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Improving the system of financial incentives for enhancing Thailand's industrial technological capabilities

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Improving the system of financial incentives for enhancing Thailand's industrial technological capabilities

Abstract

This report provides a summary of current international experiences with financial incentives for supporting technology development and identifies some important implications for public policy in Thailand. International experiences have demonstrated the broader public good that can be achieved through policies and public interventions that stimulate technology learning environments built around clusters or networks of firms and national support institutions. Financial incentives serve as a mediating influence to enhance the flow of knowledge from firms that are closer to a leading technological edge through to those firms where technological skills are lagging. They are therefore an essential tool available to governments in seeking to increase national technological capabilities and international competitiveness. Although a wide range of incentives for technology development is in place in Thailand the system overall reflects a policy perspective that has not kept pace with the changing demands of global environments. International experiences reflect the need to target incentives where they will have maximum impact. This requires targeting particular types and groups of firms and targeting the specific technology thresholds relevant to their current levels of technology capabilities. It also implies the need for incentive mechanisms that stimulate a demand for technology and skills rather than focusing simply on their supply. The report draws attention to the need to redirect the current system of incentives in Thailand to place greater attention on efforts to enhance basic engineering and design capabilities, building knowledge networks between large and smaller firms and stimulating demand for technology upgrading.

Keywords

capabilities, technological, financial, industrial, system, thailand, enhancing, incentives, improving

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Improving the System of Financial Incentives for Enhancing Thailand's Industrial Technological Capabilities

Final Report

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Acronyms

BOI	Board of Investment
DIP	Department of Industrial Promotion, MOI
GRI	Government Research Institutes
IDF	Innovation Development Fund
LSE	Large scale enterprises
MNC	Multinational Corporation
MOI	Ministry of Industry
MOSTE	Ministry of Science, Technology and the Environment
NCC	National Competitiveness Committee
NESDB	National Economic and Social Development Board
NSTDA	National Science and Technology Development Agency
OSMEP	Office for SME Promotion
SME	Small and medium sized enterprises
SDF	Skill Development Fund
TNC	Transnational Corporation
TRF	Thailand Research Fund

Executive Summary

This report provides a summary of current international experiences with financial incentives for supporting technology development and identifies some important implications for public policy in Thailand.

International experiences have demonstrated the broader public good that can be achieved through policies and public interventions that stimulate technology learning environments built around clusters or networks of firms and national support institutions. Financial incentives serve as a mediating influence to enhance the flow of knowledge from firms that are closer to a leading technological edge through to those firms where technological skills are lagging. They are therefore an essential tool available to governments in seeking to increase national technological capabilities and international competitiveness.

Although a wide range of incentives for technology development is in place in Thailand the system overall reflects a policy perspective that has not kept pace with the changing demands of global environments. International experiences reflect the need to target incentives where they will have maximum impact. This requires targeting particular types and groups of firms and targeting the specific technology thresholds relevant to their current levels of technology capabilities. It also implies the need for incentive mechanisms that stimulate a demand for technology and skills rather than focusing simply on their supply.

The report draws attention to the need to redirect the current system of incentives in Thailand to place greater attention on efforts to enhance basic engineering and design capabilities, building knowledge networks between large and smaller firms and stimulating demand for technology upgrading.

Other weaknesses identified in the Thai system concern targeting, coordination and promotion of the schemes and a lack of an overall evaluation framework.

Failure to come to terms with these issues will see Thailand fall further behind economies such as Singapore and Taiwan in terms of national industrial technology capability and skills, and in its ability to compete on the basis of ‘knowledge’ rather than on other factors of production.

Three basic propositions provide a framework for revisions to the present system:

- government financial incentives should support the full range of technology capability building activities within the firm in an integrated manner;
- incentives must be targeted at those industry sectors, firms and activities that are likely to provide the greatest public benefit; and
- the choice of particular form of incentive (tax incentive, loan, grant) is a tactical decision that must take account of local circumstances

The main emphasis in the recommendations is on developing more effective targeting and coordination of schemes and generating more flexibility to enable firms to

progress through different stages of technology development. Recommendations are made under five key headings

- ***Revising financial incentives for skills development and training;***

  Recommendation 1
  Large firms should be encouraged to become actively involved in training. This could be achieved through their representation on the SDF Board and through their involvement in collaborative training arrangements. For example the new Skills Development Fund could target specific incentives for in-house training by MNCs for staff of other companies to allow them to act as training suppliers for their industry.

  Recommendation 2:
  As the SDF develops there should be mechanisms to 'hold the hand' of smaller companies by setting up training courses and funding company employees to attend them. This could be achieved through cash contracts or grants to training suppliers (who could be large firms, universities, GRIs) to provide specific courses for groups of SMEs. There is no point in funding companies if the required training courses do not exist – parallel support for the development of the 'training industry' is also essential.

  Recommendation 3:
  Assistance with the analysis of training needs, development of training strategies and identification of appropriate training providers appears *absolutely essential* for SMEs. The SDF must devote much of its resources to building this fundamental planning capacity within firms. This has been regarded as one of the most successful aspects of SDF schemes elsewhere, and also a critical component of many incentive schemes that fund consultants to work with companies on planning for their strategic needs. We recommend that a proportion of funds be allocated specifically for this activity.

  Recommendation 4
  The SDF Board should work closely with the private sector to identify priority areas in which training funds should be concentrated. This process should take account of priority sectors already identified by the government and priorities for-shadowed by the National Competitiveness Committee. Such priorities should be elaborated only after consultation with the private sector and in the light of in-depth research.

- ***Recommendations for stimulating SMEs to improve technology capability by undertaking design and engineering activities***

  Recommendation 5:
  The definition of R&D payments should be extended to cover all in-house R&D performed by the firms themselves, *not only* within a firm's registered R&D 'organisation' or approved institution as under present arrangements.

Recommendation 6:
For ***SMEs only,*** the definition of R&D under current financial incentives should be extended to cover technology development activities such as design and engineering activities that contribute more widely to enhanced productivity and competitiveness and *not just activities directly linked to R&D* as is the case at present.

Recommendation 7:
We recommend that the programs of matching grants offered through NSTDA schemes such as CD, ITAP, MTEC, BIOTEC and NECTEC, and through the DIP of the Ministry of Industry schemes such as ITB, Project 13 or MDIC. should be strengthened and be given greater flexibility in order to provide greater incentives for SMEs.

- ***Building flexibility and options for incremental and progressive technology development into the system***

Recommendation 8:
We recommend the Innovation Development Fund be given a high level of support from government and that it be established as an independent agency under its own Act. Its activities should be coordinated with the delivery of matching grants (or credits) through funds provided through NSTDA, DIP and the newly formed OSMEP. Coordination could be achieved by allocating responsibility to IDF or OSMEP for collating information on project delivery, monitoring and evaluation. This agency should report directly to the National Competitiveness Committee on monitoring and targeting technology incentives in priority sectors.

Recommendation 9:
We recommend building in greater flexibility to those schemes directed toward enhancing engineering and design capability through the introduction of 'innovation credits for design and engineering' available on a matching basis and available only to SMEs.

Recommendation 10:
We recommend that the grants-based schemes available through NSTDA and DIP should be given greater budget flexibility to enable funds to be transferred between schemes according to demands within firms and the effective implementation of the 'innovation credits for design and engineering'.

Recommendation 11:
We recommend that the activities undertaken through the BUILD VMC programme be closely coordinated with the grants-based schemes available through NSTDA and DIP, thereby marrying the linkage development efforts with the technological development support services.

- ***Enhancing the delivery impact and coordination of grant-based schemes***

Recommendation 12:
Financial sector organisations (such as the SME bank) should be contracted to act as administrative and possibly also decision-making intermediaries between the private sector claimants and the public sector funding agencies.

Recommendation 13:
We recommend that the budget directed toward increasing technology capabilities to firms other than for R&D should be increased to a level approaching 15 percent of the national S&T budget. This should provide sufficient stimulation for Thai firms to generate the capacity to more effectively absorb and build on the technology capabilities of more advanced firms and S&T institutions.

Recommendation 14:
A single government agency such as the Office of SME Promotion should be identified as the first point of contact for all schemes providing financial incentive for R&D, technology acquisition and development, and technical skills and training. The agency should have the task of publicising the schemes and disseminating information on eligibility, guidelines for funding etc. and for coordinating applications. Administration of the schemes would remain with existing Department (such as BOI and MOF schemes).

Appropriate industry liaison bodies should be co-opted to deliver information on the schemes to their members/constituents.

- ***The drive for national competitiveness.***

Recommendation 15:
We recommend that a 'policy forum for technology development incentives' be established with representatives of all key agencies involved in the delivery of financial incentives for technology and skills development. The IDF and OSMEP would be appropriate agencies to initiate such a forum that should also have strong private sector representation. The forum should undertake to coordinate the scope and delivery of the incentives, and develop a strategy for comprehensive monitoring and evaluation of the schemes. It should also undertake to advise the National Competitiveness Committee and the Office for SME Promotion on the scope and impact of the financial incentives system and the level of financial resources required to support an effective incentives regime.

Improving the System of Financial Incentives for Enhancing Thailand's Industrial Technological Capabilities

1. Introduction to the study

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1.1 Background

The Thailand Country Partnership for Competitiveness has identified science and technology as a high priority for development. As part of this process the World Bank, together with the Thai government, have been exploring strategies for enhancing technological capability for industrial development.

Government policies and the institutional framework in support of technology development in Thai firms were recently reviewed for the World Bank by a team led by Technopolis of the United Kingdom (Arnold et al, 2000). This study found that technology and innovative capabilities in Thailand have lagged well behind comparable Asian countries. For example, their report drew attention to the observation that the current intensity of R&D performed by business enterprises in Thailand lags around 10-15 years behind the level in Korea in the early 1980s when that country had a similar level of industrial and manufacturing development as contemporary Thailand. The intensity of business-performed R&D in Thailand would need to be increased to around 20 times its present level in order to 'catch up' with the intensity in Korea at that corresponding earlier stage of industrial development.

In order to maintain a leading edge in technology capability, industrially developed countries around the world have made use of a wide range of policy incentives and institutional structures to encourage technology learning and innovation in firms and publicly funded support institutions. Many countries have made use of taxation incentives, loans, grants and skills development schemes to maintain technological competitiveness in firms. The mechanisms for delivery and focus of incentives for technology development in different countries has varied; so too have their success. However, an important observation that that can be made is that incentive mechanisms have delivered maximum benefit when they have been carefully targeted and directed toward the critical technology thresholds faced by firms in the countries in which the policy instruments are introduced.

The Phase 1 study found that for firms in Thailand, at its present stage of technological development, the most important thresholds of technological capability that firms need to cross are *not* concerned with formally organised R&D but with other technology development and learning activities:

- For larger firms, they were about building design and engineering capabilities as a basis for starting significant technology development activities;
- For the majority of SMEs, especially in traditional industries, they were about increasing the efficiency with which existing technologies were acquired, used and operated.
- Only a few firms had the capability to move forward to R&D activities.

Overall, the study identified a need to build up *firm-based* innovative activities and capabilities, to encourage learning-based activities within, and collective effort among firms, to link with and exploit the technology development activities of MNCs and using policies on FDI to influence technological behaviour.

The study suggested that ***grant-based incentives***, if designed and applied appropriately, might be more effective in the Thai context than tax incentives, and recommended that two further issues should be thoroughly examined in order to improve existing grant-based schemes:

1. Whether and how a simple and flexible grant-based mechanism could be put in place to stimulate firms to undertake technology development activities involving forms of design and engineering work that would not meet the eligibility conditions of the existing R&D tax incentive system.

2. Whether and how a flexible grant-based mechanism could be established in order to assist firms invest in ***training and related capability building activities*** concerned with strengthening their human resources for design, engineering and R&D.

These two issues provide key questions for the present ('Phase 2') study. The overall objective is to investigate and identify ways to improve the incentive structure for stimulating industrial technology development by reviewing Thailand's fiscal incentive regime and providing recommendations on the design of more effective, flexible, grant-based mechanisms and supporting institutional and legal infrastructure.

The scope of the study is covered under the following terms of reference:

- Analysing and improving grant-based mechanisms to stimulate firms to undertake design and engineering activities;
- Analysing and devising grant-based mechanism to assist firms invest in 'learning intensive' training and related capability building activities; and
- Reshaping existing enabling laws and grant-providing institutions and/or establishing new ones.

1.2 Approach to the project

The first task for the present study was to carry out a review of international experiences with financial incentives for driving technology capability and learning in comparable countries. These experiences were then used to provide benchmark for the analysis of the Thai system and to develop a strategy for action to improve their performance in Thailand

A second and parallel task was to review the Thai system of incentives for enhancing technology capability. This part of the study was not an in-depth review of individual schemes and their management or effectiveness. Rather, it was a review of the schemes as a whole and how they compare with developments and experiences in the

internal context. The international benchmarks and a set of 'diagnostics', described in more detail below, was used as a framework for the review and analysis

1.3 Developments since the Phase 1 study

Two significant developments relevant to the present study have occurred since Phase 1 of the present study was completed. The first of these has been the drafting of legislation for *The Science and Technology Act* to provide a legal framework for S&T agencies (both private and public) for the implementation and coordination of S&T development. A major feature of the Bill, likely to go before parliament over the next year, is that it will broaden the scope of the National Science and Technology Policy Committee in the area of budgetary approval for S&T projects and establish the Office of National S&T Policy. The Office when it becomes established will be an autonomous agency providing advice on S&T planning and policy, human resource development for S&T, and a range of activities to promote research and development and technology transfer.

A second development, also with implication for the present study, has been the development of legislation for the *Thailand Skill Development Fund (SDF) Act*. The new Skill Development Fund when it comes into operation will apply a levy of up to 1 per cent of the payroll on firms that do not carry out 'adequate training' as determined by the Minister of Labour and Social Welfare. The levy is thus an incentive to encourage firms to carry out their own training either in-house in collaboration with training providers or externally through training providers. This latter development is important in the context of the present project because it will provide a potential new mechanism for providing training that is *in demand by firms* for raising the capacity to absorb new technology.

1.4 Outline of the report

Following this introductory section, the substance of the report is presented in three parts:

Chapter 2 of this report provides a summary of current international experiences with financial incentives for supporting technology development. The review identifies some important trends in public policy and an urgent need in Thailand to catch up with developments elsewhere in the region.

Chapter 3 presents an overview of current schemes and identifies some major issues and areas where the system as a whole could be made more effective.

The final chapter outlines a strategy and recommendations for improving the Thai system and bringing it more into line with the current technological challenges and opportunities facing Thailand today. It is recommended that this can be achieved through more strategic targeting of schemes to enable the incentive system to be more effective in stimulating technological learning and technology upgrading in Thai firms.

2. Financial Incentives for Enhancing Technology Capability: international experiences and trends

2.1 The challenge of industrial technology and innovation environments

The global industrial innovation environment of the 2000s is vastly different from that which predominated around two decades ago (the period in which science and technology policies in South-East Asia were attracting considerable interest and support from national governments). These differences have led to some new approaches for supporting innovation and technology development. Some particularly significant observations have contributed to these new approaches. They include the following.

- A recognition that there is little national economic benefit in strengthening knowledge producing and support institutions independently **from technology capacity building in wealth creating firms.** This has reinforced a growing trend among governments to focus explicitly on firms as the prime agents of innovation **supported by** specialist capabilities and technical services provided by public institutions.
- **The majority of important decisions within firms concerning what to produce and how to produce it are crucially influenced by the way in which the owners and managers of firms respond to the incentives available to them.** There has been a growing emphasis in most countries to design and introduce financial incentives to stimulate technology development in firms that can maximise the flow of technical skills and knowledge throughout (as well as beyond) the sector in which they are operating.
- A recognition that learning and technology acquisition is a **continuous, cumulative and incremental process.** Associated with this has been the need to bridge local, national and international knowledge and innovation systems, rather than focusing on developing an isolated national innovation system.
- A recognition of the importance of **industry clustering** in the process of collective acquisition of skills and the diffusion of technology among smaller firms. This has moved the policy focus away from single sectors and toward the identification of clusters of sectors and interacting firms and institutions and emphasised the salience of knowledge networks rather than simply technology itself in driving innovation.
- **Technological systems vary in character and extent** within national economies and consequently lead to different technological capabilities; In some regions there are particularly dynamic innovation environments where information and knowledge are rapidly diffused. This raises the capacity of firms and support institutions and reduces uncertainty and risk.
- While the globalisation of multi-national firms has progressed there has been a trend toward **increased localisation** of many decisions within these firms and an industrial reliance on **knowledge intensity** rather than capital or labour intensity.

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This changing environment has demanded new ways of 'thinking about' industrial technology policy in the context of a 'global knowledge economy'. They imply new ways of formulating and implementing policies for raising and diffusing technological

capability and for overcoming barriers within firms to technology upgrading. Responses to these demands from the more advanced industrialising countries in Asia has been to move toward the introduction of financial incentives for supporting technology learning, development and diffusion through firms - ***as the key agents driving technology development*** - rather than through the provision of services provided through public institutions. The rationale has not been simply to provide financial assistance to firms to upgrade their technological capabilities.. It has been to generate an environment in which technological learning becomes a necessity for firms right along the value chain. Thus, an increasingly rich array of policy instruments and mechanisms have been focused on stimulating demand for technology development in firms rather than simply supplying capacity building services through public institutions.

This has not meant that public institutes become less relevant - rather, ***it has meant that they become more relevant***. This is because their services and support structures can be more effective with the introduction of new measures to strengthen the demand for technology within firms and their capacity to absorb, use and diffuse technology.

This policy transition can be described as moving toward:

(a) **an enterprise-based system** of financial incentives for enhancing industrial technology capabilities; and
(b) **a dual system** of incentives that strengthens support institutions in parallel with the capacity of industrial firms to build on that support and engage in technology learning and development.
(c) This has given rise to a third policy emphasis concerned to build closer interaction and **mutual interdependence** between the enterprise system and the support institutions.

Thailand has lagged behind in making this transition and as a consequence is behind many other Asian economies in terms of building up industrial technological capability within firms. This is in spite of concerted efforts of government over the past two decades to develop an appropriate infrastructure to support science and technology for industrial development. Evidence from other countries and different sectors have demonstrated that firms in newly industrialising countries can begin in the middle of the innovation cycle and catch up to global competitors.

In many cases clearly targeted policies have been extremely successful in enabling firms to cross critical technology thresholds. The experiences of countries such as Singapore, Korea and Hong Kong show that followers don't always have to be laggards. However, the evidence also shows that the 'latecomers' and their governments must go through a series of difficult technology development transitions.

Economies, such as Chinese Taipei, the Republic of Korea, Singapore and Malaysia have, in contrast to Thailand, been far more effective in 'capturing' technological capability and **diffusing** this capability, through people and the firms in which they work, for the benefit of their economies and their societies more generally. The policy environment over which their governments have influence has been a vital factor in their success.

The following brief stories illustrate the different ways that economies can turn policies toward achieving technological goals, but in quite different ways according to their different levels of technology capability and the prevailing industrial and institutional infrastructure. Malaysia (Exhibit 1) and Singapore (Exhibit 3) illustrate strategies that have focused on the role of MNCs and their supply chains, especially in Singapore. Hong Kong (Exhibit 2) illustrates a *laissez faire* policy which is now being augmented by government support for the scientific and knowledge infrastructure. South Korea (Exhibit 4) is a case where policy has been strongly directed by government through conglomerations of local firms.

