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The Roles of Intermediaries in Clusters: The Thai Experiences in High-tech and Community-based Clusters

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Summary

Industrial clusters are geographical concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) that combine to create new products and/or services in specific lines of business. At present, the conceptof industrial cluster becomes very popular worldwide, policy makers at national, regional and local levels and business people in both forerunner and latecomer countries are keen to implement the cluster conceptas an economic development model. Though understanding of clusters and related promoting policies varies from one place to another, the underlying benefits of clusters from collective learning and knowledge spillovers between participating actors strongly attract the attention of these people.

In Thailand, a latecomer country in terms of technological catching up, the cluster concept has been used as a means to rectify weakness and fragmentation of its innovation systems. The present Thai government aspires to apply the concept to promote both high-tech manufacturing clusters, services clusters and community-based clusters at the grass-root level. This paper analyses three very different clusters in terms of technological sophistication and business objectives, i.e., hard disk drive, software and chili paste. It portrays their significant actors, the extent of interaction among them and the evolution of the clusters. Though they are very dissimilar, common characteristics attributed to qualified success are found. Main driving forces of the three clusters are cluster intermediaries. Forms of these organizations are different from a government research and technology organization (RTO), an industrial association, to a self-organised community-based organisation. However, they perform similar functions of stimulating information and knowledge sharing, and building trust among participating firms/individuals in the clusters. Literature in the cluster studies argues that government policies need to be cluster specific. In this case, the best way to design and implement cluster-specific policies is through working closely with intermediaries and strengthening their institutional capabilities especially in linking member firms/individuals to other actors in clusters such as universities, government R&D institutes, and financial institutions.

Key words: industrial clusters, community-based clusters, latecomer countries, cluster intermediaries, Research and Technology Organisation (RTO), Thailand

1. Introduction

Industrial clusters are geographical concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) that combine to create new products and/or services in specific lines of business (see Porter, 1998; OECD, 2000).At present, the conceptof industrial cluster becomes very popular worldwide, policy makers at national, regional and local levels and business people in both forerunner and latecomer countries are keen to implement the cluster conceptas an economic development model. Though understanding of clusters and related promoting policies varies from one place to another (see, for example, Steiner, 1997), the underlying benefits of clusters from collective learning and knowledge spillovers between participating actors strongly attract the attention of these people.

Nonetheless, different countries pursue different policies regarding promotion of industrial cluster. In some countries like Japan (such as government-initiated "Industrial Clusters" and "Knowledge Clusters" and Malaysia (as in the case of Multimedia Super Corridor), governments take very much pro-active roles in stimulating (to some extent, creating) clusters. On the other hand, in other countries, the US in particular, clustering initiation mostly come from the private sector and governments only play facilitating and supporting roles. This paper does not aim to answer which policy type is more successful. Instead, it will focus on the role of intermediaries, which can be in many organizational forms, in facilitating the knowledge flow and building trust among different actors in clusters.

2. Industrial Cluster and Intermediary Organisations

Dodgson and Bessant (1996) indicate that intermediary organisations can facilitate innovation process by performing activities bridging user needs and supply side as shown in Table 1. These intermediary organisations can take many forms such as research technology organisations (RTOs)[9], industrial and trade associations, professional associations, private foundations and so on.

9) Research Technology Organisations (RTOs) [are] independent, non-corporate, research and technology organisations funded by government, the private sector or both (see Rush *et al.*, 1996).

Table 1 : Bridging Activities in the Innovation Process

User needs	Bridging activity	Supply side
Technology	Articulation of specific needs Selection of appropriate options	Sources of technology
Skills and human resources	Identification of needs Selection Training and development	Labor market Training resources
Financial support	Investment appraisal Making a business case	Sources of finance venture capital, banks, government, etc.
Business and innovation strategy	Identification and development Communication and implementation	Environmental signals - threats, opportunities, etc.
Knowledge about new technology	Education, information and communication Locating key sources of new knowledge Bridging linkages with the external knowledge system	Examples of best practice Emerging knowledge base
Implementation	Project management Managing external resources Training and skill development Organizational development	Specialist resources

Source: Dodgson and Bessant (1996).

Industrial associations, can play significant roles in diffusion of knowledge and new technologies among member firms. For instance, industry associations in Japan played a major role in establishing and running cooperative research in the camera industry and automobile parts industry in the 1960s. (see Goto, 1997). Although Taiwan's trade and industry associations tend to be government-sponsored rather than voluntary gathering of private enterprises (see East Asia Analytical Unit, 1995), some are rather successful in helping members enhance their capabilities. The largest and most influential manufacturers association is TEEMA, the Taiwan Electrical and Electric Manufactures Association. The association has been actively commended in assisting her members by upgrading the manufacturing technologies, expansion of international marketing ability and the operation management. Besides, TEEMA also serves as the bridge in communicating among the industries and the government.

For research technology organisations (RTOs), there is a general belief that the role of RTOs is limited to generating new knowledge through research and development. In fact, due to the resources it possesses in both human capital and facilities. RTOs can play equally important roles in promoting *diffusion and use* of both existing and new knowledge in the economy.

They can perform a "bridging role" that links together research activities on the one hand with those who implement them on the other (Whalley and Hertog, 2000: 30)

The role of RTOs in the clusters can have considerable differences. In some cases, RTOs are central and integral players within the cluster whilst in other cases they are relatively minor and marginal players. Whether a certain RTO is integral or marginal to developments within a cluster is determined by the interaction between the knowledge that the RTO possesses, the knowledge base of competing firms, the demands placed on the RTO by other actors in the cluster (Whalley and Hertog, 2000: 35). In Swedish biotechnology cluster, for instace, Swedish Institute for Food and Biotechnology has actively sought to disseminate information through network based knowledge transfer as well as acting as a co-ordinator of external research programmes and the publisher of pertinent journals and newsletters. The Swedish National Board for Industrial and Technical Development (NUTEK) also supports the development of biotechnology start-ups by providing both seed and start-up financing and other services like information, advice, and brokerage (see Backlund, et.al., 2000).

