CHAPTER IX

FDI AND TECHNOLOGICAL UPGRADATION IN THAI ELECTRONICS INDUSTRY

9.1 INTRODUCTION

The comparative advantage provided by cheap labour along with the government's aggressive export promotion measures enabled Thailand to attract electronics multinational companies that assemble manufactures for export. As we saw in Chapter VII, the dominantly foreign-owned export-oriented production base has played a major role in Thai electronics industry over the last decade, in facilitating the rapid expansion and diversification of its production structure. However, the analysis of the trade performance of the electronics industry in the previous chapter (Chapter VIII) established that the particular development path followed by the industry has been highly import-dependent, which has made it extremely vulnerable to exchange rate changes and fluctuations in demand in the narrow band of export products in which it has concentrated on. This chapter therefore attempts to explore how these structural weaknesses in Thai electronics industry came about.

As discussed in the conceptual framework in Chapter II, for an export-oriented growth strategy to be sustainable, there has to be continuous production upgradation in the industry. This requires a cumulative uplift of the technological levels in the industry. One of the underlying postulates of the 'flying geese' (FG) hypothesis is that, MNCs, by increasing the rate of technical progress through invention, innovation, and diffusion, tend to produce and transfer more sophisticated technologies than local firms, and in consequence, play a more important role in the process of technological change in the host country and thus will lead to accelerated industrial upgradation in the host industry. The main focus of the inquiry in the present chapter is to analyse whether or not FDI in the Thai electronics has been contributing to strengthening the domestic electronics industry production base in Thailand through technological upgradation and skill formation. Such an examination would also provide further insights into the sustainability of the FDI-led export growth in this industry.

The analysis in the present chapter adopts the methodology of case studies to analyse the issues related to technology transfer in Thai electronics industry. As discussed in the conceptual framework (See Section 2.3.3), direct and indirect technology transfer and diffusion through FDI can result in two distinct outcomes namely, technology capability development within a foreign affiliate itself, and in other local firms through linkages. Attempt was made therefore, to analyse as to what extent
foreign firms contributed to particular levels of technology capability upgradation in the host country. Factors that have limited or constrained technological deepening and widening in these cases are also identified. The specific questions that were sought to be answered as part of the study are: (1) Has there been a deepening of the firm’s technological capabilities commensurate with an expansion in the product profile of the firm that represents a climb up the value chain? (2) Has there been widening of its technological capabilities through backward integration into component production? (3) To what extent have foreign-owned firms established linkages with the domestic production base in the procurement of raw materials and components and helped develop technological capabilities of indigenous firms? (4) Finally, what are the implications and consequences of the present manner of development of the industry for its long-run development, especially in the context of the post-crisis scenario? The case studies have therefore strived to carefully ascertain which segments of a particular product’s value chain are being carried out in the firm’s Thai factories, and how much expansion, backward integration or domestic linkage creation etc. have been undertaken by it.

The first part of the ensuing analysis is thus based on both primary information and data gathered through in-depth case studies of firms, as well as on secondary information on the Thai electronics industry. Personal interviews were conducted with a group of 15 randomly selected companies, 3 firms from the consumer sub-sector, 4 firms from the computer and related parts (EDP) sub-sector, and 8 firms from the electronics parts & components sub-sector. The sample was mostly restricted to large companies, which together shared a large/major portion of the production, employment, and exports in the respective industries. Restricting the sample to large firms was also expected to generate a better response rate. In all the selected firms, detailed interviews were undertaken with managerial level staff, in order to obtain information on the history and performance of the firm with respect to product expansion and diversification, modes and channels of technology transfer, investment and technology policies, etc.

The second part of this analysis critically examines the specific government policies related to electronics industry, in order to examine whether and how policies might have influenced these outcomes.

1 The formal questionnaire used as the basis for the interviews is given in Annexe 4.
2 See Annexe 1 for the list of company contacts.
3 Primary data collection was very time consuming and difficult because of the reluctance of firms to grant interviews and in a few cases, even where interviews were granted complete information could not be gathered due to the unfamiliarity of a recently joined manager.
9.2 AN OVERVIEW OF THE SAMPLE FIRMS

Given that the discussion of case studies that follows is lengthy and descriptive, we highlight some of the salient features of the case study firms, in terms of: the levels of operations and technological capabilities (direct technology transfer); and the nature of sourcing arrangements which determine the scope for indirect technology transfer and diffusion.

Out of the thirty-one BOI-promoted consumer electronics firms (as per 1997 compilation), three companies making colour TVs namely, the Japanese subsidiary JVC Manufacturing, Singaporean subsidiary Thomson Television, and Thai majority-owned Kang Yong Electric were chosen, representative of the ownership structure in this sub-sector.4

Thomson is a Singaporean subsidiary producing 100% export-oriented TVs, VCRs, and VCR Combo, under the technological support of the parent firm. Based on the interview, it was observed that the company has high acquisitive, operative, and adaptive (mainly in process development) technological capabilities, but no significant linkages with indigenous firms. Except for picture tube for which about 25% is procured from the local joint venture Thai CRT Co. Ltd. owing to government rules, all the parts and components are sourced in close collaboration with global parts and component suppliers. Only mechanical components such as cartons, cabins, etc. are bought from Thai companies locally.