Some valuable underlying lessons for Thailand, in its present phase of industrial development, can be drawn from these cases. The first concerns the need to have a **flexible system** capable of responding to changing technological demands as global and local technological and business environments change. This generally results in a rich variety of schemes that has the capability to evolve over time and explicitly capture the externalities and spillover benefits inherent in skill and technology development activities. A second concerns the need to **coordinate the promotion and delivery of incentives** in order that they can ***collectively*** **contribute** toward stimulating and supporting firms to cross critical technology thresholds that will maximise impact. Thirdly, the cases vividly illustrate that technology development and diffusion can be maximised by **targeting incentives toward groups of firms that include large and small operators** along the value chain. Flows of technology, skills and knowledge can be leveraged by carefully targeting incentives toward different groups of firms and institutions and in particular by drawing larger firms more centrally into the diffusion process. A fourth and salient lesson is that most countries are already aggressively promoting the development of technology-based clusters and networks through targeted financial incentives. Unless countries such as Thailand also make such investments they will become more peripheral to the centres of dynamic productive activity that are currently driving industrial innovation in the region.

Exhibit 1: **Malaysia – the search for spillovers**

Since Malaysia achieved independence in the 1960s, the role of technology in development policy has evolved greatly. In particular, in the mid 1980s, the government embarked on a large-scale program to promote industrialisation through technological development in targeted industries. As a result of dissatisfaction with the failure to date of investments by MNCs to provide substantial spillovers, public R&D expenditures were centralised in the Fifth Malaysia Plan of 1986-90 and the Intensification of Research in Priority Areas programme of 1986. Increased private sector input was provided as a result of the Action Plan for Industrial Technology Development (1990).

Although government spending on R&D more than doubled between 1986 and 1995 and public sector technology institutes expanded greatly, a feeling arose that activities had become excessively centralised and bureaucratised and that, as a result, they were not sufficiently efficient in meeting industrial needs. To counteract these tendencies and to harness technological dynamism in the private sector, from 1993 government policy took a new direction. In order to encourage the creation of industrial clusters, the Malaysian government sought increasingly to gain spillovers from MNCs operating locally. In a policy similar to Singapore's, the government has tried to promote technological advance in indigenous firms that belong to subcontracting networks centred on foreign firms (largely from Japan or East Asian NICs) with manufacturing operations in Malaysia.

Through *keiretsu*-like structures, small local firms are meant to gain resources to upgrade their technological skills and reduce Malaysia's high level of dependence on labour-intensive operations. A cluster in Penang, built on disk-drive firms that had migrated from Singapore, has been viewed as especially successful. A more recent phenomenon, the Multimedia Super Corridor, is currently receiving large funding from the Malaysian government in order to generate another private-public cluster.

Although it is too early to evaluate these initiatives fully, there are concerns that, in reality, the spillovers from MNCs to indigenous firms are less than had been hoped. Moreover, the thinness of the local pool of skilled and educated labour may create a bottleneck to further rapid development if MNCs capture the bulk of the skilled workforce and, as a consequence, crowd out locally-based firms that wish to participate in technological upgrading. This had led to calls for an immediate and substantial growth in the infrastructure devoted to training and education.

***Exhibit 2:* Hong Kong – development with low levels of government direction**

From the 1960s onwards, the Hong Kong economy developed rapidly as measured in terms of per capita GDP. This was accomplished with very little government intervention, especially in the manufacturing sector.

After the late 1970s, the government began to direct more attention to the micro-economy. For example, in 1982, the Industrial Development Board was establish. Alongside the Board have been other groups such as the Hong Kong Productivity Council. Even when taken together, however, their activities are still very modest by the standards of most other countries. Instead, generalised incentives including comparatively low rates of corporate and government taxation have continued to feature prominently in development policy.

Despite the prosperity that Hong Kong has achieved, the policy has had mixed results from a technological point of view. The manufacturing sector in Hong Kong is still concentrated largely in low-technology industries such as textiles. As both labour and land costs in Hong Kong have increased, locally based manufacturing activities have been priced out of the market to a substantial extent. Instead, a number of Hong Kong concerns have become 'hollow' firms, which maintain their administrative and development activities in Hong Kong but have transferred their factories further afield, primarily into adjacent parts of China.

On the other hand, there has been substantial upgrading in the consumer electronics industry as a number of Hong Kong firms have switched from sole reliance on OEM contracts to introduce their own brand names for export. These firms often have technical departments in which they develop features to make their goods more attractive to customers.

Exhibit 3: Singapore – technology transfer by TNCs

In contrast to Hong Kong's reliance on locally-owned firms that acted as OEMs, Singapore encouraged foreign companies to set up operations and to use Singapore as an export base for third markets. In the words of Lee Kuan Yew (1976, quoted in Chiu, *et al.*, 1997, 127-128);

'From 1965, when Singapore became independent on her own, we have had to constantly review and revise our policies. The fundamental issue was how were we to make a living as a nation on our own. We have found one answer to this in rapid industrialization, encouraging industrialists of the advanced countries to export not manufactured goods to Singapore for re-export, but their factories, technological management expertise and marketing know-how.

Despite the growing share of TNCs, the government became concerned about long-term prospects in the late 1970s and 1980s. Worries centred on a number of factors including rising wages and land prices, relatively low productivity growth, increased European and American resistance to imports of textiles and garments, and the need to maintain a strong Singapore dollar in order to bolster the important financial services sector. The government, therefore, industries with higher rates of productivity growth and greater long-term potential than some current industries. To free up labour, the government decreed wage increases higher than could be justified by traditional levels of productivity increase in sectors such as textiles and garment manufacturing. Given the relative technological backwardness of locally-owned firms, therefore, the government encouragement of technology upgrading and restructuring involved further emphasis on the recruitment of TNCs in appropriate industries.

Branches of electronics such as semi-conductor manufacturing and software have benefited from government policy, which explicitly targets sectors seen as strategic to the local economy. In addition to encouragement of investment by foreign firms, policy has also been directed towards modernization of the indigenous sector through the Local Industry Upgrading Programme, which is intended to increase the rate of technology transfer to locally-owned firms. A further arm of technology policy is the National Science and Technology Board (NSTB), which was established in 1991 to generate a world-class technology base in selected sectors. Among other activities, the NSTB sponsors and coordinates government research institutes.

Exhibit 4: Korea – centralised direction in technological change

As Korea evolved from a very poor country in the late 1950s to one of substantial prosperity in the 1990s, its policies towards the encouragement of technological change have also evolved. In the 1970s, Korean policy emphasized the maintenance of management control in Korean hands. As a result, neither Foreign Direct Investment nor licensing of foreign technologies were highly approved by the government. Instead, technology policy revolved around reverse engineering and imports of foreign-made capital goods, financed for the most part by borrowing funds from abroad. Through reverse engineering, Korean firms (many of them large, diversified *chaebol* that could achieve economies of scale) were able to develop skills internally, although this worked only for mature industries in which intellectual property was widely available. Both industries and firms were selectively targeted by government technocrats, but management competence was insisted upon as *chaebols* could easily lose government support if they did not use their resources efficiently. Education and training received high levels of government support, but these were matched by very high levels of private support as students and their parents willingly invested their own funds in educational endeavours.

Subsequently, as Korea has moved beyond its reliance on mature industries, government policy has shifted more to the acquisition of cutting-edge knowledge and the development of indigenous capabilities. As foreign firms have often been unwilling to surrender their competitive advantage by licensing the most up-to-date knowledge, this has forced Koreans to engage in their own advanced R&D in order to continue technological upgrading. The government has supported this upgrading through its Industrial Generic Technology Development Project, National R&D Project, and Highly Advanced National R&D Project. The latter, also known at the G-7 Project, is intended to raise Korea's technological capabilities to a par with those of the G-7 countries by 2020.

Much of the funding for these projects is channeled through Government Research Institutes (GRIs) that aim to build in-depth technological capabilities in designated industries. R&D by private firms is also emphasized, and there is a concentration of both GRIs and private R&D facilities in Taedok Science Town (although not one that meets world standards). Since 1980 the government has also increased its efforts to promote technological upgrading by SMEs.

While Korea's centrally-directed technology policy coincided with enormous growth in its early decades (the high period of what Chalmers Johnson has termed 'the developmental state' in relation to Japan), Kim (2000) has blamed some of Korea's more recent troubles on excessive centralisation in the hands of bureaucrats who are no longer in touch with modern needs. As a result, he contends that the National Innovation System Korea has become too rigid and should be reformed. One message that could be drawn from Korea's experience is that, although centralisation of innovation policy may work well in a relatively small economy whose efforts are based on the assimilation of knowledge concerning mature industries, centralisation becomes less appropriate as technological complexity increases.

2.2 Financial incentives for technology development and innovation in firms: *Why and how?*

The economic rationale for public financial support for R&D and technology development and innovation *within firms* relies on arguments of ***'market failure'*** flowing from particular characteristics of these activities.[1] There is also a strong case for public support to overcome ***'system failure'*** in terms of deficiencies in the broader system of innovation and knowledge institutions and infrastructure of the country by comparison with competitor economies. Both arguments can be applied to Thailand.

The rationale for introducing publicly funded incentives is based on achieving ***broad social benefit,*** not on providing benefits for individual firms (although these may also occur) and the recognition that without subsidies social benefit will not be realised because of 'market failure'. Two forms of market failure are recognised:

- *Externalities and spillovers*: Private firms operating under market conditions under-invest in technology development relative to the level that would be socially desirable. This is because of the difficulty of appropriating the benefits of knowledge and because of spillovers of the benefits of new technology (such as higher quality products, or lower prices to consumers). Government's role is to stimulate higher levels of investment up to the point where the marginal cost equals the marginal social return.

[1] This summary is taken from the Phase 1 report (pp. 73-5).

- *Other market imperfections*: Uncertainty and risk in technology investment *per se*, and compared with other kinds of investment may lead companies to be over-cautious and invest less than is perhaps justified by the potential *private* return.

The second form of market failure is magnified in the case of industrialising countries like Thailand. Here, firms are less likely than firms in industrialised countries to be experienced in assessing the costs and future private returns from their investment in technology. Further, they face greater difficulty in gaining access to the necessary skills and resources at a predictable cost. This makes technological learning more complex, and the activity of innovation more risky than in 'experienced' firms in industrialised countries.

Economists also recognise that the particular source of the 'innovation market failure' varies with the type of innovation (diffusion of existing technology, incremental improvement, radical science-based technology) and that each requires a different policy response (Martin and Scott, 2000).

The case for providing public support for technology development and innovation within firms because of 'system failure' recognises that many of the 'building blocks' of the innovation system are missing or poorly developed and a practical policy requires government to create them. The rationale for policy action in this case is put forward by Keith Smith, who argues that market based systems:

> …not only suffer from an under-supply of knowledge, but are like to actually generate areas of systematically weak performance. These areas of 'systemic failure' may call for actions contrary to conditions of perfect competition, for example, cooperation and collaboration between firms to facilitate knowledge flows, government regulation and the creation of incentives. (Smith, 1998: p. 41).

Four categories of 'system failure' have been identified: ***failures in infrastructure provision and investment*** (both physical infrastructures like telecommunications and 'knowledge' infrastructures like technical institutes and regulatory bodies***); transition failures*** (e.g. difficulties that firms have in adapting to technological change***); 'lock-in' failures*** (caused by the difficulty of discarding existing techno-economic systems); and ***institutional failures*** (regulatory and intellectual property framework, corporate law etc).

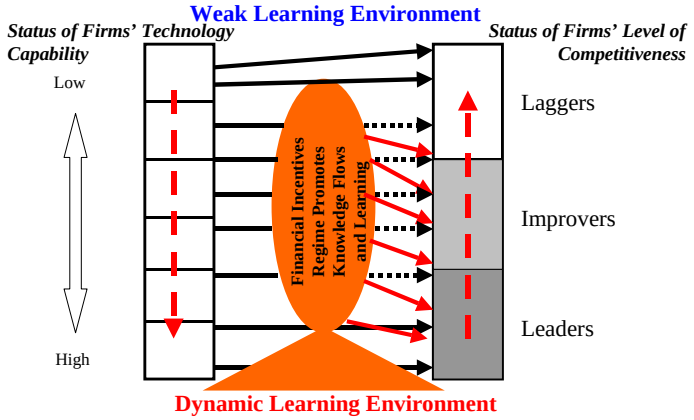
In addition to these arguments for public intervention there is also the pragmatic argument that, for whatever reason, other countries – industrial and industrialising countries that Thailand is in competition with –have accepted the above arguments for intervention both for the 'system' and for firms.. They are providing incentives for technology development and learning within firms, and businesses. Thailand will be further disadvantaged if the Government does not match the incentives available elsewhere.[2]

[2] The Phase 1 report went further in finding that opposition to financing these activities in firms *was a fundamental obstacle* to strengthening technology development within enterprises.

Finally, international experiences have demonstrated the broader public good that can be achieved through policies and public interventions that stimulate technology learning environments built around clusters or networks of firms and national support institutions. Financial incentives that build knowledge flows through firms engaged at different levels through the value chain serve to benefit all firms in the chain, not just the initial or direct beneficiaries of incentives. An important observation is that the financial incentives can serve as a mediating influence to enhance a flow of knowledge between firms that are closer to a leading technological edge through to those firms where technological skills are lagging. This is illustrated in Exhibit 5 below.

Exhibit 5:

Financial Incentives for Technology Development:
Adjusting the Learning Environment



International experience shows that the new global environment demands a dual approach to supporting technology development and innovation. There is a need for programs and initiatives that strengthen support institutions while at the same time supporting the capacity of industrial firms to build on that support and engage in technology learning and development. Policy makers must recognise that wealth is created by applying knowledge and not simply generating new knowledge.

Each side of this dual approach demands a different set of incentive mechanisms. The success of the incentives in generating the maximum possible social benefit depends on achieving integration and ***coordination between the two approaches***. Unless firms have the capacity to make use of and build on the technological resources available through support institutions, investments in support institutions will return minimal socio-economic benefit. Similarly, the technological services available through support institutions will carry little benefit for firms if they are not directed or aligned with firms' current technology and market capabilities - firms have no option but to start from where they are. Many countries in the region have crossed critical technology thresholds not by providing additional support through public support institutions but by turning attention to incentives to encourage firms to make use of existing support mechanisms.

2.3 Financial incentives for building capability in firms: *investing in the future*

There are advantages and disadvantages inherent in different forms of incentive – tax concessions, loans, and grants – as summarised in Table A1, Attachment 1. However, it is quite possible to design tax incentive and grant schemes that both operate in essentially the same way. Although tax concessions are commonly more 'horizontal' than grants or loans, there is no particular reason why grant schemes have to be more 'selective' than tax incentives.[3] This leads many countries to offer a carefully integrated portfolio of financial incentives, each with different targets in term of the eligible activities supported and the class of firms or industries eligible to receive them.

Within firms, technological capabilities can be thought of as three interlocking sets of competencies: production capability (management and engineering); project execution (feasibility, training, execution); and innovation capability (Table A2, Attachment 1); or more succinctly as 'the skills, technical knowledge and organisational coherence required to make industrial technologies function in an enterprise'.[4] Technological capability is perhaps revealed most clearly when firms are faced with the need to innovate, to *change* their products, their processes or their technological organisation.

Firms in developing economies (indeed, innovating firms in all economies) generally **need to strengthen all three types of capabilities**. As a rule, however, it is not feasible for firms in developing economies to achieve capabilities at the highest levels because they are not in a position to operate at the cutting edge of technology. In addition, substantial gains in per capita income may be attained simply by switching from low-productivity, labour intensive activities to ones that involve somewhat higher degrees of capital intensity and workforce skill. Examples drawn from Singapore and Malaysia and presented in Attachment 3 offer some good examples of effective skills development programs.

While it is possible for firms from developing economies to generate high-technology knowledge and skills eventually, as in the Korean semiconductor industry, this is time-consuming and is not achieved in one large jump.[5] Instead, firms in LDCs generally begin to improve their relative positions by entering mature industries in which technologies are more highly codified and proprietary knowledge is no longer closely held.[6] An important role of governments in LDCs, therefore, is to help firms to gain the range of capabilities (knowledge) that they need to function at intermediate levels of technological sophistication, at which codified knowledge is already widely available.

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[3] See the Phase 1 report, p. 82.

[4] Lall, 2000: p 29 "Technological Change and Industrialization in the Asian Newly Industrializing Economies: Achievements and Challenges", in Linsu Kim and Richard R. Nelson, eds., *Technology, Learning, and Innovation: Experiences of Newly Industrializing Economies* (Cambridge: Cambridge University Press), 13-68.

[5] Kim, 1997 *Imitation to Innovation: The Dynamics of Korea's Technological Learning* (Boston: Harvard Business School Press).

[6] Amsden, 2001 *The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies* (New York: Oxford University Press).

With a few exceptions, firms in developing economies do not have the resources they need to upgrade their process and product technologies, especially over a reasonable period of time. In particular, SMEs (the backbone of most economies whether developing or developed) lack both the knowledge required to make informed decisions and the financial resources to acquire that knowledge and to invest in new technologies once they have traced out a reasonable strategy. In countries with low per capita incomes, governments offer the best (and perhaps also the most equitable) prospects for concentrating the funds needed to surmount these barriers. In contrast to private-sector firms, governments have taxation powers and an ability to provide employment opportunities for educated people to create centralised reservoirs of technological knowledge. These reservoirs can then be tapped by private firms without severe and unnecessarily duplicative search costs.

Public resources are limited, and because resources are scarce, governments have an obligation to spend money as wisely as they can – which means that they need to establish priorities in helping private firms. From this it follows that, as private firms need help in making informed decisions on investments in technology. Scattergun approaches to distributing grants are wasteful because not all firms are equally worthy of receiving funds. Therefore, governments must develop criteria ('targets') for selecting the candidates that are most likely to offer substantial social returns to any grants handed out.

A key conclusion from recent studies is that most science and technology incentives are strongly context- (or country-) dependent. Policies and initiatives must be geared to the scientific and technological 'endowments' of each country, and to their government and business capabilities at particular points in time. Therefore government initiatives – like financial incentives - evolve over time as national capabilities change. Japan and Korea provide vivid examples of how S&T policies and initiatives have evolved in this way. Before borrowing from the experience of others in relation to specific incentives, Thailand would be well advised to analyse carefully the particular features of the mentor country's 'national innovation system' that firstly prompted the initiative, and secondly led to its success or positive impact.[7]

2.4 Targeting incentives: *local firms*

Locally-owned firms in developing economies are generally less mobile. For the most part, they have not developed foreign operations and do not need to think in terms of maximising returns across an international portfolio of assets. Hence, their time horizons in regard to investments in the home economies may be substantially longer than the time horizons of MNCs seeking low factor costs in an unstable international climate. Any investments made in the education and training of their workforces are therefore likely to remain within the country and be available for other uses no matter what happens to their current employers.

[7] Garrett-Jones, 2000, *National Science and Technology Initiatives for ESCWA Member Countries: Lessons from the South and East Asian Region,* Commissioned paper prepared for the:Technology Section Sectoral Issues Policy Division (SIPD) United Nations Economic and Social Commission for Western Asia (UNESCWA), Beirut, Lebanon, October 2000.

Incentives offered to locally-based firms are more effective when they involve a mixture of generalised and targeted policies. This is because generalised grants (for example, better provisions of educational facilities or training programs) by themselves will not generate enough spillovers to the economy at large. Some aspects of the need for generalised government action are uncontroversial and are common in OECD member countries as well as in NIEs and LDCs. A well-functioning education system that promotes basic literacy and numeracy is a *sine-qua-non* for economic development and increased technological sophistication. Similarly, good provision of tertiary education facilities, especially in technical fields, is needed to provide the absorptive capacity that a developing economy needs.[8] Subsidised training courses for apprentices can provide accelerated assimilation of new technologies on the shop floor. Other generalised incentives such as export facilitation schemes and tax concessions for R&D activities are also widely-used and effective for those firms that are already at a comparatively higher level of technological capability. .

