CHAPTER 5

SELECTING THE MOSE SUITABLE PARTNERSHIP MODEL FOR UNIVERSITIES IN THAILAND

This chapter deals with four issues, Status of R&D in Thailand, Thailand's Industrial Characteristics and Thailand University characteristics to assess which partnership model is most compatible with certain market conditions (supply-demand).

5.1 Overall Status of R&D in Thailand

5.1.1 R&D Expenditure

Table 5.1: R&D Expenditure in Developed, NICs, and Developing Countries; Source: Thailand Science and Technology Profile 2000

Competitive S&T Rank		Research and Development Expenditure			
Country	**Rank**	**% GDP**	**RSE $ per personnel**	**Performed by Business Enterprise ($)**	**Business $ per personnel**
America	1	2.5	842.5	171,295	633.11
Japan	2	2.8	1,035	92,466	735
Singapore	12	1.5	379	885	237
Taiwan	10	1.9	252	3,345	155
Korea	28	2.8	297	9,899	217
Malaysia	31	0.199	9.3	265	12.63
Philippines	34	0.078	0.7	21	0.28
Indonesia	42	0.092	1	87	0.45
Thailand	**47**	**0.175**	**3.2**	**42**	**0.71**

The gross domestic expenditure on research and development (GERD) as percentage of the gross domestic product (GDP) is the most popular indicator for R&D. Compared with other countries (see in Table 5.1), we see that developed countries spent a much larger amount of about 2-3% of GDP on R&D. The newly industrialised economies like Singapore, Korea and Taiwan have a figure of between 1-2%. As for developing countries ASEAN, Malaysia has the highest figure of 0.199% in 2000 while Thailand only spent 0.175 in 2000. It is believed that Indonesia, and the Philippines have around 0.1%. It shows that Thailand's expenditure, as percentage of GDP is low when compare with other countries.

R&D expenditure of business sector in Thailand is about 15% of overall R&D expenditure in Thailand that is very low level compared with developing countries and NICs, which have expensed R&D in business sector more than 50% of overall R&D expenditure.

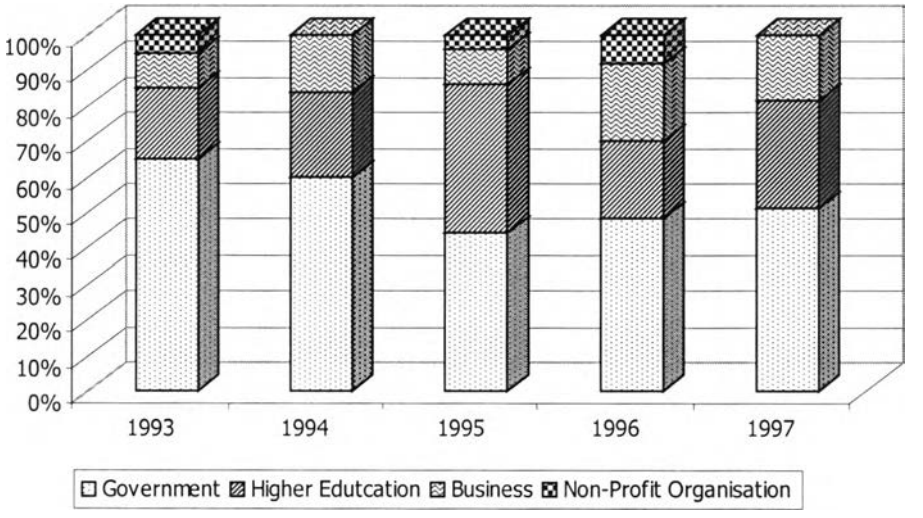

Figure 5.1: Thailand's R&D Expenditure Categorised by each sector

From Figure 5.1, government has expensed in R&D roughly constant since year 1995, while the trend of higher education in R&D expenditure has increased. On the other hand, expenditure of business sector was not constant. However, proportion of country's R&D expenditure shows almost research and development activities are in government sector and higher education. R&D expenditure in government including that of in higher education are about 90% of overall R&D expenditure, while R&D expenditure in business sector is very low or about 9%.

5.1.2 R&D Personnel

For R&D personnel, two popular indicators are total R&D personnel per 1,000 labour force and per R&D personnel in business sector per10,000 labour force.

Table 5.2: R&D Personnel in Developed, NICs, and Developing Countries; Source: Thailand Science and Technology Profile 2000

Competitive S&T Rank		Research and Development Personnel			
Country	Rank	R&D Personnel per 1,000 Labour Force	R&D Personnel in Business per 1,000 Labour Force	Engineers	IT personnel
America	1	962.7	764.5	7.433	7.238
Japan	2	891.8	589.5	7.719	7.719
Singapore	12	12.1	7.9	7.121	7.121
Taiwan	10	98.6	65.0	7.311	7.311
Korea	28	135.7	89.0	5.056	5.056
Malaysia	31	6.7	3.5	6.4	5.629
Philippines	34	15.6	1.7	7.474	7.236
Indonesia	42	239.7	33.7	5.429	5.292
Thailand	**47**	**14**	**0.7**	**6.023**	**5.093**

For Japan, these two indicators were 891.8 and 589.5 respectively. Taiwan and Korea also had the figures in high level that are about ten times higher than Thailand. For R&D personnel in business clearly are related to business enterprise expenditure on R&D. Thailand which spends much less on business enterprise expenditure on R&D had total business enterprise R&D personnel as percentage of national total five times lower than Malaysia. Moreover, indicators of engineers and IT personnel are almost the lowest figures among countries shown in table.