JVC Manufacturing is a Japanese subsidiary undertaking labour-intensive assembly production of TVs based on lower wage rates, for 100% exports. It has total technology support from the parent firm, and undertakes in-house production of two of the major TV parts, namely, deflection yoke and fly-back transformer, with completely foreign supplied components. It has significant operative and some adaptive capabilities. Again, except for picture tube, which is partly bought from Thai CRT, the procurement of all the other parts and components are bought under the parent firm’s directions. It also shows remarkable affinity towards locally established Japanese companies, except for some purchase of passive components like coil and capacitors from Thai firms. Two other products, which they assemble are CD-head used in compact disc and digital video disk, for 100% export to JVC’s Malaysian and Japanese plants for the manufacture of the final products.

Kang Yong Electric is a Thai-majority joint venture making electrical appliances and TV, established in 1964. While in the case of electrical appliances, the focus of the Japanese partners had been on successful transplantation of mature product lines from Japan with increased domestic content, in the case of TV, heavy import dependence led to lack of price competitiveness and TV production was discontinued in 1998.

4 These three very large firms covered all the main foreign presence in this industry. A major foreign subsidiary, the Hong Kong-Japan joint venture World Electric, could not be interviewed due to its location in northern province of Thailand, as the interviews had to be restricted to only firms located in the Bangkok Metropolitan Region (BMR) due to time constraint.
Thai computer and parts industry overriding features the hard disk drive industry segment, which was initiated with the investment made by Seagate in head stack assembly (HSA) in 1983. As the investment in the segment comes predominantly from the US, Japanese, and Taiwanese firms, the firms selected for the case studies are representative of this investment pattern. We have thus chosen the foreign subsidiaries Seagate Technology (American), Fujitsu (Japanese), and Delta Electronics (Taiwanese and British joint venture) and the Japanese joint venture with a minute Thai ownership Melco Manufacturing (Japanese).

Seagate is a 100% exporting first-generation American HDD subsidiary, established in accordance with the vertical integration strategy of the parent firm. It thus produces many important sub-assemblies in-house, apart from importing from affiliated firms in other countries. It has high operative and moderate levels of adaptive capabilities.

Fujitsu is a 100% exporting Japanese subsidiary having a diversified product profile with six separate divisions under discrete parent firms with cross-holding, handling: telecommunications; HDD; printers; camera shutters; electronic parts such as transformer, stepper motors and EMI components; and high precision mechanical parts. Each unit is provided the core parts and technical design support by the respective parent firm. There is backward integration by the parent firms especially in telecommunications and HDD. Sub-contracting linkages are strongest with mostly Japanese or other foreign firms, both locally and overseas.

Melco Manufacturing is also a 100% exporting Japanese majority joint venture, making floppy drives. High levels of backward integration have been achieved in the host plant, as the parent firm shifted completely towards design and development. It has high operative and some adaptive capabilities, with strong technical support from the parent firms. It maintains close supply links with the parent firm and other Japanese firms locally and overseas, and has sub-contracts with Thai firms only for plastic parts.

Delta Electronics is a British-Taiwanese joint venture, exporting ODM (original design manufacturing) computer monitors, many low-end products like transformers and other magnetics like line filters, coils, choke, etc., and also switching power supply (SPS), etc. It has significant indirect exports, i.e.; domestic sales to 100% export-oriented firms, as well. It has its own full-fledged R&D unit which designs and develops the various products (especially in magnetics) and is thus observed to have innovative capabilities, in the low-end and medium-end product lines. About 60% of the procurement consists mainly of plastic and metal parts done locally, though not essentially from Thai firms.

5 See discussions in Chapter VII on the evolution of Thai electronics industry and the product profile of various sub-sectors.
6 It played a significant role in paving the way for the development of a foreign-dominated satellite supplier base in other HDD components.
In the electronics parts and components (P&C) sub-sector also, nine firms have been selected, which are very diverse and are representative of the ownership pattern. The first company Electronics Industry (USA), is a non-BOI-promoted Thai majority-owned joint venture with Hong Kong, which is a sub-contractor of semi-conductors such as diodes, with 95% direct and 5% indirect exports. It has strong operative and adaptive capabilities. The technological support is provided by its Taiwanese/Hong Kong affiliates and Germany, while it is dependent on imports from Japan and Taiwan for most components and raw materials. It has local sourcing only for chemicals and packaging materials.

GSS ARRAY is a 100% exporting American majority-owned joint venture, which has evolved from a component supply sub-contractor to an OEM making finished products under contract, with high levels of operative and adaptive capabilities, and a flexible production structure. Its complete procurement comes from the customer-approved vendor list consisting mostly foreign suppliers, and undertakes local sourcing only for metal and plastic parts, which are also from foreign subsidiaries or joint ventures.