Firms in developing economies (usually SMEs) generally lack the intellectual assets to make informed decisions on knowledge-based inputs, and if they also lack the resources needed to acquire those intellectual assets, then there seem to be only two ways forward.

The first is through pure reliance on market-based mechanisms in which a few firms succeed through their own initiative (and perhaps some good luck) in upgrading their technological capabilities despite the barriers that they face. The mechanisms and pathways for getting the process under way are usually not clear. Guides as to how firms can gain the assets to finance their initial searches, learn to negotiate deals for the licensing of technologies, whom to contact for negotiations, and so on are often unavailable to the managers of SMEs in developing economies. In the absence of efficient markets, the process depends on having enough capital and knowledge (somehow) accumulated in the hands of private individuals or firms with sufficient expertise to make informed decisions. The diffusion of such knowledge relies on the efforts of others who (somehow) have acquired enough capital and knowledge to enter the game as followers. Even if successful, this could be a very lengthy procedure.

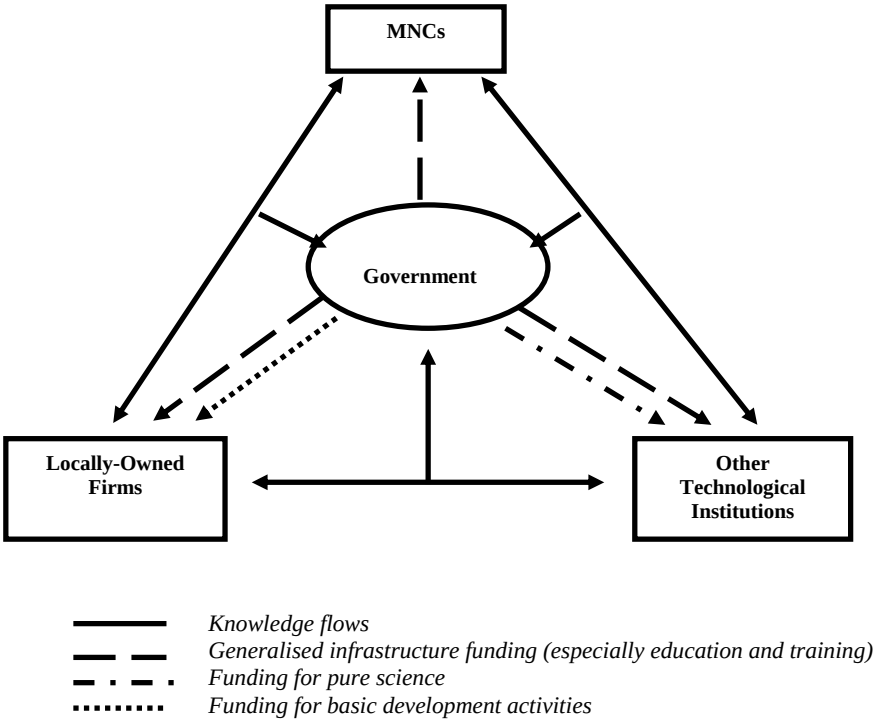
The second approach, and one which has been more successful in the globalised environment, is to make use of the ability of national governments to concentrate financial and human resources in order to create a pool of resources to complement (not to replace) the resources in the hands of firms. The combined resources in the hands of firms and governments can then be used for technological upgrading. Thus, while private incentives for efficiency and effectiveness remain, access to requisite start-up resources are more readily and more quickly available than through unaided market-based mechanisms. This approach is illustrated in Exhibit 6.

The range and levels of grants open to locally-owned firms in industrially developing economies is much greater. Not only are locally-owned companies themselves taxpayers but, because their roots are deeper than those of MNCs, local spillovers

[8] Universal provision of tertiary education is of course desirable, but a base of well-educated technologists is also needed to take advantage of the opportunities available to developing economies. In other cases, scarce resources could be better allocated to providing high-level secondary training in technical fields and supporting apprenticeship and other training programs.

from grants are more likely and leakages and wastage are less likely. Nevertheless, grants for pure research in countries such as Thailand are not usually offered to locally-owned firms because, at this stage of their development, in common with MNCs, their activities would be concentrated in mature industries. As a result, they would be able to take advantage of foreign advances through licensing, joint ventures or spillovers. On the other hand, for locally-owned firms, some grants can be extremely valuable for promoting basic development activities. In order to make eventual progress up the technological ladder,[9] locally-owned firms generally move from heavy reliance on OEM status to the establishment of independent brands, where competitive success depends on improved process efficiencies and the development of attractive product features that are associated with the emerging brand image.[10]

Exhibit 6: **The Role of Government in Supporting Flows of Knowledge and Funding**



2.5 Targeting incentives: *multinational corporations*

In the case of multinational corporations, the types and amounts of government incentives offered in developing economies are usually more limited. These firms are

[9] Say, to follow a path similar to the one taken by the Korean semiconductor industry as described in Kim (1997*) op cit.*

[10] As has happened, for example, in the course of development of many Hong Kong firms as they developed from OEMs to MNCs in their own right. SeeYu, (1997), *Entrepreneurship and Economic Development in Hong Kong* (London: Routledge).

assumed to produce goods, and sometimes services, at the mature end of the product life cycle. Their operations in developing economies are usually restricted to using known technologies to turn out standardised goods. Moreover, most MNCs already have research establishments in developed countries, with substantial capital investments and good access to trained scientists and engineers.

However, as **the presence of MNCs can be useful in promoting technology transfer**, employment and export earnings, governments in developing economies need to provide good public infrastructure. In the context of technological change, this translates into making sure that the local workforce is sufficiently well-educated and trained in order to participate efficiently in technological upgrades. Modest grants for firm-level training can be justified for MNCs if the skills learned are largely transferable to other uses. Small development grants can also be used to assist in adapting the products and processes of MNCs to local needs. To qualify for funding, an MNC would have to be deemed a 'good citizen', responsive to the needs of the developing nation, as well as to meet a number of criteria including the introduction of a technology that is both more sophisticated than the norm in the country and likely to foster technological upgrading in other firms and industries, including suppliers of OEM equipment.

2.6 Targeting incentives: *institutional support structures*

A range of institutions need to be supported to enable private firms to succeed. These institutions include universities, trade schools, and government research institutes (GRIs) serving particular industries. As firms operating in developing economies are unlikely to be in the technological forefront, they, and government departments, need access to highly trained personnel with up-to-date knowledge of international technological trends. Otherwise, the ability of firms and departments to engage in the next stage of technological improvement will be impaired because of a lack of absorptive capacity. Therefore, these institutions must operate at high scientific and technical levels to lay the basis for subsequent improvements in the private sector – by training scientists and engineers for private and government employment who are capable of grasping and acting on the implications of constant improvements in technological knowledge.

For a grants system to be effective, these institutions should meet stringent criteria. Universities, for example, should continually modernise their courses of study to meet evolving needs. They should consult carefully with private firms and with government research institutes when drawing up curricula so that their standards are not too inward-looking or without reference to commercial usefulness. Similarly, the GRIs should develop a perspective for commercial usefulness. Grants offered on a contestable basis and cooperative basis to institutions provide a good mechanism for maximising impact and cooperation between large and small firms and between GRIs and private firms. Collaborative *obligation* helps ensure cross-fertilisation between new technological knowledge and evolving commercial opportunities.

2.7 International practice at the program level

Table A2 (Attachment 1) provides a series of examples of specific financial incentives programs used in selected European, Asian and Australasian countries. The table classifies the objectives of the incentives as follows:[11]

(A) Assistance targeted at individual firms:

- strategic capabilities (awareness of the technological and business environment);
- management of tangible technological resources (products, equipment, design);
- management of intangible technological resources (knowledge, skills and training);
- organisational structures and assets; and
- linkage and networking capabilities (ability to access external knowledge, to manage user-producer relations, to form alliances with partners).

(B) Assistance targeted at groups of firms and technology organisations:

- linkage and networking capabilities.

While the objectives themselves are fairly clear and discrete, it must be noted immediately that many programs, if not the majority, target several or many objectives.

While our brief is to devise more effective grant-based incentives for industrial technology capability-building and training, we consider it vitally important to consider the place of such incentives in the national strategy. Any selection of incentives should consider firstly the overall national strategy that they are intended to support, secondly the sectors and/or firms/organisations to be targeted for the initiative, and *only lastly* the specific form of the incentive to be used.

In other words we believe that incentives should be chosen on the basis of their effectiveness in meeting goals of acknowledged importance, rather than choosing the goals to be pursued on the basis of the political attractiveness of the incentives required to achieve them.

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[11] This is a slight modification of the classification scheme used in the Phase 1 report.

3. Review of Financial Incentives for Supporting Technology and Skills Development in Thailand

3.1 Introduction

The observations and findings expressed in Phase 1 of the study have been reinforced through the present review of financial incentives for industrial technology development. That is, that a well targeted and coordinated set of financial incentives for technology and skills enhancement are required to stimulate and assist firms to cross the critical technology thresholds that they currently face in Thailand. It is vital that firms make this transition in order to achieve sufficient industrial competitiveness.

For government policy, the challenge is to achieve an appropriate portfolio of incentives that takes account of current weaknesses in the technological capabilities of Thai manufacturing firms, of the commercial and technology markets they operate within, and the full range of players in the Thai innovation system.

In the light of experiences in other countries the range of incentives likely to be required includes:

- generalised incentives (such as provision of basic training and technical education for the work force);
- targeted incentives (such as for acquisition of technological knowledge from overseas or negotiating with technology suppliers);
- incentives for R&D;
- incentives for basic technology development (e.g. to achieve OEM qualification or progress to own-brand products);
- incentives for specific technology development (to develop or adapt specific products for Thai-served markets);
- incentives for skills development appropriate for absorbing, adapting and generally engaging in such technology development
- links between steps in the incentive system so firms can progress from crossing basic technology thresholds to more complex thresholds; and
- incentives to promote collaboration and knowledge-based cluster formation between small and large firms and between firms and support institutions.

This chapter summarises the present status of financial incentives for stimulating technology development in Thai firms, identifies some important gaps and provides a framework for some revisions to the system. The final chapter outlines the revised strategy and offers recommendations for meeting the present challenge.

3.2 Reviewing the current incentive system

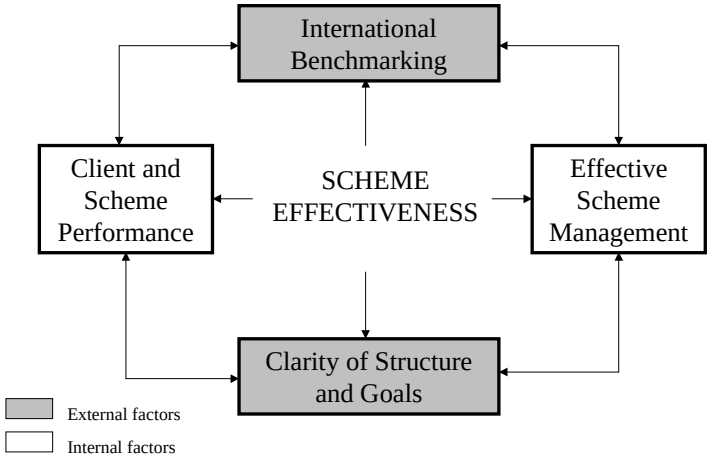
In order to review the current system of incentives the project team carried out two major exercises. The first was to review experiences in other countries and identify some benchmarks for good and effective practice for stimulating and assisting firms to cross technology thresholds. Major observations from this analysis were introduced in the previous chapter. At a more micro-level the review provided some base-line

comparisons and benchmarks for developing, administering and evaluating flexible grant-based incentive schemes. It is against this backdrop of overseas experiences that we carried out the second exercise - a review of the current Thai incentive system.

A set of key questions guided the review. It is important to recognise, however, that the purpose was not to review in detail the impact, operations and effectiveness of individual schemes but rather to review the collection of schemes as a system and the extent to which they collectively contribute to an overall objective. That is, we were concerned to identify strengths and weaknesses in the extent of coverage of the schemes as a whole and the extent to which clarity and structure of schemes contributed to the system as a whole. We were also concerned to identify gaps in their coverage, given the current state of technology capability in Thai firms. The objective of this analysis was to identify ways that the system as a whole might be adjusted to improve flexibility and to respond to the critical technology thresholds currently inhibiting international competitiveness. The analysis was based on a series of interviews and group discussions with agencies involved with administering the current schemes and a review of available documentation on the schemes. Exhibit 7 illustrates the approach taken by the team. Attachment 2 presents the analytical framework that guided the interviews and discussions.

Exhibit 7:

Incentive Scheme 'Diagnostics'



The following section briefly describes the current Thai incentives system. These are discussed below on the basis of portfolio management responsibility. While it is necessary to discuss these schemes separately there are two points that should be noted. Firstly, in practice, firms themselves are not concerned with such portfolio distinctions, rather, they are simply concerned with getting on with their daily business challenges. Indeed it is precisely these administrative distinctions that often inhibit the success of schemes. Secondly, the distinction between schemes that support training, design and engineering, research and development are often immaterial to firm based technological learning. Our final analysis therefore is

focused on identifying ways to enhance the system as a whole, rather than simply individual schemes, or the administration of specific schemes.

While there are many good aspects of current practices, for the Thai incentives as a whole, the diagnostics also reveal a number of shortcomings.

1. Clarity of structure and goals - There is an overlap between some schemes and while training schemes are sometimes linked to technology development within agencies, there are comparatively weak connection between training and technology development offered through other agencies.

2. Effective scheme management - Monitoring and evaluation is variable across schemes and there is rather weak systematic coordination across schemes for this purpose. Coordination in scheme promotion and delivery is also weak.

3. International benchmarking - Given Thailand's current state of industrial development there is a surprisingly high emphasis on R&D compared to enhancing basic engineering and design capabilities. These leaves significant gaps for firms struggling to develop their capacity at lower levels of technology threshold a critical target in the Thai industrial context.

4. Client and scheme performance - Definitions of eligibility are sometimes variable and lead to confusion and limited uptake among smaller firms. While some schemes are focusing on supporting groups of firms many of the schemes could be more specifically promoting links between large and small firms.

3.3 Assessment of current schemes

Skills Development and Training

Thai companies face critical shortages of high quality engineers and in specific skills like tool-and-die making. In Thailand, almost forty percent of manufacturing establishments provide formal skills training to some members of their workforce, either within the firm in in-house training programs, or in courses given by external training providers. The incidence of in-service formal training in Thai manufacturing appears to be as high as that in Malaysia, and higher than those in other developing countries with lower average per capita incomes where broadly comparable training data are available.[12] However, the distribution of employer-provided formal training is very uneven, with the incidence of training is particularly low among SMEs. Nor is training focused on innovation. In the 2000 innovation survey, three-quarters of medium-large companies surveyed had undertaken no innovation activities, including relevant training.

Thailand is in the process of formulating a new Skills Development Act and associated Fund. The new Skill Development Act makes provision for pre-employment training, re-skilling on change of occupation, setting national skills

[12] Hong Tan and John Middleton, *Demand-Side Training in Thailand*, World Bank Institute, m/s, n.d.

standards and accreditation, and tax relief for training organisations and firms. The Act will also establish a restructured Skill Development Fund (SDF) to pool government and employers' contributions, donor funds and income, in order to provide loans to trainees and training organisers. Employers will contribute to the SDF only if they are unable to arrange the necessary training for themselves. The objective is to improve both the skills of workers and of the trainers, particularly for in-house training. However, the detail of the SDF remains to be revealed, and much rides on its administrative implementation.

Experience in Singapore (Exhibit 9, Attachment 3) and Malaysia (Exhibit 10, Attachment 3) and elsewhere suggests that successful SDFs share a range of characteristics.[13]

- They are ***joint endeavours between government, industry and training providers***, sustained by industry and government funding and with very strong industry involvement in, or control of, their management.
- They ***engage a wide range of training providers***: public sector organisations, in-house firm trainers, private trainers, and expert consultants.
- They tend to provide grants to the trainee firms and loans to the training providers. ***The overriding philosophy is one of 'firms accessing their own contributions' in the fund.***
- The scope of training schemes supported by Funds is also wide ranging from basic literacy to technical, craft, and managerial skills. On the other hand, some component schemes are narrowly targeted towards particular types of firm, industries or technologies.
- Recognising that the training 'industry' itself may be weak, ***a crucial element is the support for the development of training providers: through accreditation, promulgation and application of standards, and financial assistance for training infrastructure.***
- A further critical element is the support that successful SDFs provide for skills planning and the development of training strategy within firms; and for ***cooperation in training between firms, and within industries, employer groups and geographical regions***.

The Skills Development Act is a welcome step in this direction but careful implementation will be a crucial factor if it is to produce best outcomes. Concerns expressed at the December 2001 workshop about the new Thai SDF proposal therefore rested on its scope and implementation, not on the legislation itself. Issues raised at that workshop included the following.

- Imposing a levy only on the firms that have no training activities might ignore firms that had the budget but not the expertise to implement a training strategy. The scheme must encourage learning from other firms. To maximise this, large companies and MNCs should be involved in the scheme in some way.

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[13] Hong Tan, *Do Training Levies Work? Malaysia's HRDF and Its Effects on Training and Firm-Level Productivity*, Working Paper, World Bank Institute, July 2001; A. Dar, S.; Canagarajah and P. Murphy, *Training Levies: Rationale and Evidence from Evaluations*, draft m/s, Nov. 2001; S. Garrett-Jones, *Government Incentives for Technological Skills Development*, paper presented to 'Skills Development Fund Seminar', Dept. of Skill Development, Bangkok, 19 Dec. 2001.

- The public sector and the bureaucracy should not be the sole 'drivers' of the SDF. Strong employer representation including the establishment of working committee(s) from particular industrial sectors are likely to provide a critical success factor.
- Integration of public sector training will be highly desirable (e.g. vocational and university education) as well as substantial involvement of the private sector. The SDF should therefore provide incentives to encourage the 'training service industry' to expand its activities and to improve its quality, rather than simply acting as an industry watchdog. In Korea, an intrusive 'regulatory' approach to firm level training and eligibility skills standards had proven counterproductive and failed to produce any increase in training activity by firms.[14]

Given the pending introduction of the new Skills Development Act and the need to ensure subsequent implementation is well aligned with other financial incentives for enhancing technology development we emphasise a number of key issues and propose some specific recommendations in Chapter Four to achieve that.

3.3.1 Administering institutions and schemes

The range of schemes providing financial incentives directed toward enhancing Thailand's industrial technology capabilities is extensive. Through the course of this study we identified 47 separate schemes. Many of these had a range of activities with different targets and objectives covered within the scheme. Responsibility for the administration, promotion, delivery and evaluation of these schemes is spread across five separate portfolios of government: the Office of the Prime Minister; the Ministry of Finance; The Ministry of Science, Technology and Environment; The Ministry of Industry and the Ministry of Labour and Social Welfare. In addition there are a group of schemes with independent status, such as the Office of the Thailand Research Fund.

A summary of the schemes, the mechanisms through which they operate, their objectives, financial commitments and industry 'take-up', and monitoring mechanisms are summarised in tabular form in a matrix presented in Attachment 4. A final column in the matrix summarises the major issues identified for schemes in relation to the overall system of incentives. The information in the matrix was collected through a series of interviews with senior administrators responsible for the schemes following the 'diagnostics' outlined above and supplemented with relevant documentation available to the project team.

[14] Tan and Middleton, op. cit., p. 4.

