Chapter 6 - The Acquisition and Assimilation of Technology

Following the introduction of Doi Moi more than 10 years ago, Viet Nam opened its doors to foreign investment. It was expected that this would bring much needed capital, new knowledge, and new technologies. This has happened to an extent, but in recent years foreign investment has fallen, and this has been accompanied by a decline in the importation of technology.

Broadly speaking, two approaches are taken to technology development. One is the technological development pushed by new discoveries and breakthroughs. This involves new technologies created initially by technology push. In advanced countries, numerous examples can be given of successful economic advance resulting from technology push. The industrial market sectors of developing countries, however, are often formed almost overnight with the introduction of imported products or services. Many examples can be given of East Asian economies where success in modernization and industrialization has derived from S&T policies based on a demand-pull approach, as well as disappointing experiences resulting from S&T policies focused on the technology-push approach.

During our interviews with policymakers and researchers in Viet Nam, we noticed in many cases a search for policy instruments of the technology-push variety. Inadequate attention appears to have been given the expected evolution of technology demand in the fast-changing national, regional, and international markets. For example, the decision to establish the four focus areas — IT, biotechnology, new materials, and automation — seemed to be based on observations of general trends elsewhere, rather than on an in-depth analysis of current Vietnamese economic structure and markets.

The starting point is also important in this context. According to MOSTE (Thu 1997, p. 3), Viet Nam's technology is

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\text{50 to 100 years behind that of the most modern countries in the world.}
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\text{Viet Nam's equipment is backward from two to three generations (20 to 30 years) or from four to five generations, depending on each specialised sector, compared with [the] modern level in the world. The coefficient of value decreases because of technical backwardness and the standard of production organisation is commonly from 0.5–0.7.}
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Some further factors that emerged during our interviews and bear on the acquisition and assimilation of technology are the following:

- Some significant efforts have been made to adapt imported technology to local conditions, and electronic and software firms perform adaptive research activities continuously. For example, one company adapted the technology
acquired through a joint-venture agreement to manufacture refrigerators in accordance with Vietnamese conditions and consumer preferences (variable power supply, noise level, automatic defrosting, speed of ice making, separate compartments for different types of food). In-house research teams, mostly financed by the firm, are in charge of these activities. Joint ventures and technology agreements (for example, to manufacture under an Original Equipment Manufacturer licence) are also perceived as a major source of technical expertise, managerial technology, and administrative practices, which have helped local firms considerably. Access to such soft technologies is obtained through technical and managerial assistance provided by expatriates, who are asked to train local employees, or through visits to foreign enterprises and to joint-venture partners in particular.

- The cost of technology acquired through joint ventures is perceived by some local partners to be rather high, which can be a serious problem in industries that operate with relatively low margins (for example, electronic consumer goods and garments for export). At the same time, some foreign partners view joint-venture agreements as rather rigid, cumbersome, and too troublesome, primarily because of the problems involved in the management of joint ventures between foreign investors and SOEs. The leading local industrial firms, some of which have joint-venture agreements, are trying to improve quality while maintaining competitive prices on export products: "produce with Korean quality and Chinese price" was how one manager described the objective of his enterprise. The desire to obtain, absorb, adapt, and improve on foreign technology has led, at least in one case, to a mix of cooperative and competitive relations with the supplier of foreign technology: the firm has a joint-venture agreement and sells products under the foreign partner's name but also promotes its own brand of products manufactured with adapted imported technology (much of it obtained through the joint venture).

- The perception is quite widespread among both policymakers and businesspeople in Viet Nam that industrial enterprises wholly owned by foreign corporations do not engage in technology transfer to any significant degree. They are thought to operate as enclaves that keep their technology to themselves, at least in the short run. Although they engage in a significant amount of training activities for their own personnel, the relatively limited turnover of technical staff does not allow their abilities and technical knowledge to spill over to other industrial firms. Indeed, it was reported on many occasions that foreign firms and joint ventures attract highly qualified personnel from SOEs and local private firms, which creates problems because of the shortage of skilled and experienced workers, technicians, and engineers. The established pattern we observed appears to be highly biased to acquiring technologies on a turnkey basis.

- Reverse engineering plays a major role in technology transfer in the metalworking, machinery, and industrial-electronics sectors. We observed some good examples of reverse engineering in the Vietnamese
household-electronics firms we visited. Research institutes, which behave very much like consulting and engineering design organizations, carry out reverse engineering based on foreign designs. However, they face a number of constraints regarding financing for the construction of equipment and entering into joint-venture agreements with foreign technology suppliers. This limits their ability to expand operations, increase in-house engineering research, and move up the technological ladder. Nevertheless, one can appreciate the ingenuity they have shown in their efforts to circumvent regulations and deal with restrictions.