Intronics is a 100% Thai-owned OEM, producing low-mid-end electronics products such as air conditioner controls, electronic bedside control panels, electronic safe, PABX etc., etc. It has a BOI-promoted R&D unit which designs and develops new products for customers. It imports major components, while it also has significant local sourcing for PCBs from Thai majority-owned joint venture firms. Its relative strength has been attributed to the founding engineers' earlier work experience and learning with the Thai factories of MNCs.

KCE is a 100% exporting Thai majority-owned joint venture, an original brand manufacturer (OBM) of advanced PCBs, with two factories for PCB, a subsidiary facility for raw materials (copper-clad laminate and pre-impregnated fibre glass), and two overseas marketing affiliates. Imports constitute some 45% of its raw materials. The technology for all its PCBAs is from Germany, while the company has very high operative and adaptive capabilities.

TATL is a 100% export-oriented component supply sub-contractor in medium to high-end PCBAs and a contract equipment manufacturer (CEM) for telecommunications-related final products. It has high acquisitive and operative capabilities, and strong adaptive capabilities in some products. While there is high import dependence in the major component PCB, other procurement is from Thai factories of fully foreign-owned or joint venture firms. Sourcing from Thai firms takes place only in the case of minor parts/ materials.

Samsung Electro-Mechanics is a Samsung subsidiary producing parts (monitor, fly-back transformer, oil condenser, deflection yoke, etc.) almost exclusively for
Samsung's joint venture TV assembly factory7 in Thailand. It has high operative capabilities, and some adaptive capabilities related to product and process improvement, under heavy presence of expatriate engineers at the managerial-level. All major parts and components are imported under complete supervision of the parent firm, and there is internalisation of component technologies within the parent group’s affiliate companies.

Tatung is a 100% export-oriented Taiwanese subsidiary, making monitors for colour TV and computers. It has strong operative and some adaptive capabilities. It imports all major components from affiliated and unaffiliated firms in Taiwan, Japan and Malaysia, and has significant linkages also with Taiwanese and Japanese firms in Thailand for other parts and components. The Taiwanese parent firm provides its complete R&D support, while predominant customers are also the Taipei parent firm and its own affiliates and other companies in Europe.

Toshiba Display Devices (Thailand) is a 100% export-oriented Japanese joint venture (with 97.5% Japanese holding), making colour picture tubes for TVs and computers, and supplying affiliated and non-affiliated foreign firms. It has strong operative and some adaptive capabilities, under the strong design support from the headquarters. It imports major components and parts from Japan or Japanese firms in Thailand, and undertakes in-house production only for the labour-intensive assembly of electron gun using completely imported components. It has complete dependence on Toshiba HQ for R&D.

9.3 SOURCING ARRANGEMENTS AND SCOPE FOR TECHNOLOGY TRANSFER AND DIFFUSION

From the above outlining of the defining characteristics of the sample firms, we may identify three distinct types of levels of operations and sourcing arrangements. (1) The first set is that of foreign firms (both 100% subsidiaries and joint ventures) involved in the vertical integration strategy of their parent firms. They have total dependency on the parent firm, which arranges the procurement of all or majority of its input requirements. This takes place either through: (a) in-house production or production of parts and components in its own separate facility located in Thailand; or through (b) imports from the parent firm, or its affiliates around the world. Imports can also occur from other foreign firms. Seagate, Fujitsu, Samsung, Melco, Tatung, Toshiba, JVC all belong to this category, with minor variations.

Where the production of parts and components takes place under any of these models, the parent firm is a very protective vertically integrated firm with complete internalisation of the product and core component technologies, and as such is a very closed production network allowing no technology diffusion to unrelated firms. There is

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7 The TV factor has since been 'acquired' by the parent firm following BOI’s relaxation of joint venture criteria in 1997.
a division-of-labour type investment among the various affiliates, which is technologically self-assimilating or self-absorbing. In this division of labour, Thai affiliates are observed to occupy the assembly-based and occasionally mid-end technology range of products, in most cases. Even in those so-called hi-tech product lines such as HDD, Thai affiliates are concentrated on the above-mentioned product range. Thus, the high levels of operative capabilities and often, moderate adaptive capabilities observed in such Thai affiliates are restricted to these mostly labour-intensive and mid-end product ranges. Further, due to the vertical integration strategy, there is very little scope for indirect technology transfer or diffusion to indigenous firms through linkages.

Comparatively speaking, the first case, where some components are produced in-house or in other affiliates located within Thailand, as the parent firm introduces more product and process technologies into the host country itself, this is more beneficial to the host economy in developing wider technological capabilities. In the case where procurement is from the parent firm itself and/or its affiliates abroad without any in-house production, there is high import content in the production process and there is no scope for widening the technological capabilities of the Thai affiliate, as the technologies introduced by the parent firm into each of the host countries remain segmented.