Exhibit 8 Illustrative Map of the Current System of Financial Incentives

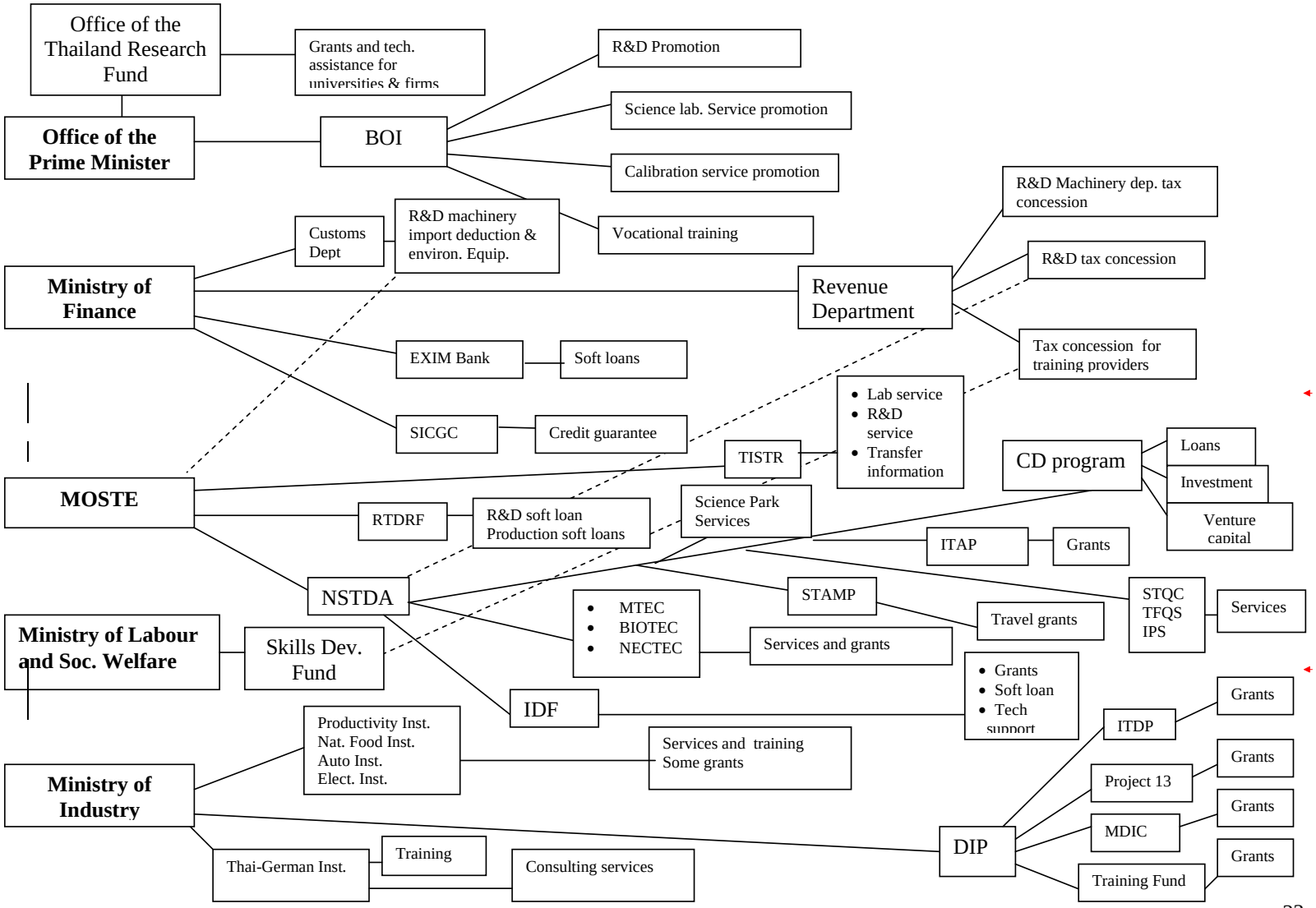

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Exhibit 8 condenses this information into an illustrative map of the overall system of schemes. Although this illustration does not take into account the varying size of different schemes, their financial commitments or the numbers of firms assisted it does serve to reveal some overall key features of the system.

First, the map illustrates the ***complexity*** of the schemes. There are five separate ministerial portfolios involved and across these are similar types of schemes offered with similar objectives, different reporting requirements, eligibility criteria and implementation time-lines.

Secondly, while international experience identifies the value in having a range of schemes in place to respond to different needs of firms at different stages of technological development the current map illustrates a high degree of ***fragmentation***. International benchmarks of successful incentives regimes reflect more integration and coordination between schemes with similar objectives, targets and mechanisms.

This complexity and fragmentation leads to two major problems. The first concerns the ***effective promotion of schemes***. Potential user firms are unlikely to fully benefit from the system as a whole unless they are clearly aware of the goals and the relative benefits for their specific needs. Planning for technology development requires a reasonably informed scan of the options available. The present structure of schemes implies the need for an extensive commitment to coordinated of promotion and delivery.

The second problem concerns the need for ***flexibility to enable firms to move between schemes***. International benchmarks show that effective client and scheme performance rests very much on their capacity to stimulate technology learning in firms to enable them to make appropriate technology development choices. This implies that it is not so much the number of schemes that are available but the ***accessibility of schemes to firms at times that match their specific and immediate needs***.

These overall issues associated with effective scheme management, their clarity of structure and goals and their performance are addressed with some specific recommendation in Chapter 4. The following section briefly discusses the individual schemes in the context of these overarching issues. More detailed summaries of the schemes are presented in Attachment 4 and in the matrix included in that same attachment.

3.3.2 Schemes administered through the Office of the Prime Minister - Board of Investment (BOI)

Administration:
The Board of Investment provides a range of mechanisms for encouraging Thai firms to engage in R&D activities. The BOI definition of R&D is quite broad and includes basic, applied and experimental development in the guiding definition.

Goals:
The mechanisms target two categories of firms: those who carry out R&D as separate activities from their regular business and those firms who carry out R&D on behalf of other firms. Support is targeted toward firms located in priority investment zones.

Impact:
According to respondents, private investors are generally not enthusiastic about the R&D promotion measures. Among the reasons offered to explain the lack of such enthusiasm are:

- a lack of qualified researchers and engineers to conduct R&D in Thailand The approval process is cumbersome and requires many steps;
- concern among some potential applicants that because the BOI definition of R&D is quite broad the judgment is to whether an application will be successful will fall to an individual official;
- different incentives for R&D activities, depending on the zone, presents confusion between different objectives: that of R&D activities and that of regional distribution;
- other countries such as Singapore and Malaysia offer more attractive incentives for firms to invest in R&D including customized incentives such as grants or land.

By international standards, the monitoring and evaluation system is comparatively limited. BOI officers usually monitor the scheme once or twice through project approval and project expansion approval processes. Annual monitoring is provided through submission of balance sheets to BOI.

BOI Unit for Industrial Linkage Development (BUILD)

Administration:
The Bureau of Investment administers the Unit for Industrial Linkage Development (BUILD). The objectives of BUILD are to:

- stimulate more consumption of local parts and components
- provide chances for the parts manufacturers to enter new assembly markets
- help the parts manufacturers understand related businesses
- encourage more investment in parts and components manufacturing in Thailand

In practice the 'Vendors Meets Clients' (VMC) program within BUILD is the only scheme with a specific focus on technology development or transfer.

Goals:
VMC seeks to match vendors/manufacturers with customers/assemblers. The program involves taking parts manufacturers to visit assembly plants. This linkage opportunity assists the manufacturers to initiate business deals to supply parts and components for the plants. As a result, the parts manufacturers learn what the assemblers want, while the assemblers learn more about the firms who can supply the parts they require.

Impact:
So far, 1,000 Thai companies have joined the programme and participated in a total of 42 visits to large manufacturers. Although this program is not strictly speaking a

scheme that offers financial incentive for technology development it is noted here because the activity has the potential to stimulate initial demand and offer information which might lead to involvement in other schemes.

3.3.3 Ministry of Finance - Department of Revenue

Depreciation allowances for machinery and equipment

Administration
The Department of Revenue delivers schemes to encourage private sector investment in R&D. These schemes include tax concessions on the depreciation of machinery and equipment used for R&D. There is no specific monitoring system in place although the general taxation provisions allow for accountability.

Goals
The objective of these schemes is to deliver taxation relief to encourage firms to direct machinery and equipment specifically toward R&D activities.

Impact
One major problem in taking advantage of this provision is the definition of R&D machinery and equipment. Firms are uncertain whether their machinery and equipment will fit the understanding of the Revenue Department whose officials are expected to come and their premise. For example, one firm reported that it had filed for such provision 3 years ago and had not yet received an edict on the matter.

200% Tax Concession for R&D Expenditure

Administration:
Under this measure, firms can apply for a 200 percent deduction of their R&D expenditure from their taxable income. However, firms' R&D projects and agencies must be certified by NSTDA to qualify for relief under the scheme. Follow-up project evaluation is carried out by NSTDA.

Goals:
The objective of the scheme is to encourage firms to engage contract research agencies to carry out R&D on their behalf and to encourage firm-based R&D where in-house capability can be demonstrated. There is a condition that the firms or organisations contracted to carry out the R&D must be included in a list of agencies approved by MOF and NSTDA. This latter feature of the scheme is different from the practice in other countries where firms incurring their own R&D expenses are automatically eligible for a tax concession. Approved agencies include subordinate research units or spin-off firms of a conglomerate; independent research units or companies; universities, labs and government research organizations.

Impact:
By the end of 2000, tax deductions had been granted to 36 firms/organisations. Most of companies benefiting from the tax concession are subordinate research units or companies. Only a very small number of independent companies or research units receive the R&D tax concession.

According to respondents factors contributing to lack of firms taking advantage of the tax concession include:

- the approval process is cumbersome and takes considerable time;
- lack of clarity in definitions - according to some firms, the definition of R&D activities is not clear and they are not certain what kind of expenditure will actually qualify for the deduction;
- design and engineering activities, essential for many firms in developing their R&D potential are not included in the Revenue Department 's definition of R&D;
- the requirement that only R&D expenditures paid to the listed organisations in the MOF announcement are eligible for tax concession does not encourage firms to carry out R&D within their own firms - some firms have overcome this separating out their R&D section from the parent company and applying for their R&D section to be listed.

Deduction/exemption of R&D machinery import duties.

Administration:
The Customs Department provides for deduction/exemption from import duties for R&D machinery and equipment.

Goals:
The objective of this scheme is to promote R&D by reducing the import cost in acquiring machinery or equipment necessary for R&D. Import duty relief covers: scientific tools; R&D chemicals; environmentally sound machinery; computer and electronics parts; training and testing equipment.

Impact:
Comments received through the present study indicate that the approval process for deductions takes considerable time.

150% tax concession for training expenditure

Administration:
The Revenue Department also provides a 150 percent tax concession for expenditure on employee training with the Department of Skill Development for in-house training approved by the department.

Goals:
The tax concession is designed to generally encourage more spending on training courses by the private sector rather than to specifically enhance technological and production capabilities. In its present form the scheme provides generalised training support. Although generalised skills development is a critical activity for countries such as Thailand there is a need to specifically targeted training toward enhancing skills for undertaking technological activities such as design and engineering and quality management.

Impact:
The agency reported that involvement in the program has been declining over the past three years, in terms of the number of firms involved, the number of courses offered and the number of training participants.

3.3.4 Independent agencies

Thailand Research Fund - R&D Grants (TRF)

Administration:
The Thailand Research Fund was established as an independent agency with the mandate to provide research grants to the private sector. TRF coordinators, mostly recruited from universities, assist in identifying appropriate firms and in preparing applications for grants. A small team of experts is appointed to assess the proposal and monitor its progress if it is successful. Because of the 'selective' project development process most applications are successful. TRF coordinators manage the scheme and monitor progress through six month visits. A project planning tool for project and overall schemes evaluation. Administration of the programme is maintained within 10 percent of total annual expenditure.

Objectives:
Two programmes are offered to support R&D activities for production processes and product development by allocating grants to SMEs. Grants up to the value of Baht 50,000 are available to firms who must match the grant by contributing to at least 50 percent of the total project cost. Activities must be carried out in collaboration with public sector researchers. The support is targeted to industry sub-sectors identified by government as a high priority. The fund has recently introduced a programme to build closer links between university training programmes and industry.

Impact:
TRF currently administers 153 projects and has delivered Baht 100 million to firms over the past eight years. Delivery of grants to the private sector is currently limited by: a) the 50 percent matching requirement; b) matching grants do not qualify for relief through the 200 percent tax concession scheme, unless they are carried out in one of the approved agency or firms; c) limited awareness of the scheme and identifying firms with the appropriate capacity to carry out projects.

3.3.5 Ministry of Science, Technology and the Environment

Revolving Fund for Technological Research and Development (RTDRF)

Administration:
The Research and Technology Development Revolving Fund provides two programmes of financial support in the form of soft loans.

Goals:
The objective of the loans is to reduce financial risk and stimulate investment in the commercialisation of R&D results. Two programs have different targets. One provides soft loans for amounts up to 10 million baht targeted for technological R&D. These attract an interest rate of four percent per year with maturity required within eight years. A second program provides larger amounts for process improvement and

commercialisation, up to 20 million baht per project. These attract an interest rate of six percent per year and maturity is required within 10 years.

Impact:
The Fund has not attracted much enthusiasm from the private sector. Since 1988, 47 projects from SMEs have been supported with a combined value of 455.088 million baht. Reasons identified for limited impact include the following:

1) the approval process takes more than one year to complete;
2) there is limited awareness of these scheme as it is is not strongly promoted;
3) there is shortage of personnel directly responsible for fund management;
4) the available funds, conditions and interest rate are not sufficiently attractive;
5) there are other similar funds available such as through NSTDA;
6) many firms find the reporting and evaluation process too burdensome;
7) SMEs have difficulty meeting the collateral needed while larger firms find the amount of loan available to be too small.

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Innovation Development Fund

Administration:
The IDF is a new programme established in 1998 as part of a package to stimulate innovation and increase the competitiveness of Thai firms. It is currently under the administration of NSTDA. The fund provides the private sector with financial support (grants, soft loans) and technical and business advisory service through Business Innovation Projects, Business Start-up Projects, and Strategic Projects.

An office oversees the management of the Fund and an Executive Committee carries responsibility for the functioning of the Office. NSTDA, the Ministry of Finance and NESDB provide the legal framework within which IDF is established. Financial support is available through a program of grants and loans. The IDF mandate also allows it to make investments in selected projects. In addition IDF can provide technical support for project or process development and for financial and business activities. Monitoring is carried out through established performance measures, however, because the program is still in a development phase full program evaluation has not yet occurred.

Goals:
There are four key objectives in IDF's approach:

- to establish an operational system to provide definitions of 'innovation projects';
- to promote awareness and appreciation of the benefits derived from innovation;
- to develop strategic projects with the potential to have major impact on specific sectors; and
- to work with potential innovators to develop innovation project proposals.

Project support is targeted toward projects that qualify as having a clear 'innovation action' such as the introduction of a new product, new service or process as well as new ways of supporting and servicing products or processes. Projects must also demonstrate technical and business feasibility. One of the roles of the fund is to assist firms to develop proposals to the stage where such feasibility can be demonstrated.

Impact:
The program is still in early stages of development. In the first year of its operations (2000) 62 proposals were received 'in various stages of development'. In 2001 IDF staff were engaged with the development of 26 projects. Although the IDF was intended to provide a driving force for large and extensive innovation projects involving groups or clusters of firms, its operations to date have been comparatively modest. However, more recently the program has been expanded and given a higher priority by the Government. By mid 2002, 109 firms had applications registered for support.

The majority of funds are allocated toward 'upgrading innovation' (1,180 million Baht - 83 percent of funds); 'building an innovation culture' is allocated 105 million Baht (7.4 percent) and 'building innovation organisations' is allocated 135 million Baht (9.5 percent). Administration takes up approximately 9.5 percent of funds.

During its first year of activities the Chairman noted a number of features that would require attention in future development of the scheme. These included:

- a need to be more proactive in seeking out new projects and provide assistance in developing proposals;
- a need to provide an appropriate match of technical and financial support;
- a need to establish a database of technical and business experts to assist in project assessment; and
- a need to enhance networking and cluster formation between organisations engaged in related activities.

NSTDA - Department of Industrial and Business Development

Administration:
NSTDA is responsible for the Department of Industrial and Business Development. Interested companies can apply to participate in the program. NSTDA's Industrial Technology Advisors (ITA) will visit firms to assess firms' needs and identify skills and information lacking in firms (e.g. good quality management system, business plan, or marketing). The ITA then presents a draft project proposal to assist firms develop a capacity to innovate. Once the project has been approved, the ITAs recruit qualified consultants to provide assistance to the firm. The level of grant varies by scheme.

Goals:
The overall objective is to support and stimulate the private sector to adapt technology, promote R&D and innovation for new products and processes in the manufacturing sector.

MTEC, BIOTEC and NECTEC

NSTDA is also responsible for MTEC, BIOTEC and NECTEC that provide technology services, and grants directed toward projects within universities and the private sector. One of the issues associate with these latter schemes is that there is some overlap with similar schemes offered through TRF and more recently IDF.

Standard Testing and Quality Control (STQC) and Thai Foundation Quality System (TFQS):

Administration:
These two programs are quality management programs. The schemes are monitored by an auditor. As a precautionary measure applicants have to place a deposit with NSTDA at the beginning of the program to guarantee they will devote time to make the activities successful.

Goals:
TFQS provides a beginning standard of quality management, created by NSTDA staff, which is lower than ISO. The scheme is targeted toward firms requiring certification for ISO, GMP or TQM. Firms who are not ready for ISO will be advised to apply for TFQS at the beginning. NSTDA will grant 50 percent of support required under the TFQS scheme but to a maximum of Baht 30,000. Financial support for STQC is not provided.

The Company Directed Technology Development Programme (CD)

Administration:
The CD programme was established within NSTDA to provide grants and soft loans to enable SMEs to invest in R&D for commercialization. Monitoring is carried out every six months by ITAs with assistance from other experts

Goals:
Funds are targeted toward building or improving laboratory facilities, upgrading technology, or new product development. Soft loans are available for the development of new production processes or new products, building or improving laboratory facilities, upgrading technology, or utilisation of scientific and technological R&D capabilities existing within private and government laboratories. The maximum amount of loan available is 20 million baht but the amount must not be more than 50 percent of the total cost of the project. Interest rate is currently half that offered by the banks, but includes an overhead fee. Grants have now been removed from the scheme because these are available through other agencies - TRF, IDF, MTEC, BIOTEC and NECTEC.

Impact:
Apart from the limited amount of fund available per project the condition that the firm has to finance at least half of the project presents a formidable hurdle for many firms. Another major difficulty with soft loans is the condition that the financial institution has to guarantee the principal payment. Financial institutions are not very active in lending out R&D soft loans because of this additional risk. Between 1992 and 2001 the scheme provided support for 89 projects involving 77 firms.

Industrial Technology Assistance Programme (ITAP)

ITAP, previously known as the *Consultancy Services* introduces experts (freelance or retired university professors) to firms to provide advice on technology and product development. The scheme also offers project evaluation service and financial support for up to 50 percent of the total cost of expenses. Evaluation is carried out during the

beginning of the project with interim monitoring that incorporates comments from experts and firms. When the project is finished, firms must submit a report to NSTDA.

Goals:
ITAP has the objective of enhancing the capability for production technology of SMEs by supporting Thai industry to use technical consultants.

Impact:
ITAP has supported 217 projects involving 184 firms.