In Japan, the government is trying to create "intellectual clusters", i.e., regional-based clusters of universities, public R&D institutions, relevant institutes and knowledge-intensive core companies. The central government provides budgetary support yearly while the cluster plans were initiated by local government together with local universities and local firms. The aim is to foster interaction between the original technological seeds of the public research organisations and universities and business needs of regional companies to create the chain of technological innovations and new industries. To achieve this goal, each cluster is managed and co-ordinated by a Central Project Organization. Central projects organisations can be in various forms depending on local conditions. They can be local/regional RTOs, local/regional scientific foundation, organisations managing science parks or technopolis and industry. These organisations recruited new and experienced executives used to work for private firms. Some of these people have had international experiences (see MEXT, 2002). Since these cluster plans just started, it is still to early to evaluate the successes of these clusters as a whole and these organsations in particular.

In "less successful" latecomer countries, Intarakumnerd and Virasa (2002) elaborate that RTOs, despite limitations, are probably best nexus of knowledge and human resources in those countries. With right strategies, they can perform roles of coordinators or "fixers of systemic failures" in national innovation system and clusters.

3. Thailand's STI Policies: Towards More Cluster Specific?

Up to the present government of Prime Minister Thaksin Shinawatra (starting January 2001), scope of S&T policy in Thailand was rather narrow. It covered only four conventional functions, namely, research and development, human resource development, technology transfer, and S&T infrastructure development. This narrow scope of S&T was very much based on the perception that private firms were "users" of S&T knowledge mainly produced by government agencies and universities (see Arnold, *et. al.* 2000). There was no articulate national innovation policy. Though the word "innovation" was mentioned in several national plans, it was not whole-heartedly incorporated into the scope of S&T policies (see Lauridsen, 2002). In addition, unlike Japan, Korea, and Taiwan, S&T elements were not part of broader economic policies namely, industrial policy, investment policy and trade policy and, to the lesser extent, education policies (see Intarakumnerd, et.al., 2002).

Industrial policy of Thailand has not paid enough attention to the development of indigenous technological capability as an integral factor in the process of industrialisation (Sripaipan, Vanichseni, and Mukdapitak, 1999: 37). Investment policy, especially the promotion of foreign direct investment (FDI), aims primarily at generating inward capital flow and employment. Unlike Singapore where FDI is specifically used to upgrade local technological capability (see Wong, 1999), there is no explicit and pro-active link between promoting FDI and upgrading of local technological capability in Thailand. Trade policy, the most important instrument in Thailand being tariff, has not been used strategically to promote technological learning like in NIEs (see Amsden, 1989; Chang, 1994; Lall, 1996). Instead, trade policy was very much influenced by macro economic policy, for instance, to reduce domestic demand for imports at the time of balance of payment deficit. The Ministry of Finance, the dominant agency which controlled the policy, had little knowledge or experience of industry and industrial restructuring (Lauridsen, 1999: 16-20).

Moreover, industrial policy in Thailand has been limited to the so-called 'functional' intervention such as promoting infrastructure building, general education, and export push in general. There have been virtually no selective policy measures, such as special credit allocation and special tariff protection, targeting particular industries or clusters. The exception was the local content requirement in automobile industry, which was rather successful in raising local contents of passenger vehicles to 54% in 1986 (see Doner, 1992). Interestingly, with the exception of automotive industry, there has been no reciprocal performance-based criteria (such as export and local value added and technological upgrading targets) set for providing state incentives like in Korea or

Japan (see Johnson, 1982; Amsden, 1989; Evans 1989, 1998; Chang, 1994; Lall, 1996). Investment promotion privileges, for example, are given away once approved. The intention to attract foreign direct investment and promote export overshadowed the need to develop local initiatives and indigenous technological capabilities. As a result, linkages between multinational corporations and local firms were also weak. Unlike Taiwan, the governmental protection and promotion, without strengthening absorptive capabilities of Thai suppliers, left a profound impact on the weak technology and suppliers' network of industries. (Vongpivat, 2003)

The major change in policy came recently under the present Thaksin government. Media and academics in Thailand and the Southeast Asia labeled this government distinctive policy as "Thaksinomics" (Thaksin's Economics). Dual track policy is the main thrust of Thaksinomics. The government is trying to enhance international competitiveness of the nation by strengthening 'external' side of the Thai economy, namely, export, foreign direct investment and tourism. At the same time, it is attempting to increase capabilities of domestic and grass-root economies by implementing projects like Village Fund (one million Baht to increase local capabilities of each village), a three-year debt moratorium on farmers' debt, One Tambon[10] One Product Project (supporting each Tambon to have product champion), and People Bank (giving loans to underprivileged people with no requirement of collateral).

This government, unlike its predecessors which pay most attention to macro-economic stability, focus more on enhancing meso- and micro-level foundations for international competitiveness. The high priority of 'competitiveness' issue on the government's agenda is illustrated by the establishment of National Competitiveness Committee chaired by the Prime Minister. It was the first time that Thai government has serious "selective" policies addressing specific sectors and clusters. The government declares five strategic clusters which Thailand should pursue: automotive, food, tourism, fashion, and software. Clear visions have been given to these five clusters. Kitchen of the World (food cluster), Detroit of Asia (automotive cluster), Asia Tropical Fashion, World Graphic Design and Animation Centre (software cluster), and Asia Tourism Capital. Building innovative capabilities of the nation is highly regard as very important factor increasing and sustaining Thailand's international competitiveness. "Innovative nation with wisdom and learning base" is one of seven Thailand's Dreams projected by this government. To make this dream come true, several strategies have been devised. These include continuous investment in R&D and technology, well environment for attracting and stimulating innovation, high accessibility to knowledge and information across the nation, fluent English as a second language,

10) Tambon is a unit of local government administration. One Tambon comprises several villages.

possessing strong learning basissuch as passion for reading, better accessibility to cheap but good books, thinking school with innovation movement (see Phasukavanich, 2003).

