TDRI Quarterly Review
Published in *TDRI Quarterly Review*
Vol. 7 No. 4 December 1992, pp. 36-39
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The Development of Thailand's Technological Capability in Industry*

Executive Summary

In recent years, Thailand's economic growth has been impressive, with Gross Domestic Product (GDP) rising from 3.5 percent and 4.5 percent in 1985 and 1986 respectively, to 8.4 percent and 11 percent in 1987 and 1988. According to the National Economic and Social Development Board (NESDB), the sectoral shares of GDP in 1988 reached 16.6 percent for agriculture and 24.8 percent for manufacturing.

Growth over the last decade has been attributed to the country's macroeconomic stability and to a steady shift from that of a traditional-commodity-based economy toward one that is manufacturing and services oriented. Factors favorable to the current economic boom are generally perceived as being short-term trends. These include a relatively efficient and low-wage labor force to gain price competitiveness, as well as some strong pressures to shift and relocate manufacturing bases away from Japan and many Asian newly industrialized economies (NIEs). As continual and sustained growth would normally entail producing high value-added products and services, in turn requiring the introduction of new or more-sophisticated production techniques, equipment or services, there is rightly cause for concern that, without such diversification away from the country's traditional primary products and simple, labor-intensive exports, Thailand may soon be faced with intense competition from the many less-developed nations with cheaper labor.

That technology is an increasingly important element in international competitiveness, necessary to sustain a nation's economic growth, is well understood and widely accepted. It is, however, not merely a question of having the right technology alone. There is also the problem of being able to effectively absorb and deploy technology, and to make efficient use of available resources to produce better quality and lower cost products and services or, where demands arise, new types of products and services.

Thus, the question of the technological capability of a nation and its industry, and the strategies for enhancement of its technological capability to meet new demands, are of vital importance to maintain international competitiveness and to sustain healthy economic growth.

To this end, it is the central aim of this study to provide insights into the present status of technological capabilities in Thai industries, as well as to present a number of useful measures for determining the appropriate science and technology (S&T) strategies for Thailand.

AN ASSESSMENT OF THE TECHNOLOGICAL CAPABILITY OF THE FIRMS SURVEYED

A sample of 119 firms across three industrial sectors, which use the key technologies in biotechnology, materials, and electronics technology, was employed in this study. The technological capability (TC) of these firms was assessed by categorizing some 20 components into four types of TC: acquisitive, operative, adaptive and innovative, and by rating each with a score of between 0 and 5.

Acquisitive capability rated a firm's ability to search, assess, negotiate and procure needed technologies, and to install and start-up production facilities. Operative capability appraised the operation, control, and maintenance of production facilities, as well as skill development, production planning, and quality control. Adaptive capability concerned technology digestion and minor product and process modifications. Finally, innovative capability assessed the capacity to make radical product and process modifications, to carry out

in-house RD&E, and to invent new products and processes.

Of the four technological capabilities, operative capability was generally found to be the highest, followed closely by acquisitive and adaptive capabilities, while innovative capability not only fared poorest, but lagged far behind the other three. Such a pattern holds true for all the three industrial sectors.

FIRM ATTRIBUTES AND TECHNOLOGICAL CAPABILITY

Overall TC ratings appear to be affected more by type of industry, size, and ownership than by market orientation and Board of Investment (BOI) promotion status.

Large firms tend to possess higher overall TC than small- to medium-sized firms. In particular, large size appears to have significant associations with higher operative and adaptive capabilities, but only a marginal effect on acquisitive and innovative capabilities.

Joint-venture and foreign-owned firms tend to have the best operative capability. The same, however, cannot be said of the other capabilities. Many foreign subsidiaries and joint-venture firms rely on their parent firms to carry out the various innovative and acquisitive activities abroad. As a result, they tend to perform somewhat poorly in innovative and acquisitive capabilities compared with the average Thai firm, particularly in the electronics sector and to a lesser extent in the materials sector.

While both operative and adaptive capabilities tend to be influenced by firm size and ownership, innovative capability is influenced somewhat by ownership and market-orientation. The study found that firms producing mainly for the local market tend to possess better innovative capabilities in the materials and electronics industries, while the opposite is true for the biotechnology sector. On the other hand, acquisitive capability does not appear to have any clear pattern of association with firm attributes. Finally, the study found no significant difference in TC ratings between BOI-promoted and non-promoted firms.

MAJOR PROBLEMS IDENTIFIED

In the course of the study, a number of problems and limitations became apparent, which may directly or indirectly have a bearing on the technological capabilities of the industries under study. They are:

Inadequate Supply of Technical Human Resources

There appears to be a general shortage of S&T personnel, in particular of engineers, while the ability of S&T personnel is questionable, as newer technologies proliferate and push many existing technologies into obsolescence.

Inadequate Technical Information Services

The present technical information is inadequate, while available information is spread over many different sources, making access to information difficult. This is detrimental to the acquisition, adaptation, and development of technology, and to the upgrading of human resources.

Inadequate Technical Services

Most small- and medium-sized firms need, from time to time, outside assistance to assess technology, install and start-up new production equipment, as well as to provide relevant testing, analysis, and certification of products and processes. Available consultancy and technical services generally lack adequate standards and coverage.

Tax Structure

Import tariffs on testing and laboratory equipment for adaptive and innovative activities are prohibitively

high, making them less readily affordable, particularly to small-sized firms. Furthermore, multiple taxation is widely seen to deter subcontracting, which in turn considerably reduces the levels of industrial linkages and technology transfer.