Support for Technology Acquisition and Mastery Programme (STAMP)

Administration:
STAMP provides financial support and arrangements for factory visit abroad for key staff within SMEs. Participating firms have to prepare and deliver a presentation to the host firms. Evaluation is carried out independently by the University of the Thai Chamber of Commerce.

Goals:
The objective is to assist firms discover new technology. Inbound and outbound missions are organized to introduce technology to firms. The scheme provides financial support for air fares.

Impact:
The emphasis on travel introduces a controversial issue that STAMP is predominantly a 'fun trip' rather than for serious technology development. STAMP has provided support for 227 firms. Evaluations carried out by the University of the Thai Chamber of Commerce have been positive.

Intellectual Property Services (IPS)

NSTDA, through the IPS, provides legal advice and service in intellectual property rights protection. The Intellectual Property institute at Chulalongkorn University provides registration service and organizes seminars related to intellectual property. IPS has provided support for 37 projects involving 35 firms.

NSTDA Investment Centre (NIC)

NIC supports the development of joint ventures with the private sector to invest in technology identified as 'vital to the country' e.g. ISP, Distance Training, GMO analysis. The proportion of investment from NSTDA varies case by case but can not be more than 49 percent of the overall activity.

Summary Issues for the NSTDA schemes

Goals:
NSTDA primarily targets its schemes toward support for SMEs estimated to be around 80,000 firms. The client base has grown over the past five years. Demand

continues to increase but the availability of funds does not appear to be sufficient to meet the growing demand.

Impact:
The budget is allocated scheme by scheme, which does not currently allow for funds to be transferred from one scheme to another. Recovery of loan funds has remained at 100 percent. In the process of project selection, ITAs play an important role in selecting, analyzing and devising the project. Critical question that ITAs are asked to answer concern whether the projects are in line with strategies (to promote firms bringing technology for R&D and innovation).

NSTDA promotes its schemes through direct mail, exhibition participation, seminars and training. In 2002, NSTDA began utilising a PR company to promote the schemes through newspaper (publishing a 'scoop of success stories'), TV and radio.

The Thai Institute of Scientific and Technological Research

The Thai Institute of Scientific and Technological Research provides laboratory services, research and development services and technology transfer services. These services are available to the private sector on a fee for service basis.

3.3.6 Ministry of Industry

The Thailand Productivity Institute

The Thailand Productivity Institute provides public and in-house training. The objective is to enhance human resource development for productivity improvement. The cost for delivery of training is subsidised.

The National Food Institute

The National Food Institute provides training and laboratory services for supporting firms in that sector.

The Thai Automotive Institute

The Thai Automotive Institute has a scheme for supporting supplier development directed primarily toward SMEs. The scheme provides funding for group consulting to the value of 200,000 baht per factory. Support for individual firm consulting is also available which supports 75 percent of the cost with a Baht 200,000 ceiling.

The Electrical and Electronics Institute

The Electrical and Electronics Institute provides product testing and calibration services and training services for firms in this sector.

The National Institute of Metrology

The National Institute of Metrology provides technical assistance and measurement testing services.

The Thai-German Institute

Administration:
The Thai-German Institute was established with a ten year grant from the Thai government. The government also supports individual training projects. The Thai-German Institute provides in-kind support through the provision of experts, machinery and training. TGI promotes their program through their own marketing staff and carries out routine customer satisfaction surveys. These surveys evaluate content of the modules, equipment and machinery, trainers and TGI management. TGI also monitors its operations by creating efficiency indicators such as monthly operation efficiency and customer satisfaction and sales per staff or per true delivery or per supporting staff. In addition the institute is monitored and evaluated by external agencies - usually every two years.

Goals:
The main objective of the TGI activities are to train technicians in advanced manufacturing technology and to provide industrial consultancy services for firms.

Impact:
The demand for TGI service has increased in CAD-CAM and computerization related courses. However, TGI staff report they are not certain whether some of the other technical training offered suits the changing demand of their Thai clients. Main constraints identified for the program include:

1. the relevance and level of knowledge/ technology of trainees
2. ability of employees to gain leave to attend the training;
3. a high training cost due to TGI's high operation cost (approximately 70 percent and up to 90 percent when including depreciation cost).

Department of Industrial Promotion (DIP)

Administration:
The Department of Industrial Promotion has various schemes providing grants to firms in hiring consultants to improve firms' productivity. These schemes include: Project 13; Consultancy Fund (CF), ITB and MDIC.

DIP - Project 13 Goals:
Project 13 starts every fiscal year. Interested firms have to submit their application to participate in the program during certain period of time. The total number of applications submitted to Project 13 is 400 firms. Those 400 firms will be allocated to institutes sub-contracting consultancy work from the Ministry, mainly university professors that are interested to become consultants of the program. The consultancy is carried as group work, not individually. The period of the project is strictly limited to 6 months. The government fully covers the consultancy fees.

DIP - Consultancy Fund Administration:
Project development starts with the diagnosis of problems and needs of clients by experienced DIP officers. Then, a TOR will be drafted and a bidding process is put in

place to appoint consultants. Grant are available for up to 20% of the total budget value but to a maximum value of 200,000 baht.

Evaluation is provided through a requirement that consultant teams submit a progress report every quarter to the approval committee. The approval committee also visits firms participating in the project to identify any problems. When the project finishes, an approval committee, consisting of one DIP official and one expert assess whether the consultant has delivered the work according to the TOR.

DIP - Consultancy Fund Goals

The Consultancy Fund (CF) was established in 2000 to provide consultancy services to SMEs. The programme provides financial support of up to 50 percent of consultant fee but to a maximum value of 200,000 baht. There are eleven regional Industrial Promotion Centers involved with delivering the program.

DIP - Consultancy Fund Impact:

Between 1996-1999 there was a total budget of Baht 45.5 million. However, only Baht 5.2 million (11.43 percent) was granted to 48 firms. The majority of services (90 percent) were related to management rather than technology - mainly consultancy for ISO 9000, QC or TQM.

CF's target is approximately 100 factories per year, with 40 firms in central area and 60 firms in the regions. Criteria for firms to be eligible for the program is that they should be SME in the manufacturing sector with more than 50 percent of Thai shareholders. The trend of demand is increasing slowly. There is some overlap with the ITB.

Annual budget for CF is 15.5 million baht. However in 2000, 5.2 million baht was granted to the private sector (33.7 percent of the budget allocated). This increased to 7.65 million baht (49.4 percent of the budget allocated) in 2001. Administration cost is 10.5 percent of the total budget allocated.

DIP - Invigorating Thai Business (ITB)

The Invigorating Thai Business Program offers grants directed toward SMEs to assist them solve technical and management problems. Grants are provided to cover expert fees. The scheme is similar to the CF program.

DIP - Management Development Program (MDIC)

There are five components to the MDIC program. Modernisation of production; technology management planning and acquisition of technology; strategic planning; financial management; and marketing. The program provides up to 170 person days of consultancy. Firms must pay one third of the cost out of a maximum of 900,000 baht. To be eligible for support under the program firms must participate in all five components.

DIP - Training Fund

The DIP Training Fund provides grants up to the value of 150,000 baht to cover 50 percent of training costs to eligible SMEs.

DIP - Productivity Improvement Loan

The Ministry of Industry, with support from BOT, has financial assistance in the form of soft loans through IFCT and EXIM Bank. The soft loans are for the purpose of improving firms' productivity and machinery. The soft loan interest rate is 1 percent with maturity period of five to seven years. The total amount loaned must not exceed 200 million baht.

3.3.7 Ministry of Labour and Social Welfare

Department of Skill Development - Skills Development Fund

Administration:
This fund seeks to promote training for both skilled and non-skilled workers. The fund provides soft loans for trainees at 1 percent interest rate. Funds are available to cover expenses incurred for personnel and associated expenses.

A new draft Skill Development Act is currently before parliament. The proposed new Act will allow for the transfer of funds from the previous Skill Development Fund. It will essentially operate through levying an amount of up to 1 percent of payroll on firms that ***do not*** carry out adequate training as determined by the Ministry of Labour. The Act will therefore act as an incentive to encourage firms to provide training by penalising them if they do not do so.

Goals:
The training schemes will engage large firms and SMEs in collaborative training approaches, draw together industry and public sector involvement and engage a wide range of training providers. They are also intended to support a wide range of schemes, from basic literacy to technical, craft and managerial skills. Some will be targeted toward particular sectors and technologies and some will be targeted toward accreditation of training providers.

Potential impact:
The draft Act is not specific on how these features will be incorporated in practical delivery of training. Given the importance of delivering appropriate training to ensure industrial technology development in Thailand can proceed we offer some specific recommendations for the implementation of programs under the new Act in the concluding chapter of this report.

3.4 Weaknesses and limitations in the present framework

There is a wide range of incentives for technology development in place in Thailand. However, the current range of incentive schemes described above reflect a policy perspective that has not kept pace with the demands of global environments. International experiences reflect the need to target incentives where they will have maximum impact. This implies targeting particular types or groups of firms and targeting the specific technology thresholds relevant to their current levels of technology capabilities.

Some general areas of weakness can be observed from the above overview and the summary of schemes provided in Attachment 4.

The main elements of these weaknesses are summarised below.

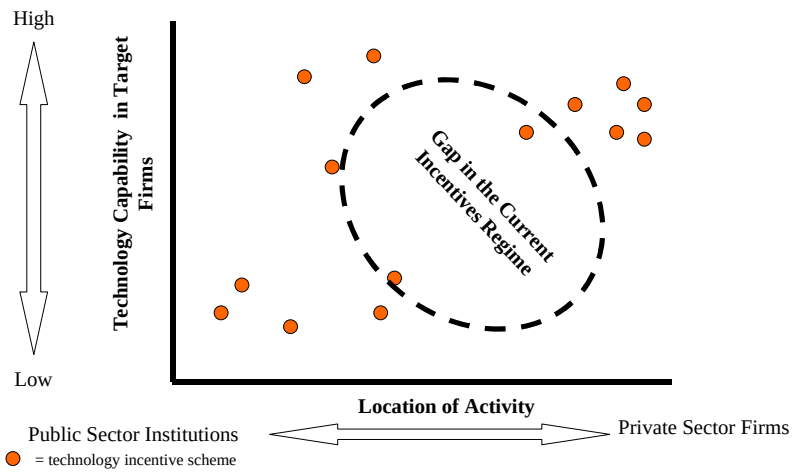
- Current R&D incentives are inhibited by eligibility criteria that supports the 'top end' of firm technology capabilities but leaves gaps for firms struggling to develop their capacity at lower technology thresholds. This 'gap' in the current incentives regime is illustrated in Exhibit 9.
- Given Thailand's current state of industrial development there is a surprisingly high emphasis on supporting R&D compared to the attention given to enhancing basic engineering and design capabilities.
- Those schemes that do address this level of technology development are faced with increasing demands for support from firms but have insufficient resources and budget flexibility to adequately meet such demands.
- While some schemes provide matching grants for research and development the private sector contributions are often excluded from attracting R&D tax concessions.
- There is an overlap between some schemes which can lead to confusion among firms that are targeted by such schemes.
- Schemes that address training are sometimes linked to technology development schemes delivered by the same agencies but there is far less connection between training schemes with technology development (or training) offered through other agencies.
- At a general level the grants and loans schemes are either too small to provide sufficient incentive to large firms and the matching fund requirements too stringent for small firms.
- There is some rigidity in the system that does not allow for firms to progress through 'incremental steps in developing their technology capabilities.
- There remains a strong focus on supply driven incentives compared to incentives that stimulate demand for technology upgrading.
- There is an apparent recognition of the need to support groups of firms and in particular links between large and small firms, but the many of the schemes could be more specifically and aggressively turned toward this objective.
- Monitoring and evaluation is variable across schemes[15] and there is rather weak systematic coordination across schemes for this purpose.
- Cooperation and coordination in scheme promotion and delivery is also weak.

[15] However, new budget procedures are likely to introduce much more stringent requirements on the monitoring and evaluation of public sector expenditures.

3.5 The Challenge for Thailand

Far from retreating from public investment in technology development and training, the challenge for Thailand is to find efficient and locally acceptable means of underwriting technology development and learning within private firms. Solutions will require support for collaborative strategies among the whole range of 'knowledge system' players as well as for firm-based activity. Success will deliver public benefits to the country: benefits measured in terms of skills and experience in technology, as well as monetary return. ***Failure to come to terms with the necessity of developing functioning 'knowledge networks' will see Thailand fall further behind economies such as Singapore and Taiwan in terms of national industrial technology capability and skills, and in its ability to compete on the basis of 'knowledge' rather than on other factors of production.***

Exhibit 9: **Locating the Gap in the Current Incentives System**



A further challenge will be to devise ways to use appropriate financial support mechanisms, including grants to private companies where these are warranted. Contestability (competition) and transparency of funding are essential. ***Support schemes must be complementary and well coordinated and delivered and well understood by firm managers.*** Options such as 'one stop shops' and contracting the private sector to deliver the schemes have been canvassed through the present project, and specific proposals for rationalisation and coordination of government support are outlined below.

3.6 Developing a revised framework

We see three key propositions or 'strategies' that together provide a framework for revising and improving the effectiveness of present system of financial incentives.

Proposition 1: ***Government financial incentives should support the full range of technology capability building activities within the firm in an integrated manner.***

This proposition recognises that Thai government financial incentives for technology capability building and training are not currently as ***comprehensive*** or as ***effective*** as firms require. Firms' technological capabilities comprise three interlocking sets of competencies (skills, technical knowledge and organisation): production capability (management and engineering), project execution (feasibility, training, execution) and innovation capability (new product development, R&D). Effective incentive schemes should therefore support the full range of these activities and ***integrate these activities*** in a way that takes account of how firms operate.

A notable gap in current incentives lies in the area of ***networking and cooperation***, between firms both around technology development and in relation to training. Some incentives should specifically encourage ***cooperation in technology development and training*** between firms (including between local and between local and foreign firms), and between firms and public sector institutions such as universities.

Well-targeted and comprehensive incentives will be ineffective if hampered by poor definition of eligibility (in activities or clients), inadequate resources, and poor administration and delivery. We consider that the management of current incentive schemes need to be more ***integrated*** in terms of activities supported, and more ***aggressively delivered*** to firms. This does not necessarily require consolidating all existing schemes under one or two government agencies, but it does require consolidating their promotion, monitoring and evaluation.

Proposition 2: ***Incentives must be targeted at those industry sectors, firms and activities that are likely to provide the greatest public benefit.***

At a strategic level, the Thai government should develop criteria ('targets') for selecting the candidate ***industry sectors***, ***firms*** and ***activities*** that are most likely to offer substantial social returns to any grants handed out. A critical factor in delivering maximum impact will be to target technology thresholds (irrespective of sector) that are creating the greatest bottlenecks for technology upgrading. ***In the case of Thailand the evidence is that this is not at the level where firms are already engaged with R&D, but at the level where firms need to build their capacity for design and engineering capabilities.*** This observation was emphasised in Phase 1 of this study. It is further reinforced in this Phase of the study. The strength of demand for financial assistance sought by firms for developing these capabilities is considerably more than the level of take-up of incentives for schemes that predominantly designed to promote R&D would suggest.

The criteria for targeting should emphasise development where target sectors, target firms and target activities intersect and where firms themselves have already made

progress toward enhancing technology capability. Criteria for achieving this is elaborated further below.

Targeting industry sectors:

Key sectors are those where levels of technology are higher than those currently common in Thai industry but not at the cutting edge. This would permit: (a) technology upgrading when Thailand enters the sector but at a level that can be accommodated with achievable (if still substantial) investments in further training; (b) ready access to technical knowledge that is already codified or potentially available through learning and know-how gained through closer interaction with other firms; (c) an ability to upgrade technology capabilities for process engineering and limited R&D development (localisation of the product); and, (d) allow limited engagement with basic research where it can serve to embed firms in research and development processes and link them to innovative clusters.

There should be an emphasis on sectors where there are substantial existing markets are clearly identified niche markets, preferably both international and domestic, to permit increased exports and import substitution. But essentially where there is limited competition from firms in other developing nations to avoid potential glutting of the market. There should also be an emphasis given to sectors where there is a comparative advantage in non-technological factors of production, such as geographic location, opportunities for tourism and cultural factors.

Where possible, areas to target should be in those sectors where there is a demonstrated willingness on the part of existing MNCs to operate in Thailand and give business to Thai suppliers at segments of their supply chains that would allow local firms to engage in initial technological upgrading and lay the foundations for further upgrading in the future.

In general, these criteria imply moving into mature industries at positions in their supply chains that do not rely simply on low factor costs – e.g. of labour and raw materials – but also provide entrees to technological sophistication beyond those currently prevailing in Thailand.

Targeting firms.

Local ***SMEs are a clearly a first priority*** for support. It is appropriate to fund activities in SMEs that would not be supported in larger, more technology-capable companies. There is strong argument for a new scheme that is far more accessible to SMEs. There is also a place for incentives (but not necessarily grants) targeted at ***multinational corporations***, to encourage them to assist local companies in technology development and training.

For local firms criteria for eligibility requirements to receive incentives should be based on: (a) the introduction of updated (but not cutting-edge) technologies; (b) operating in industries with good commercial prospects; (c) demonstrated commercial probity of owners and managers with an outward focused approach to innovation and marketing; (d) sufficient initial technical capabilities within firm to support

upgrading; and (e) potential for transferring knowledge and skills to other firms and industries.

For MNCs, eligibility requirements should be based on: (a) those MNC who introduce more sophisticated (although probably not cutting-edge) technologies than are currently in general use; (b) where these technologies offer good prospects for diffusion to other industries (act as leading sectors), thereby spreading technological upgrading; (c) "good citizenship" in the sense of a high probability that firms receiving incentives will adhere to local laws and regulations.

Targeting *'activities':*

The criteria for targeting types of activities should emphasise: a) those types of incentives that they require levels of technological skill above those currently common in Thailand; b) those that can be taught locally (and to local workers) at a reasonable cost and in a reasonable span of time; those that are flexible and potentially applicable to a variety of firms and industrial sectors. This should allow for the promotion of potential indigenous entrepreneurship by those who are trained and wish to go into business independently, and serve to avoid workers becoming so highly specialised that the value of their skills is destroyed if their initial employer fails for some reason.

Phase One of the present study, identified the need to target technology thresholds in Thai firms toward stimulating demand and building capacity in firms for raising design and engineering capabilities. However, within this overall national objective the nature of critical technology thresholds for firms in Thailand will vary in different sectors. It will therefore be necessary to investigate priority industry clusters very carefully to ensure that financial incentive scheme ***activities*** are designed, promoted, and delivered at targets most likely to maximise benefit from the investment. This is discussed further in the concluding chapter of this report.

In addition and complementary to the above, ***training*** and formal skill development are clearly first priority activities for incentive support. This includes support to assist firms in formulating their technology and training strategies. However, training support should be targeted toward those same technology thresholds addressed by other schemes. A key to achieving this is to provide ***flexibility for firms to sort out this matching process themselves***. In short, this implies building on the efforts already underway within the private sector. This challenge is taken up with some specific recommendations below.