5.1.3 R&D Management

Table 5.3: R&D Management in Developed, NICs, and Developing Countries; Source: Thailand Science and Technology Profile 2000

Competitive S&T Rank		Research and Development Management		
Country	**Rank**	**Technological Cooperate**	**Business-University Cooperate**	**Investment in Technology Development**
America	1	6.333	6.540	7.127
Japan	2	6.0661	4.017	5.083
Singapore	12	5.8182	6.061	6.031
Taiwan	10	5.5778	5.022	5.022
Korea	28	3.628	3.196	2.916
Malaysia	31	4.257	3.594	4.029
Philippines	34	4.316	3.357	2.421
Indonesia	42	3.917	3.184	2.082
Thailand	**47**	**3.535**	**3.047**	**2.419**

From Table 5.3, it shows that Thailand's research and development are in the lowest level among countries shown in table. The linkages between universities and the private sector are a key to industrial development. Currently, the linkages in the form of the cooperation in applying research results in the manufacturing sector still remain at the minimal level. Moreover, Thailand lacks human resource planning. This missing link prevents universities from carrying out integrated research activities. Research may not be relevant to the needs of the society. This situation is also related to the mismatch between graduates and the labour market needs in terms of both quantity and quality.

In sum, overall status R&D may be concluded as follows:

- Thailand's R&D activities are almost in government and university. There is very small role of private sector in R&D.
- Thailand lacks database of research and development, research investment, other information in research management.
- The efficiency in using R&D investment of Thailand is low.
- Thailand R&D characteristics lack of efficient linkages among industry-university-government collaboration.

- Thailand has no the R&D culture. That means Thai society does not concern the important of R&D. Almost R&D in Thailand is supply push from researcher, is not demand-pull from business/industry.

5.2 Overview of Thailand's Industrial Sector Characteristics

Thai industries have been growing by exclusively depending on imported technology for approximately 40 years since the introduction of the First National Economic and Social Development Plan in 1961. The industrial sector still highly relies on the imports of technology, machinery and equipment. This situation is entirely different from the industrial guideline adopted by Japan and Newly Industrialised Countries.

Japan has been a technologically modern society for 100 years. Thus, people in general maintain a strong scientific background. Moreover, the national policy that places an emphasis on basic education and technical education indicates a strong objective of leading the country to industrialisation. After the World War II, Japan exclusively depended on imported technology, but did not import capital or brand names. At present, Japan owns technology, and spends on R&D at the same level as western countries.

Newly Industrialised Countries such as Korea and Taiwan adopted a similar development approach. Both applied the Japanese approach. There were some differences between Korea and Taiwan. Korea imported technology, particularly from Japan and the United States, but brand names were not imported. When technology contracts expired, the imported technology would then be further developed until it became Korean technology. Taiwan took a more liberal approach by importing both technology and brand names. Those who imported technology alone would try to develop the imported technology until they became technology owners themselves and could develop their own products. It should be noted that these three countries are currently exporting to Thailand and investing here. They also sell production technology to Thai companies.

At present, Thailand's industrial factories can be divided into 2 major groups:

1) Foreign investment or joint-ventures

- **Subsidiaries of foreign companies**

  Subsidiaries are those whose parent firms are located overseas. Most of them are large firms investing in Thailand due to these incentives provided by the Thai government to manufacture quality products to export to the world market. Most of these firms conduct R&D overseas.

- **Majority Foreign-Owned Companies**

  These firms are joint ventures with more than 50percent of foreign equity participation. The management is controlled by foreigners. Most of these firms do not perform any R&D activities except those related to management and production cost reduction. R&D activities are normally carried out in parent firms overseas.

- **Minority Foreign-Owned Companies**

  This group refers to joint ventures with less than 50 percent foreign equity participation. Management may be controlled by Thai personnel, depending upon the type of joint venture and product. R&D activities are at the minimal level due to low necessity. If these companies realize the importance of technological development, they tend to be able to implement R&D.

2) Thai Companies

- **Large Enterprises**

  This group refers to Thai companies with high development capabilities and competent management and staff. Thai nationals hold 100 or almost 100 percent of shares. These firms import technology and pay technology fees. They sell their products to both domestic and export markets. Many of these large enterprises, i.e. Siam Cement recognise the importance of R&D and have established in-house R&D units. These firms are financially and technically ready to perform their own R&D activities, but need incentives from the government such as tax privileges and regulations supporting R&D investment.

- **Small and Medium Enterprises**

  This group is the largest in terms of number. These firms produce metal and plastic parts and finished parts to supply to large factories, for sale in domestic and export markets. These enterprises; Thai wholly owned, manufacture products as demanded by large firms. The other subgroup consists of manufacturers of industrial goods and appliances of moderate quality mainly for domestic sale. This subgroup needs assistance regarding production process development and product development.

From studies indicates that scientific and technological R&D play a very minor role in supporting industrial growth. At present, neither public nor private R&D is a major factor affecting the industrial growth rate. A very small portion of R&D implemented in the public sector and universities respond to the needs of the industrial sector.

When considering the past status of the Thai industry, we can give two reasons for the rapid industrial growth, namely, external factors that are not under control and the internal factors that can be controlled such as private sector's role in investment, production efficiency enhancement, close co-operation between public and private to support and strengthen private organisations.

However, to compete in liberalisation market, it is essential for Thai manufacturers improve their technical knowledge, have employees having better skills and know ledges. Strong recognition of the important of R&D will lead to create technological development and ultimately industrial development.

5.2.1 R&D Activity and Technological Capability

The government has attempted to emphasise the involvement of the private sector in research and development since the Fifth National Development Plan. The government has offered financial and fiscal incentives to private sector to increase its R&D efforts. The response from the private sector has not been satisfactory due to lack of readiness and confidence. The industry may not recognise the importance of R&D. Most firms indicated no R&D efforts.

Most companies in Thailand do not have a formally constituted R&D department, they have no special R&D personnel, nor do they allocate special funds for R&D. R&D is usually informally organised, and inseparable from daily production activities. The foreign multinationals, and joint ventures relied on parent companies abroad for R&D intelligence, and maintained access to information through personal networking and international technical information systems within the company.