(2) The second group of firms are those foreign affiliates (subsidiaries and joint venture) making final products, which import or procure from the Thai factories of other foreign-affiliated suppliers, which are not necessarily related to them through equity arrangements. Thomson and Kang Yong Electric belong to this category. The procurement tendency of the Taiwanese and Japanese firms (in Group one) to source from their historical unaffiliated Japanese and Taiwanese supplier firms also falls in this category. A large number of foreign component suppliers have been encouraged by the ‘customer firm’ to set up affiliate plants in the host country. While this brings down the import dependence and increase ‘local’ content for the original host country foreign firms under discussion, from the point of view of their technological capability development, this kind of sourcing arrangement has the same effects as in the case of importation from unaffiliated foreign companies from abroad, that is, the host country affiliate’s production and technological development remains at the level of efficient assembly operations. Further, such networking rules out the scope for domestic linkage creation, which would lead to more technology diffusion. One benefit in having locally established foreign supplier firms’ manufacturing base would be the introduction of more operative capabilities into the host country. However, to the extent that the production process involves not more than the assembly of the imported parts and

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8 Samsung subsidiary producing parts exclusively for Samsung’s joint venture TV assembly factory in Thailand is an example.
components, this can be considered similar to the case of final product assembly line production where the technology transfer process is rather limited. This offers no further scope for higher intra-firm capability development or for inter-firm technology diffusion to indigenous suppliers.

(3) The third group of firms consists of Thai-owned and joint venture component supply sub-contracting firms, which export mostly 100% of their output. With very few exceptions, all these sub-contracting firms are concentrated in the low- and mid-end technology products, or in the low-mid-end processes of high-tech products. While some of these firms are completely dependent on their customers and have to use the latter's vendor list for supplies, others make more independent procurement. Delta Electronics, GSS ARRAY, Electronics USA, Intronics, TATL, etc. fall in this category. KCE is also a component sub-contractor, but operate in a relatively higher technology range of PCBs. In this group also, import content is very high. Let us now look at the operations of each company in detail.

9.4 FIRMS WITH VERTICAL INTEGRATION STRATEGIES

9.4.1 JVC Manufacturing Co. Ltd.

JVC Manufacturing Co. (Thailand), a subsidiary of the Japanese company Japan Victor Corporation (JVC) was set up in 1989 for the production of colour TVs (CTVs). Additionally, JVC started the manufacture of CD-head used in compact disc (CD) and digital video disk (DVD).

In the case of colour TV, the entire output is exported to JVC’s Singapore sales office, from where 50% of the total CTV output is sold in the Japanese market under the Victor brand name9 and the remaining 50% is exported from the Singapore warehouse to Southeast Asian countries like Malaysia, Indonesia and Philippines, as well as to Thailand. CD-head is 100% exported to JVC’s Malaysian and Japanese plants for the manufacture of the final products. Thus, the entire ASEAN market for JVC products is catered to by the Thai factory, which produces a total of 1.2 million sets per year. The American market is supplied by JVC’s Mexican factory. It has two plants in France and one in the UK to supply the European markets. JVC opened a factory in China in 1996 only with a very small capacity, although a plant was set up in Malaysia in 1989 itself for video production. It has a plant for video in Philippines also, as a joint venture project. In Indonesia, JVC has set up a plant for making multi-layered PCBs, which are sophisticated and are used for specific applications.

9 TV production of JVC (or Japan Victor Corporation) in Japan was closed down twenty years ago due to environmental hazard following the Minamata disease of lead poisoning.
9.4.1.1 Sourcing and Technological Capabilities

The technology and design for TV assembly are provided by the parent firm. While it imported all other major parts and components in the beginning, it started producing deflection yoke for TVs in 1989 itself. Since 1995, it has been producing deflection yoke for computer monitors as well, which is a 100% export-oriented product. The technology for deflection yoke which is made in-house also comes from the parent JVC firm, which has a 10% world-wide market share in deflection yoke. The most important part of the TV, namely, the picture tube (or the cathode ray tube-CRT), is bought partly from Thai CRT and partly from Toshiba Display Devices (Thailand) Ltd. (TDDT). The back cabinet is bought from the Thai company Thai Summit (joint venture) and also from the locally-established Japanese subsidiary Haimo. Tuners are bought from the Thai plant of Matsushita. Since Matsushita is a major shareholder of JVC company, the latter is obliged to buy certain parts and components from the former. Speakers and PCBs are also imported 100% from Matsushita’s Malaysian plants.

Table 9.1: Sourcing arrangements of JVC Manufacturing Co. (Thailand) Ltd. for Colour TV