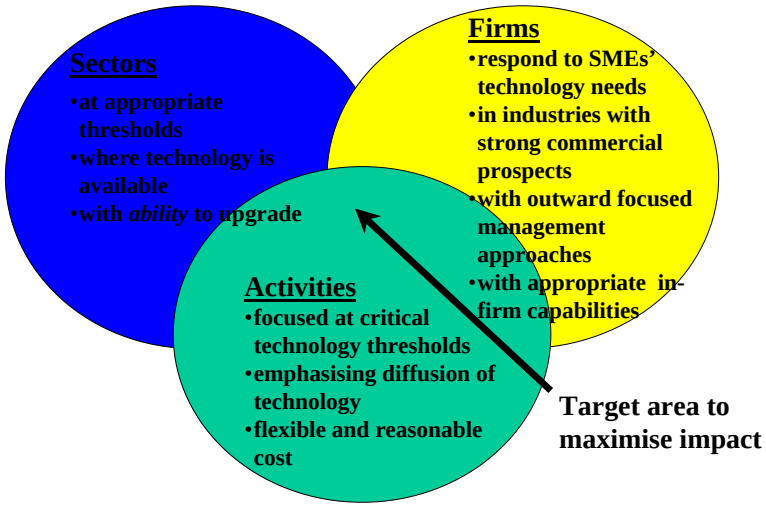
The point of these criteria is that maximum impact and efficiency of the incentive system is most likely to be realised when the schemes target the intersection between key sectors, firms and activities. This is illustrated in Exhibit 10.

Proposition 3: ***The choice of particular form of incentive (tax incentive, loan, grant) is a tactical decision that must take account of local circumstances.***

We consider that the particular form of financial incentive provided to companies is not in itself a critical factor in the effectiveness of the incentive. However, in the Thai

context, providing grants to companies *would* overcome some of the problems that firms have with raising collateral, with the definition and administration of tax incentives, and with cash flow problems.

Exhibit 10: **A Framework for Identifying Targets for Incentives**



We note that most industrialising countries have a portfolio of incentives that include grants to private companies. Like other financial incentives, these grants are justified where the activity is particularly high risk (long-term R&D), where there are substantial spillovers from the firm (eg. of knowledge or trained people), or where a firm is too small to resource the activity on its own.

We therefore consider that there is strong argument for delivering financial assistance to SMEs in the form of ***grants, 'vouchers' or 'innovation credits'***, or by other means that do not require large 'up front' payments by the firm.

Obviously, the process for targeting, awarding and administering grants must be a fair one. Contestability (competition) for funds and transparency of funding guidelines and administration are essential. To reduce the risk of funds being misapplied, agencies must be able and sufficiently resourced to allow them to assess that firms are both sufficiently ***competent*** and ***honest.***

4. A Revised System of Incentives for Enhancing Technological Capability in Thai firms

The analysis of the present incentive systems and mechanisms for skill development and technological upgrading leads to a number of key recommendations. These are presented below under five key headings. The final section (4.6) sets out a plan for action by key agencies to implement these recommendations.

4.1 Revising financial incentives for skills development and training

A first issue for maximising the impact of incentives for skills and development concerns changing the behaviour of firms towards training. The existing tax deduction for training, 'typically subsidises the types and volumes of training that would probably have been undertaken in any case.'[16] Exempting firms on the basis of their existing training activities (with no other assistance from the SDF) would provide even less leverage on firms. It would not seem to give the SDF the opportunity to improve the *level* or *quality* of training within these firms.

Large firms in particular carry out a disproportional share of training and are also in a position to assist SMEs that they have commercial relations with. However, they fall largely outside the purview of the proposed SDF. The potential for the diffusion of knowledge for technology development to smaller firms will be enhanced if larger firms are part of training networks.

> **Recommendation 1:**
> Large firms should be encouraged to become actively involved in training. This could be achieved through their representation on the SDF Board and through their involvement in collaborative training arrangements. For example the new Skills Development Fund could target specific incentives for in-house training by MNCs for staff of other companies to allow them to act as training suppliers for their industry.

In the Singapore case, noted in Exhibit 11, partnerships were established with MNCs to create industry specific training centres. This approach could be adopted by the SDF as a mechanism to enhance the diffusion of skills from large (including foreign) to smaller firms.

A second issue concerns establishing an effective way to reach *smaller* firms. Evidence from the Malaysian HRDF suggests that the scheme has worked best for large firms; attempting to target the smaller firms through the combination of mandatory and optional levies has been ineffective. Several years after the start of the scheme, almost half of the eligible firms in the 50-100 employee category had not registered with the HRDF for the levy and, of those that had, only around half claimed any reimbursement for training activities.[17] If this pattern is repeated in Thailand, the new SDF scheme will fail, since it encompasses primarily the smaller firms. This is partly a question of adequate resources for enforcing compliance and partly one of the scope of the scheme.

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[16] Phase 1 report, p. 89.
[17] This was documented in the Phase 1 report, p. 90.

Mechanisms to reduce cash/cost outlays by SMEs appear effective in securing their participation. In certain cases the Malaysian HRDF, for example, makes direct (partial) payment to a training provider on behalf of a firm.

The SDF Board should have sufficient degree of autonomy to modify the scope and priorities of the scheme as needs arise and the skills base of companies develop. For example the SDF schemes should allow for direct payment to be made to training providers on behalf of small firms.

The SDF schemes should specifically and aggressively also target *groups* of SMEs for joint training. This could be implemented through group training activities, activities through employer organisations, industry groups, and TNC supplier chains. This would enable small firms with the need and will to undertake training, but not the capability to offer training, to 'redraw their levy paid into the fund – in the form of targeted training. The SDF should give some consideration to providing matching funds to the levy to generate a sustainable and effective national training scheme. Existing training schemes, such as those offered through the Productivity Institute have been moving in this direction. These approaches should be strengthened both in terms of quantity and quality.

Recommendation 2:
As the SDF develops there should be mechanisms to 'hold the hand' of smaller companies by setting up training courses and funding company employees to attend them. This could be achieved through cash contracts or grants to training suppliers (who could be large firms, universities, GRIs) to provide specific courses for groups of SMEs. There is no point in funding companies if the required training courses do not exist – parallel support for the development of the 'training industry' is also essential.

A key challenge for effective skills and development concerns improving flexibility to enable the SDF to respond to different priorities over time. Schemes such as those in Malaysia and Singapore have changed in scope, levy rates, reimbursement rates and priority training areas over the life of the schemes. For example, the schemes initially focused on generic skills (even from the primary or secondary curriculum) and evolved to fund (in addition) higher level, more specialised vocational skills.

Commenting on the Malaysian Fund, the consultants for Phase 1 noted: 'the ability to respond flexibly to specific plans and projects at the firm level may be an important means of supporting demand-driven training development, but it also indicates the importance of informed administrative support for the operation of such services'.[18] In order to improve flexibility and more effectively draw SMEs into SDF training schemes, the SDF should consider introducing a system of training 'credits'. These could be allocated to firms who could spend them with any registered training provider (including MNCs with the capacity to deliver appropriate training) over a given period of time.

[18] Phase 1 report, p. 92.

There is already evidence that MNCs and local LSEs can provide, and are willing to contribute to, the development of 'train the trainer' modules for delivery by Thai training institutes. For example, BOI have recently received support from firms in the electronics sector to create six day training modules for employees of local supplier firms. This suggests that models for involving large firms in the delivery and the development of training such as those used so effectively in Singapore could be equally effective in Thailand.

> **Recommendation 3:**
> Assistance with the analysis of training needs, development of training strategies and identification of appropriate training providers appears *absolutely essential* for SMEs. The SDF must devote much of its resources to building this fundamental planning capacity within firms. This has been regarded as one of the most successful aspects of SDF schemes elsewhere, and also a critical component of many incentive schemes that fund consultants to work with companies on planning for their strategic needs. We recommend that a proportion of funds be allocated specifically for this activity.

In relation to *priorities* for training, we concur with the recommendations from Phase 1 that there is a case for concentrating resources in 'threshold' areas of skill development where under-investment is likely to be greatest. Government resources for training should be targeted primarily at areas characterised by (1) high priority skill activities in (2) sectors with good development prospects, and they should be restricted to (3) firms that seem most likely to make efficient use of any grants provided.

> **Recommendation 4:**
> The SDF Board should work closely with the private sector to identify priority areas in which training funds should be concentrated. This process should take account of priority sectors already identified by the government and priorities for-shadowed by the National Competitiveness Committee. Such priorities should be elaborated only after consultation with the private sector and in the light of in-depth research.

Training in priority areas could be further encouraged by offering premium rates to firms doing a disproportionate share of training within priority industries. This would help overcome the concern expressed by some firms that in high demand skills areas they experience high levels of outflow of trained staff. The industry as a whole can benefit through outflows of trained staff through ***increased*** spillovers of skills from individual firms.

At present there is no systematic audit of training needs for technology development in priority industry clusters for Thailand. We propose that the SDF should work closely with the IDF and OSMEP in carrying out the proposed sector study outlined below in Section 4.5.

Experience indicates that it is critical to *integrate* the range of support mechanisms for technology capability building within firms and not artificially splitting activities into 'R&D', engineering/technology development, training etc. As such, many of the

proposals and options put forward above apply to support for technology development activities such as design and engineering, as well as to training and skill development.

Integration of support for technology development and training is a key issue. It can be argued that, 'precisely because of the current stage of capability development and technological learning in industry, there is a very blurred distinction between (1) support for technology development and (2) support for developing the underlying skills and capabilities needed to manage and implement it'. We therefore propose a set of recommendations for revising the system of incentives that support technology development and aligning them more effectively with incentives for enhancing skills and training.

4.2 Recommendations for stimulating SMEs to improve technology capability by undertaking design and engineering activities

Several issues have been raised in relation to incentives and support for other 'non-training' incentives, particularly for SMEs. The first of these concerns the definition of R&D. At present it appears too narrow, both in terms of the eligible applicants and of the activities covered, to offer sufficient incentive for most Thai firms. The requirement to register a separate research organisation (or R&D unit) within the firm disadvantages SMEs in particular who may not have the organisational flexibility or constancy that a separate R&D unit requires.

> **Recommendation 5:**
> The definition of R&D payments should be extended to cover all in-house R&D performed by the firms themselves, *not only* within a firm's registered R&D 'organisation' or approved institution as under present arrangements.
>
> **Recommendation 6:**
> For ***SMEs only,*** the definition of R&D under current financial incentives should be extended to cover technology development activities such as design and engineering activities that contribute more widely to enhanced productivity and competitiveness and *not just activities directly linked to R&D* as is the case at present.

Many of the current schemes that support R&D are tax-based or loan-based. These are not particularly attractive to SMEs who face problems in raising collateral or with cash flow when compared with outright grants or 'in kind' support. On the other hand, there appears to be limited uptake of grants from SMEs (and the private sector generally) through the Thailand Research Fund. Under present arrangements, some firms who receive grants through the TRF are not eligible to receive the 200% tax concession for their private sector contribution because they are not carried out by an approved R&D provider. This is out of line with international practice and a disincentive for firms to apply for collaborative grants through the Fund. Recommendation 5 would ensure that firms who have been allocated a matching grant through for example TRF would be eligible to receive the 200% tax deduction for their private sector contribution – irrespective of where the research is carried out.

Further, R&D activities in firms in Thailand are more focused around development than around research. We believe that TRF should give serious consideration toward specifically targeting activities for matching grants with firms that emphasise technology development rather than just research as it is generally understood in universities and research institutions.

Grants under the NSTDA Department of Industrial and Business Development appear well utilised and demand appears to be increasing. We suggest that this is because the latter relate more closely to smaller firms' needs for expert services and the need for an easier way for firms to 'learn to use' the incentives that are available.

> **Recommendation 7:**
> We recommend that the programs of matching grants offered through NSTDA schemes such as CD, ITAP, MTEC, BIOTEC and NECTEC, and through the DIP of the Ministry of Industry schemes such as ITB, Project 13 or MDIC. should be strengthened and be given greater flexibility in order to provide greater incentives for SMEs.

This could be achieved, for example, by further promoting grants to groups of firms and placing a high priority on supporting grants for projects that include a combination of large and small firms. We note that among some of the NSTDA schemes there is an emphasis being placed on grants to groups of firms. This provides a stimulus to enhancing links between SMEs and larger firms with more advanced technological capabilities. The Singapore LIUP scheme discussed in this report provides an appropriate and successful model for this approach.

A further criticism of the existing incentives (and related to the comments on uptake) is that they offer funding for defined R&D projects, but not for the support services required to carry them out (advice, consultancy, capability-building etc.). Access to expertise, consultancy and testing services is clearly a prerequisite for all but the most capable larger firms. Any expansion of existing schemes should be in this area rather than in support for R&D *per se*.

In order to support basic levels of technology capability development and learning in Thai firms there should be a continued emphasis on strengthening the delivery and coordination of technology and skills development schemes, such as through MOI institutes that support expert consultancy and extension services, particularly to SMEs. One way of working toward this aim would be for the newly developed Office for SME Promotion to ensure a major component of their activities and support programs are directed toward technology enhancement. We would suggest that at least one third of their budget would be an appropriate proportion to target for this critical area of development.

4.3 Building flexibility and options for incremental and progressive technology development into the system

The recently established Innovation Development Fund offers the potential to support more substantial and sector focused technology development activities. We note that

to date it has only been possible to support a small number of projects. However, given more resources and a higher priority in government, for example through the National Competitiveness Committee (NCC), it would have the potential to provide a second level of support for innovation and technological development to complement the more basic capacity building provided through the innovation credits discussed above. Under present arrangements the IDF is providing support at the level of other programs available through NSTDA or DIP. Given sufficient support and autonomy it could perform a more valuable role in the incentive system by supporting much larger scale projects and involving larger numbers and clusters of firms along the supply chain. This would enhance skills flows from larger to smaller firms. Other innovative types of programs could include the provision of matching funds for industry technology and training institutes, and programs that focus on building linkages throughout the supply chain.

> **Recommendation 8:**
> We recommend the Innovation Development Fund be given a high level of support from government and that it be established as an independent agency under its own Act. Its activities should be coordinated with the delivery of matching grants (or credits) through funds provided through NSTDA, DIP and the newly formed OSMEP. Coordination could be achieved by allocating responsibility to IDF or OSMEP for collating information on project delivery, monitoring and evaluation. This agency should report directly to the National Competitiveness Committee on monitoring and targeting technology incentives in priority sectors.

One of the major findings of our review of the Thai schemes, when compared to international bench-marks, is the organisational complexity they present for the firms toward which they are targeted. It is important for the effectiveness of the overall system that the various schemes ***should not be dysfunctionally competing with each other*** but rather, offering complementarity. We therefore offer a range of suggestions for the rationalisation of some schemes and improving the ability of firms to move between schemes as their technology capacity deepens.

> **Recommendation 9:**
> We recommend building in greater flexibility to those schemes directed toward enhancing engineering and design capability through the introduction of 'innovation credits for design and engineering' available on a matching basis and available only to SMEs.

Innovation credits would essentially provide grants along the lines of those already offered through existing programs. However, the introduction of credits would allow for greater flexibility enabling SMEs to direct their credits toward the range of technology development services required by the firms. They would also provide the opportunity for firms with similar needs to pool their credits. In other words they would be adjusted to demand rather than being driven by supply.

Each eligible SME would be provided an annual allowance to 'spend' as it wishes on a defined range of technology development services. Service provision would be competitive and available through a range of providers including the private sector,

GRIs, universities and foreign consultants. The 'credit' could fund activities in approved external agencies or *within the firm* providing they are carried out with approved agencies or specialists. Firms could accumulate credits for no more than 2-3 years and be allowed to participate in the scheme for up to 5 years, at which point they would be required to 'graduate' to other larger schemes. The 'credit' would be a small grant, paid to a third party. In the case of the UK Enterprise Initiative, it amounted to the equivalent of 15 consultant-days; in other cases it has been variable, for example related to the firm's R&D personnel expenditure or other benchmarks.

In order to enable the schemes to respond more effectively to the innovation credits there will be a need to achieve greater financial flexibility between schemes. As firms are able to progress toward greater technological capability they are likely to place greater emphasis on the acquisition of different skills for production processes. International experiences have shown that as greater flexibility is introduced into the system it is not always easy to predict changing patterns of demand. By introducing greater budget flexibility, schemes can more effectively respond to demand while at the same time being maintained within overall budget allocations.

> **Recommendation 10:**
> We recommend that the grants-based schemes available through NSTDA and DIP should be given greater budget flexibility to enable funds to be transferred between schemes according to demands within firms and the effective implementation of the 'innovation credits for design and engineering'.

We note that the BUILD program offered through BOI does not provide financial incentives for technology development but that through its VMC Program, BUILD does support the establishment of links between large and small firms. The objectives of the VMC program therefore are closely aligned with the objectives of the grants schemes discussed above, but with no resources to address the technology upgrading often required to qualify an SME as a supplier. The impact and implementation of the grants schemes could be strengthened if the VMC, NSTDA and DIP schemes are coordinated and integrated with the development and delivery of the proposed 'innovation credits for design and engineering'.

> **Recommendation 11:**
> We recommend that the activities undertaken through the BUILD VMC programme be closely coordinated with the grants-based schemes available through NSTDA and DIP, thereby marrying the linkage development efforts with the technological development support services.

One option for achieving this would be to integrate responsibilities for these schemes to the Ministry of Industry[19]. This would serve to draw together the substantial links with large firms that have already been developed through BOI with the activities of NSTDA and DIP that have been working more closely with smaller firms.

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[19] Indeed, it is planned in October 2002 for the BOI to be integrated as a department within the Ministry of Industry.

4.4 Enhancing the delivery, impact and coordination of grant-based schemes

An important issue for enhancing effective delivery of grants-based schemes is to minimise the potential for corruption and misuse of grant funds. Awarding bodies must be in a position to be able to scrutinise both the capability and honesty of applicant firms. Where schemes are discretionary, decisions on awarding grants or loans should be made by independent, expert committees. Their procedures and decisions should be open to scrutiny by public audit. This also applies equally to other financial incentives. Firstly, efforts must be made to choose recipients that are not overly prone to opportunism or theft. Financial institutions in advanced economies do this routinely, and agencies should also be able to find information on which to make judgements as to the reliability of potential target firms. A second step is to enforce agreements with firms to ensure that they abide by the terms on which incentives are offered. This involves the development of suitable legal and other institutions (as well as taking strenuous steps to make sure that agreements are adhered to.

> **Recommendation 12:**
> Financial sector organisations (such as the SME bank) should be contracted to act as administrative and possibly also decision-making intermediaries between the private sector claimants and the public sector funding agencies.

We recommend that the enhanced delivery mechanisms and accountability achievable through the above recommendations should be matched with an increase in funds directed toward those schemes delivering credits as proposed above. These would essentially be directed toward grant-based schemes designed to stimulate technology development through enhancing design and engineering capabilities ***not otherwise covered through incentives directed toward increasing R&D.***

The present study has revealed that many countries in the regions have been making significant investments in technology capability building. It is difficult to make sensible comparisons regarding the levels of investment devoted to this area in different countries because there are so many variables that influence optimal models. However, it is clear that given the current level of technology development in the majority of Thai firms additional investment is required if Thailand is to provide an incentive system that will return any substantial benefit. We note that Australia, for example, devotes just under 19 percent of its total science and technology budget toward schemes for supporting innovation in firms.[20] This does not take into account collaborative grants for R&D or cooperative research centres, which are also directed toward technology development in firms. For Thailand, the need to enhance technological capability in local firms is more pressing, yet indications are that budget allocations are not great and the richness of schemes falls short of more successful regional players. Without a considerable increase in the proportion of support directed toward technological development in firms in Thailand, other S&T investments will deliver increasingly smaller socio-economic returns.

[20] Minister for Industry, Science and Resources (2000) *Science and Technology Budget Statement 2000-01,* Department of Industry, Science and Resources, Canberra 2000.

Recommendation 13:
We recommend that the budget directed toward increasing technology capabilities to firms other than for R&D should be increased to a level approaching 15 percent of the national S&T budget. This should provide sufficient stimulation for Thai firms to generate the capacity to more effectively absorb and build on the technology capabilities of more advanced firms and S&T institutions.