The study of TDRI reports the survey on the recovery economy structure in 1998 that reports technology development in private sector. The weakness of Thailand's R&D status is the lack of linkages between the producer and user of science and technology knowledge, leading to the second weakness, which is the lack of problem solving-oriented research. Thailand has only recently recognised the importance of technological capability development. The lack of technological capability resulted in inability, to further develop its own technology. TDRI's report on Thailand's technological capability development indicates that the Thai industry's technological capability, including technology operate, transaction, innovation and support depends on the types of company and industrial fields. Large firms and joint ventures usually apply high technology acquired from parent companies, but technology innovation often occurs in medium-sized firms. The Thai industry's innovative and supportive capabilities are found to be weak. R&D activities are still at the minimal level. This report make a remark that firms conducting R&D activities mostly possess capabilities in acquiring, applying and improving technology through international competition. Thus, export industries usually possess a slightly higher technological capability than industries serving the local market. Moreover, the technological capability of promoted firms is not much different from that of non-promoted firms.

However, under the current situation with higher competition, the productive sector needs to initiate its own R&D. some R&D activities are in the form of quality

control. Large enterprises such as Siam Cement Group and Chareon Phokphan have established their own research units. Medium-sized firms may start with operative and transaction efforts while small firms cannot afford to have R&D investment although they recognise the importance of R&D.

5.2.2 R&D Problem

Based on the interviews, R&D problems can be categorised as follows:

5.2.2.1 Management and Support Problem

1) Research funds management, subject to government regulations and cumbersome disbursement procedures.
2) There is no agency in charge of handling service and supporting work for researchers, resulting researchers wasting time on administrative work instead of concentrating on research work.
3) The management and allocation of resources are inefficient.
4) The intellectual property protection system is still defective.

5.2.2.2 Resources Problem

1) There are few financial sources for R&D projects especially, now we still face in economic crisis. Financial assistance to upgrade researchers' basic capabilities is still limited in number of sources and magnitude.
2) There is not adequate support of the private sector. Some researchers require cooperation from the public sector/universities to develop the research outputs to commercialisation stage.
3) Since the research career is not attractive or interesting to new graduates and research institutes fail to maintain researchers, there is a shortage of researchers both in quality and quantity.
4) Researchers are working separately in many institutions without cooperation. Besides, the majority of researchers lack industrial experience, thus unable to help solve industry's problems.
5) Most university researchers are lecturers who bear quite considerable teaching burden, particularly those in basic areas who have to service others; therefore, they do not have time to implement research. Besides, some consider a research as a private work not a duty.
6) Full-time researchers in universities are government officials. They have problems of promotion resulting in lack of incentives to work.

5.2.2.3 Problem of Linkages and Research Output Commercialisation

1) Some private sector does not have confidence in universities' problem-solving capabilities, because there are few specialised research institutes to provide the industrial sector with advice.

2) There are few co-operations among universities, public agencies and the productive sector in implementing R&D for commercial benefits, including no existing agencies act as the contact point between the producer and user of research results, leading to lack of awareness of each other's needs.

3) The research currently conducted is considered basic and applied research which has not reached the commercialisation stage.

4) The industrial sector is not interested in carrying out R&D.

5.2.2 Success and/or Failure of R&D for Supporting Industrial Development

It is generally accepted that R&D is very crucial to long-term industrial development because it will help strengthen international competitiveness. The analysis based on interviews indicates that R&D activities are successful only regarding the specified objectives of the projects, which include searching for new knowledge and problem solving. This is due to the fact that most research agencies are in universities oriented toward basic and applied research. Moreover, researchers assume responsibilities other than conducting research that is teaching. Research for industrial development also lacks distinct directions and objectives. In the past, research considerably depended on personal interests and the requirement of financial sources. R&D in universities has been negligible whereas private R&D has been rare. R&D activities have been only in a few large firms. The success of R&D for industrial development can be assessed as follows:

The ongoing R&D helps strengthen basic research capabilities of individuals. There are few specialised organisations capable of giving advice to the industrial. The opinions derived from interviews also give the same conclusion: a need to create more specialised research institutes.

Based on the survey results derived from interviews and literatures surveys, the objective of research oriented toward basic and applied research is to publish an article on research outputs rather than research result application. Although some applied research can be found, it must be further developed to reach the commercialisation stage. Thus, commercial oriented research is very rare. Research outputs in other forms such as inventions, both patenable new products and processes, are hardly created. Besides, the relationship between research institutions and the productive sector is geared towards giving advice rather than conducting research. The existing research activities involve contract research, especially small scaled design work, rather than joint research projects. Finally, research capability enhancement is not decentralized to regional areas. Thus, universities in each region should play an important role in determining it own research direction to avoid social and cultural problems.

5.3 Thailand's University Characteristics

Higher education in Thailand is provided in a wide range of institutions, both public and private, and varying widely in terms of admission standards, methods of

teaching, modes of study, and level and type of courses offered. These institutions are under the responsibility of the Ministry of University Affairs (MUA) and the Ministry of Education (MOE) as shown in Table 5.4.

Table 5.4: Thailand's Higher Education Institutes in Year 1998; Source: MUA Web Site

MUA	22 public closed admission universities	2 public open admission universities	42 private universities or colleges
MOE	Vocational Diploma Colleges (where many study part-time)	Rajamangala Institute of Technology (RIT) (degree level)	Rajabhat Institutes (formerly teacher training colleges but now with university status)

Of the total graduated student of 108,903 students under the responsibility of MUA in 1998, 21,715 are the number of students who graduated in S&T programs. In 1998, a total 21,715 students graduated in S&T subjects, of whom 73% were from public universities and 27% from private universities.