<table>
<thead>
<tr>
<th>Product/part</th>
<th>Supply Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Machinery/equipment</td>
<td>Japan (imported through the Japanese HQ)</td>
</tr>
<tr>
<td>2. Cathode ray tube (CRT)</td>
<td>Thai CRT Co. &amp; Toshiba Display Devices (TDDT) Co.</td>
</tr>
<tr>
<td>3. Deflection yoke</td>
<td>100% In-house</td>
</tr>
<tr>
<td>4. Fly-back transformer (FBT)</td>
<td>100% In-house</td>
</tr>
<tr>
<td>5. PCB</td>
<td>Matsushita (Malaysia)</td>
</tr>
<tr>
<td>6. ICs</td>
<td>Japan &amp; Singapore</td>
</tr>
<tr>
<td>7. Capacitors</td>
<td>Thai factories and some import</td>
</tr>
<tr>
<td>8. Resistors and diodes</td>
<td>Japanese companies in Thailand</td>
</tr>
<tr>
<td>9. Transistors</td>
<td>Rohm Apollo- Japanese subsidiary in Thailand</td>
</tr>
<tr>
<td>10. Coil</td>
<td>Thai company (60%) and import (40%)</td>
</tr>
<tr>
<td>11. Speakers</td>
<td>Matsushita (Malaysia)</td>
</tr>
<tr>
<td>12. Tuners</td>
<td>Matsushita (Thailand)</td>
</tr>
<tr>
<td>13. Switches</td>
<td>Subcontracted by Singapore HO and imported</td>
</tr>
<tr>
<td>14. TV cord</td>
<td>Japanese joint venture Asahi</td>
</tr>
<tr>
<td>15. Front cabinet</td>
<td>Sub-contracted to Japanese company in Thailand</td>
</tr>
<tr>
<td>16. Back cabinet</td>
<td>Thai Summit and Japanese subsidiary Haimo</td>
</tr>
<tr>
<td>17. Magnetic wire (main raw material for CRT)</td>
<td>Japanese company Sumitomo’s Thai facility Siam Electric</td>
</tr>
<tr>
<td>18. Raw materials- ferrite, plastic, etc.</td>
<td>Japanese companies in Thailand</td>
</tr>
</tbody>
</table>

Note: Matsushita Group is a shareholder of JVC, Japan.

Another important part for TV, fly-back transformer, used to be imported from the parent facility of JVC in Japan, and also was bought from Samsung’s Thai facility. However, since Samsung’s quality did not satisfy them, JVC Thai began making fly-back transformers in-house from 1991. The main raw material for both deflection yoke and fly-back transformer, magnetic wire, is supplied 100% by the Japanese company Sumitomo’s Thai subsidiary Siam Electric.

ICs are imported from Singapore and Japan from companies like Philips.\(^\text{10}\) It was acknowledged that it is the parent firm that decides the suppliers to ensure the

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\(^{10}\) It was mentioned that Philips’ products coming actually from Hong Kong are sold through Singapore, and thus was imported by JVC from Singapore.
quality of the product, and thus the Thai plants do not have choice in procurement. Even
coil is imported to the extent of 40%, while 60% is bought from a Thai company.
Capacitors are bought from Thai sources, while some are imported also. Switches are
ordered on subcontract by the Singapore head office. Resistors and diodes are bought
from local firms of Japanese companies. Transistors are bought 100% from Rohm
Apollo’s (a Japanese subsidiary) Thai facility. The cord for TV is also bought locally
though from a Japanese joint venture, Asahi. For front cabinet, JVC sub-contracts out
the production to Japanese firms in Thailand, as Thai companies reportedly cannot make
the cabinet design according to the JVC parent company’s mould design. Raw materials
like ferrite and plastic, which are required for in-house production are also bought from
Japanese companies in Thailand.

All machinery and equipment are bought from Japan by the parent company and
then sent to Thailand. The automatic insertion technology, namely, surface mount
technology (SMT) equipments for PCB assembly (PCBA) is imported from Panasonic,
Japan. In 1995, personnel from that company came to set up the SMT equipment and
provided training to the Thai staff for the process and operations. Every two-three years’
time, new machines come and this was pointed out as one of the reasons why Thai
engineers are unable to keep up with such learning process.

Thus, clearly, except for the two major parts, namely deflection yoke and fly-
back transformer which are being made in-house, all the other major parts and
components are either imported or bought from mostly Japanese companies’ plants
located in Thailand. It was pointed out that new TV models come out almost every
month, most of which are successful. For each new model, the PCBA is different and
even the cabinet design also changes often. No Thai parts or components company
could reportedly yet keep up with such a fast pace of change in product and process
development in TVs. The only successful case of JVC’s local procurement from the
joint venture Thai CRT can be attributed solely to the active government promotion for
the latter’s operations by protecting the domestic CRT market.

9.4.1.2 Technological Capabilities
It was pointed out that JVC had chosen Thailand for its CTV manufacturing in 1989, as
this is a very labour-intensive assembly production and Thailand was offering lower
wage rates than Singapore or Malaysia (at 60 Baht per day) and political stability as
well. Wages have continuously risen and have increased more than 100% to 160 baht
per day currently. The two facilities- one for TV assembly and the other for deflection
yoke etc.- employ 5000 and 2000 persons respectively.11 In the place of about thirty
Japanese expatriate employees who stayed in the Thai facility in 1989, currently there

11 In both cases, about 90% of the labour force were women.
are about forty Japanese at the managerial level itself, while Japanese engineers reportedly come only to impart training and do not stay long. There is regular training for R&D for minor modifications. There is also some managerial training.

