Increase in Effectiveness of Technology Development in Thai SMEs with Group Approach

Sauwapa Yuwawutto, Thitapha Smitinont, Numtip Charoenanong,
Nattaka Yokakul, Somchai Chatratana

[1]sauwapa@tmc.nstda.or.th, [2]thitapha@tmc.nstda.or.th, [3]numtip@tmc.nstda.or.th,
[4]nattaka@tmc.nstda.or.th, [5]somchai@nstda.or.th

Industrial Technology Assistance Program (ITAP), Technology Management Center (TMC),
National Science and Technology Development Agency (NSTDA),
111 Thailand Science Park, Paholyothin Rd., Klong 1, Klong Luang,
Pathumthani, 12120 Thailand.

Subtheme: S6 Enterprises and industrial development in a knowledge-based city or region (Government policies for enterprises and industries)

Abstract

This paper explores the Triple Helix development by using the case of the Thai confectionery industry in Thailand which comprises mostly small and very small-sized enterprises. Technology development in small and medium-sized enterprises (SMEs) is considered crucial for innovation and growth of firms. Many government agencies in Thailand have generated support and intervention to promote research and development (R&D) in SMEs. The group approach on the technology development project initiated by the Industrial Technology Assistance Program (ITAP) is one of the most successful cases to significantly improve technology and innovation at the firm level. The group approach which is based on the concept of networking involves various steps of strategic innovation development. Activities in a project with group approach cover survey of industry, seminars and training, preliminary visit, technology acquisition, and business matching. These series of activities create a sustainable innovation network between the actors in Triple Helix system, which is the starting point for Sub-Sector Innovation Network (SSIN). The success in SSIN will lead to the formation of innovative cluster which is very important to constitute to national innovation system and national competitive advantage.

Keywords: Government policy, SMEs, technology development, Group Approach, Sub-Sectoral Innovation Network

1. Introduction

Technology development is one of the main important factors for driving competitiveness of Thai small and medium enterprises (SMEs) in the global market. The model for technology development starts from conducting research and development (R&D), innovation management, and transfer of technology. Investment in R&D of Thai industrial sectors, especially SMEs, is therefore crucial for the innovation. Thai government implements many supporting schemes to promote R&D in SMEs. However, due to high risk nature of R&D and innovation, investment of Thai SMEs in R&D is still very limited (Arnold et al., 2000; NSTDA, 2004).

The situation of low investment in R&D follows the trend of R&D investment of Thailand. During 2001-2006, the GERD/GDP ratios of Thailand are relatively constant approximately 0.24-0.26% which is 14 times lower than Japan (3.39%) as shown in Table 1 and 2. In addition, in comparison with other industrialized countries in Asia such as Korea, Taiwan and Singapore, Thailand expenditure in R&D is 9-13 times lower than those countries. The R&D investment in the countries with high R&D expenditure is mostly made by business enterprises (more than 60%), while the investment by business enterprises in Thailand is relatively low (41%) which is only half of the investment by business enterprises in Malaysia (84 %).

Table 1: Thailand R&D expenditure in 2001-2006

Year	2001	2002	2003	2004	2005	2006
GERD/GDP (%)	0.26	0.24	0.26	0.26	0.24	0.25
Business Enterprise (%)	42	39	38	36	40	41
Other sectors (%)	58	61	62	64	60	59
Total (*MUSD)	401	380	443	473	476	559

* The exchange rate is approximated to be constant at 1 USD = 35 Baht
Source: Thailand S&T Index 2008, National Science Technology and Innovation Policy Office (STI) 2009

Table 2: GERD/GDP of selected country in Asia for year 2006

Country	GERD/GDP (%)	Business enterprise (%)	Other sectors (%)
Japan	3.39	77	23
Korea	3.22	77	23
Taiwan	2.58	68	32
Singapore	2.31	66	34
China	1.41	71	29
Malaysia	0.64	84	16
India	0.61	20	80
Thailand	0.25	41	59
Philippines	0.12	58	42