The low number of students graduating in S&T at the university level is a critical problem of national higher education which will have a direct effect on the country's capability to maintain economic and advanced technological expansion for industrial development for quality of human and society progress.

5.3.1 Technological Capabilities of Universities

The technological capabilities of each university are different. However, from the interviews, the interviewers agree that many universities in Thailand have the technological capabilities in the innovative level and others are in operative and transaction capabilities. Universities in Thailand have set agencies involved in R&D activities.

Agencies involved in R&D in universities are classified by function into 3 groups as follows:

- Administrative agency
- R&D implementing agency
- Supporting agency

The agencies involved in R&D in universities are shown in Table 5.5.

Table 5.5: University Research Agencies (Own Summary)

University	Administrative Agencies	Research Agencies	Supporting Agencies
Chulalongkorn University	- Research Affairs - CHULA UNISEARCH	- Research Unit Cell Department - Research Institutes - Research Centre	- Computer Service Institute - Research Equipment Centre
Mahidol University	- Institute of Science and	- Department	- Computer Service

University	Administrative Agencies	Research Agencies	Supporting Agencies
	Technology Research & Development		Office
Kasetsart University	- Research & Development Institute	-Food Product Research & Development Institute - Department	- Computer Service Office
King Mongkut's Institute of Technology, Lad Krabang campus	- Engineering Service and Development centre	- Department - Electronic Research Centre - Research Centre for Communications and Information Technology	- Computer Research and Service Centre - Scientific Equipment Centre
King Mongkut's Institute of Technology, North Bangkok campus	- Institute of Technological Development for Industry - Institute of Technical Education Development	- Department - Thai-French Innovation Centre	- Computer Centre
King Mongkut's Institute of Technology, Thonburi campus	- Institute of Scientific and Technological Research and Service - Industry Cooperative Research Centre	- Department	- Computer Centre
Silapakorn University	-	- Department	- Computer Centre
Srinakarintharaviroj University	-	- Department	- Computer Centre
Ramkhamhaeng University	-	- Research Centre - Department	- Computer Centre
Burapha University	-	- Marine Science Institute	- Computer Centre
Khon Kaen University	- Research Affairs - Research & Development Institute	- Research & Development Institute - Department - Water Resources and Environment Institute	- Computer Centre
Chieng Mai University	- Institute for Science and Technology Research Development - UNISERVE	- Department	- Computer Service Centre
Prince Songkhla University	- Research & Development Institute	- Research Unit	- Scientific Equipment Centre - Computer Service Centre

5.3.1.1 Administrative Agency

Pursuant to more promotion of research activities in universities, R&D administration started to become a more distinct body in charge of managing and

determining the directions of university research. Units specifically handling research are set up in many universities. In some universities, research division may be integrated into other units/divisions. Research-related units refer to those in charge of promoting, coordinating and monitoring university research activities. With increasing research activities, universities tend to set up more research institutes. Thus, an initiative to establish an administrative body known as R&D institute covering various research institutes within the same university under the same umbrella to manage and coordinate the research activities of every department and institute concerned.

University research work depends more on the interests of researchers rather than the market needs. Thus, most of the research work involves basic and applied research required by the funding agencies. There is a small linkage with the industrial sector. The interaction with the industrial sector started to be more distinct. Additional academic services have been provided. The need for business-oriented management agency arose. This type of organisation requires management flexibility to respond to the operation of the private sector. Proactive marketing strategies are essential.

In 1986, Chula Unisearch was formed to commercialise the intellectual properties of the university. The King Mongkut's Institute of Technology at Thonburi had centre of operation for research and development and industry cooperative research centre. Other universities also have the same type of organisation, but the administration is still not entirely independent.

5.3.1.2 Research Implementing Agencies

Departments are research-implementing bodies in universities. Within one department, there may be informal or formal division called by several names such as project laboratories, and research units. Most of the research work conducted aims at researching for new knowledge or educational purposes. The informal cluster of researchers usually starts working on a large funded research project. Research topics will then vary according to the needs of the funding agencies, and may be totally diverted from the previous research.

The major objective of these research units is, firstly, to carry out R&D activities in their areas to develop the theoretical aspect and to search for new knowledge, and secondly, to produce graduates or to upgrade personnel capabilities, and services to the society. Therefore, the objectives of the research units are in line with the research category with an emphasis on applied and basic research and the major responsibilities of the units which give first priority to R&D activities, and lower priority to providing consulting services and technical services. It is a shame that although some units are sufficiently equipped with specialised testing device to service the private sector, the manpower shortage prevents them from efficiently perform their function. Nonetheless, the interviews indicate that the research implementing units above mentioned are scattered and of uncertain organisational formats.

5.3.1.3 Supporting Agency

Supporting agencies refer to those, which do not directly implement but support research work such as service agencies. All universities have computer centres or institutes, which provide instructional and administrative services. Apart from computer centres, equipment centres are found in some universities, both at the faculty and departmental levels. Equipment centres are established through the concept of sharing expensive equipment among departments to bring about more application and maintenance efficiency. These centres offer services to agencies within and outside universities. Some centres mostly service internal agencies.

From the above information, we can see that universities in Thailand implement the Agency Model. However, they manage their agencies inefficiently and have few relationships with industry sector.

5.3.2 Linkages between Research Agencies and External Agencies and the Private Sector (Linking Mechanism)

The linkages between research agencies and external agencies are classified into the following three levels:

1) Linkages with foreign agencies in the forms of research grants and joint research with foreign researchers.

2) Linkages among university research unit: The linkages among research units within universities are still weak because each unit conducts research work specifically to respond to its own objectives. The lack of information also results in duplication and no cooperation. The possible linkages are between university research units and research units within departments and divisions. This cooperation will lead to the application of basic research conducted by universities to be adapted by research units within departments of the ministries.

