

An approach for enhancing industry-university collaboration by funding of university-owned enterprises for technological universities in Taiwan

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ABSTRACT: Revenue from technology transfer ventures is one way to increase a university's budget. New knowledge produced by the university is hard to value. Difficulties in valuing university-commercial knowledge are caused by unclear product demand and unpredictable applications. In addition, the entity-return resources of behind-knowledge are comparatively lower, and the number and amount of university-industry collaborations and technology transfers are limited and often cannot be paired successfully. Technology transfer institutions, incubation centres and technology parks can further derive new ventures, attract established joint ones, obtain government grants and use university fund purchases in hybrid-organisation capital projects. Joint venture initial investments are not large-scale; thus, government grants and school-matching funds can establish trials using hybrid organisations to thrive as independent new start-ups. With technology transfer plan and capital investment into the manner, the university owned enterprise business model is a suitable approach for modern university. Combined with the major school functions of the incubator and the capital investment by the university funds, the university owned enterprise would help to enlarge the revenue of the university by the effective incubating of the incorporation.

Keywords: University owned enterprise, industry-university collaboration, education policy

INTRODUCTION

Senior university education leaders must have the ability to raise funds in these financially difficult times. To increase cooperative education income, Taiwan's higher education leaders should assess their institutions' strengths, communicate with the business community, respond to globalised resourcefulness through businesses, understand the fundamental points of economic development, strive for the establishment of entrepreneurial R&D units at universities, seek new research resources, and form strategic alliances between universities and the industrial world [1]. During university-industry cooperation, industries propose cooperative ventures and provide the resources to do so. Universities undertake appropriate cooperative actions and gain resources. Mutual interaction occurs and a match is made.

Subsequently, the reciprocal effectiveness involving the developmental pace of industries and the publishing of university research must improve. Etzkowitz proposed the Triple Helix Model, which emphasises the interactions among stakeholders from the government, industry and universities, and derives the concept of an entrepreneurship university or universities established with ownership rights [2]. He also stated that when new knowledge becomes the main tool of new and old economic strategy applications, the strength of the university's technology R&D activities becomes the core helix of the model. The government and industry can support the development of universities and accelerate the production of new knowledge. Simultaneously, industries can create benefits from new technology and the government can promote social macro-economic development. Similarly, when market supply and demand become the main tools of new and old economic activity policy applications, industries become the model's core helix.

When government policies become the main tools of new and old economic activity policy applications, governmental strength can also become the model's core helix [2]. Taiwanese government programmes and developments, including the Ministry of Economic Affairs local academic R&D plan, specialty R&D centres and regional industry-university collaboration centres established by various universities through Ministry of Education funding, National Science Council grants for industry-university collaboration, and other programmes, are in the scope of the Triple-Helix Innovation Model. Although industry and personal donations to universities are not common practice in Taiwan, universities can generate considerable effective cooperative education income if they apply their strengths to collaborate with industries. With their backgrounds of excellence and leadership authority, universities have recently been promoting a strong culture of industry-university cooperation to create and transfer knowledge. They hope to unite the

research abilities of college and university professors with the resources of industry research and development (R&D) activities and to narrow the gap between students and corporate training.

University professors' expert research abilities can create economic value and increase national competitive advantage. In addition, professors' research can be expanded beyond pure theory and develop the applicability and practicality of their research. These steps inevitably aid in strengthening industry R&D and can simultaneously increase university cooperative education revenue. If universities wish to cultivate expertise and technology and ensure stable technology transfers or patent licensing in endowment funds, they should consider the investment channels for the endowment funds, invest university funds into university spin-off companies, and pair technology shares with capital investments to grasp university-owned enterprise model management rights.

The authors conducted a university-operated enterprise establishment feasibility assessment to serve as an operating-decision reference in establishing university-operated enterprises by studying relevant domestic laws and analysing domestic and foreign research. The authors considered education policy authority deregulation of the remaining private school investments and public school endowment fund management, as well as the urgent requirement for university investment income and cooperative education revenue. They subsequently obtained copies of domestic and international laws and documentation related to university-owned enterprises to examine the connotations of cooperative education and attempted to establish a viable university-owned enterprise approach.