The new ten-year Science and Technology Action Plan (2003-2013) places the concept of national innovation system and industrial cluster at its heart. The scope of the plan is much broader than the aforementioned four functional areas. Measures to stimulate innovations and to strengthen national innovation system and industrial clusters are explicitly highlighted. Equally important, the Board of Investment (BOI) has substantially changed its policy by paying more attention to issues underlying long-term competitiveness of the country, namely, development of indigenous technological capability and human resources. Special investment package promoting "Skill, Technology and Innovation or STI" has been initiated. Firms can enjoy one or two years extra tax incentives if they perform the following activities in the first three years: spending on R&D or designing at least 1-2 percent of their sales, employing scientists or engineers with at least bachelors degree at least 5% of their workforce, spending on training of their employees at least one percent of their total payroll, and spending at least one percent of total payroll on training personnel of their local suppliers.

To carry out these changes, the government has introduced the private sector's management style to improve efficiency and effectiveness of bureaucratic system. Chief Executive Officer (CEO) style is now being implemented both at central and local government levels in order to integrate related government policies under clear leadership. Together, the Performance-Based Management (PBM) which clearly illustrates contractual relationship and delegation of authority in the bureaucratic lines of governance has been put in place.

Cluster concept is also used as a main industrial policy of Thaksin Government for national, regional and local levels. At the national level, it is used to strengthen advanced industries both in service and manufacturing sectors like automotive, textile and garment, software and tourism in order to make them to be coherent and innovative 'industrial clusters'. At the regional level, Thailand is now divided to 19 geographical areas. Each area has to plan and implement its own cluster strategy focusing on a few strategic products or services. It will be supervised by CEO governors located in the area. For the local level, the cluster concept is applied to increase the capacity of grass-root economy in the name of 'community-based clusters', especially to help the 'One-Tambon-One Product' succeed.

4. From Hard Disk Drive to Software and to Chilli Paste: Thai Cluster Experiences

We will discuss at length three cluster development experiences in Thailand: hard disk drive, software and chilli paste. These three clusters seem to be different, as one appears to be quite modern high-tech manufacturing product, another is knowledge-intensive service, and the other look rather primitive. They represent a modern manufacturing cluster, a service cluster and a community-based cluster respectively.

4.1. Hard Disk Drive (HDD) Cluster

National Science and Technology Development Agency (NSTDA) commissioned a study on HDD cluster to Asian Institute of Technology (AIT) and Asia Policy Research (a consulting company) in 2003. They studied the importance of the industry to Thailand's economy, reviewed past studies on the industry, outlined cluster mapping, and evaluate roles, technological capabilities and linkages of key players of the industry. The following is the summary of their study.

The hard disk drive is an electronic product playing a significant role in Thailand's electronics exports. Thailand is ranked as the most important global base for hard disk drive manufacturing. Thailand stands 2nd in the world rank of hard disk exporters next to Singapore with manufacturing segment of 20 percent of world production in 2004 which is expected to rise to 42% by 2005. The HDD sector in Thailand employs more than 50,000 people and generates an export worth of 5 Billion US$. This has become possible due to the Thai manufacturing bases of the hard disk giants like Fujitsu, IBM/Hitachi, Western Digital and Seagate.

Thailand-based operations generally import high technology components from abroad into the country as raw materials and exports the products to markets worldwide. The level of local content is estimated to be quite low, approximately 30-40 percent of total production cost, due to the lack of suppliers, low quality domestic components and the complicated processes of buying between domestic factories. Since the majority of HDD suppliers receive tax incentives from the Board of Investment (BOI) similar to the HDD assemblers, they are also eligible for raw material import tariff exemption for export products. If the manufactured components are not exported as declared to the BOI, the suppliers must submit papers declaring the value of indirect exports which may be considered as domestic sales for payment of the raw material import duties. Therefore, it is frequently easier for suppliers to directly export to neighboring countries like Malaysia and Singapore, leaving the assemblers to re-import it as raw materials for use in Thailand.

The industry heavily relies on technology transfer from their foreign affiliates. The foreign affiliates usually provide raw materials, machinery technology and markets. In addition, the TNCs' headquarters play a major role in formulating marketing and production strategies.

The HDD cluster in Thailand is shown in Figure 1. It can be seen that there are five major private-sector players of the cluster: (1) HGA/HAS/HDD Assembly, (2) Motors, (3) Suspensions, (4) Base plates, (5) Flex assembly.

