programs based on core disciplines of core industries. Every college or university proposes integrated proposals and only the projects working on interdisciplinary integration are proved and subsidized. Some national universities, with abundant budget for academic expenditures and excellent achievement of faculty performance, usually win more subsidies from STAO with well-planned engineering educational programs. However, there are some private or junior colleges always can not be subsidized due to the lack of capability to propose well-organized engineering educational programs. Meanwhile, there are distinct educational purposes among universities and colleges. Inter-campus communications between faculties and students are not greatly promoted. Usually, theoretic lectures and practical training seem not compatible while curricula are arranged. In the past ten years, a plenty of special theme teaching laboratories and specific teaching resources centers were set up in universities and colleges due to the engineering educational programs with STAO's subsidies. However, the marginal utility of educational improvement projects might be only limited within campus. There are no knowledge flows among departments with the shared discipline domains. In order to make the greatest profits out of the engineering educational programs; STAO try to takes steps in promoting the inter-campus strategic alliances to foster high-tech human resource of core industries. The pilot schemes are applied on the engineering educational programs of "precision machinery" and "aerospace" technologies.

3.2 Regulations of inter-campus strategic alliances

As the pre-engineering planning on educational improvement of specific industrial domain is accomplished, the department head identified to be responsible for facilitating strategic alliance constituted, called an alliance manager, is contracted by STAO to arrange an inter-campus task force committee. Respective representatives of departments inclined to develop the common discipline of engineering education are the members of the task group. Usually, there are four or five strategic alliances established in each core industrial domain. The task force of alliance is responsible for proposing the integrated projects in terms of partnership on strengthening the specific disciplinary engineering education. The alliance projects are preplanned through open-minded negotiation, and consulted with the professionals who are identified by STAO as national consultants. The alliance managers have to facilitate the partnership during pre-planning for inter-campus cooperation on specific engineering educational projects. The integrated learning is acknowledged crucial since there is no single disciplinary knowledge along applied for problem shooting. The driving force of inter-campus alliances is that faculties among campuses can be teamed up for cooperative instruction, which makes instructional preparation for integrated courses more efficiently and comprehensively. The alliance proposals are collected and
re-evaluated by a centralized program office, which is contracted to connect and integrate the inter-alliance educational programs. Once all the alliance-proposals are proved by STAO, the subsidies will be released for the expenditure of alliance personnel, educational material and hardware. Each strategic alliance is required to establish a web-site to illustrate current progress of projects and share the knowledge acquisitions via partnership. The program office is also responsible for tabbing the accountability of respective strategic alliance.

The proposals of engineering educational programs only with inter-campus scales are exclusively granted by STAO. The ones proposed by individual colleges or university will be not accepted. The alliances are constituted to integrate and amplify the overall resources of engineering educational programs among campuses. The key successful factors of strategic alliances are organizational consensus on shared visions, systematic design of knowledge value-added flow, and tangible cooperative accomplishments. The ultimate goal for constituting strategic alliances is to build inter-campus learning communities based on a specific discipline. Through integration complementary knowledge resources of departments from different colleges or university, the theoretical and practical knowledge is comprehensively organized on web-site, which provides the opportunities of learning on demands for students across island. Faculties can make a great use of alliance resources to arrange any inspired education activities, such as theme-devise contest, to promote students' learning interest. The derivative benefit from the strategic alliances is to provide the access for international cooperation. WWW make worldwide communication much easier and we provide the valuable engineering educational resource through the Net. Meanwhile, the industry is inclined to involve in industrial-academic cooperation since the interface for negotiation will be easily accessed due to inter-campus strategic alliances constituted. Once the inter-campus engineering

educational programs (usually 3-4 years) are accomplished, the overall performance of each alliance will be evaluated. STAO will honor the faculties who contribute greatly on promotion of alliance partnership and make remarkable progresses on specific engineering educational programs. That reward will be recognized as important reference for academic promotion of faculties in colleges or universities.

4.Outlook of Strategic Alliances for Engineering Educational Programs

Developing and sustaining the alliance partnership is a time-consuming task since the shared visions only come after on-going communications and understandings among partners. In the very beginning, inter-campus alliances are constituted in light of the specific engineering educational programs with subsidies provided by STAO. The inter-campus partnership has to be institutionalized [4]. At pre-planning stage, the alliance manager is responsible to facilitate the inter-campus communication and identifies the partners' roles on cooperative projects. The missions, goals, objectives, and shared resources should be well documented. Alliances usually bring significant learning payoffs for partners as the learning processes are strategic managed [5]. The issue is what should be learned. Recently, the current industrial-academic cooperation programs are challenged for over business-oriented. Only the pilot plants with economic potentials draw industries interests. Specialized programs with industrial potentials usually catch the spotlight. Therefore, the engineering educational programs are usually designed with respect to specialized disciplines. However, the specialized knowledge of industrial has a great turnover. What have been learned at schools is usually not updated with current industrial purposes. The theories of organizational learning and the strategic management of knowledge produced by learning have been documented recently. Organizational scholars are inclined to focus on how new ideas should be learned rather than what should be known [5]. How to foster students with the re-learning capacities? The specialized engineering educational programs should be re-generalized as integrated and focused on tacit knowledge acquired through active systematic learning. Students with learning "receptors" embed during systematic learning at schools will be capable to receive, to learn and to acquire valuable knowledge during learning process. The aim of engineering educational programs is to foster students with the capacities to accommodate themselves to knowledge-based economy. Faculties should enjoy teach less and enable students to learn more.

STAO provides the subsidized engineering educational programs to drive inter-campus strategic alliances constituted. The alliances bring together departments with shared vision of fostering human resources on common industrial domains. Inter-campus alliances provide opportunities to learn and share the specific engineering educational resources developed through inter-departmental cooperation. In the future, STAO would drive forces on how to promote more activated inter-campus alliances with less governmental subsidies. The inter-campus learning communities established are to be believed as the most profitable investment during knowledge economy.

5.Reference

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