Source: Thailand S&T Index 2008, National Science Technology and Innovation Policy Office (STI) 2009

Promotion of R&D in industry is thus one major mission of many government agencies as can be discerned from continuous promoting schemes implemented to promote investment on R&D of Thai industry, such as the 200% deduction of R&D expense from the earnings before income tax scheme by the Revenue Department, soft loan for technology development projects by the National Science and Technology Development Agency (NSTDA) and interest-free loan for R&D and commercialization for innovative products by the National Innovation Agency (NIA). However, these supporting programs appear to be bureaucratic, selective and not atrractive enough to promote the R&D in private sectors. The barriers in R&D investment in private sector have been elucidated and published by many investigators (Lauridsen, 2002; Berger, 2005; NSTDA, 2005). Some of the major factors can be listed as

follows: research outputs from academic sector can not be directly applied at industrial level, lack of the system to support the implementation of research results to prototype and commercialization and high risk of R&D.

Technological development and innovation at firm level, particularly the SME sector, is presumed to be promoted by the strong links and network of university, industry and government as suggested in the Triple Helix model (Etzkowitz & Leydesdorff, 2000). This would help firms increase ability to access external resources such as knowledge, financial, support and technological infrastructure. SMEs in developing countries are generally resource constrained in which technological knowledge, capital fund and network are limited. In the prevalence of weak links between government, university and industry, intermediary agency is crucial for interfacing and facilitating such linkages that enable firms to access more external resources that would make up for their shortfalls (Yuwawutto et al. 2010; Yokakul & Zawdie, 2010). This can be seen from a study of the OECD (1997) on firms in many countries that have and do not have collaboration with external sources. The result shows that firms having joint R&D with external sources have more product development than firms that do not have joint projects.

In the case of Thailand, where Triple Helix system of innovation is weak and fragmented (Intarakumnerd et al., 2002), the Industrial Technology Assistance Program (ITAP) was initiated and currently operates under the Technology Management Center (TMC) of the National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology of Thailand to play supporting role for technology development of private sector, particularly SMEs. ITAP aims to be an intermediary to bridge the gap between industry (the demand side), government research and technology organisations (RTOs) and universities (the supply side). ITAP does not only match the needs of the demand side with expert from the supply side via technical consultancy service, but provides other suitable supports such as, project management, group facilitator and consultant, to promote stronger links and to sustain them. In general, ITAP staff which is called Industrial Technology Advisor (ITA) helps SMEs identify the technical problem related to products or processes. Once the needs for technological development from firm are identified, ITAP acts as an intermediary that establishes collaboration between technical experts and entrepreneurs. This scheme effectively strengthens individual firm by providing an exact match between a particular need and a particular solution to the problem. Over 18 years, ITAP has brought experts to Thai SMEs to work with the owners of the factories, to apply technology for various aspects, e.g. energy saving, loss reduction, process improvement, value creation and new product development. During the last five years, 2005-2009, ITAP supported 1,283 R&D projects. The number of projects per year increased significantly from 79 projects in 2006 to 455 projects in 2009, or 576% increase. Even though more and more SMEs conducting R&D projects with ITAP each year but they accounts for only small percentage of total number of SMEs in Thailand which is about 2.9 million enterprises.

At the initial phase, the main scheme of technology development project by ITAP has been based on a single project approach focusing on serving the needs of individual firm. The single project approach works well with individual firm with any levels of technology absorption capability because the consultancy project can be individually designed to suit each firm. However, the consultancy fee for each company on the single project approach can be considerably high. The expansion of activity is not possible due to one to one nature of the project (one expert to one factory). It is not surprising that the number of projects which is related to R&D in comparison to the number of Thai factories is still very small. With the large number of companies that can benefit from the services provided by ITAP, the challenge for ITAP is to design appropriate public intervention to promote technological development and innovation in industry in a larger scale.