CONTRADICTION BETWEEN INDUSTRY-UNIVERSITY COLLABORATION

In addition to knowledge dissemination restrictions by the knowledge creators, when certain industry companies collaborate with a university, it might also be necessary to withhold new knowledge within the collaborative scope from the public. This is a demonstration that university knowledge dissemination is subject to definite limitations because of this market-oriented requirement. By maintaining knowledge gaps, universities can attain higher anticipated compensation resources, particularly for commercial knowledge. The creation of academic knowledge that attracts high numbers of publication citations is advantageous in improving the reputation of the relevant university. Through publications in international journals and exchanges with top international academics, the image of a world-class university can be enhanced.

Ji indicated that industry-university collaboration education and industry-university collaboration research are a sub-concepts of overall industry-university collaboration [3]. The two differ in that industry-university collaborative research is research and development-oriented and its products include technology. Industry-university collaborative education is oriented toward knowledge production and dissemination, and its products are people. The cooperative education lies in providing students with internship and employment-guidance channels. It serves as a starting point for counselling and assisting students, whereas industry-university education is multifaceted.

In addition to providing students with internships and research opportunities with professors, industries also provide industry-related education and on-the-job education channels. Therefore, industry-university collaboration includes education, training, research and services depending on the nature of the industry-university programme, and does not only rely on industry-university education and industry-university research. The primary mission of universities is to create and disseminate knowledge. The creation of knowledge induces a knowledge gap; and dissemination of knowledge can pre-empt this gap. University knowledge creators generate knowledge from collected resources. These resources come from government and private agencies. To prompt a knowledge gap, university knowledge creators disseminate the information so that the knowledge is not lost. They abandon opportunities to self-accumulate knowledge and replace these opportunities with external reputation enhancement, such as in publications [4].

According to present industry-university collaborations and the definition of collaborative education before the University Act was amended in 2004 [5], university-accumulated knowledge gaps, research, training, education and services can be used to collaborate with industry or other entities and obtain appropriate resources. A collaborative relationship is formed when both parties agree on the prerequisites for exchanging equal resources. Universities not only improve their reputation, as well as assist in enriching the college fund with external compensation resources, but also enrich the follow-up resources of the knowledge creators. In this atmosphere of industry-university collaboration, a contradiction appears between university knowledge creation and dissemination and obtaining anticipated returns. To gain greater compensation returns, knowledge creators often disseminate less knowledge.

The incentive for improving their reputation is less than that of compensation returns. Subsequently, knowledge dissemination relies on the lag in knowledge flowing from the entity compensation resources model and on whether the magnitude of the knowledge creator's lead can force the lagging party to pay with increased compensation resources. The majority of industry-university collaborations must address the requirements of local plans and university research-results technology transfer. This forms a positive cycle that elevates the national economic cycle. Through continued government resource investments, the five year NT\$50 billion higher education development plan focuses on prospect research and competitive published results, which attracts students to the university through academic features, such as the number of citations and its international prestige [6]. These achievements contribute to the country's advancement,

bringing prestige to the university and government, albeit with limited assistance for economic and industrial growth. Public opinions shift with the reduction of national resources and when government project resources decline.

MAKING OR SMOOTHING OF KNOWLEDGE-GAP IN UNIVERSITY

The primary university goal is to disseminate knowledge. Knowledge creation is an accountability requirement and is gradually receiving more recognition. Newly created knowledge is divided into two types, specifically: academic knowledge and commercial knowledge [4]. Academic knowledge is disseminated easily, but it is not clearly applicable and is difficult to value. Conversely, commercial knowledge is clearly applicable and easily valued.

Under the promotion of education authorities, universities who disseminate academic knowledge gain prestige from published articles that have high published numbers and citation rates. These universities are advertised among renowned universities. However, they disseminate commercial knowledge and achieve high entity compensation resources from collaborative programme technology transfer cases. As mentioned previously, a knowledge gap exists. Thus, when new knowledge generated by universities shows marketability (it can be valued), the foundation for the industry-university collaboration is established and further derive new ventures.

For incubation centres, Li believes they should establish university-owned enterprises and the relevant business matters should be operated by a commissioned professional managerial team [7]. In addition to providing venture-related business counselling, it can mobilise and manage venture capital, permitting a combination of the two functions of venture incubation and venture capital.

The professional managerial team can assist with important functions of university-owned enterprises, such as migrating university R&D results to industries or deriving and establishing technology companies, and assisting student-teacher ventures (company regulations, financing and financial planning, factory construction, government subsidy programme information, patent application assistance, equity negotiation information assistance), which permits universities to become a core base in driving overarching social innovations. Taiwan must move toward a vision of a knowledge economy before it can realise its social vision [7].