9.4.2 Seagate Technology (Thailand) Ltd.

Seagate Technology, Inc. is recognised as the world’s largest manufacturer of disc drives, magnetic discs and read/write heads. Seagate (Thailand) was started in 1983 with just a single element of the labour-intensive head sub-assembly of HDDs namely, head stack assembly (HSA), employing some fifty workers. It expanded its production and shifted its operations to another bigger plant (Teparuk) in 1988. In 1989, Seagate Thailand made the first move in backward integration into components and expanded the Teparuk plant for the labour-intensive sub-assembly of head gimbal assembly (HGA), which feeds the head stack assembly lines. In 1994, one of the major components viz.; spindle motors’ production was started in the Rangsit plant, along with coils and printed circuit cables (PCC) at Latkrabang, and HSA at Wellgrow. HGA was further expanded to Korat also in 1996. By 1997, all of Seagate’s subassemblies for mobile and desktop drives were being done in the six Thai plants, with head drive assembly (HDA) being done at Seagate’s two China facilities in Wuxi and Shenzhen and testing done at Singapore. Seagate (Thailand)’s products are meant for the price-sensitive low-end to mid-range desktop and mobile PC markets. Thus, Thailand has been made an integral part of Seagate’s regional division of labour\(^\text{12}\) in which mid-range products are assembled based on R&D support from Singapore.\(^\text{13}\) As the major factory is in Singapore, Thai plants used to report to Singapore previously, where ramp up and testing was done.

9.4.2.1 Sourcing Arrangements

In both the hardware and components business, the parent company has pursued a strategy of vertical integration which brings them advantages in technology leadership and sustained R&D, in the ability to aggressively ramp production, in advanced inventory controls and just-in-time delivery and in cost savings. Accordingly, Seagate designs and manufactures disc and tape drive components including recording heads, disc media, substrates, motors and custom-integrated circuits.\(^\text{14}\) This strategy enables

\(^{12}\) In fact, as much as 99% of Seagate’s HDD was being produced in Southeast Asia and the US production of HDDs was already only about 1% of the world total, by 1996. See Gourevitch, et al., opcit., p. 7 for details.

\(^{13}\) Singapore is Seagate’s sole R&D and design centre outside the USA, except for Springtown in Northern Ireland.

\(^{14}\) In fact, Seagate Inc. is considered the second most vertically integrated HDD firm after IBM, as it carries out all the activities that go into the making of HDD by itself, except for the purchase of semiconductors from outside vendors. Second to IBM, because IBM makes its own semiconductors also, for use in its HDDs. See Gourevitch, Bohn, and McKendrick, opcit.
Seagate to control key technologies and the supply of components critical to manufacturing its disc drive products.

Seagate has highly integrated operations in Thailand too. As we saw above, Teparuk and Korat plants undertake HGA which supply Wellgrow’s HSA facility, which in turn, supplies the HDA plant at Chokchai. Further, Seagate (Thailand)’s disc drive production benefits from the parent company’s vertical integration strategy by using advanced components and technologies developed and marketed internally, within Thailand itself or from Seagate’s various subsidiaries across the world. For instance, the Latkrabang plant produces PCC and coils which supplies the Wellgrow plant’s production of HSA and E-block. The Rangsit plant makes poles and spindle motors, and supplies the HDA plant at Chonburi. PCBs are imported from Seagate’s Malaysian and Singapore plants. One of the technologically most sophisticated part for head, wafers, are produced in Seagate’s Minnesota plant and imported. The complete machinery and equipment required are bought by the headquarters and then imported here. Thus, evidently, almost all of the important parts and components for Seagate Thailand’s HDA assembly are either made in-house or imported from its own affiliate firms in mostly other East Asian countries.

There is hardly any subcontracting given out by Seagate to companies outside its own network, except in the case of spindle motors (50-50%) and suspensions. About one-fourth of Seagate’s demand for spindle motors is met by its own Rangsit plant, while the base plates are supplied by TPM. The rest of Seagate’s requirement for spindle motors come from Nidec, the world’s largest producer, and Minibea, another Japanese component maker whose spindle motor production Seagate actually helped to promote. Nidec established its Thai operations in 1990 to produce motors for low-end drives. 15 Suspension is bought from KRP’s and Hutchison’s Thai plants. 16 Some of the suspensions are also imported from Magnecomp’s China facilities. Again, Innovex, the world’s largest supplier of thin film lead wire used in suspension assemblies, supply the wires to Boron, which has a factory in Korat, Thailand, who then prepares the lead wires to be shipped to Seagate.

Thus, evidently, Seagate’s vertical integration strategy has precluded the scope for any linkages with the domestic component makers, even in PCBs, where there are quite a few large PCB makers such as Thai-owned KCE with a 5% British share. Brimble and Doner (1998) have argued that from the perspective of local firms, low margins and demanding schedules make production for disk drive firms less attractive than other alternatives. On the contrary, there has been a tendency for foreign suppliers

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15 High-end production had remained in Japan, but some of this production will also be shifted from Japan to Singapore, for reasons of proximity to high-end drive producers. Brimble and Doner, opcit.
16 KR Precision is the second largest producer of suspensions in the world and its only production unit is in Thailand, while Hutchinson Technologies, a US company, is the first with around 70% worldwide share. Brimble and Doner, opcit., p. 8.
of HGA-related products and spindle motors to follow the HDD assembler into Thailand. In fact, Seagate’s efforts to develop internal capacities in spindle motors and head-related components, especially, suspensions, led to a foreign-dominated satellite supplier base, with foreign-owned firms exclusively supplying to foreign affiliated end-users, and not indigenous supplier development. The company pointed out that this came about because the only area where Thailand had developed international level capability is in automotive parts and it has not yet developed international level expertise in the case of electronics parts. Apart from the lack of expertise, another factor which hindered subcontracting to local companies, according to Seagate, is the fact that local companies did not have sufficient capacity.