2. The Beginning of Group Approach

During the first few years of ITAP operation, Thailand still lacked technical experts in nearly all fields. During that time, ITAP cooperated with many international organizations to provide high quality technical consultancy, such as; Senior Experten Services (SES) in Germany, Canadian Executive Service Organization (CESO) in Canada, Australian Executive Service Overseas Program (AESOP) in Australia, and Japan Overseas Development Corporation (JODC) in Japan. Many highly successful projects were the results of the assistance of foreign experts, the field of technologies conducted include plastic technology, wood working technology, food technology, composite material technology, rubber technology etc.

Even though the consultancy services provided by foreign experts have been regarded as successful in promoting technology development for industry, the services could be provided only to companies with high financial capability because the consultancy fee and other expenses were normally high due to travel cost and need of Thai moderators or assistances. In order to share such cost, a group of Thai SMEs of the same industry has been invited to join the program and obtain consultation to reduce the financial burden of individual company. In addition, a more extensive program has been designed to get the most benefits from the program. The program of activities which include seminar, visit of companies for problem diagnosis, and short term consultation have been carried out during two or three weeks of the visit of foreign expert. Being aware of the shortfall of competent local experts, ITAP recruited Thai lecturers from the universities to join in these projects to absorb technology involved in each industry. Although group approach (one expert to many companies) for foreign expert is born out of the necessity to share the high cost of the project, it has provided new benefits to all parties participating in the project. Apart from the benefit of cost sharing, a network has also been formed among the participating companies. The moderators and assistances have gained knowledge both in technology and consultancy techniques from the foreign expert. In some cases, Thai experts could later replace the foreign expert and provided consultancy to other companies in the same industry.

3. Design of Group Approach for Targeted Industry

The essential components for initiating group project for specific industry are the common problems from industry, the availability of expert team and sufficient number of firms. The cumulative information obtained from company from questionnaires, telephone interviews or on-site visit in each industry could suggest some common problems of the industry. These can be either problem related to production or emerging non-tariff barrier such as new regulations, environmental issues or competition from other countries. The experts in the team should have sufficient time to carry out on-site visit at the companies, provide consultancy services and to work on technological development projects. The expert team should have sufficient number of members to share the workloads. The number of firms sharing similar problems should be high enough to initiate group activities, discussions and exchange of information in order to create more impact to the industry.

A framework of group approach for targeted industry is specified from the information accumulated from the industry and the experiences of ITAs who manage the project. Activities in a project with group approach usually involve the study of the industry situations, questionnaire survey, preliminary visit, a series of seminar and training, technology acquisition trip and focus-group meeting which in the end will lead to single company consultant. Details of some activities such as seminar and technology acquisition trip are usually specified later after the suitable topics or technology has been elucidated from the study of industry situation. The group approach is flexible and the plan of activities can be continuously adjusted to suit the needs of the group at each development stage and different time frames. Termination or postponement of the activities is even encouraged, if the pre-determined technology needs no longer match the real interests of the group. The main output expected from these activities is that most firms should be able to identify their technological need and proceed to establish collaborative projects which can involve one or more firms in a single project.

In the last few years, ITAP has conducted several projects with group approach which are focused on technology or non-tariff barrier such as quality and safety system in food industry, quality system in medical devices industry and in cosmetic industry. In each project, at least 20 companies were visited to determine their needs. The number of firms conducting development projects with ITAP from each project ranged between 5-40 projects. It is not surprising that the number of companies conducted projects with ITAP involving the quality system were relatively high as these systems directly affect their exporting capability.

In this paper, Thai confectionery industry was selected as a case study. The interest in this industry arises from its unique characteristics. Firstly, it is Thai identity products but shows high potential for export market. Most of the SMEs in the industry are relatively of small-sized or family-based with low financial capability and low technology capability. In addition, there is no apparent regulation imposing a crisis to the industry. Therefore, the plans or proposals to promote growth and development do not normally come from the industry but rather come from government, university and supporting agencies. The discussion on group approach to enhance technology development in this industry would serve as a good lesson and would offer some guidelines for the implementation of the project to improve the technology capability of small industry.