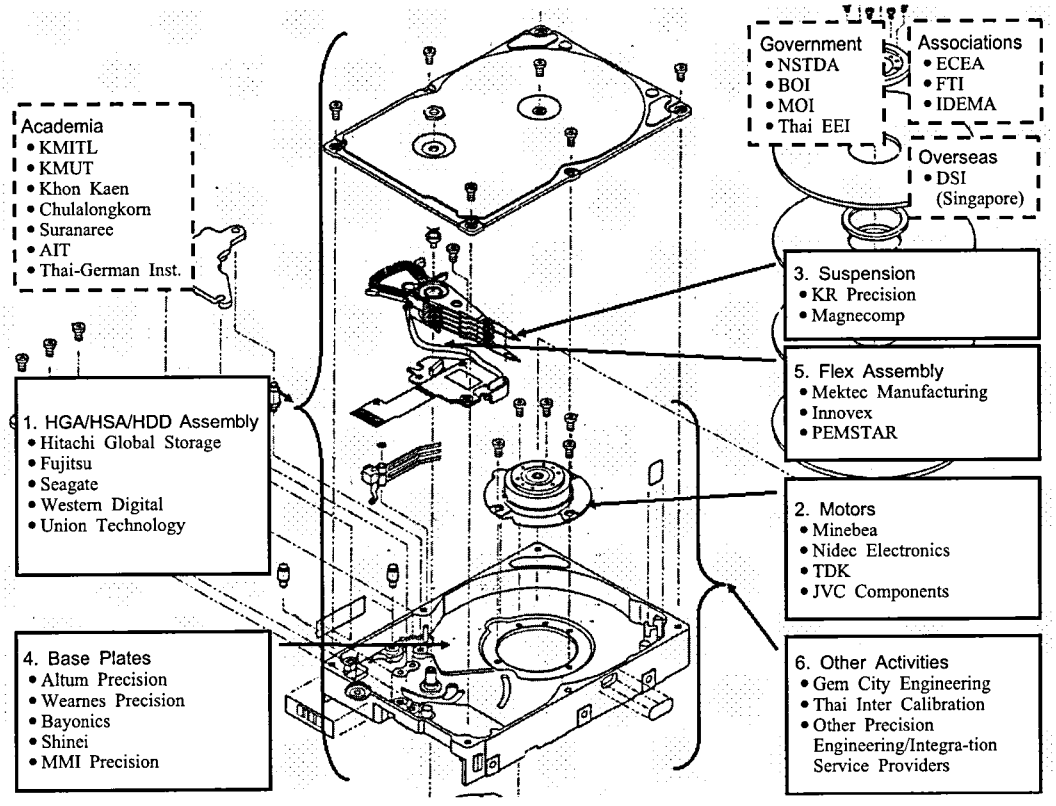
In addition, there are a few other value-added activities carried out by various players such as Gem City Engineering (automation engineering services) and Thai International (calibration). Apart from private-sector players, there are key government agencies important to the industry, namely, BOI, government research institutes like National Science and Technology Development Agency (NSTDA), universities conducting research related to and in cooperation with the industry like Asian Institute of Technology (AIT), Chulalongkorn University, Suranaree University and Khon Kaen University, and training institutes providing courses in automation like Thai German Institute.

Technology Capabilities and Linkages in the HDD Cluster

Framework for analysing technological capabilities and extent of linkages of firms in the HDD industry (see Table 1) was developed based on existing literature (see Lall, 1992; Bell and Pavitt, 1995; Amsden, 2001).

The firm-level interview survey of the HDD industry generated some mixed indications with regard to the technology activities of foreign invested firms in Thailand. Building on detailed interviews with 10 major companies in the HDD sector - all clearly foreign owned with the exception of one firm listed on the Thai stock market, the research exercise measured the technological capabilities in five broad areas and at three different levels The basic findings were that:

- The firms exhibited strong capabilities in investment, process development and industrial engineering areas, all areas that are required to support their manufacturing operations in Thailand;
- The firms showed much weaker capabilities in product engineering and innovation, with some indications that American firms had gone much further in building these capabilities in their Thai operations than non-American firms; and
- The firms show very weak capabilities in linkage development but showed a strong interest in developing stronger linkages if the support infrastructure is in place, and indicated that



Source: AIT/Asian Policy Research (2003).

Figure 1 : The HDD Cluster in Thailand

it would call for concerted efforts from both industry and the government to build an environment that is conducive to linkage development.

A closer examination of the linkages that were reported, following the basic framework presented in Figure 3, indicated that most companies are linked to a certain degree into the vertical supply chain of the Thai HDD cluster and share related information with regard to specific product related issues, especially for new products. But only a few firms co-operate closely with either Thai-based suppliers or customers in broader product, process, or human resource development related activities, indicating rather weak innovation-related vertical links. And even fewer companies have horizontal linkages to universities, R&D institutions, service providers or competitors: indicating weak innovation-related horizontal links.

Table 2 : Technological Capabilities: A Unified Framework for HDD Industry

	Investment	*Manufacturing*			Innovation	Linkages
		Process Engineering	Product Engineering	Industrial Engineering		
• *Basic*	• Feasibility Studies • Site selection • Project preparation	• Scheduling • Maintenance • Quality management	• Understanding basic product design • Adapting minor product changes	• Optimization based scheduling • Basic skill upgrading programs	• Process improvement • Local parts development	• Local supplier base development • Subcontracting to technological service providers
• Interm-ediate	• Technology selection • Contract negotiation • Technology transfer agreements • Recruitment and initial training project execution	• Process optimization • Process adaptation for product variations • Introduction of TQM/Kanban techniques	• Technology transfer for new products	• Productivity analysis • Benchmarking • Advanced inventory control (JIT etc) • Advanced skill development • Logistics management • Supply chain management	• Product support improvement (packaging, testing) • R&D transfer • New process design	• Process/product upgrading in collaboration with supplies and R&D institutes • Reverse system engineering in collaboration with external partners • Industry networking and collaboration for competitive development
• Advanced	• Organization management using ISO an BS standards • Ability to develop own turn-key projects • Export of project know-how.	• Implementation of MRP ERP systems • Process standardization using ISO and BS standards	• Tracking global product changes • New product design	• Long term HR development programs • Supply chain development (cluster based)	• New product innovation • Organization set up for innovation	• Long term linking with R&D institutions and universities • Licensing new technology to partners and suppliers • Strategic alliances with academic and R&D institutes to open new product/service markets

Source: AIT/Asian Policy Research (2003).

Most companies are linked to a certain degree into the vertical supply chain of the Thai HDD cluster and share related information with regard to specific product related issues, especially for new products. But it was found that a few firms cooperate closely with either Thai based suppliers or customers in broader product process or human resource development related activities that are marked by weak innovation related links amongst them. Moreover, fewer companies maintain links with universities, R&D institutions and service providers or with the competitors in their field.

The success of the HDD cluster in Thailand is partly contributed from the active work of the industrial association, IDEMA Thailand which is the Thai branch of the International Disk Drive Equipment and Materials Association (IDEMA). IDEMA is an international not-for-profit trade association that represents the $22 billion HDD industry and its infrastructure. Founded in 1986, IDEMA provides more than

500 corporate and individual members worldwide with trade shows, technical conferences, symposia, education classes, networking events, and an active international standards program.