3) Linkages with the private sector: The linkages with the private sector are still at the initial stage, and mostly developed from personal relationship. If coordinating agencies exist in universities, they will become the focal point for linkages with external agencies.

   The existing linkages between research agencies and the industrial sector is mostly in the forms of consultancy services, contract research and training and seminars. Other forms of linkages are of less importance. However, for research institutes, the relationship is more in the form of conducting contract research rather than providing consulting services.

   The problem of linkages between universities and the private sector lie in universities' unawareness of the industrial sector's problems and the industrial sector's lack of information on universities' capabilities. Public relations are then very crucial. Those private firms that have ever contacted universities usually misunderstand that the services provided are free of charge. Moreover, researchers cannot provide services due to budget

constraints. Another important problem is that universities have not created creditability. Thus, private firms do not wish to take risks. To create initial relationship, universities need to show their capabilities through researchers who simultaneously act as salesmen. One creditability has been created, the private sector will naturally rely on university services. Universities also need to set up contact points by depending on the mechanism of provincial federations of industries or provincial chambers of commerce.

Research efforts in regional universities differ from those in central universities in the sense that the emphasis depends on the conditions and culture of each region endowed with different natural resources.

Most of the industries in the southern region are small and medium scaled. Only a few large industries are established. Most industries are based on resources from agriculture, fisheries, forestry and minerals such as natural rubber product factories, rubber tree product factories, seafood factories and metal and nonmetal product factories. Southern industries are mainly family industries lacking knowledge, technology, information and management skills. Therefore, the research linkages with universities hardly exist. There are only linkages regarding research services which require little time but can help the industry solve only short run problems.

Most of industries in the northeast are family industries. Industries with high growth include canned food, food and beverage, tapioca products, animal feed, plastic products, agricultural machinery, paper pulp, auto parts, silk yarn and silk fabric. Khon Kaen University can assist the industry both at the investment decision stage and the post investment stage. During the decision stage, the university can play an important role in providing research information through seminars and training programs and reciprocal assistance given on a personal basis. After the investment has been made, university services will be in the forms of research and consultancy. Khon Kaen University concentrates on research related to rural and agricultural development, which is the major task of the Research and Development Institute. However, the direction of research for industrial development is still unclear due to the limited number and small size of existing industries.

Northern industries are mostly agro industries and handicraft industries. Other industries include ceramic, mining and jewellery industries. Chiengmai University initiated S&T research projects responding to the university potentials. Research projects related to the local and national development involve national development.

From the interviews, in recent years, attempts have been made in Thailand to promote public-private interaction and collaboration, such as through linkage mechanisms whereby the private sector participates in university extension services. Despite these efforts, most institutions have yet to develop an effective mechanism for active solicitation of industry's needs and participation in project design and institution development. Although some universities have collaborative activities with industry, they often engage in solving company-specific problems such as product testing,

equipment calibration, and feasibility studies. These efforts are mainly basic technical services in nature and unlikely to have much industry-wide technological impact.

These are reasons to believe that unless industrial firms have built up significant in-house capabilities they cannot effectively draw on the R&D results of universities, thus limiting the effectiveness of the universities R&D. In other words, unless the technology users are sufficiently sophisticated to conceptualise and translate their needs into a requirement for products or services, they cannot exert an effective "pull" on universities R&D system to a significant proportion of its efforts towards technological areas and activities that are relevant and useful to their needs.

5.3.3 Research Budget

Research in universities has been greatly promoted through the granting of research funds by the government. Still, the support was deemed negligible. Research in universities concentrate on basic research for academic advancement initiated by individuals. Applied research on existing problems will take place only when universities receive financing, but research for the private sector is still rare.

The following table shows the detail of research fund in each university under Ministry of University Affairs.

Table 5.6: Funding Support for Research Projects Classified by Universities in 1998 (Units: Baht); Source: MUA Web Site

University	National Budget	University Income	Other sources	Grand Total
Chulalongkorn University	94,677,479	28,456,660	59,011,302	182,145,441
Kasetsart University	128,456,635	-	892,704	129,349,339
Khon Kaen University	73,136,703	1,437,000	16,256,881	90,830,594
Chiang Mai University	119,111,238	1,437,000	85,526,772	205,957,285
Thammasart University	21,314,400	1,319,275	600,000	23,259,400
Mahidol University	57,796,042	-	57,457,793	115,253,835
Silpakorn University	2,007,500	-	-	2,007,500
Sri Nakharinwirot University	1,603,900	1,174,320	600,000	3,378,220
Prince Songkla University	37,083,915	1,730,520	3,155,535	41,969,970
National Institute of Development Administration	10,407,900	-	11,200,650	21,608,550
Maejo University	6,425,100	443,230	-	6,868,330
King Mongkut's University of Technology Thonburi	34,803,301	-	-	34,803,301
King Mongkut's Institute of Technology North Bangkok	13,119,800	264,000	-	13,382,900
King Mongkut's Institute of Technology Ladkrabang	36,969,315	-	1,740,000	38,709,315
Suranaree Technology	14,696,162	-	911,465	15,607,627

University				
Walailak University	1,703,069	-	-	1,703,069
Ubonratchathani University	4,798,700	-	-	4,798,700
Burapha University	4,814,700	1,702,200	1,932,740	8,449,640
Naresuan University	7,909,952	400,000	24,083,700	32,393,652
Mahasarakham University	9,529,700	274,100	2,500,000	12,303,800
Thaksin University	1,503,700	394,000	-	1,900,700
Ramkhamhaeng University	2,257,280	446,248	-	2,703,528
Sukhothai Thammathirat Open University	2,322,400	423,594	-	2,745,994
Total	**686,447,991**	**39,813,147**	**265,869,542**	**992,130,680**

From Table 5.6, the sources of research funds for universities are national budget 69%, university income 4% and other sources 27%. It can be seen that the budgets of research considerably vary, ranging from 1.7 million to 200 million baht. When compare with annual budget of university, research budget of each university range from 1% to 4% of the total budget.