4. Case Study of Group Approach for Thai Confectionery Industry

Traditional Thai confectionery or 'Khanom' in Thai has long been a traditionally remarkable industry in Thai community and lifestyle. Most of raw materials used in production are from local sources, while the application of new ideas and technological development would help to add value to local resources. Many studies and ITAP survey indicate that Thai confectionery looked very promising for the Asian market, particularly China, Hong Kong, Singapore, and Japan (ISRA Institute, 2008). However, SMEs in this traditional sector is generally weak and fragmented, that inter-firm collaboration does not normally or easily occur because they perceive each other as competitor. Moreover, this industry is considered to be low technology and labor-based industry, in which the extent of technology development and innovation is few and far between.

With this concern and the potential access to worldwide market as mentioned above, the Office of Small and Medium Enterprises Promotion (OSMEP) thus set up a company in 2003, called Thai Confection Industry (TCI), as well as retail outlet, *Sawasdee shop*, at former Bangkok's International Airport, Don Muang. TCI played an essential role in developing Thai confection industry. TCI database at the time consisted of 424 Thai confectionary firms and its member committee consisted of over 10 confectionery producers, which are mostly rooted in ordinary OTOP, a government project to promote local specialty products based on each village's available resources and native tradition. TCI regularly conducts committee meeting in order to identify real problems and needs of the manufacturers and opportunity to promote the industry. Not only does it play an advisory role in disseminating packaging technology to hopefully attract interest from consumers, but TCI also creates and reflects unique characteristics of delicate Thai confections, a position of strength for expanding market. As the bottom line, it is to raise firms' awareness on the importance of R&D and their potential to be global players.

Nevertheless, most Thai confectionery producers show apparent lack of applying such science and technology as well as food safety system such as Good Hygienic Practice (GHP) and Good Manufacturing Practices (GMP). The latter is an international standard required by most export markets. Undoubtedly, insufficient understanding of food science leads to poor efficiency of production process and short shelf-life considered an impediment to export.

Since 2007, ITAP has collaborated with TCI to provide opportunities for potential entrepreneurs in the Thai confectionery industry to improve production process and product to meet international standard. The group approach has been applied to this group with some selected activities as described below.

Industrial survey: ITAP activity in the Thai confectionery industry started with industrial site visit of 8 potential companies suggested by TCI. The top technical needs were identified in most cases as machine development to replace manual work and shelf-life extension. Other less popular topics included process improvement, new product development and food quality system. These technological needs were also explored further through preliminary visit conducted with more companies after the seminars.

Seminars: This activity was conducted at the early stage of the project to attract interest from producers by providing information on potential market, possible readily available technology to increase the shelf-life of their products which was found to be the industry's common problems and involved with their day-to-day production. After the first seminar, 15 companies expressed their interest for a one-day preliminary consultation which does not require R&D, to advice on some general problems, and to identify their technological problem and possible development opportunities. Only few companies decided straight away to initiate collaborated R&D projects to solve such problems mostly due to cost and investment on R&D project that they have to bear.

The following seminar focused on more sophisticated technology which required R&D such as the application of suitable ingredients for product formulation, more advanced production technology, introduction to food safety standard and effective production management. After the second seminar, other 17 companies addressed their interest in the one-day consultation.

Preliminary visit: This activity was individually conducted for each company to address its technological needs. ITAP invited experts from universities and research institutes to provide a one-day consultation to 33 companies. The technology needs of the companies are summarized on the pie chart in Figure 1.

The top two common needs were product shelf-life extension (32%) and utilizing machine to replace skilled workforce (23%). Other needs included new product development, process improvement and implementing of food safety system. Apparently, the Thai confectionery industry shows a potential for technology improvement but this could be develop through knowledge transfer and exchange processes, and support from public agencies, which will be discussed in the rest of the paper.