- The provision of high-technology services — such as testing, design, calibration, and quality control for manufacturing — is another channel for the acquisition of foreign technology. At least one foreign firm specializing in such services faced policy and administrative constraints (import procedures, customs delays, legal requirements) that limit its capacity to establish links with local firms and reduce its effectiveness as a technology supplier. The people we interviewed repeatedly mentioned the establishment of high-technology parks, particularly in places with an already significant number of high-technology research centres, institutes, and firms as an initiative to facilitate and speed up the acquisition of effective access to technology services. Other potential benefits of such parks would be improvements in the use of equipment and machinery and greater collaboration between researchers in institutes and those in enterprises. During our visits and interviews, people also mentioned the need for adequate information on foreign sources of technology and the establishment of a "technology intelligence service."

- The Vietnamese industrial sector comprises firms with widely different levels of technology and technological capability. Although the bulk of industrial technology appears to be at least two to three decades behind current best practice (as exemplified by the widespread importation of second-hand equipment, machinery, and production lines), a few relatively advanced technology firms (foreign and joint ventures) show that Viet Nam can successfully move into high-technology production. The technological heterogeneity of industrial enterprises poses the problem of how to manage technological pluralism to increase industrial production, improve productivity, and enhance the competitiveness of Vietnamese industry while creating spaces for relatively efficient low-technology firms to survive and gradually move up the technology ladder. Quality control within industrial firms appears adequate, at least for the domestic market and for low-technology export niches, but it will have to be significantly upgraded and improved to face foreign competition in coming years and to penetrate foreign markets beyond low-technology niches.

- Several issues of intellectual property rights need to be addressed to provide incentives to invest in R&D and adapt foreign technology. Whereas industrial property-right regulations appear to be adequate, a perception widely shared
by researchers and businesspeople is that government agencies in charge of these rights do not have the power to enforce existing regulations. Software-production firms complain about piracy of their programs (one firm indicated that for every legitimate CD-ROM they sold, at least two were sold by software pirates); research institutes in industry, agriculture, and biotechnology indicated that they were unable appropriate the benefits of their research results; and creative researchers have almost no incentives to innovate and make the results of their research available to others.

Several routes lie open to allow a country or enterprise to acquire technology from abroad. They can encourage foreign firms to establish wholly owned subsidiaries; the government can promote joint ventures between domestic and foreign companies; or the local enterprises can acquire the technology through licensing agreements. Vietnam has acquired foreign technology through each of these routes, but we were unable to gather credible statistics on how much technology had been acquired through each, and we do not know what the trends have been over time.

The evidence we collected from our interview is of necessity anecdotal, but it suggests, as indicated above, that most of the imported technology comes as a turnkey package. All the importer has to do is to train people to operate the equipment. Initially this is a very effective way of introducing new technology, but experience in other countries has shown that over a period of a few years the productivity of the equipment declines in comparison with that of the same equipment in firms making incremental improvements to the technology. Also, with turnkey transfers, local firms and suppliers have little opportunity to develop the capacity to compete in the manufacture of components.

A more effective form of industrial development occurs when specific steps are taken to assimilate technology. This implies training for not only the operators but also the technicians and engineers who can modify, adapt, and change the technology. These investments are expensive, and studies in Japan and South Korea (Wilks and Wright 1991) have shown that successful firms in those countries frequently invest as much in assimilating the technology as in importing it in the first place.

One of the most thorough studies of the technological behaviour of East Asian firms was carried out by Professor Michael Hobday of the Science Policy Research Unit, at the University of Sussex, in the United Kingdom. His book, *Innovation in East Asia* (Hobday 1995), presented the results of his research. Primarily he investigated the development of the electronics industry in Hong Kong, Singapore, South Korea, and Taiwan, and within this he focused on firms’ strategies. His work showed that in all four territories firms followed a similar progression, building on imported technology. At the heart of this progression was export-led technological learning. Hobday summarized his findings in the diagram reproduced in Figure 2.
Hobday explained the diagram as follows (Hobday 1995, pp. 188–189):

The left-hand vertical axis represents electronics exports, which also correspond to employment and output growth. The right-hand vertical axis represents the innovation frontier, defined as the point at which R&D becomes central to competitiveness.

**Figure 2.** Innovation in East Asia. Source: Hobday (1995). Note: R&D, research and development.

The frontier is a constantly moving, dynamic target. In order to catch up firms must constantly narrow the gap between themselves and the market leaders. The horizontal axis represents the acquisition of process and product technologies by latecomer firms through time, beginning with simple activities such as assembly and graduating towards more complex tasks such as process adaptation and R&D. The relation between export growth and technological acquisition is presented in the shape of a diffusion curve, which corresponds to the slow initial start-up of the 1950s and 1960s, the adoption phase of the 1970s and the rapid take-off in the 1980s. As more latecomers entered to profit from new opportunities, others followed in a Schumpeterian swarming fashion, bringing about the surge in growth during the 1980s. The curve also suggests the possibility of a slowdown in the future as more subsectors of electronics mature.