A further set of issues relates to the coordination and delivery of incentive programs. There is a wide range of programs, with varying objectives, run by different Thai government agencies. Several of the schemes include support for R&D, training or technology acquisition/development as only part of their objective. It can be argued that these incentives are 'too general' – and that firms do not know what they cover and thus fail to take advantage of them.

Further, some agencies may not be best qualified to deliver the incentives. BOI for example freely admits a lack of experience with R&D incentives. There also seems to be a perception by firms that if they apply for a tax concession (or even a loan), this application will somehow leave them open to additional scrutiny by the by revenue raising (taxation) agencies. In this case, the close linkage of the R&D tax concession with revenue collection agencies is a disincentive and they might be more effectively delivered by a 'neutral' agency. (In Australia, similar incentives are administered by the Industry Department on behalf of the Australian Taxation Office.)

In addition, different technologies have different learning requirements. Programs tailored to the needs of one industry are therefore unlikely to be totally suitable for firms in other industries. Intermediary agencies with sectoral experience may assist in locating appropriate support for companies in the industry. In the case of Singapore's LETAS scheme, delivery of the incentives is devolved to sectoral agencies that are familiar with the requirements of firms in their industry.

In order to deliver a comprehensive 'system' of financial incentives there is a strong case for more deliberate coordination and integration of existing incentive schemes in a national strategy.

Recommendation 14:
A single government agency such as the Office of SME Promotion should be identified as the first point of contact for all schemes providing financial incentive for R&D, technology acquisition and development, and technical skills and training. The agency should have the task of publicising the schemes and disseminating information on eligibility, guidelines for funding etc. and for coordinating applications. Administration of the schemes would remain with existing Department (such as BOI and MOF schemes).

Appropriate industry liaison bodies should be co-opted to deliver information on the schemes to their members/constituents.

4.5 The drive for national competitiveness

Enhancing industrial technology capability is a critical prerequisite for developing competitiveness among Thai firms. The system of incentives discussed in this report and the proposals for enhancing the present system should be a central feature of the national competitiveness policy.

> **Recommendation 15:**
> We recommend that a 'policy forum for technology development incentives' be established with representatives of all key agencies involved in the delivery of financial incentives for technology and skills development. The IDF and OSMEP would be appropriate agencies to initiate such a forum that should also have strong private sector representation. The forum should undertake to coordinate the scope and delivery of the incentives, and develop a strategy for comprehensive monitoring and evaluation of the schemes. It should also undertake to advise the National Competitiveness Committee and the Office for SME Promotion on the scope and impact of the financial incentives system and the level of financial resources required to support an effective incentives regime.

Technology and skills development within Thai firms is a critical prerequisite for national competitiveness. Because of the urgent need to coordinate and generate greater efficiency and impact of public investments in raising technological capability in Thai firms we believe the National Competitiveness Committee should take on the task of establishing and chairing this forum. Because the NCC is not an implementing agency it would ensure neutrality is maintained in chairing the forum.

Among the most immediate and pressing tasks for such a committee will be to develop an information base. This should have two elements: one directed toward program managers in firms; and another directed toward program managers of incentive schemes. The former could provide on-line access to managers in firms to assist them in identifying their technological problems and strategies for implementing improvements. The latter would enable scheme managers, also through an on-line service, to identify changing patterns and demands for services, successful versus less successful activities and practices, and areas where large and small firms are forming industry clusters. In addition it will assist them through sharing problems associated with targeting, program delivery and evaluation as well as developing strategies for dealing with them.

In order to provide for comprehensive and coordinated monitoring and evaluation of schemes across the system the above committee should seek to develop an evaluation framework to guide periodic and ongoing scheme-based monitoring and evaluation. A useful model is the evaluation framework recently developed and refined by the Australian Department of Education, Science and Training.

Throughout this report we have placed a strong emphasis on the need to target financial incentives toward critical technology thresholds in Thai firms. At a general level Phase 1 of this study identified an urgent need to enhance design and engineering capabilities in ***many*** large domestic firms and ***most*** Thai SMEs. Evidence collected through this project supports that observation. However, we believe that

further careful targeting can be directed toward the five industry priorities already identified by the NCC. In Chapter 3 we outlined a set of criteria for targeting financial incentives across sectors, firms and activities. An analysis of the critical technology thresholds in each of these five national priority areas would allow for more specific application of these criteria in areas where national priorities have already been defined. In order to maximise impact in these areas we propose that a study is undertaken to identify critical technology thresholds across each of sub-sectors comprising the five priority industry clusters. This will ensure incentives build on efforts and achievements already underway in the private sector. The study should also be carried out in collaboration with SDF in order to more effectively target and align incentives for skills and technology development.

4.6 Conclusion: an action agenda

The recommendations for revising the technology development incentive schemes presented in this report involve a range of agencies involved with their planning, delivery and evaluation. The complexity and fragmentation inherent in the present structure was illustrated in Exhibit 8. In order to achieve the changes proposed here we suggest an action plan that identifies key agencies responsible for some action on each recommendation. We group these under the following agencies: NSTDA; BOI; the Office for SME Promotion; the Skills Development Board; the Innovation Development Fund; the Thailand Research Fund; and the Department of Revenue.

NSTDA

Recommendation 9:

Action: *In collaboration with the Office for SME Promotion, design a program for the implementation and finance of 'innovation credits for design and engineering' available to SMEs along the lines described above and to seek the support of the National Competitiveness Committee and the Office for SME Promotion. The innovation credits scheme could be initially implemented within current budget constraints by targeting only key national priority industry sectors. The scheme could be progressively extended into other areas.*

Recommendation 10:

Action: *Explore options with the Budget Bureau for budget flexibility to transfer funds between schemes according to private sector demand.*

BOI - MOI

Recommendation 11:

Action: *In collaboration with NSTDA, coordinate the promotion, delivery and evaluation of grants-based schemes available through NSTDA and DIP and in particular to link large firms promoted through the BUILD program to the support*

and delivery of training for technology development in smaller firms and groups of smaller firms.

Recommendation 13:

Action: *In collaboration with NSTDA, propose a target budget in the S&T Action Plan for increasing technology capabilities to support innovation credits at a level approaching 15 percent of the national S&T budget.*

Office for SME Promotion,

Recommendation 7**:**

Action: *Promote the programs of matching grants offered through NSTDA and DIP to enhance accessibility for SMEs.*

Recommendation 12**:**

Action: *Investigate the potential role of the SME bank, or other financial agency to be contracted to act as administrative intermediaries between the private sector claimants for grant-based incentives and public sector funding.*

Recommendation 14:

Action: *Establish a first and single point of contact for all schemes providing financial incentive for enhancing technology and skills development for SMEs.*

The Skills Development Board

Recommendations 1 - 4:

Action: *Introduce mechanisms for involving the private sector in the design and delivery of training, to introduce flexibility appropriate for SMEs, carrying out research and planning, and responding to private sector training needs.*

The Innovation Development Fund

Recommendation 8**:**

Action: *To carry forward with NSTDA and BOI a plan for coordinating the delivery of matching grants (or credits) and identifying responsibilities for collecting information, promoting schemes and carrying out systematic monitoring and evaluation.*

Recommendation 15:

Action: *In collaboration with OSMEP and NSTDA, establish a 'policy forum for technology development incentives comprising key agencies involved in the delivery of financial incentives for technology and skills development. The Forum should carry out an initial set of tasks concerning coordination of information, promotion and evaluation.*

IDF, OSMEP and NSTD should take the first initiative to develop a proposal for the NCC to support a study to investigate technology capabilities in key industry sub-sectors comprising the five national industry priority clusters. This should be developed and carried out in collaboration with the SDF.

Thailand Research Fund

Recommendation 6

Action: *Extend matching grants to Thai firms to support technology development activities as well as research matching grants (see page 47).*

Ministry of Finance - Department of Revenue

Recommendation 5**:**

Action: *Remove the registration requirement on firms for eligibility for the 200% R&D tax concession.*

Recommendation 6:

Action: *Extend the allowance for the 200% a tax concession to design and engineering activities that contribute to enhanced productivity and competitiveness for SMEs, but not necessarily directly emerging from R&D.*

We believe that this action and the implementation of these recommendations will significantly improve the system of financial incentives for enhancing Thailand's industrial technological capabilities. However, we concur with the observation made in Phase 1 that 'financial incentive mechanisms, however they are designed, will not on their own induce radical change in attitude and behaviour'. The incentive regime must be embedded in, and articulated with, Thailand's broader strategies and institutions for scientific and technological development and national competitiveness. In particular, they should be consistent with and build on the efforts already underway within firms in Thailand. We believe the recommendations offered from this study will contribute toward that aim.

Finally, the recommendations and action identified above are focused on bringing about some immediate change by stimulating demand for technology development in the private sector. This approach, following international experiences, also contributes

to the longer term objective of transferring the benefits from technology enhancement in the private sector to Thai society more generally. We therefore draw attention to the need to complement the recommendations made in this report with longer term strategies for improving S&T education in primary, secondary and higher education throughout Thailand.

Attachment 1

Table A1: Administrative benefits and constraints on different forms of financial incentive for research and technology development

Assistance measure	*Benefits*	*Possible constraints*	*Budgetary/Administrative/Legal issues*
Tax concession	Non-discriminatory: open to all firms that meet stated criteria. Businesses more likely to be aware of taxation benefits. 'Arm's length' instrument: activities chosen by industry. Maintenance of firm confidentiality. Speedy processing (where approval 'automatic').	Of no benefit to unprofitable/start-up firms. Subsidises 'existing' activity that would have occurred anyway (unless based on incremental performance, which is hard to police). Abuse eg 'double dipping' – if firms also eligible to claim loans or grants. Selection criteria may encourage risk aversion to achieve short-term repayment.	Cost is open-ended (difficult to control the level of revenue foregone). Relatively simple administration. Does not require annual approval of budget. Usually requires changes to taxation legislation. Requires careful accounting of eligible costs within the firm. Problems of definition and legal interpretation arise.
Repayable loans	Can be targeted widely or for focused activities. Priorities or scope (type, timing, size) set by govt., specific proposals made by firms.	Less likely to subsidise activity that would have occurred in any case. Formal application may be required. Cumbersome and lengthy selection procedure.	Maximum cost can be set, but actual cost hard to determine. Requires annual budget. Requires formal procedure for application and selection. Difficult to decide what constitutes a successful outcome for the purpose of repayment – clear criteria required.
Grants	Generally for focused activities. Priorities or scope set by govt., specific proposals made by firms.	Less likely to subsidise activity that would have occurred in any case. Formal application required. Cumbersome and lengthy selection procedure.	Annual cost is set. Requires clear criteria for selection and evaluation of outcomes. Requires formal procedure for application and selection.

Table A2: A framework for assessing the coverage of grant-based government assistance for technology capability development within firms

Objective	*Types of assistance required*	*Example of foreign schemes that provide such assistance*[21]
A. Assistance targeted at individual firms		
1. Strategic capabilities (awareness of the technological and business environment)	a) Business capability development b) Business and technology audits c) Mentoring by other firms or organisations; industry 'masterclasses' d) Awareness, visits to 'demonstration' sites, technology benchmarking etc e) Feasibility assessments	The Enterprise Initiative (UK) (a, b, e) National Technology Audit Program -NTAP (Irl.) (b) Benchmarking Index (UK) (a, b) SMART Scheme (UK) (e) LETAS (Sing.) (a, b, e)
2. Management of tangible technological resources (products, equipment, design)	a) Subsidies for R&D b) Subsidies for development of technology or for particular types of technology (e.g. ITC, biotechnology) c) Selection of plant and equipment d) Manufacturing consultancies e) Subsidy for adoption (purchase) of technologies (e.g. CNC, IT) f) Feasibility assessment - new product or process development	NTAP (Irl.) (c) SMART Scheme (UK) (b, c, e) Feasibility Grants (Irl.) (f) Steinbeis Foundation for Economic Promotion (Germ.) (d) LETAS (Sing.) (d, f) R&D Start (Aust.) (a, b) SDF (Sing.) (b)
3. Management of intangible technological resources (knowledge, skills and training)	a) Quality programs b) Placement of skilled personnel within firm (e.g. secondment of postgraduates, technicians or technical managers, graduate recruitment, salary subsidy) c) Loan/secondment of R&D personnel d) Training needs/strategy analysis e) Training course subsidies f) Secondment of firm's personnel to other firms/organisations	Techstart and Techman (Irl.) (b, c) KIM (Netherl.) (b) Engineers to Japan (UK) (f) LETAS (Sing.) (a, d) R&D Start (Aust.) (b) SDF (Sing.) (d, e) HRDF (Malay.) (d, e)

[21] The basic structure and examples are taken from Arnold et al (2000), modified and extended by the current study. The European examples herein are also from the Phase 1 report, pp. 147-170, where details of each scheme mentioned may be found.

Table A2 (cont.)

4. Organisational structures and assets	a) Technology management courses b) Technology management consultants	R&D Management Scheme (Irl.) (a) LETAS (Sing.) (b)
5. Linkage and networking capabilities (ability to access external knowledge, to manage user-producer relations, to form alliances with partners)	a) Subsidies for use of external consultants or expert services b) Subsidies for use of university or GRI staff c) Subsidised access to GRIs and quality/testing/standards facilities d) 'Innovation credits' allowing firms to purchase services from a range of providers	Innovation Vouchers scheme (UK) (d) LETAS (Sing.) (a) HRDF (Malay.) (a)
B. Assistance targeted at groups of firms and technology organisations		
Linkage and networking capabilities	a) Subsidised and/or facilitated R&D or technology development collaborations or networks b) Support for university-industry GRI collaboration c) Technology transfer or brokerage (GRI-industry; university to industry, firm to firm) d) Industry associations, and their firm networks e) Technology centres, tech. Parks f) Liaison offices and information services g) Support for firm's 'supplier development' programs h) Public procurement i) 'Partner search' programs j) Firm to firm network programs (e.g. MNC-SME, SME networks) k) Support for technology demonstration projects and publications/information diffusion l) Personnel exchanges between firms	BTS and predecessor schemes (Netherl.) (a, b, g, j)) Steinbeis Foundation for Economic Promotion (Germ.) (c. j) Technologie Transfer Ring Handwerk (Germ.) (c, d) Programs in Advanced Technology PATS (Irl.) (b, c). FMW (Germ.) (b, c, l) RUK (Indon.) (b) LETAS (Sing.) (f) SDF (Sing.) (d, j) HRDF (Malay.) (j)

Attachment 2:

Diagnostics for Reviewing the System of Schemes

1. International Benchmarking

- Scope of scheme by comparison with international best practice.
- Scale (budget, coverage) of scheme by comparison with international best practice.
- Impact of scheme on the client population by comparison with international examples.

2. Clarity of Structure and Goals

- Presence of clearly defined objectives for the scheme.
- A clearly defined client base (target population) for the scheme.
- Degree of awareness of scheme and its components on the part of putative clients (target population).
- Absence of countervailing schemes (e.g. other incentives that make this incentive less attractive or unattractive to clients).
- Absence of overlap with other incentive schemes.
- Unambiguous definition of activities covered, eligibility criteria, guidelines for applicants etc.

3. Effective Management

- Good procedures and management practices in place
- Transparency of administration
- Funds allocated by an expert panel.
- Scheme is managed by a dedicated, expert secretariat familiar with technological innovation.
- Presence of explicit performance measures or indicators for the scheme.

4. Client and Scheme Performance

- Number of clients (by comparison with the target population). Is demand for the scheme growing?
- Quality of applications; success rate of applications (grants as proportion of applications)
- Evidence of user satisfaction (grant/loan recipients) with scheme.
- 'Success stories' of projects/companies supported by the scheme.
- Expenditure of funds as proportion of allocated budget.
- Existence of any evaluation (internal or external) of the effectiveness of the scheme.
- Effective use of resources: Scheme operating costs as a proportion of total scheme budget; Program operating costs per client.
- (For loans) rate of recovery of loan funds.
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Attachment 3

Exhibit 11: Examples of Skills development incentives in Singapore

Environment:

- Singapore has a sound education system, with a bias to early vocational training.
- A range of public and private training providers operates in competitive environment.
- A range of human resource development programs apart from the SDF is in place.
- Skills Development Fund: Financing and Administration
- Its SDF is long-standing: established 1979 under the National Productivity Board, Trade and Industry Ministry.
- The SDF has evolved: originally established with employer subsidies; moved to planned training priorities, 1987; adopted an SME focus, 1992.
- It is funded by a 1% employer levy on low-paid, unskilled workers; At times the levy has been set higher: at 2% (initially) and 4%.
- Its budget in 1996-7 was S$86 mill.
- Most of its budget comes from industry funding and interest on invested funds; only 2% is from government funds (1991 figures). However, expenditure is currently exceeding the amount raised from levies; and government 'tops up' the Fund.
- Assistance is provided on a cost sharing principle: SDF pays 50-80% of cost, employers pay 20-50%.
- It has provided grants for more than 500,000 training places.
- In 1990, 30,000 approvals were made; a 90% success rate.
- It requires prior approval for programs and involves a 2-year wait for reimbursement in some cases.
- Monitoring and evaluation are carried out at three levels:
- Macro-level (skills shortages, redundancies)
- Program level (various performance indicators)
- Firms/trainees (client quality control/tracer studies)
- The SDF manages a broad portfolio of schemes/programs.

SDF Schemes & Programs

- Training Grants
- Training Leave (for unskilled mature workers)
- Training Vouchers (all firms are eligible)
- Worker Training Plan (to support a firm-level approach to training)
- Training Needs Analysis Consultancy Scheme (assistance with training strategy for locally-owned firms)
- Approved-in-principle Scheme (pre-accreditation of public courses, making it easier for firms to use them)
- Emerging/Critical Skills Development Grants (eg in nominated priority areas like robotics, wafer fabrication, health care)
- Basic Education for Skills Training - BEST (providing fundamental functional literacy/numeracy, to 'Year 6' level).
- Worker Improvement Through Secondary Education - WISE (English, Maths)
- Training Infrastructure Development
- Partnerships with MNCs to set up industry-specific training centres.
- Financial assistance to trades union groups for training.

Exhibit 12: Examples of Skills development incentives in Malaysia

Environment:

- There is strong industry involvement in training, especially with MNCs as partners.
- In several cases, an effective regional focus has been successfully created (eg the Penang Skills Development Centre, where 'competing companies pool their resources').

Malaysian HRD Fund and Council: Funding and Administration

- HRD Fund and Council were in established 1992; under the Ministry of Human Resources and have been in operation since 1993.
- Council comprises 14 members: 8 from industry, 4 from government, and 2 independent (i.e. a non-government majority).
- The Fund covers all manufacturing and selected service industries.
- There is a mandatory 1% levy on the payroll of firms with 10 or more staff which have high capital assets (50 or more staff in manufacturing).
- In addition, there is an optional 0.5% levy on manufacturing firms with 10-50 staff which have low capital assets.
- The budget is MYR 50 mill. of levy/interest funds, plus MYR 16 mill. government funds
- The levy is collected through the commercial banking system.
- Grants defray partial costs. Firms can reclaim the levy they paid in each year, up to 75% or 80% of the costs of training.
- Eligibility for grants/loans
- Firms must be registered (i.e. they must be levy-payers and up-to-date with their payments; levy defaulters are barred from receiving support).
- The trainees must be Malaysian citizens.
- The training mode must be approved by the HRDC, although there is some 'pre-approval' of training providers, training courses and, importantly, firms' own annual training plans.
- Eligible skill areas are defined, but quite broad. The overriding criterion is that training must be of direct benefit to the business.