Linkage to the S&T Community

Industrial firms tend to doubt the effectiveness of universities and public technical institutes to solve practical industrial problems. As a result, the latter have not been given sufficient opportunities to gain the relevant experience. Most of the S&T community's research and development (R&D) activities, therefore, continue to be mainly for their own academic interests or for public and state benefits only.

Attitude of Entrepreneurs

There seems to be a widespread absence of a proper perception of the benefits of human-resource development, preventive maintenance practices, R&D activities, and modern management techniques. Also, protected industries tend to be complacent because of the lack of competition.

MEASURES TO ENHANCE EFFORTS TO ACQUIRE AND IMPROVE TECHNOLOGY

S&T Manpower Development

Apart from finance and infrastructure, human resources are another critical component of developing technological capability, as technological capability is, after all, essentially embodied in people and not in machines.

To reduce current shortages and increase future supplies of S&T manpower, several measures, both immediate and long term, were put forward. The immediate measures proposed include: provision of special training courses to enable scientists and technicians to handle engineering tasks; making it easier for foreign engineers to work in Thailand; lifting the 2 percent growth ceiling for engineering and science teaching positions in state universities; and organizing a major campaign to boost S&T under-graduate enrollments and improved remuneration systems to attract and retain high-caliber academic staff. Long-term measures involve recommendations for substantial investment to train more and better science and engineering graduates; the granting of some 800 overseas study scholarships, particularly in the three priority technology areas in this study; initiation of an on-going upgrading of the curricula in science and engineering; and encouraging management to accord better recognition and remuneration to deserving scientists, engineers, and skilled technicians.

Creating Competitive Pressure

Allowing free market competition is a most effective means of forcing firms to develop much-needed technological strategies to increase efficiency and lower production costs, enhance quality and improve reliability and develop new designs, so as to be competitive both domestically and internationally. It is important that tariff protection be removed, or reduced to the minimum possible.

Conditions for Direct Foreign Investment

So far, foreign investment has not proven to be a sufficiently effective means of technology transfer. A more selective approach is required to ensure that new investments truly create jobs, and yield genuine technology transfer and net income to Thailand.

Promotional conditions could perhaps contain stipulations, for example, to conduct regular on-going training programs for firms' personnel, using foreign and local experts, to set up research development and engineering (RD&E) facilities, carry out in-house RD&E activities, and other measures that would bring about real transfer and accumulation of technology and knowledge.

Assistance to Small- and Medium-sized Firms

The less resourceful small- and medium-sized firms need to be given assistance, without creating adverse effects in the way, for example, that protection barriers do. These may include: soft loans for process and technology upgrading, dissemination of vital technical and business information, technology transfer through the provision of appropriate consultancy services, training in quality control and productivity improvement, as well as special skills upgrading.

Creation of an Environment Conducive to Subcontracting

The multiple taxation system has severe drawbacks, making subcontracting work less attractive. Such a system is seen to favor vertical integration manufacturing, and deter the subcontracting that is particularly suitable for small- and medium-sized firms. Thus, the government's implementation of a value-added tax (VAT) system should be fully supported, while incentives should be considered to encourage collaboration between large firms and subcontractors.

Firm-level Human Resource Development

The government should be instrumental in arranging for experts from universities, government agencies, and private organizations to conduct training programs specializing in technical and general human resource development for the private sector, in particular for the most needy small- and medium-sized firms. Furthermore, incentives should be considered to encourage such human resource development efforts.

Support for Firm-level RD&E Efforts

The pending legislation for the promotion of technology development and RD&E efforts should be fully supported and speedily introduced.

Moreover, RD&E funding to state universities and research institutes should be re-examined with a view to achieving a balance between basic and applied/industrial research, with the latter specifically aimed at tackling the needs of industries. A spill-over effect would mean the forging of better and closer linkages between public S&T institutes and the production sector.

MEASURES FOR STRENGTHENING TECHNOLOGICAL INFRASTRUCTURE AND SUPPORT

If an environment conducive to encouraging the production sector toward much greater technological efforts is created, then an adequate basic S&T infrastructure and support system becomes necessary to enable producing firms' technological efforts to be more fully developed and realized. Major infrastructure which needs to be strengthened or established is as follows:

- Information center with extension services
- Science and technology park
- Centers of excellence
- Systems of metrology and industrial standards
- Dissemination of technology
- Intellectual property protection

CONCLUSIONS

A key to enabling the enhancement of technological capability is to increase the level of competitive pressure, while at the same time making sure that the essential supportive S&T infrastructure is firmly in place to support producing firms' technological efforts. This undoubtedly calls for a well-conceived national S&T development plan with appropriate policy measures, incentives, or penalties, and for a strong and adequate technical human resource base.

While innovative capability is a very important element, human and financial resources must be prioritized and skillfully managed for maximum returns. RD&E efforts should be targeted at programs that yield ready benefits to the country's immediate development efforts. Only then will more and more firms begin to realize the necessity for and the benefits of RD&E, and hence readily subscribe to undertaking RD&E themselves.

Finally, a clear and well-conceived S&T development strategy must be mapped out to complement or supplement other national plans, and must not be planned in total isolation. Subsequent implementation plans must be accompanied by constant monitoring and control, and timely changes should be made, where necessary, to respond to unforeseen environmental, economic, major policy, or other changes that may arise later.