Asia outside Japan produces more than 85% of the world's disk drive output. IDEMA has been very active in Singapore, Malaysia, and the Philippines and extended its activities to Thailand in 1999, raising the awareness of the significant contribution of the industry. IDEMA aims to promote business networking, to facilitate information sharing through education program and technical symposiums/conferences, and to allow technical issues faced in the industry to be discussed globally. IDEMA activities in Thailand ensure that the country maintains and enhances its competitiveness in the drive industry. It is necessary to make a plan for keeping up with technology development and for providing the training to people at all levels (foundation level, intermediate level, advanced level) involved in the HDD industry.

On July 15, 1999, IDEMA presented a paper on addressing the training needs for the Southeast Asia HDD industry at a workshop organized by the National Science & Technology Development Agency, the National Electronics and Computer Technology Center (NECTEC), the Federation of Thai Industry, the Thailand Board of Investment, the University of California San Diego and the Brooker Group. Government and industry participants identified HDD industry workforce training as one of their leading issues. IDEMA Asia-Pacific was seen as being able to address this critical educational need. The idea of forming a branch of IDEMA in Thailand was born at this workshop.

On September 15, 1999, the first meeting of the IDEMA Thailand Advisory Committee was held, and IDEMA Asia-Pacific, Thailand was formed. It includes the following leading storage technology companies: Seagate, Western Digital, Hitachi, Fujitsu, KR Precision, Magnecomp,

and Gem City Engineering. Representatives from BOI, AIT, NECTEC, and Asia Policy Research Co., Ltd. are also on the Advisory Committee. The activities are carried out in close collaboration between industry, academia, and policy makers. It aims to serve the following basic objectives:

- A platform for business networking;
- A platform for information sharing - fundamental education, symposiums, market updates and advance technology seminars; and
- A platform to address issues of relevance to the HDD industry.

Two sub-committees of the IDEMA Asia Pacific Management Committee - Thailand Management Committee have also been formed to focus on critical needs of the industry, namely:

1. *Human Resource Development Sub-Committee*; and
2. *Automation Infrastructure Development Sub-Committee*

In order to kick-off the IDEMA Thailand educational activities, AIT-IDEMA jointly offered a *Certificate of Competence in Storage Technology* (CCST) recognized by both institutions (see attached AIT/IDEMA Press Release). The first two "Core Modules" of the CCST were held on November 5 and 6, 1999 - one on Micro-Contamination and one on the Fundamentals of Hard Disk Technology. Subsequent ad-hoc courses have been offered, and a full program is planned for 2004 with support from the Thailand government.

The IDEMA Thailand Advisory Committee has organized 8 major international disk drive symposiums in Thailand. Each symposium has attracted a world-class set of speakers and around 150-200 industry participants from the industry in Thailand. A number of other networking activities are regularly held by the IDEMA Thailand Advisory Committee.

In January 2004, IDEMA worked closely with the BOI to make the HDD industry a "prioritised" industry with a special investment privileges. One extra year of tax exemption will be given to HDD assemblers and components workers if they perform the following activities:

A) invest in R&D for on average in the first three year not less than 1-2 percent of sales or not less than 50 millions Baht for assemblers and not less than 15 millions Baht for component makers,

B) employ personnel educated in sciences, technology and engineering or disciplines concerning with R&D and design not less than 5 percent of their workforce for the first three years

C) spend not less than one percent of their payroll on training of their Thai personnel in the first three years,

D) spend not less than one percent of their payroll or not less than 150 millions Baht for assemblers and not less than 15 millions Baht for component makers to develop capabilities of Thai suppliers or to support related education institutes.

E) Establish R&D centres within three years of their operation.

This is a remarkable change in the Thai industrial policies, since the country did not have serious selective industrial policies promoting specific sectors or cluster in the past 50 years of its industrialisation.

In August 2004, IDEMA worked with NSTDA to set up a cluster management organisation headed by a technopreneur-cum-university professor who used to work for the industry and understand the industry's needs. This organisation is acting as a coordinator between all main actors, and push forward future projects aiming to upgrade capabilities of the whole industry in Thailand such as joint training programmes and collaborative R&D projects.

4.2. Software Cluster

The performance of software industry in Thailand is not quite impressive. Going by the Board of Investment statistics, the number of promoted software companies increased from just 2 in 1996 to 49 in 2001 and declined to 13 in 2003. Since 1996, the cumulative number of promoted companies stands at 170. Out of these, 75 were fully owned by Thai companies, 34 were foreign companies and the others were joint ventures. Of these, 33 licenses were issued during 2002 and 2003 and hence most of them have not started operations. The total investment commitment by 137 companies promoted prior to 2002 amounted to 1632 million Baht with a mean investment of 11.9 million Baht. But the actual investment made amounted to only 52 percent (846.5 million Baht) with an average investment of 9.7 million Baht.

In the case of fully Thai owned companies the investment commitments amounted to 532 million Baht and actual investment was of the order of 389 million Baht (73 %). When it comes to fully-owned foreign companies, total investment commitments were of the order of 113 million Baht and the actual investment was about 90.8 million Baht (80%). This tends to suggest that, in contrast to electronics, the foreign firms have been less enthusiastic to invest in the ICT software and service sector of Thailand. In the case of 55 joint ventures (1996-02) total investment commitment was of the order of 986 million Baht with an actual investment of 365.9 million Baht (35.7 percent).

Total employment commitment by the 170 promoted companies has been of the order of 4207, whereas the actual employment generated was only of the order of only 1969 - a fraction of the total employment one of the leading IT firm in India. Out of the realized employment, 1184 (60%) was accounted by Thai firms, 165 (8%) by foreign firms and 620 (32%) by joint ventures. From discussion with industry sources it was discerned that the export base of Thailand

is rather limited[11].