Malaysian HRDF: Schemes and programs

- SBL: Grants for all types of firm-based training for registered firms.
- SBL Pre-Approved: As above, for regular in-house programs. For example, induction courses for new recruits do not require individual approval if the content is the same.
- PROLUS: Reimbursement for recognised external training courses. There is a register of approved providers / training programs from both the public and private sectors.
- PERLA: Companies pay 20-25% of course fee to the approved provider, the HRDC pays balance to provider. This is particularly useful for SMEs who do not have to provide the money 'up front'.
- JURUPLAN: Provides assistance from consultants in developing the firm's annual training plans (HRDF meets 50-70% of the cost of the consultant).
- PLT: Provides blanket approval of firms' annual training plans
- SLB: Supports joint in-house training schemes, i.e. cooperation in training provision between firms, especially between SMEs and MNCs.
- Apprenticeship scheme: eg mechatronics/electronics; hotel industry (100% cost)
- Industrial automation for manufacturing workers: external providers (95% of costs for approved courses).

Attachment 4: (A) Table on Financial Incentives for R&D Technology Development and Innovation in Thai Firms

Note: The information in this table is presently being compiled and checked as part of a project being carried out by Wollongong University and the Brooker Group for the National Science and Technology Development Agency with financial support from the World Bank. It represents a work in progress and will be a key input into the final outputs from the project designed to enhance the financial incentive system to support industrial competitiveness in Thailand.

1. Office of the Prime Minister

Institution	***Scheme***	***Mechanism***	***Objective***	***Current Legislation***	***Private Sector "Take Up" Budget***	***Monitoring System***	***Critical Issues***
1.1 Office of the Board of Investment (BOI)	Promotion for R&D Activities – Activities 7.12 Promotion for Scientific Laboratories – Activities 7.13 Promotion for Calibration Services – Activities 7.14 Promotion for Educational Institutes or Vocational Training Centers – Activities 7.15.1	• Tax-based incentives: tax holidays (scale of incentives are subject to location of activities whether located in special investment promotion zones, nature of production – export, or engaging in industries identified as Priority Activities • Non-tax privileges: guarantees, protections, permissions, and services (regardless of location) • Income tax concession on the payment for Goodwill, Copyright, Patent, Trademark, Royalty, Know-how, etc. • Tax-based incentives: 8 year income tax holidays or tariff exemptions, without zoning issue (only for activities) • Income tax exemption dividend derived from the promoted activities	• To promote firm based R&D • Encourage firm based R&D • Encourage technology acquisition	• Section 28-31, 33-36 of the Investment Promotion Act, B.E. 2520 • Board of Investment Announcement 1/2543 • BOI Notification No. Sor. 11/2532 • BOI Announcement No. Por 13/2544	(1996-2000) Average investment = 77.25 million Baht per project 17 firms approved	• Submission of balance sheet to BOI by firms once a year • Site inspection at the beginning of the project and when requesting for project expansion	• Private investo[illegible] not enthusiasti[illegible] • Incentives pro[illegible] for R&D activ[illegible] are quite simil[illegible] general BOI incentives gra[illegible] to other activi[illegible] • Focused primarily on services for firms rather than in firms – • Difficult to predict budget implications in advance • Incentives offered by other countries are more customized and attractive • Lack of qualified researchers

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
2. Ministry of Finance							
2.1 The Revenue Department	R&D Machinery and Equipment Depreciation	40% depreciation rate of the cost of machinery/ equipment on the acquired date in the first year, and lower as indicated in general accounting practice in the following years	• To promote R&D activities by reducing tax burden • Encourage firm based R&D	• Section 65 bis (2) of the Revenue Code, • Section 4 bis of Royal Decree No. 145, B.E. 2527 • Director-General Notification on Income Tax No. 48	N/A	• Non specific monitoring system for firms applying the scheme – only general tax assessment system available	• Focused ma on firms alre capable of carrying out their own R
2.1 The Revenue Department	Tax Concession for R&D Expenditure	• Applicable to certified bodies (total number of 34): ➢ Subordinate research unit ➢ Independent research unit/ company ➢ University laboratories and government research organizations • 200% of R&D expenditure for tax computation • Project certified by NSTDA	• Encourage firm contracting out R&D projects • Promote local R&D firms/ units	• Section 3(1) of the Revenue Code, • Royal Decree No. 297, B.E. 2539 • Ministry of Finance Notification on Income Tax No. 3, dated 16 December B.E. 2539 • Departmental Instruction No. Por 103/2544	(2001-April 2002) • 132.8 million Baht approved (9 projects) • 296.2 million Baht under consideratio n (9 projects)	• Following up with firms by NSTDA on progress of the project	• Long timeli for assessme processing a approval • Only few fi participating • Concern am firms over criteria for eligibility • Difficult to predict budg implications advance
Institution	*Scheme*	*Mechanism*	*Objective*	*Current*	*Private Sector*	*Monitoring*	*Critical Issue*

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				Legislation	*"Take Up" Budget*	*System*	
2.1 The Revenue Department	Tax exemption for training providers	• Certified training providers are allowed to have tax exemption for generated profits	• To promote training providers	• Section 3(1) of the Revenue Code, Royal Decree No. 284, B.E. 2538	N/A	N/A	
	Tax Concession for Training Expenditure	• 150% tax concession for expenditure on employee training ➢ Training with the Department of Skill Development ➢ In-house training approved by the Department of Skill Development	• Promote training through certified training institutions	• Section 3(1) of the Revenue Code, Royal Decree No. 298, B.E. 2539	(1996-2000) Average 175 Million Baht a year or 1.16 million Baht per firm	N/A	• Lack of skill development policy to meet industry's n • Difficult to predict budg implications in advance
2.2 The Customs Department	Deduction/ Exemption of R&D Machinery Import Duties	• Scientific tools: 30-40% to 5% or less • R&D chemical substance: 30% to 5-20% • Environmentally sound and economically machinery: 30-40% to 5% • Computer and computer parts: 20-40% to 5-1% • Electronics Parts: 35% to 1% • Scientific education equipment: tax exempted • R&D testing equipment: 15-35% to 5%	• To encourage technology acquisition • To reduce cost conducting R&D			N/A	• Approval process of deduction/ exemption o import duty takes long time

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
2.4 EXIM Bank	• Term Loan for Machinery Upgrading ➢ Machinery upgrading ➢ Replacement of used machinery • Modification of machinery	• Soft loan with 5-7 year repayment term • Loan not exceed Baht 200 million	• To promote production capacity for exporters		(2000) 4.79 billion Baht	N/A	• Available for exporters only
2.5 Small Industry Credit Guarantee Corporation (SICGC)	Credit Guarantee	• Guarantee unsecured credit but not exceeding 50% of the total credits with the lender • Maximum guarantee amount not exceeding Baht 40 million for each enterprise • Annual fee at 1.75% of guaranteed amount, payable in advance	• To assist SME lacking fixed assets to guarantee loan to be able to obtain more loan from commercial banks	• Section 11, 12(1) and (9) of the SICGC Act, B.E. 2534	Total outstanding loan in 2000: 755 million Baht		• Fees considered high • Not well known to SME

Institution	**Scheme**	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
3. Ministry of Science, Technology and Environment							
3.1 Permanent Secretary Office, MOSTE	Revolving Fund for Technological Research and Development	• Soft loan for R&D ➢ Baht 10 million loan per project ➢ 2.5% interest rate ➢ less than 8 years maturity • Soft loan for building up laboratory ➢ Baht 10 million loan per project ➢ MLR-4% interest rate ➢ less than 8 years maturity • Soft loan for production process development and R&D commercialization ➢ Baht 10-20 million ➢ MLR-3% interest rate ➢ less than 5 years maturity	• Conducting technological R&D project which must be able to commercialize • Provision of laboratory equipment or building up laboratory • Product and process development/ improvement • Commercialization of R&D results		(1997-2000) Average 62.2 million Baht a year	• Site inspection by a sub-committee	• Fixed interest rate is not attractive particularly after the crisis when interest was lowered • Long administrative process • Limited information available • Small firms cannot find sufficient collateral • Too small amount for large firms • Gradual decline in the number of project approval at the beginning decreasing to 1 at present)

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Institution	***Scheme***	***Mechanism***	***Objective***	***Current Legislation***	***Private Sector "Take Up"***	***Monitoring System***	***Critical Issues***
3.2 National Science and Technology Development Agency (NSTDA)	Innovation Development Fund	• Grants ➢ For projects in stage of prototype, pilot plant, pre commercial, full scale trial or commercial start up ➢ Not more than 50% of total budget proposed by the team and lesser than Baht 10 million ➢ Recover grant after the project has been commercialized (full amount repayment or monthly royalty fees • Soft loan and investment funds ➢ Focusing on projects requiring financial support of more than Baht 10 M • Technical Support ➢ Provide assistance in project development ➢ Conclude the project and disseminate information ➢ Technical training ➢ Hire experts for technology transfer ➢ Reengineer business process & management	• Focusing on business innovation/ development projects • To support private sector design and create prototype • To provide expertise to private sector • To promote market survey to acquire basic information for innovation • To provide initial fund for commercializing innovative products	• Section 12 of the NSTDA Act, B.E. 2534 • NSTDA Regulations on the IDF Management, B.E. 2542	(1997-2000) Average 9.93 million Baht a year (26 projects approved)	• IDF manageme nt committee to report project progress and expenditure to NSTDA board every 3 months	• Very little uptake • Unavailability of matching fund as a result of firms' non performing loan (NPL) status • Project evaluation criteria is very strict • Lack of understanding of R&D capability [?]in firms • Lack of capability in evaluating projects in business aspect

Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
3.2 National Science and Technology Development Agency (NSTDA)	Standards, Testing and Quality Control: STQC • Technical Assistance for Productivity Improvement • In-house and public training • Consultancy services • Advisory services on ISO9000	• Consultancy services and technical assistance •	• To promote firms acquiring international standards for productivity improvement	• Section 12, NSTDA Act, B.E. 2534	N/A		N/A
	Thai Foundation Quality System Standard (TFQS) Development Project	50% support of expenditure occurred from TFQS quality system standard set up but lesser than Baht 30,000	• To promote firms acquiring industrial standard for firms not able to acquire ISO9000			Monitoring by an auditor	• Strong commitment from particip firms to devo the project • Firms have to place a deposit to guarantee their commitment, unless it will be forfeited

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
3.2 National Science and Technology Development Agency (NSTDA)	➢ MTEC ➢ BIOTEC ➢ NECTEC	• 100% of expenditure grant for research projects in universities, lesser than Baht 5 million • 75% of expenditure grant for basic research by private sector • 50% of expenditure grant for research that is almost ready for marketing	• To promote private and public sector doing R&D and innovation	• Section 12, NSTDA Act, B.E. 2534		N/A	• Competing w other institu offering sim schemes eg. TRF, IDF

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Institution	*Scheme*	***Mechanism***	***Objective***	***Current Legislation***	***Private Sector "Take Up" Budget***	***Monitoring System***	***Critical Issues***
3.2 National Science and Technology Development Agency (NSTDA)	Company Directed Technology Development Program: CD • Financial Support to Private Sector Promoting R&D and Innovation	• Soft loans ➢ Maturity lesser than 7 years ➢ Supported by financial institutions participating in the project ➢ Government supports 2/3 of the total loan while the rest is supported by participated financial institution (not more than 75% of the project value and lesser than 30 million Baht) ➢ Private sector has to invest not lesser than 50% of the total investment ➢ Interest rate = (Reference Rate + 2.25%) / 2 • Grants ➢ Grant not more than 50% of total investment and lesser than Baht 3 million per project ➢ 67% grant of total investment, but lesser than Baht 3 million per project is available in some cases ➢ Repay the loan when research results could be commercialized ➢ No longer available	• To promote and support R&D and engineering in private sector • To stimulate private sector innovate new products by providing grants and soft loans to reduce R&D risks	• Section 12, NSTDA Act, B.E. 2534 • NSTDA regulations on project approval for 1) soft loan and 2) grants	(1996-2000) Average amount • NSTDA's investment: 52.47 million Baht • 39 projects approved • NSTDA's investment: 5 million Baht *(No project approved in 1996)*	Monitoring every 6 months by ITA and experts	• Firms still ha to invest hal R&D cost • Difficulty in guaranteeing principal • Issues of intellectual property rigl who will pro the IPR; allocation of benefits fron research rest • Main emphasis on firms already with R&D capability. • Similar schemes are also provided by other agencies eg. TRF, ID

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
3.2 National Science and Technology Development Agency (NSTDA)	Industrial Technology Assistance Program (ITAP) – (formerly known as ICS)	• Grant not exceeding 50% of the total expenses and within Baht 500,000 supporting expert fee in conducting technology development program	• To enhance production capability in SMEs through use of consultants	• Section 12, NSTDA Act, B.E. 2534	(1996-2000) Average 8.77 million Baht a year	Evaluation during the beginning of the project with interim monitoring that incorporates comments from experts and firms. At the end of the project, a report submitted by firms	• Firms have to advance the expenditure and taking time to be reimbursed • Language barrier between foreign consultants and Thai firms • Implementation of recommendations is still a problem • Firms' attitudes towards their competitiveness when the same consultant provide services to their competitors
	Support for Technology Acquisition and Mastery Program: STAMP • Technology Site Visit • Technology Acquisition • Appropriate Technology Sourcing	• Grants supported for airfare	• To support technology acquisition and technology transfer		(1996-2000) Average 1.03 million Baht a year		Controversial issue whether traveling is work or pleasure

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Institution	**Scheme**	*Mechanism*	**Objective**	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
3.2 National Science and Technology Development Agency (NSTDA)	Intellectual Property Services: IPS • Consultancy Services • Training/ Seminars • Intellectual Property Application Filing Services	Free of charge except IP application filing services	• To promote registration and protection of intellectual property rights	• Section 12, NSTDA Act, B.E. 2534 • NSTDA Regulations on the Registration and Benefits of Intellectual Property, B.E. 2543		N/A	N/A
	NSTDA Investment Center (NIC)	• Joint-venture with private enterprises in science and technology investment that is vital to the country • Investment by NSTDA should not be more than 49%	• To develop feasible technology investment project	Section 12, NSTDA Act, B.E. 2534		Profitability of firms	Investment ma be profitable o loss
3.3 Thailand Institute of Scientific and Technological Research	Laboratory Services	• Scientific analysis • Product testing • Product standardization	• To initiate and provide S&T service	• Section 6(1),(3),(4) and (5) of Thailand Institute of Scientific and Technological Research Act, B.E. 2522			
	Research and Development Services	• Research and development • Manufacturing process design and development • Consultation					
	Technology transfer	• Transfer of technology to rural areas • Disseminate information to researchers and stakeholders					

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
4. Ministry of Industry							
4.1 Thailand Productivity Institute	Public and in-house Training Courses	• Provides training to public • Training cost subsidized by government	• Human resource development for productivity improvement				
	Consultation Services	• No charge					
4.2 National Food Institute	• Training • Laboratory Services						
4.3 Thai Automotive Institute	Testing						
	Supplier Development Program	• Applicable to SMEs • Group consulting: supporting funds of Baht 200,000 for expert fee per factory • Individual consulting: supporting funds of 75% but lesser than Baht 200,000 for expert fee per factory					
	Training Enhancing Automotive Parts Design Capabilities Program Japanese Technology Transfer Program: supported by JETRO, JICA, JODC, NEDO						

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up"*	*Monitoring System*	*Critical Issues*
4.4 Electrical and Electronics Institute	• Product testing and calibration services • Training						
4.5 Thai German Institute (Thailand)	Training • Automation Technology • CNC/ CAD/ CAM Technology • Tool & Die Technology • Energy Management • Plant Maintenance	• Funding supported by the German gvt, MOI and Thai and German private sector • Short modules • Teaching factory • Small group teaching • Hi-tech equipment training • In-plant training	To train technicians in Advanced Manufacturing Technology to become high skilled	Cabinet Resolution on September 12, 1992			Need to link monitoring, evaluation and promotion with other similar schemes
	Industrial Consultancy Services • HRD advice • Training needs assessment • Design of machine process prototypes • Advice on reducing production downtime, maintenance and running costs • Advice on upgrading production/ processes	Funding supported by the German government and MOI					

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
4.6 Department of Industrial Promotion	Invigorating Thai Business Program	• Grants supporting expert fees ➢ 90% for firms with less than 100 employees ➢ 80% for firms with more than 100 employees	• To assist SME in solving technical and management problems				Similar scheme are offered with the same department
	Consultancy Service	• Grants supporting expert fees – 20% of the total budget but lesser than Baht 200,000			(2000-2001) Average 7.89 million Baht (25.45% of total budget allocated)	• Timesheet from the consultants • Progress report every quarter • Site visit during the project	Similar scheme are offered with the same department
	Project 13	• Grants supporting expert fees – 50% but lesser than 200,000 Baht				• Report by consultants	Strictly abide b fiscal year Group consulta may not be ver effective and cannot serve every firm's needs
	MDIC	• Grants supporting expert fees – 2/3 of the cost but not more than 900,000 Baht					
	Training Fund	• Grants support 50% of training cost directly to consultant but lesser than 150,000 Baht		• To promote training for firms	Budget allocated in 2002 was Baht 10 million		

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
5. Ministry of Labour and Social Welfare							
5.1 Department of Skill Development	Skill Development Fund	Soft loan for trainees, 1% interest rate, for training expenses and personnel expenditure occurred during the training	• To promote employees receive more training	N/A			
	Training • Basic Training • Skill Upgrading Training • Skill Certification	• Provides skill development training • Cost of training subsidized by the government	• To provide training for non-skilled and skilled workers	• Section 13, Vocational Training Promotion Act, B.E. 2537			

Institution	**Scheme**	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
6. Independent Agencies							
6.1 Technology Promotion Association (Thailand-Japan)	• Industrial Instrument Calibration Services ➢ Electrical ➢ Pressure ➢ Mass & Balance ➢ Temperature ➢ Guage Block ➢ Humidity ➢ Length	• Technology supported by TPA members • Subsidized by funds supporting TPA from MITI	•	•			Need to link monitoring, evaluation and promotion with other similar schemes.
	• Training Services to suit the needs of Thai Industry ➢ Management Technology ➢ Industrial Technology ➢ Technological Information Center	• Technology supported by TPA members • Subsidized by funds supporting TPA from MITI	•	•			

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Institution	*Scheme*	*Mechanism*	*Objective*	*Current Legislation*	*Private Sector "Take Up" Budget*	*Monitoring System*	*Critical Issues*
6.2 Office of the Thailand Research Development Fund	Industrial Research Support Scheme: Medical Equipment Project; Jewelry and Ornament Industrial Development: SME Project; Agricultural Machinery and Industry; Textile Industrial Development; Para Rubber Industrial Development; General Production Development; Wood and paper Pulp Industrial Development; Industrial Research Associate Support Program; Industrial Projects for Undergraduate Students	• Non specific amount of supporting grants but also require investment from the private sector (at least 20% of the total project value) • Technical assistance by providing experts preparing project proposals • Grants not exceeding Baht 50,000 for issue identification and additional Baht 50,000 for project proposal preparation	• To promote research and development in industrial sector for technology upgrading, both production and management • Emphasis on SME at the beginning stage	• Section 6(1) of Thailand Research Development Fund Act, B.E. 2535	(1992-2000) Average TRF Investment: 39 million Baht Private Sector Investement: 16 million Baht	• Site visit or presentation on progress of the project to project committee by funded researchers every 6 months	• Requirement public sector researchers' participation granted projects • Available budget is lesser than firms' demand • Researchers do not have concern on duration of research project while firms do • Private sector investment in the scheme is not qualified to apply for 200% tax deduction scheme

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