5.3.4 Universities Culture

Public universities get budget from government. Therefore, the universities do not realise to have collaboration with industries. Universities in Thailand are principally teaching universities, R&D remains an extension of academic pursuits. However, in recently, if universities go private, they will have to realise more collaboration with industries in order to have more incomes.

5.3.5 Human Resource Characteristics

The interviews indicated that the creativity of lecturers is high. It is measured by number of innovation activities related with community development, teaching duties and research proposals. Unfortunately, there were few activities relating with industry as potential customer. It is more technology push than demand-pull. The research work depends more on the interests of researchers rather than the market needs.

The professional skill's level of lecturers is high skills. Almost lecturers hold Ph. D and master degree. Some lecturers have experiences in his/her own job, while some lecturers are just starting. They did consultancy, contracting, design engineering, teaching at other university, etc. These phenomena can support industry-university partnership.

The teamwork ability of lecturers is relative high. They appreciate each other, works as a team, but then they prefer work individually. Everybody has different time available. There is a fix office hour. It is difficult to meet each other. This condition is not an advantage for industry-university partnership.

There are some barriers regarding to industry-university partnership. For examples teaching load, has own-job, no time, do not know right contact person in business, high prestige as seniors in academic, bureaucracy and lack of special incentives.

At first, the willingness of lecturers to work, as a team is high, but because of some circumstances/barriers, they preferred individual responsibility, independence in working. It is not supporting industry-university relationship.

5.4 Status of Industry-University Linkage in Thailand

Thailand is now at the beginning stage of industry-university linkages. Many of the industry-university linkage identified are short-term training or ad-hoc use of consulting and research services and the levels of understanding and vision of true potential of such linkages among the players are not great. However, from findings show that quite a variety of activities and linkage mechanisms in training, service, and research are emerging and there are a number of initiatives.

Activities. Continuing education or short training courses are commonly offered by universities. Many companies sponsored their employees to attend these courses. Tailored courses to meet the need of a particular company are less common, but increasing. From the industry side, many companies are willing to accommodate summer training for university students. Quite a lot of industry people lecture at universities in their private capacity. Many companies retain university professors as consultants on an individual basis and utilise miscellaneous analysis and testing services at universities as the need arises. However, some industry-university liaison offices have built up sufficient reputations to enjoy longer-term relationships with certain companies.

Since the volume of research in Thai universities is rather low and Thai companies mainly use imported technology, this is an area where extensive linkages would not yet be expected. Some applied research is carried out by universities for small and medium industries and some lecturers also work as part-time researchers for larger companies.

Mechanisms. Public training courses are usually offered through a Centralised Continuing Education Centre and by respective faculties. Company-specific courses are more likely to be provided by industrial liaison offices and university-owned training companies. The Petroleum and Petrochemical College of Chulalongkorn University is an example of international Master's degree courses that receives a very high level of support from industry through corporate sponsored scholarships. In the case of Ayutthaya Technical Training Centre, staffs from the King Mongkut's Institute of Technology North Bangkok run a fully cooperative vocational training program, numerous short courses, and an apprenticeship program in the premise of the Hi-Tech Industrial Estate.

University industrial liaison offices tend to concentrate their activities according to the expertise of the university, as well as that of their directors. Most of them are part of the university civil service system, either as an informal organisation attached to the Office of Research Affairs. The only exception is Chula Unisearch of Chulalongkorn University which is an autonomous unit created by a special regulation issued by the University Council. Chulalongkorn University even went another step in establishing the Intellectual Property Institute Foundation as a separate legal entity to enable the holding

of equity in companies providing training, consultancy, and research services. The Power Management Institute, a public-private partnership providing training in power management and energy efficiency, is one of the first companies invested in by this new institution. As for research linkages, there are few instances of companies setting up research laboratories in universities. Some others have formalized research links through signed memoranda of understanding and provision of research grants.

Science parks have been talked about quite a lot and many feasibility studies have been conducted. However, there is only one has been being implemented to date that developed by the National Science and Technology Development Agency.

As for support activities and sponsorship from private sectors, the private sector provides student scholarships, support for public service activities of students, and donations of equipment or cash though this is nowhere near the scale in developed countries both in cash and in kind. This may be partly because the mentality to support education institutions is not well entrenched in Thai culture, and partly due to extremely low tax benefits for those who carry out charitable activities. Importantly, mechanisms and channels to involve the private sector in human resource and academic activities, such as human resource and curriculum development, remain weak.

5.5 Barriers in Thailand's Industry-University Partnership

However, as a result of the prevailing approach to science and technology development (see in Appendix), there has been little technological linkage between universities and the private sectors. R&D activities in universities had been largely carried out in ways, which were isolated and disconnected from the real world of industrial production. Despite attempts to launch "commercialisable R&D" and foster linkages with the private sector, various "centres of research excellence" had often been unable to have a strong impact on the industry both in terms of the direct application of their R&D results and technical assistance to industrial enterprises in acquiring and digesting technologies from elsewhere. A well-known argument that has usually been used to explain their ineffectiveness is that industrial firms have a tendency to utilise proven technologies from foreign sources, thus limiting the demand for local scientific and technological capabilities. This argument, however, remains questionable because it presumes that those "centres of excellence" have available the kinds of products which are relevant to needs of their potential clients. As noted by an empirical study, "industrial firms tend to doubt the ability and effectiveness of universities to solve practical industrial problems" (TDRI, 1998, pp.12). Moreover, universities in Thailand are principally teaching universities, sufficient only to prevent academic stagnation. This situation also accounts for the scarcity of meaningful research results deriving from university R&D activities.