NSTDA: The Largest Research Technology Organisation in Thailand

NSTDA is a leading research technology organization in Thailand. It undertakes a broad-based, systematic approach towards enchanting the entire science and technology system of Thailand in support of national economic and social development. Four specialised centers-Genetic Engineering and Biotechnology (BIOTEC), Metal and Materials Technology (MTEC), Electronicsand Computer Technology (NECTEC), and Nanotechnology - come under the NSTDA umbrella. Three centres, except Nanotechnology Centre, have been established in the 1980s in line with the global trend at the time and perceived local needs for strong research capability in these areas. Though it is not an official policy, NSTDA, therefore, has strong path dependency of focusing on R&D with a smaller interest in supporting advancement of technological capability development of private firms through several financial and technical supporting schemes such as technical consultancy services, IP services, training services, quality control services. Nonetheless, NSTDA is trying to change its orientation from a 'mere' R&D institute to an intermediary in selected clusters. Software cluster is one of NSTDA's targeted cluster.

To strengthen the industry, NSTDA in 1997 received an approval by the cabinet to set up the Software Park Thailand (SPT) in order to induce the first local cluster of software industries. The SPT has been successfully run, occupying 13,000 square meters of a high-rise building, for nearly five years. It received strong supports from well-known transnational corporations like IBM, HP, SUN, Oracle etc. Around 50 companies, mostly Thai nationals, have fully occupied the available space. Among various facilities, NSTDA together with the Carnegie-MellonUniversity has consistently offered training and certifying the Capability Maturity Model (CMM) to raise the standard of software production of the tenants. Many of them now have customers and business links with their foreign counterparts such as US, EU, Australia, New Zealand, Malaysia and so on. Local universities are also participating with some companies in the SPT to produce the local e-learning services. The establishment of SPT has facilitated technology transfer within and outside the Park and encouraged a first step toward the clustering concept that the tenants will be able to learn from each other, NSTDA, participating universities, and firms located outside the park, especially transnational corporations.

11) One estimate claimed exports in 2000 at $ 11 million.

4.3. Chilli Paste Cluster

As mentioned above, cluster development is a major industrial policy of this government. At the local or community level, the government initiated "One Tambon, One Product" by encouraging each Tambon to select its product champion based on their comparative advantage. A 'product' can be anything such as handicraft, herbal medicine, foodstuff, manufacturing items, and tourism. 'Cluster concept is applied at the community level to support these products and the government called them community-based clusters. Here we will examine a community-based cluster in the making. This cluster grew rather successfully before the government cluster policy initiative and, to larger extent, with little government intentional supports. The study was done by Rajaphat Phetchaburiwittiyalongkorn under joint funding of the Office of Rajabhat Institutes and National Science and Technology Development Agency in 2002. The following is the summary of the study.

Wat Tuptimdang Community is located at Tambon Klong Song, Klong Luang District, Pathumtani province. This community is an old community dated back to the reign of King Rama V or more than 100 years ago. The community was named after a Temple, Wat Tuptimdang Dharmadaram, which was highly respected and used for religious ceremony by local people. At present, there are 1,031 inhabitants living in 171 households. Most inhabitants are farmers with their own land. Their economic status is fair and quite sufficient. Most of them are Buddhists and had only primary and/or secondary level of education. Relatives live together closely and rely on each other. These rural people live simply and close to nature.

The Taptimdang Community has been rather stable. Ways of life have been maintained. The community has wisdom in the areas of agriculture (e.g. farming, breeding, mixed animal and plant farming), handicraft, food and food processing. These areas of knowledge are mostly tacit as it is embodied in certain individuals of the community. The most striking local wisdom of this community is, of course, knowledge in making grilled fish chilli paste. Fish has been very abundant and can be consumed all year round. Fish is cooked, processed and preserved in many forms. Chilli paste is an every-day food of people in the central region. Grilled fish has been used as important ingredient in a certain types of chilli paste and is considered as local wisdom passed on from one generation to another.

There are several concerned actors in the chilli paste cluster.

1. Producer of grilled fish chilli paste are local people who live in the community. They grouped together as Klong Song House Wife Association. At present, there are 70 members. The association acquires all necessary ingredients, grind and fry them, put them into a

small plastic packages ready to market.

2. Raw material and packaging suppliers. These include farmers producing general raw materials and growing vegetable, and producers of can and other types of packaging.
3. Specialised suppliers. These are suppliers of specific ingredients like fish, garlic, fish sauce, dried chilli, tamarind, salt. These suppliers are mostly located in a local wholesale market called 'Rangsit Market' (or Talad Thai).
4. Customers. The chilli paste is sold both to local customers and ordinary customers in Thailand.
5. Knowledge institutes. Several local tertiary education institutes and knowledge-diffusion organisations of government helped the association by the means of knowledge transfer. For example, Rajabhat Phetchaburi Wittiyalongkorn, a local university, help the association by introducing canning technology, so that the chilli paste would have a long shelf live and being able to market with higher price.
6. Government promoting & regulating agencies. They are several government agencies both at the district and provincial levels concerning agriculture, development, cooperative, and health issues, which directly and indirectly promote and regulate activities of the House Wife' s Association. For example, Agriculture District Authority provided the association with agriculture knowledge, especially in food processing. Livestock District Authority provided knowledge in animal farming, animal disease prevention, Cooperative District Authority helped the association with fertilizer and pesticide, Commerce Provincial authority gave soft loan for the association's investment in setting up booth for selling the chilli paste in a nearby department store, and Health Provincial Authority certified the quality and standard of the chilli paste and helped to assure the public in this respect.
7. Community networks. The House Wife's Association has linkages with several existing community networks like Women Cooperative Group, Agriculture Saving Group, Community Shop and so on. They exchanges agriculture knowledge and experiences regularly.
8. Service and specialized infrastructure providers. Marketing channels are provided by a few private organizations such as the Future Park Rangsit Department Store, with the financial support from Commerce Provincial Authority provided a booth for the association to sell chilli paste. Several organizations both private and public organisations also invited the association to their trade and exhibition fairs (see the cluster map in figure 3).