As the model suggests, latecomers passed through various historical stages of technological development. The first latecomer firms emerged in the 1960s, producing labour-intensive products under joint ventures or sub-contracting arrangements with Japanese, US and European firms. TNCs [transnational corporations] and foreign buyers were initially attracted to East Asia by low labour costs. Foreign firms supplied training, advice on manufacturing processes and product styling, as well as capital goods. At the same time, local technicians, engineers and managers were trained within the subsidiaries of the TNCs. The larger foreign buyers and TNCs supplied formal training courses for assembly workers and technicians to ensure that quality and delivery targets were met. Some TNCs worked closely with local sub-contractors to buy low-cost parts and components, giving rise to a variety of electronics support industries.

Through the 1960s and 1970s the latecomers learned by manufacturing simple consumer electronics and by assembling and testing semiconductors. Firms entered from the electrical goods sector, clothing and other industries. Other companies started from scratch.
Some individuals left their jobs in TNC subsidiaries and began their own companies, often supplying their former employers. Gradually the latecomers learned by upgrading their production processes and by efforts to improve the quality and speed of manufacturing.

Hobday also explored the various government policies of the four territories. Singapore and South Korea followed highly interventionist policies, whereas Hong Kong and Taiwan had more laissez-faire approaches, with the Taiwan government intervening occasionally in semiconductors. Hong Kong and Singapore pursued export-led policies, whereas South Korea and Taiwan combined these policies with import substitution, controlling or banning imports to protect local firms and using government procurement to stimulate local enterprise.

As Hobday also noticed, direct investment in Southeast Asia has been proliferating in form and scope, as well as in national origin and destination. Although equity investments once dominated, over the last decade Southeast Asia has experienced a dramatic spread of newer relational forms of investments by the MNCs, notably interfirm networks. According to Hobday, four types of networks collectively define the MNC production and technology relationships of concern to Vietnamese industrial strategy-makers:

- **Supplier networks** — These include subcontracting, original-equipment manufacturing, and original-design manufacturing arrangements between foreign MNCs and domestic suppliers of intermediate production inputs, such as materials, tools and moulds, parts and components, subassemblies, and software.

- **Producer networks** — These enable competing producers to pool their production capacities and their financial and human resources, to broaden their product portfolios and geographic coverage.

- **Distribution networks** — These comprise the MNC affiliate's forward linkages with distributors, marketing channels, valued-added resellers, and end users, both in export and in domestic markets.

- **Innovation networks** — These facilitate the acquisition of product design and production technology, enable joint product and process development, and permit firms to share generic scientific know-how and R&D.

In electronics, the semiconductor producers pioneered supplier networks in the late 1960s, gradually moving from tightly controlled joint ventures to looser subcontract and OEM relations. Starting in the 1980s, the other three network forms began to emerge. Taken together, the coalescing networks of firms constitute the infrastructure for integrated production in electronics in East Asia.

For Vietnamese firms slowly moving into technologically more advanced positions, the four types of network open up a range of possibilities. For the Vietnamese government, any strategy for technology and related science must consider these
relatively new forms of regional integration. Different parts of regional networks are concentrated in different countries or even in different regions of these countries. The result is a changing division of labour in electronics production across not just Southeast Asia but also East Asia as a whole.

A feasible national strategy for S&T must be based on future scenarios of opportunities and requirements for integration into such regional, cross-border networks. A deeper understanding of changing opportunities will enable the government to select from alternative policy options.

In this report to the Government of Viet Nam, we have pointed out that Viet Nam begins its industrialization push at a different time than the four Asian Tigers did in pursuing their dramatic industrial growth. There can be no direct transfer of their experiences. Nevertheless, we think that a number of common characteristics seem to be associated with their success and that these provide some guidelines for Viet Nam's long-term S&T strategy. These characteristics include the following:

- Industrialization was based primarily on export led strategies.
- The managers of enterprises made the key decisions related to technological learning.
- It took 20–30 years to build all the technological capabilities needed to successfully exploit the innovations derived from domestic in-house R&D. Many technical and engineering skills had to be accumulated in the process. Starting today, the process might take only 10–15 years.
- Government policies to influence the behaviour of entrepreneurs and the managers of enterprises varied considerably between the Tigers. But each showed the following characteristics (also see box 7):
  - Governments followed a set of macroeconomic policies to provide stability, low interest rates, and high savings (that is, they provided an environment conducive to long-term planning and investment).
  - Government policies promoted export-oriented industrialization and facilitated the acquisition and adaptation of foreign technology.
  - Governments developed an appropriate educational and technological infrastructure. This included provision for widespread literacy, vocational education, development of a cadre of engineers, and training and support for research scientists. Vocational courses, often directed to company needs, were carried out in local universities and polytechnics.
  - When necessary, governments intervened to ensure that the entrepreneurial base was strong enough to lead industrialization.
Box 7

Suggestion
Measures to facilitate acquisition and assimilation of technologies

1. Implement policies that facilitate technology importation but require the full transfer of technological know-how from the overseas suppliers.
2. Encourage the development of export-led industrialization by facilitating overseas business travel, together with similar measures.
3. Ensure that training and education provide an appropriate balance of the many technical (and scientific) skills needed to staff the emerging industrial enterprises. In particular we urge the introduction of a crash program for training the management personnel in charge of technology.

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