In addition to the above analysis in barriers of partnerships, from interviews, constraints in Thailand's Industry-University Partnership are identified as follows:

1) Ingrained attitudes and scepticism from both sides which have formed a significant credibility between them

2) Bureaucratic regulations and attitudes that continue to influence the university sector in a number of areas
3) Continuing tendencies for academics to pursue private sector work through personal contracts
4) Weaknesses in the intellectual property rights system
5) Lack of adequate channels for communication, support and formal collaboration
6) Low support of activities and sponsorship from government, the public and private sectors
7) Some set goals are quite idealistic and much too advanced to achieve a short time span.

It is worth emphasising that the support mentality in Thai culture for educational institutions is not well entrenched, partly due to extremely low tax benefits for those who carry out charitable activities; and mechanisms to involve the private sector in activities such as curriculum development remain weak.

Besides the result of interviews, the credibility gap between Thai universities and Thai industry discussed by participants in Modalities of University-Industry Cooperation in the APEC region can be summarised as follows:

Weakness of Universities from Industry's View:

1) Some university faculties are not up to date with technology.
2) Insufficient modern facilities.
3) Lack of research and new ideas.
4) Poor administrative system for collaboration.
5) Obsolete educational programs.
6) Lack of understanding on industry's needs and requirements.
7) R&D does not meet industry's needs and expectations.

Mistrust from the Industry Perspective:

1) No investment vision and understanding of business.
2) Non-competitive working environment.
3) Not a useful source of knowledge and advanced technology.
4) No ownership of results by industry.
5) Lack of research and development.
6) Lack of professionalism.

Mistrust from the University Perspective:

1) No serious interest in R&D
2) Short-term investment mentality.
3) Lack of budget and incentives for collaboration.
4) No investment in human resources development.
5) Lack of understanding of intellectual property.

These are the barriers of industry-university collaboration in Thailand. After we considered the characteristics of industries and universities in Thailand, we will identify the suitable partnership model; No Model Applied, Agency Model, Membership Model, and Research-Oriented Park Model, for Thailand's Universities.

5.6 Identifying the Suitable Partnership Model for Thailand's Universities

Before identifying the suitable partnership model for Thailand's Universities, it is important to recognise the industries' and universities' characteristics in Thailand. Then those characteristics should be applied to previous analysis, to choose which partnership model is appropriate.

As mentioned above, industries characteristics in Thailand may be concluded as follows:

- The technological capabilities in large firms and joint ventures are high acquired from parent companies. The Thai industry's innovative and supportive capabilities are found to be weak. R&D activities are still at the minimal level. Most industries are in operative and transaction capability level.
- Initiate recognising the importance of research and development because increasing of competition. Industry has to improve quality, reliability, efficiency, etc. to meet with international requirements and standards.
- Industries depend on imported technologies that are from the foreign suppliers for technology development because it is easier, quicker and taking lower risk that do own research & development and. They don't think about asking help from university, which they think is relevant for teaching only.
- The industry do not recognise the importance of R&D. Most firms indicated no R&D efforts.
- Industries have no big research budget and do not have research department or centres. .

As mentioned earlier, universities characteristics in Thailand may be concluded as follows:

- The technological capabilities in most universities are in innovative level. Interview indicated that Thai universities have already to research for commercialisation. The most universities set agencies involved in R&D activities. However, these agencies are scattered and of uncertain organisational formats.
- The linkages among research units within universities are still weak because each unit conducts research work specifically to respond to its own objectives. The lack of information also results in duplication and no cooperation. The possible linkages are between university research units and research units within departments and divisions.
- Few of communication and intense interaction with industry. The linking mechanisms with industrial sector are mostly in the forms of consultancy services, contract research, training and seminars, and technical services related to analysis, testing and designs.
- Universities do not realise to have collaboration with industries or no serious interest in R&D because they get fund or budget from government. It will necessary to contact with industries in recently, if they go private.
- There has been little technological linkage between universities and the private sectors. R&D activities in universities had been largely carried out in ways, which were isolated and disconnected from the real world of industrial production.
- Some internal barriers such as financial difficulties, lack commitment of top management, too high teaching loads, has own-job, no time, do not know right contact person in business, and lack of special incentives.

According to above analysis and the condition of Thailand, the most suitable industry-university partnership approach is seems to be apply agency model. From Agency Model, the partnership can be improved become either Membership Model or Research-Oriented Park Model. It is not a viable decision if some universities jump too fast, because each model has different characteristics and preconditions for becoming successful.