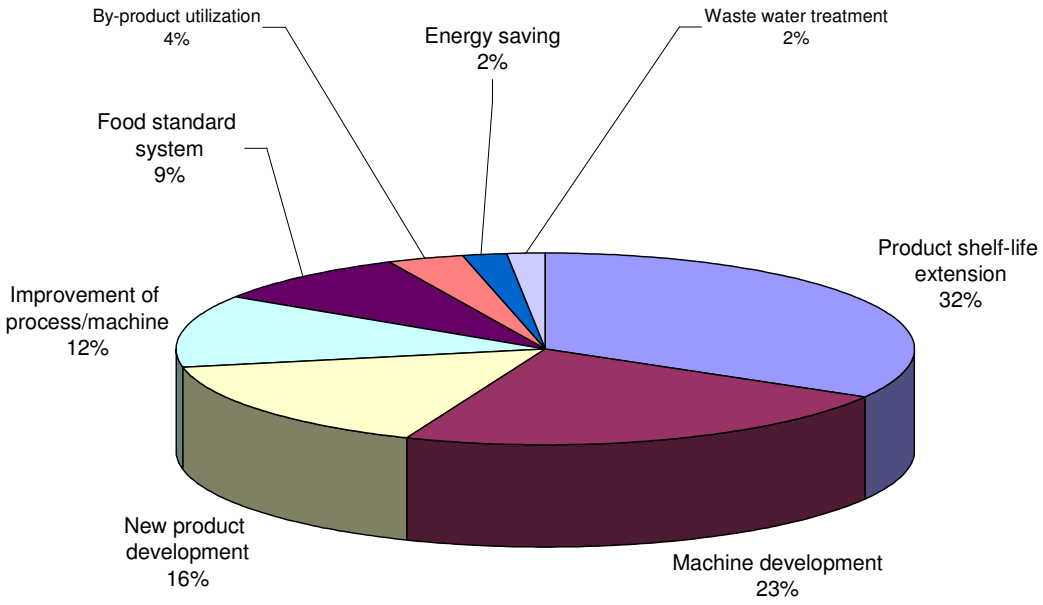

Fig. 1 The technology needs of Thai confectionery industry (data obtained from visiting 33 companies)

Technology Acquisition At a later phase of the project, ITAP arranged domestic technology acquisition trips. The technology acquisition trip is designed to create awareness of new technology and provide visible and tangible examples to the participants. Upon seeing the real utilization of technology, it would be easier for the entrepreneurs to perceive and understand the advantage of adopting new technology. The first technology acquisition trip was organized to visit Silpakorn University to learn about solar drying process in a solar drying dome. The solar drying dome, which is a closed system, offers the solution to the high loss problems, thus increase production capacity and hygiene problems. A one-day consultation was requested by 6 companies after the trip to obtain consultation and to determine the possibility of implementing the solar drying technology to their production. The second trip was arranged for a visit to the Thai-China Flavors and Fragrances Industry Co. Ltd., a Thailand's leading flavors and fragrances manufacturer. The purpose of the second trip was to introduce the participants to the application of flavors and fragrances extracted from natural plants and herbs to enhance the smell and the taste of their products.

Business Matching/ **Networking** In addition to technology development from one-day consultation or R&D project, all above activities open opportunity for participants to unofficially meet and discuss, creating relationship, thus enhancing the chance for business partnering. The success of group project activities in this regard can be shown in these two following cases.

The first case is in rice cracker business. From the second seminar, a business matching between companies in fried rice cracker producers were established. This case is a good example of relationship built upon the opportunity to meet during the seminar. One fried rice cracker producer, basing in the rice-growing province, offered to sell its raw rice chip to other fried rice cracker companies in the metropolitan area. This created a new business line for the first company. After the first technology acquisition trip to see solar drying dome, together with the market expansion has brought this company to adopting the solar drying dome for the raw rice chip drying process to ensure the production capacity and the food hygienic and safety through a project coordinated by ITAP. The second technology acquisition trip to visit a flavor producing company resulted in the ideas for new product development. The interest in conducting R&D for technology development of this company is also shown in its connection to local experts for some machine development to increase the production capacity, such as rice chip forming machine, modified equipment to be used in the fryer, new microwave drying technology, product shelf-life extension by lowering the oil level in products. As a result, suppliers of raw material to this company also have higher sales and revenue and more solar drying domes were built.