9.4.2.2 Technological Capabilities

As expected in the case of a foreign subsidiary, the headquarters provides the complete design and technology of Seagate’s Thai facilities. It is pointed out that the expertise required for design capability is still not developed in Thailand and would take about ten to twenty years to build up an experienced designer. For new models, US engineers give training to the ‘new product transfer group’ in existence at Teparuk since 1997, which fully consists of Thai engineers. After a new design is introduced, debugging is done locally and there is continual evolving of the product. There is continuous and regular training for engineers and technicians. While operators get process training, front-line supervisors are given separate training. Testing (for which also high technical skills are required) is also being done at Thai facilities. The tester is designed at the head office. While the head office also initially provided the sophisticated technology required for testing, since 1998 it is being developed at Teparuk.

Thailand, especially Teparuk, is accorded the best grade in cost and quality in the world, by the management. Thailand had the lowest cost per unit due to the productivity and efficiency built over the years. Mechanical damage is very low. For instance, HGA had a defect rate of only 0.5%. However, lack of technical strengths among Thai technical personnel has indeed hindered Thailand’s Seagate operations from carrying out more sophisticated tasks on the technological scale. It has been pointed out that Seagate’s retreat from its initial plans to do complete assembly and back-end testing in Chokchai soon after its opening in 1987-88, had to do with the fact that Thailand’s technical personnel could not compete with those in Singapore where

17 While KR Precision is Thai-based and listed on the Stock Exchange of Thailand (SET), it is run and managed by ex-Seagate expatriate employees and strictly speaking cannot be considered a Thai firm, as except of the capital, there is very little Thai involvement at the decision making level. For a detailed account of how Nidec and KRP came to set up their subsidiaries in Thailand, see Brimble and Doner, opct., page 15-16.

18 However, in the case of foreign suppliers too, Seagate had developed multiple suppliers for the critical components which they obtain from outside sources, so as to ensure supply and to obtain competitive pricing from their suppliers, as seen in the case of spindle motors.

19 Trouble-shooting and minor design changes necessary when introducing a new product design.
workers knew how to "tweak", and tweaking is critical to keeping high yields.\textsuperscript{20} However, the recent plan to integrate HSA and HGA in each location into HDA, making each plant independent in head assembly,\textsuperscript{21} might well imply that Thai engineers have become more capable, although whether or not this restructuring plan indeed materialised fruitfully will need to be ascertained.

Earlier, HDA had been taken out of Thai operations and was carried out in China, whereas Chinese HSA facilities were consolidated into existing HSA facilities in Thailand, in an attempt to consolidate each type of sub-assembly into one location. It was pointed out that while both HSA and HDA are more or less equally labour-intensive, the technology support requirement for HSA is much higher than that for HDA, for which Thailand is better equipped. Even though China offered lower labour costs, they were yet to develop this technical support and infrastructure, and that was the reason for shifting HDA there instead of HSA. However, under the new agenda, HDA for laptops will also be carried out in Thailand itself and Thai operations would completely assemble all of Seagate's disk drives for laptops, while Malaysian and Chinese facilities will focus on desktop products, and Singapore will make stand-alone workstation drives, and higher capacity drives for the storage and performance-intensive network servers of the large OEM system makers like Compaq, Dell, etc.\textsuperscript{22} According to Brimble and Doner (1998), there are two main implications of this shift. One is that Thai operations, rather than working through Singapore will be more directly linked to the design facility in Colorado. Secondly, it implies that tooling and other process changes will occur in Thailand itself. Both may imply better capability acquisition and learning prospects for the firm's Thai operations.

At the time Seagate started its Thai operations, there were not enough engineering graduates in Thailand. However, Seagate had no difficulty in getting employees until other HDD firms also started setting up plants in Thailand from 1988 onwards. Following that and with the entry of a large number of other electronics companies also into the labour market during the boom years of the early 1990s, the supply situation of engineers was tight. On the management side, while in the early 1980s, the head of Thai facilities used to be a Singaporean, and there was only one Thai director, currently the number of Thai directors stood at 50. According to the interviewee, there were three expatriates at the director level and two at the managerial level at Teparuk, while Wellgrow had 4-6, and Chokchai and Korat had one each. The

\textsuperscript{20} Ibid.
\textsuperscript{21} As part of the restructuring and production realignment undertaken since the end of 1997, Seagate had begun integrating each country's operations independently. Thus, the company had begun integrating HSA and HGA operations (which was expected to be completed by the end of 1999).
\textsuperscript{22} The company expected this move to bring down the high freight costs as well as enable increased flexibility, communication, and quality for Seagate's operations and products.
fact that Rangsit plant did not have any expatriate and was being managed solely by Thais does reflect the strides made by the experienced Thai management personnel.