After a company obtains a business license from the industrial and commercial administration departments, they can qualify as a legal entity that independently conducts business activities within the scope of their constitution/articles. However, the organisation, economically and in other aspects, continues to be subject to the administrative and business management of the school's relevant competent departments. Thus, university-owned industries pass the operating-profit obligations to the school [8]. University-owned enterprises have three main characteristics: a) the university has an absolute or relative maximum investment ratio; b) in the start-up period, members of the corporate management team primarily come from university faculty or students; and c) the company primarily relies on the university's resources to draw up contracts, develop new products, and for other development processes. University-owned enterprises are the background of high-technology enterprises, and focus on studying the industrialisation of new discoveries [9].

The applications of academic knowledge are not obvious and cannot be valued. The applications of commercial knowledge are clearer and easier to value. However, the nature of knowledge cannot be explicitly distinguished with the binary method, particularly, the knowledge created in engineering and applied sciences departments or R&D centres. To obtain higher numbers of published journal articles, some knowledge creators trend towards research with science prospects to accelerate promotion. In addition, knowledge creators in the engineering and applied science fields primarily trend towards applied science knowledge creation. Applied science emphasises utilisation, thus related knowledge creation would inevitable be applied. However, knowledge creators are concerned regarding the lack of market development time. New-knowledge application timing is often determined by the industry.

The industry is often the main factor in whether a university-industry collaboration case succeeds. If a university has a venture capital firm but hesitates about whether to invest in university-industry collaboration, it can use the knowledge valuing method to establish a university-owned enterprise. It can, then, focus on expanding the knowledge developed by the university, creating greater niches, and can, then, focus on attracting industry collaboration, mergers and acquisitions and, thereby, increase the school's endowment fund. This is the prospective establishment of university-owned enterprises, which can further increase knowledge value prices.

PRIVATELY-OWNED UNIVERSITIES EASILY FUND UNIVERSITY-OWNED ENTERPRISES

In Taiwan, the Private School Act states that after the year's annual budget expenses have been paid, half of the remaining amount must be invested to increase the school's financial resources. Article 50 states:

...To increase teaching effectiveness and enrich the school's financial resources, after this rule receives approval from the school's competent authorities and industry competent authorities, the school foundation's private university must establish subsidiary bodies for teaching, training, experiments, and promotions. The same applies to using investments, accepting government authorities, private enterprises or private

commissions, cooperative business operations or other legal methods, to handle education, training, experiments, research, and promotions related to businessmen.

However, this surplus is dependent on each year's annual budget.

Private School Law Enforcement in Taiwan [5] governs private-school funding using the following methods: a) depositing in financial institutions; b) purchasing government bonds and short-term bills; c) purchasing school-occupied real estate; and d) using safe and reliable principles, and with the agreement of the board of directors, half of the fund is converted into investments that can aid in increasing school financial resources. This amount does not include establishment funds. In addition to half of the surplus amount being placed into investments, the Private School Act states that after deducting the establishment fund, the endowment fund can still be invested to increase school financial resources, including deposits, bonds, bills and real estate. Investing in real estate can be used to increase school-facility management revenue, such as conference centers, incubation centers, factory management incomes, school guesthouses and student dormitories.

Certain industry-university collaboration projects implemented by university knowledge creators requiring greater amounts of space, can flexibly cope with programme venue- and equipment-use fees to invest in school financial resources, and can convert venue- and equipment-use fees into university-owned industry shareholdings. There is one provision. However, if there are losses through fund investment, *these losses must be replenished by the directors.*

Although this provision was meant to urge directors to evaluate investment targets carefully, the members of the board of directors only serve in a public service framework. According to the regulations, colleges are only eligible for meeting their travel expenses. Board members are willing to risk investment resolutions. Thus, private schools typically do not invest their funds in ventures.

Investment of private school surpluses is used to purchase domestic listings, OTC stocks and corporate bonds, beneficiary certificates issued by domestic security investment trusts or placed in limited amounts into other investment projects approved by the school foundation's competent authorities [10]. Because of the exclusion of establishment funds and retirement funds from the remaining payment investment fund total, the premise for investment is that the private school must have surplus funds, must wish to invest in unlisted or new ventures and must receive the approval of the school foundation's competent authorities. Therefore, if they wish to invest surpluses into new ventures or university-owned enterprises, they must first await an amendment of the law.