Another case is a fried sticky rice cracker entrepreneur. This entrepreneur was encouraged by TCI to develop new innovative product by using unique ingredients and new application method. Upon the success in the sales of this product, the entrepreneur turned to technology development with consultancy from one university expert. R&D projects were conducted with ITAP on finding optimum processing conditions to lower the amount of cooking oil in the sticky rice cracker. Other R&D projects with the expert included new frying technology and machine development. The knowledge diffusion from the expert gradually increases the technical knowledge of the entrepreneur that he now has direction for R&D for his business and knowledge to implement research results for the optimal use in his production.

In conclusion, the group approach for the Thai confectionery industry can bring about following outputs:

- Production improvement from the one-day consultation activity
- Technology development through R&D project
- Business matching and partnering
- Networking among the companies
- Increase linkages between U-I-G

5. The Development of Triple Helix Network

The development of triple helix network within the Thai confectionery industry is shown in Figure 2. After gathering of over ten producers, TCI, a highly specialized Thai confectionery expert, embarked on an initiative to assist in development of new packaging. Later, it joined forces with iTAP, who had an intermediary role in drawing on technical expertise and experience, in the area of food technology, from various prestigious universities and research institutes. The support, which already mentioned above, includes the provision of counseling, developing training courses, and organizing technology acquisition trips. It is a repetitive process intended to draw more companies to join in the network and increase social interactions between firms and firms; and between firms and knowledge sources.

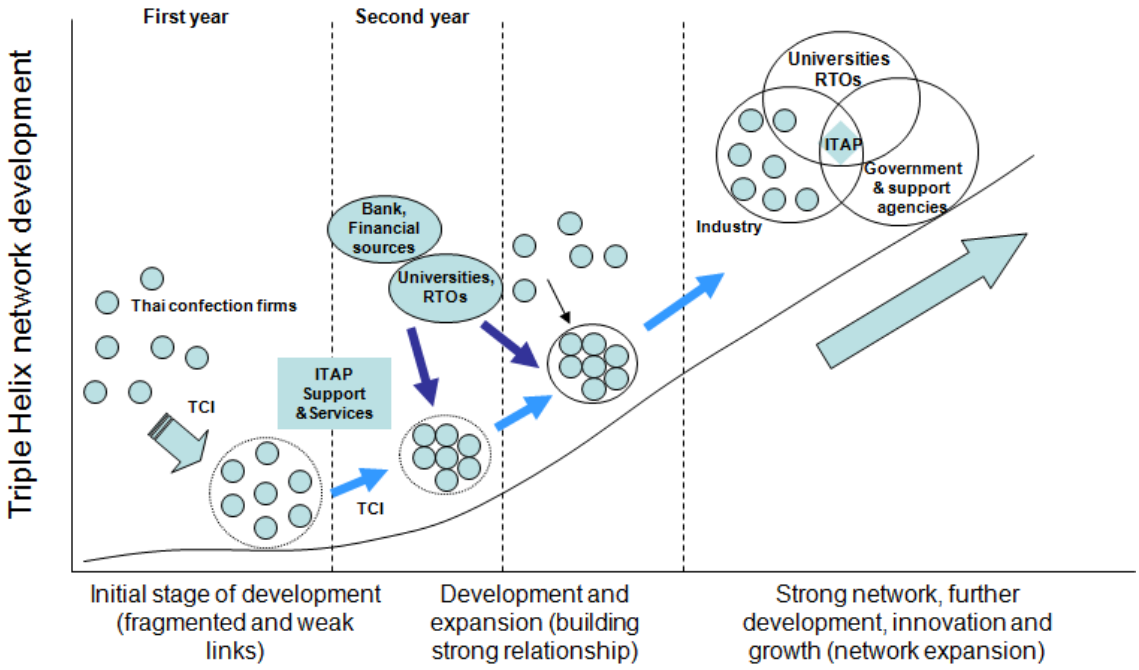

Fig.2 The development of linkages in the Triple Helix for the project on Thai confectionery industry with group approach