Roles of Klong Song House Wife's Association

The driving force of the cluster is the Klong Song House Wife's Association. The association was established in 1992 with 19 founding members. These people observed development of an association in a neighbour area and decided to set up an their own association. The objectives of the associations are: a) to promote career advancement and increase incomes of its members, and b) to solidarity among members and enhance the strength of Klong Song community. In the setting-up process, the Agriculture District Authority sent its official to act as an assistant. The chairperson of the group is a charismatic and well-respected person. He later became the head of the village. After the association was established, the association has allowed its members

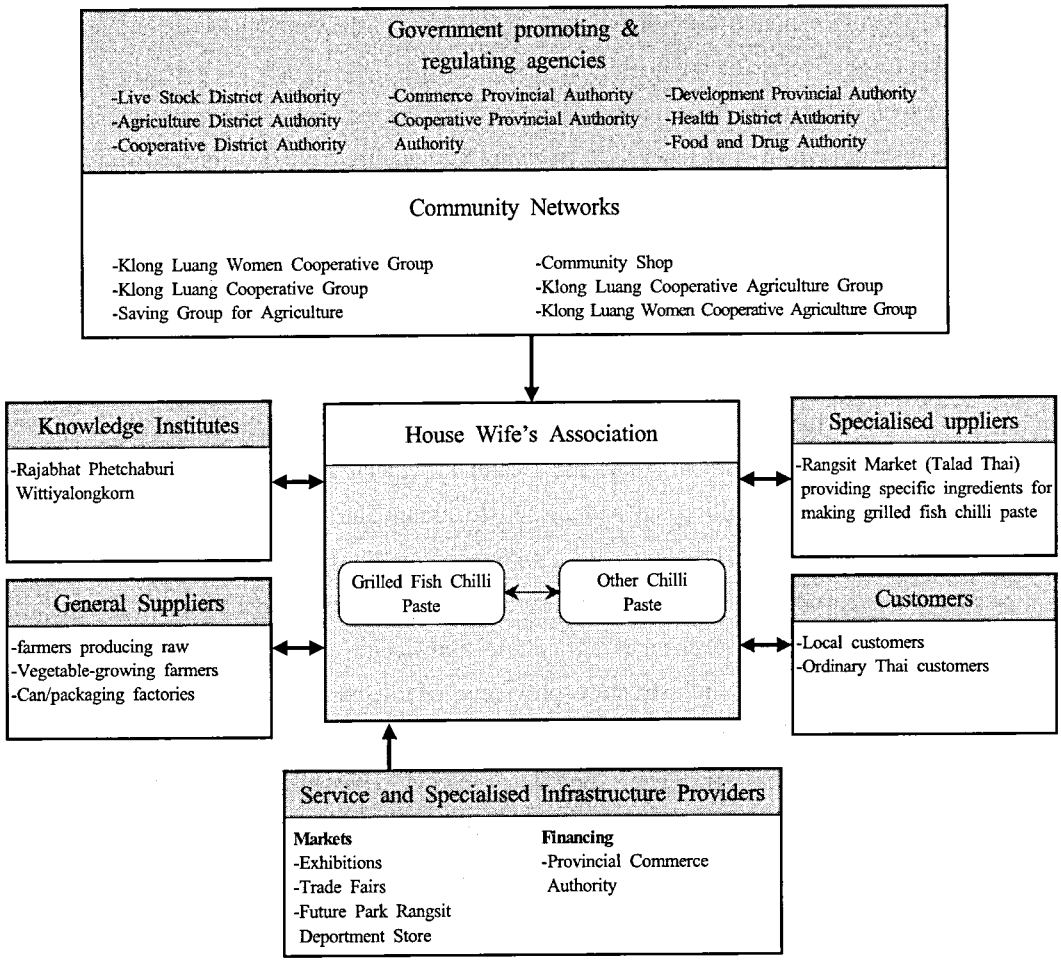


Figure 3 : Cluster Map of the Production of Chilli Paste with Grilled Fish

to hold its shares (valued 50 Baht or 1.25 dollar per share) at the maximum of 100 shares. Apart from making chilli paste the association also engage in making preserved gargle, growing vegetable, making natural fertilizer and growing flowers.

5. Conclusions

Today, the word 'cluster' has become a buzz word. It has been used by policy makers, business people and general public. Though, the concept of cluster should not be theorized rigidly, for developing countries, the concept should be well placed in the development context. It can and should be seen as a 'development' tool bringing people to work together, facilitating trust building process, and encouraging them to share their knowledge. Many developing countries face two different sets of development problems. On the one hand, many countries want to be well integrated in the global production network of transnational corporations. These countries want to be internationally competitive, attractive to foreign investment especially in higher technologically sophisticated activities such as R&D, design and engineering, and being able to export high-value added products. On the other hand, a large part of developing countries' economies are still economically backward. Here, the problem is not to about how to be well integrated to the global economy but on how to improve welfare of local people, enhance grass-root economy and, to a certain extent, being able to be self-sufficient.

The case of Thailand demonstrates how the cluster concept can be used as a 'development' tool addressing these two sets of problems. Major policy shift came with the new Thanksin government in the name of 'Thaksinomics'. Instead of just focusing on micro economic stability and getting the 'fundamental' right, more attention has been paid to increasing micro level and meso level of country competitiveness. Cluster concept has been used as a policy tool to realise this objective. It works both for technologically sophisticated manufacturing and service clusters mainly dominated by TNCs' investment and knowledge, and community-based clusters relying mainly on local knowledge and wisdom.

In the hard disk drive cluster where the industry's direction is mostly in the hand of transnational corporations, technological capabilities of actors are relative not so high and their linkages among each other are still reasonably weak. Nonetheless, there is a possibility that an industrial association like IDEMA can stimulate the 'clustering' process leading to more interaction and knowledge sharing among actors. As in knowledge-intensive service like software, an Research and Technology Organisation, having accumulated knowledge in rather high-technology field, organisational

flexibility, and human resources, can be well placed to act as a bridging intermediary between transnational corporations, local start-ups, IT service providers, university and government agencies. For the chilli paste cluster, its main source of knowledge is very much tacit and localised. It is embedded in individuals and their relationship. The success of the cluster depends very much on a community-based intermediary that has local knowledge and trust of community members.