ASSESSING AND AUDIT OF ENTERPRISE

During the financial crisis beginning in 2008 and continuing to the present day, Yale University Foundation's Chief Investment Officer, David Swensen, claimed that Yale's wealth had shrunk by approximately \$5.9 billion in the previous year. This caused other universities to hesitate in making investments. Subsequently, establishing expert assessment and management of permanent establishments help enhance investment returns. Feng Chia University explicitly appointed eight investment team members, one of whom was assigned the responsibility of matters relating to investment activities, which is unheard of for college and university management [11].

The cause is that the available university investment income units and manpower are significantly inadequate compared with the manpower required to manage and operate a college or a university. For example, the previously mentioned Yale University Foundation's Chief Investment Officer, David Swensen, grew the university fund of \$1 billion to \$23 billion through investments during his service. For effective investment-return assessment, the derivative income could surpass the income from student tuition and other fees, showing that the university has ineffective investment assessment capabilities and management.

Universities should incorporate internal and external experts and boards of directors to form investment assessments and management teams and should include technology and financial experts. These teams routinely focus on investments at their school's education incubation centres and vendors and further guide these incubation centres and vendors into mass production stages. The incubation centres and vendors should further be guided to convert the revenue from technology transfer property into school's shareholdings. For example, the Yale University Investment Committee consists of three trustees, Yale's President, and the other 11 enterprise, finance, non-profit sector or investment expert members. They are responsible for reviewing and assessing the asset allocation policies, endowment fund effectiveness and for evaluating strategies proposed by investment staff.

In the process of cultivating private university, university-owned enterprises, the schools must also combine internal and external experts to assess the risk management, such as the Yale University Investment Committee. They use technology transfer expenses, incubation-centre resource input, capital account leasing and input resources, and further convert them into university holdings [11]. Permanent assessment and management units are responsible for consulting the university-owned enterprises to effectively increase the university's income. They also counsel the university-owned enterprise on OTC trading and listings. When university shareholdings appreciate ten-fold, they can effectively form a long-term positive cycle.

CONCLUSIONS

The primary problems of university-industry collaborations are local plan requirements and technology transfers of R&D results that universities release. In addition to promoting industry upgrades and spurring the growth of the national economy, universities make academic and research institution investments, and industry or government research investments and, thus, are a positive influence on the national economic cycle. For example, universities adopt new knowledge in economic activity policy applications. When the industrial technology establishments are adopted as the primary tools for new or old market demand economic activity strategy application, universities expect to implement endowment funds using technology transfer or patent licensing.

Additionally, universities participating with autonomous and non-autonomous developers in the industry, occasionally collude with developers to hide key technology and leave fundraising ventures. If universities wish to involve in specialised technology or secure the investment of technology transfers and patent licenses through endowment funds, they should consider placing their endowment funds in investment channels and create university-derived university-owned enterprises, regardless of whether they can attain certain shareholding derivative businesses by using technology shares or customised technology shares with fund implementations to maintain derivative business rights of university-owned enterprises. The new knowledge universities create includes academic and commercial knowledge. Academic knowledge is innovative and easy to disseminate, but its applications are vague and difficult to value. Commercial knowledge has clear applications and is easy to value.

When a knowledge gap exists, there is a foundation for industry-university collaboration. However, the entrepreneurial success of new knowledge is low. Difficulties in valuing university-commercial knowledge are caused by unclear product demand and unpredictable applications. In addition, the entity-return resources of behind-knowledge are comparatively lower, and the number and amount of university-industry collaborations and technology transfers are limited and often cannot be paired successfully.

Technology transfer institutions, incubation centres and technology parks can further derive new ventures, attract established joint ventures, obtain government grants and use university fund purchases in hybrid-organisation capital projects. Joint venture initial investments are not large-scale; thus, government grants and school-matching funds can establish trials using hybrid organisations to thrive as independent new start-ups. This trial production line and plant can be rented out to new ventures, combining university incubation-centre abilities to further expand capital investments, and achieve effective university-owned enterprise benefits.

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BIOGRAPHIES



Hsi-Hsun Tsai received his BS degree in aeronautical engineering from Tamkang University in 1990, followed by the MS and PhD degrees in power mechanical engineering from the National Tsing Hua University, in 1992 and 1997, respectively. In 2001, he joined the faculty of Ming Chi University of Technology as an assistant professor. He was promoted to the grade of associate professor in 2005. From 2005 to 2007, he was Chairman of the Department of Mechanical Engineering and the Graduate Institute of Electro-Mechanical Engineering. His research is focused on the fields of optomechanical device, manufacturing and engineering education. He was a *Pioneer* in teaching of the engineering college in 2011.



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