Figure 3 shows the actors in the Triple Helix relationship in more details. It can be seen that the ITAP, at the intersection of three circles, plays an intermediary role in seeking and introducing new players to the project. Starting from the confection producers introduced by TCI, ITAP brought four units from three universities namely; the Department of Physics and the Department of Food Technology from Silpakorn University, King Mongkut's University of Technology Thonburi and Kasetsart University as RTOs and University partner. Coordination was made to bring in four units from government support programs and even private financial agency namely; The Office of SME Promotion, Thailand Research Fund, a private GMP consultant and the commercial Bangkok Bank to play the role of the government and private supporting agencies. With the activities designed for the project with group approach all three groups supporting and interacting with each other in the innovation development process.

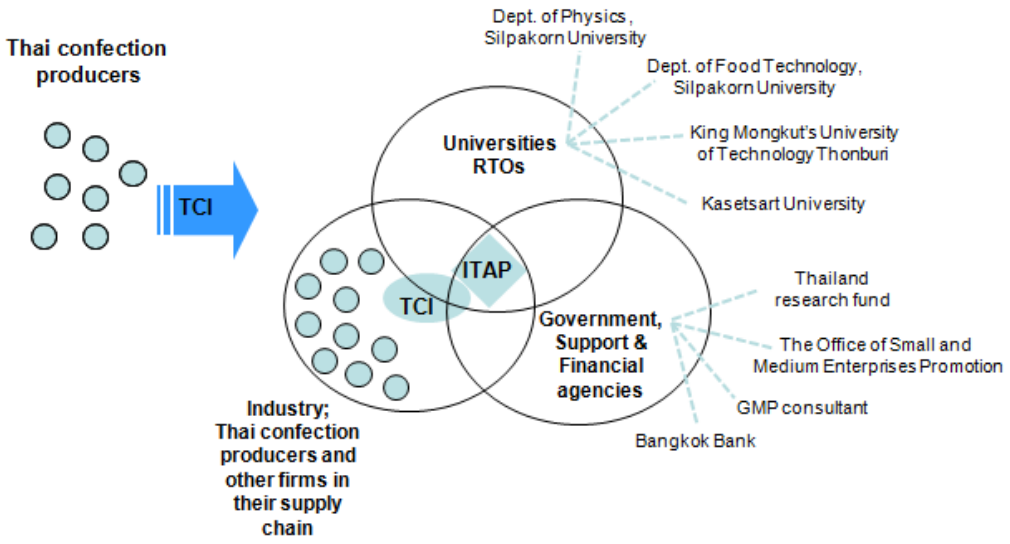

Fig. 3 ITAP as intermediary to promote Triple Helix relationship among group of companies, universities and government and support agencies

From the experience with the Thai confectionery industry project with group approach, it can be concluded that in order to initiate the linkages among U-I-G, each component of the Triple Helix framework should have following roles or characteristics: executives in private sector must be determined and dedicated to undertake technology development and at the same time provide sufficient human and financial resources; experts from academic sectors must be willing to support and highly capable of transferring knowledge; intermediaries must be capable of matching the needs of industry with suitable technology provider and continuously drive the interactions among U-I-G. Moreover, the challenge of intermediary or support agencies, like ITAP, is to appropriately design various support schemes to help SMEs to overcome their constraints from being so small in order to successfully develop their technological capability and innovation. This should be done by not only enhancing the production and distribution of technology, but also building up social networking and strengthen relationship to create knowledge network that can effectively function in the long run. During the course of the implementation of the project with group approach, the force of the market was realized to be the most powerful force to drive the companies for any development.