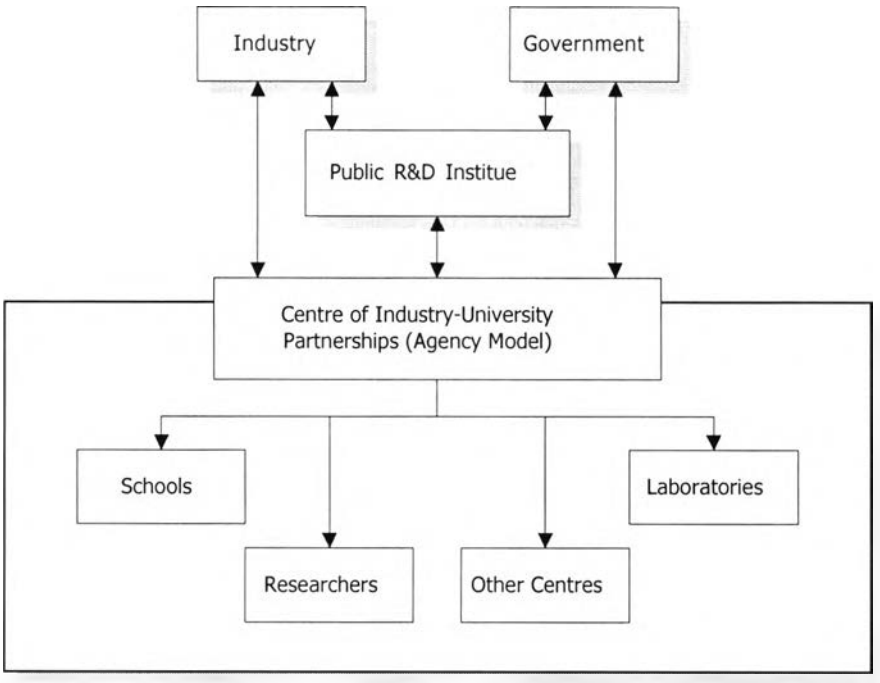

Figure 5.2: Proposed Model for Industry-University Partnerships in Thailand

The Agency Model with a single agency may be the suitable for universities in Thailand. Universities in Thailand have a lack or communication with industry, less capability in negotiation, no experience in marketing of technology and are often inefficient in administration (procedure, contract, legal issues, patent, etc.). The industry engineers don't know the researcher's capability, with whom they should discuss their problems, how to find the right person, etc. on the other side, university researchers had no chance or good reason to come to industry in the first time. They did not know to whom they should talk. Other constraints are low risk-taking, fear to be disappointed, and worry about high uncertainty.

The following explanations give some additional decision support for establishing an agency.

1) Technology push by university and demand-pull by industry should be combined together.

According to the theories discussed in Chapter 2, the role of universities in facilitating technology transfer is not successful only through university's effort itself (technology push). It must be combined with demand-pull by industry. To integrate technology push and demand pull, faculty members should build intense interaction with industry through visits, discussions, and informal contacts.

2) The collaboration should be built step by step from the easier stage to more difficult stage.

The collaboration takes a long time to develop. It must be built step by step. The university's service should start from development stage of technology development (see Figure 5.3) such as function modification from manual to automation, then 'integrate back' to the applied research and finally to basic research. It is better if the university starts with small projects such as developing software for controlling machines, electronic and/or mechanic modifications, technical advice, etc.

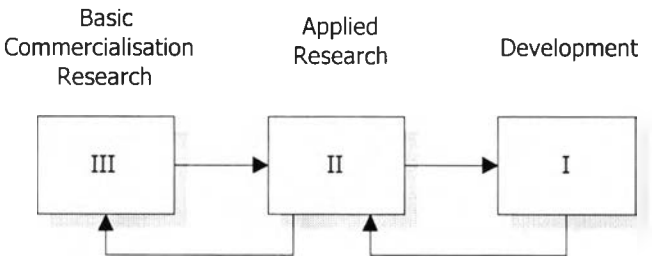

Figure 5.3: Strategy and Priority of University Service

3) Building credibility and informal collaboration type.

Building credibility is very important to attract industry customers to try university's services first. If they are satisfied, they will come back. It will be an advantage if satisfied customers encourage their firm group to buy more university's services. In the beginning, the relationship is more an ad-hoc partnership. The form is usually informal or semiformal. If industries later demand more regularly university's services, such ad-hoc partnerships can become stable or formal partnerships.

The best start up strategy for universities is to achieve a good image. It is a strong determination to visit potential corporate clients, discuss mutual interest, create a friendly atmosphere and provide accurately a high quality service for reasonable price. Once industry circles know university's image well, the next steps will become easier. It is better if university administrators and faculty become more tolerant of industry's needs and more interested in solving real world problems. Industry's attitudes also need to change. Industry can be more willing to invest the necessary time and effort to cultivate long-term relationships, and to assist interested universities in growing the requisite skills to become viable partners and sole-source suppliers. If both university and industry partners apply the above strategy, they will get benefits. University will get practical experiences and funds from industry and industry will get right technological supports from university and no need to spend to much money.

4) The centre of industry-university partnerships should be profit-oriented.

Both university and researchers need money. Universities need much money to support the education process, build new buildings, develop new area, subsidise social activity, higher employee with better salary, etc. The university could not only depend on tuition fees and grants or funds from

government. The researchers need money for their efforts, and additional salaries, because their salaries from university are relative low, compared with engineers in industry.

5) Location of the centres should be on campus.

The centre is better located on campus. The benefits are saving money, easy communication with the rest of university because close to faculty members, researcher, laboratories and other departments. The weaknesses are the location usually far from down town, creates some difficulties to communicate with business people, which have office in central business districts. Others disadvantage as to many procedures and bureaucracy on campus, dependence on top management, slow improvement.

Establishing the centre of industry-university partnerships is great decision, high risk and uncertainty. Build or rent an office off campus need high capital, more complex procedure and need special promotion.

6) University should provide an appropriate office on the right place and subsidise the centre, at least the staff's salary.

The management concept of this centre could be dependent to top management of university and connected with one department in university or directly under Vice Director. The centre can get subsidise usually manpower. University gets little percentage of dividends sharing as incentive to the centre personnel. This management style usually for the first period of evaluation to encourage faculty member involve in the centre services.

The other concept is independent from university management. All expenditures should be paid from the profit, avoid loss and unprofitable-oriented project, also emphasis on effective, high efficiency and normally quick response to the need of industry. Usually this concept applied after two years of centre establishment.

7) The centre should approach the government R&D institutes and becomes a partner.

In developing countries, the role of government R&D institute is very important, because they often have more and sophisticated laboratory facilities than universities and private companies.

In NICs and developed countries, private companies and government universities have good and sophisticated facilities as well as government R&D institutes. Hitachi, Sony, Daewoo, Sam Sung, Hyundai, Toyota, Unilever and other big multinational companies have good facilities, so they do not need to use universities' facilities. Then what is the role of government R&D institute? They do basic research, which not related with industry directly or applied for immediate need of industry. This is a good chance for university to do applied research to implement the research result of public R&D institute, because the lecturer does not have much time and research budget to do basic research.