To summarise, the roles of an industrial association, an RTO and a community-based organisation are quite striking here. IDEMA, NSTDA and the House Wife's Association have played significant roles in building trust between actors of the cluster, encouraging knowledge flows, and envisaging shared cluster vision. Government should work with these types of intermediary organizations, try to enhance their capability, and implement its policies through them.

References

AIT/Asia Policy Research (2003), *Strengthening the Hard Disk Drive Cluster in Thailand*, An Interim Report submitted to National Science and Technology Development Agency.

Amsden, A. (2001), *The Rise of the Rest: Challenges to the West from Late-industrialising Economies*, New York: Oxford University Press.

Amsden, A. and Hikino, T. (1993), "Borrowing Technology or Innovating: An Exploration of the Two Paths to Industrial Development", in R. Thomson (ed.), *Learning and Technological Change*, New York: St. Martin's Press.

Arnold, E. et al., (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, December 2000, Washington D. C.: World Bank.

Bell, M. and Pavitt, K. (1995), "The Development of Technological Capabilities", in Haque, I. (ed.), *Trade, Technology and International Competitiveness*, Washington D.C.: The World Bank.

Chang, H. (1997), "Institutional Structure and Economic Performance: Some Theoretical and Policy Lessons from the Experience of the Republic of Korea", *Asia Pacific Development Journal*, Vol. 4, No. 1, pp. 39-56.

Chang, H. (1994), *The Political Economic of Industrial Policy*, London: Macmillan.

Dodgson, M. and Bessant, J. (1996), *Effective Innovation Policy: A New Approach*, London: International Thomson Business Press.

Doner, R. (1992), "Politics and the Growth of Local Capital in Southeast Asia: Auto Industries in the Philippines and Thailand", in McVey, R. (ed.), *Southeast Asian Capitalists, Southeast Asia Program (SEAP)*, New York: Cornell University Press.

Evans, P. (1989), "The Future of the Developmental State", *The Korean Journal of Policy Studies*, Vol. 4, pp. 129-146.

Evans, P. (1998), "Transferable Lessons? Re-examining the Institutional Prerequisites of East Asian Economic Policies", *Development Studies*, Vol. 34, No. 6, pp. 66-86.

Goto, A. (1997), "Cooperative Research in Japanese Manufacturing Industries", in A. Goto and H. Odagiri, *Innovation In Japan*, Oxford: Oxford University Press.

Intarakumnerd, P., Chairatana, P. and Tangchitpiboon, T. (2002), "National Innovation System in Less Successful Developing Countries: the Case Study of Thailand", *Research Policy*, Vol. 8-9, pp. 1445-1457.

Intarakumnerd, P., Virasa, T. (2002), "Broader Roles of RTOs in Developing Countries: From Knowledge Creators to Strengtheners of National Innovation System", Paper presented at Science, Technology and Innovation Conference, JFK School of Government, Harvard University, 23-24 September.

Johnson, C. (1982), *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925-1975*, CA: StanfordUniversity Press.

Lall, S. (1992), "Technological Capability and Industrialization", *World Development,* Vol. 20, No. 2, pp. 165-186.

Lall, S. (1996), *Learning from the Asian Tigers: Studies in Technology and Industrial Policy,* Macmillan Press.

Lauridsen, L. (1999), *Policies and Institutions of Industrial Deepening and Upgrading in Taiwan III-technological upgrading*, Working Paper No. 13, International Development Studies, Roskilde: Roskilde University.

Lauridsen, L. (2001), *Coping with Globalization: The Recent Thai Experience with Openness and Increased World Market Integration,* International Development Studies, Roskilde University.

Lauridsen, L. (2002), "Coping with the Triple Challenge of Globalization, Liberalization and Crisis: The Role of Industrial Technology Policies and Technology Institutions in Thailand", *The European Journal of Development Research,* Vol. 14, No. 1 (June 2002), pp. 101-125.

Lind, M. and Persborn, M., (2000), "Possibilities and Risks with a Knowledge Broker in the Knowledge Transfer Process", Paper presented at the 42nd Annual Conference of the Operational Research Society, 12-14 September 2000, Swansea, UK: University of Wales.

MEXT (2003), "Cluster: Cooperative Link of Unique Science and Technology for Economy Revitalization", A published paper prepared by Ministry of Education, Culture, Sports, Science and Technology, Japan.

OECD (1999), *Boosting Innovation: The Cluster Approach*, Paris: OECD.

OECD (2000), *Knowledge Management in the Learning Society*, Paris: OECD.

Phasukavanich, C. (2003), *The Pace of Thailand through the Year 2020,* Powerpoint presentation by Chakramon Phasukavanich, 20 May 2003.

Porter, M. E. (1998), "Cluster and the New Economics of Competition", *Harvard Business Review*, November-December, pp. 77-90.

Rajabhat P. (2002), "The Study of Strategic Methods for Upgrading Local Wisdom: A Case Study of the Production of Chilli Paste by Klong Song House's Wife Association", A Report submitted to the Office of Rajabhat Institutes and National Science and Technology Development Agency.

Rush, et al. (1996), *Technology Institutes: Strategies for Best Practice*, Suffolk: St Edmundsbury Press.

Sripaipan, C., Vanichseni, S., and Mukdapitak, Y. (1999), *Technological Innovation Policy of Thailand* (in Thai), Bangkok: National Science and Technology Development Agency.

Steiner, M. (1998), *Cluster and Regional Specialization*, London: Pion limited.

Vongpivat, P. (2003), "A National Innovation System Model: An Industrial Development in Thailand", Unpublished D.Phil. Thesis, The Fletcher School of Law and Diplomacy, Tufts University.

Wong, P. (1999), "National Innovation Systems for Rapid Technological Catch-up: An Analytical Framework and A Comparative Analysts of Korea, Taiwan, and Singapore", Paper presented at the DRUID's Summer Conference, Rebild, Denmark.