6. Conclusion

As seen in the above cases, ITAP has been a successful case of intervention initiated by a public organization. ITAP intervention promotes triple helix collaboration and network development. In brief, this group approach brought about these results;

1. Problems of several SMEs who participated in the program were solved by experts as consultants in R&D projects.
2. The cost for individual company was lowered.
3. A small network among the participating companies was formed from interaction, information sharing and stimulated interactive learning
4. Increasing technical capability both for SMEs and local experts.
5. Diffusion of knowledge from experts to Thai SMEs through R&D projects and other activities such as seminars and workshops.
6. Increase R&D investment in industry.

In addition, network-based approach or group approach by ITAP is in line with other public agencies to focus on industrial cluster and networking. For example, the National Science and Technology Strategic Plan (2004-2013) suggested the adoption of "clustering" as an approach to enhance technological capability of strategic sectors (NSTDA, 2004). The implementation began with development of the so-called "Sub-Sectoral Innovation Network", SSIN, which aims to stimulate tri-partite collaboration: S&T organization, supporting agencies and industry. The Board of Investment of Thailand (BOI) has announced a new investment promotion strategy which reflecting its paradigm shift in the strategy (Chanjavanakul, 2006). The incentive packages are customized with higher incentive for higher level of technology development (from buying technology to creating innovation) and higher collaboration (from single project to cluster-based projects). This paradigm shift of policy interventions at implementing level could bring higher impact to micro (firm, industry) and macro (institutional and national) economic levels. The success of ITAP group project could be a guideline and initial emergence for the development of sub-sectoral innovation system (SSIN) through the triple helix framework.

7. References

Arnold, E., Bell, M., Bessant, J., & Brimble, P. (2000). *Enhancing Policy and Institutional Support for Industrial Technology Development in Thailand - The Overall Policy Framework and The Development of the Industrial Innovation System* (Vol. 1). Washington: World Bank; Science and Technology Policy Research (SPRU); Centrim - University of Brighton; Technopolis.

Berger, M. (2005). *Upgrading the system of innovation in late-industrialising countries: The role of transnational corporations in Thailand's manufacturing sector.* Christian-Albrechts-Universität zu Kiel, Kiel.

Chanjavanakul S. (2006). *BOI paradigm shift Thailand S&T Index 2008*: The Board of Investment of Thailand, NSTIPO 2009, Bangkok, Thailand.

Etzkowitz, H., & Leydesdorff, L. (2000). The Dynamics of Innovation: from National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations. *Research Policy, 29*(2), 109-123.

Intarakumnerd, P., Chairatana, P., & Tangchitpiboon, T. (2002). National innovation system in less successful developing countries: the case of Thailand. *Research Policy, 31*(8), 1445-1457.

ISRA Institute. (2008). The OTOP Thai desserts in Asian market: call for government interventions [Electronic Version]. Retrieved 25/01/2010 from http://www.isranews.org/community/index.php?option=com_content&task=view&id=77&Itemid=2 [in Thai].

Lauridsen, L. S. (2002). Coping with the Triple Challenge of Globalisation, Liberalisation and Crisis: The Role of Industrial Technology Policies and Technology Institutions in Thailand. *The European Journal of Development Research, 14*(1), 101-125.

NSTDA. (2004). *The National Science and Technology Strategic Plan (2004-2013)*: National Science and Technology Development Agency (NSTDA), Thailand.

NSTDA. (2005). *An evolution of national innovation system in Thailand: past, present and future*. Bangkok: Department of Science, Technology and Innovation Policy Research (STAIR) [in Thai].

OECD. (1997). National Innovation Systems. Paris: OECD Publications.

Yokakul, N., & Zawdie, G. (2010). Innovation network and technological capability development in the Thai SME sector: The case of the Thai dessert industry. *International Journal of Technology Management and Sustainable Development, 9*(1), 19-36.

Yuwawutto, S., Smitinont, T., Charoenanong, N., Yokakul, N., Chatratana, S., & Zawdie, G. (2010). A Triple Helix strategy for promoting SME development: the case of a dried banana community enterprise in Thailand. *Industry & Higher Education, 24*(3), 177-187.