Seagate's early eighties' Thai operations belong to that category of investments by American computer peripheral manufacturers who were shifting the low-skilled labour-intensive segments of production in their value chain to countries where low skilled wages were significantly lower, in order to save on labour costs. Thus, Seagate was the single largest employer in Thailand employing about 44,000 in its six plants in 1997. However, at the end of 1997, about 12-13,000 or roughly 2% of its employees were laid off by Seagate after the economic crisis, in the production restructuring and rationalisation undertaken by the new management, and no new appointments had been made until early 1999. Even then, it is evident that the employment provided by Seagate's operations in Thailand is too large to be ignored in a critical analysis.

The highly automated and technically complex element of the head sub-assembly, viz.; wafer fabrication and the technology-intensive sub-assembly of media, are not done in these Thai facilities, but in the American plants. Apart from these, the other most important elements of the value chain such as R&D, product development, and equipment manufacturing, which require little unskilled labour, but for which availability of highly skilled engineers is crucial, have also been kept in the US. Again, PCBs, another technologically involved component of HDD, are being made in Malaysia and Singapore, and not in Thailand. However, to an extent, Seagate's Thai facilities may be characterised as involving both medium and some high-end technological sub-assemblies. This is because, while they involve rather highly labour-intensive processes, Thai operations are considered by the management to be capable of handling all stages of the sophisticated head sub-assembly, as well as the skill-intensive spindle motor assembly. It has been pointed out that in such highly sophisticated production, separating design from production geographically requires tremendous confidence in the processes for long distance ramp-up. Therefore, the direction of expansion undertaken by Seagate in Thailand despite the lack of very high technological capabilities of its labour force, points to a certain degree of learning process which seem

23 Thailand's relatively low wage rates had indeed played a key role in Seagate's decision to shift HSA production from Singapore to Thailand in 1983. Thai labour rates in 1985 were almost $5000 less than those of Singapore (and over $8000 less in 1990). Ibid.
24 At the end of 1997, Seagate's Thai plants accounted for approximately half of Seagate's global workforce. Brimble and Doner, opcit, p.5.
25 Women constituted 99.9% of the direct labour employed by Seagate.
26 However, low wages alone do not account for Seagate's choice of Thailand over Philippines or Malaysia, especially for the expansion in investments since the late 1980s, as Thailand's wage rates were somewhat higher than Malaysia's by 1990. This has been attributed to Thailand's general investment climate, and the easy recruitment of mature workers and trained personnel which contributed to the rapidity of start-up in Thailand. Ibid.
27 This is because yield loss that arises from small glitches in moving from design to volume production, aggravated by long distances or unskilled workforces, can swamp savings from direct labour cost. See Gourevitch et al., opcit., p. 19.
to have occurred among Thai workers. It is this availability of expertise, especially of engineers with skills needed for that stage of production, that has driven the firm's expansion so far. Thailand's mid-range position in Seagate's division of labour in its HDD value chain therefore points to the possibility of some degree of spillovers in terms of the large pools of workers and experienced engineers and managers trained in Seagate's Thai plants can lead to, just as the microelectronics companies established in the country in the 1970s had paved the way for the arrival of more electronics components and HDD-related firms into the country later on.

9.4.3 Fujitsu (Thailand) Co. Ltd.

Fujitsu (Thailand) Co. [FTC] was started in 1989 as the 36th overseas subsidiary of the Fujitsu Group\(^\text{28}\) of companies, with a registered capital of 1004 million baht. It is a 100% foreign-owned company.\(^\text{29}\) Initially producing components for telecommunications, printers, office automation and cameras, FTC now produces hard disk drives (HDD) which constitute 79% of its total output; page printers, serial printers and printer heads (9%); VTR rotary transformers for video cameras (6%); camera components (shutter- 5%); transmission equipment (communication modules 2%); scanners (less than 1%); and a small percentage of mechanical parts. While Fujitsu Ltd.'s representative office has been functional in Bangkok since 1977, the plant was set up in 1988.\(^\text{30}\) In 1989, it started operations with two production facilities in the Navanakorn Industrial Estate for printer, facsimile, camera shutter and transmission equipment.

In the start-up period, the parent firm had misgivings about the technological capability of the Thai operators (most of who come from a relatively agrarian background), and thus, started with relatively more standardised and technologically less sophisticated products. However, the success of products like printers, prompted the head office (HO) to upgrade Thai operations and attempt a trial production of HDD assembly in 1992, which was successful. Following this, full-scale HDD assembly was begun in 1994. By this time, it had expanded its production by adding four new manufacturing facilities in the Navanakorn Estate. Another major expansion was the manufacturing facility which had started operating in 1992 for expanding component production capacity. Further, a machine, plating and assembly facility was also started. However, since there was an environmental restriction regarding heavy metal operations in this location, FTC set up this unit in another (Bangkadi) Industrial Estate.

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\(^{28}\) With over 500 group companies, including Amdahl Corporation, and ICL PLC, Fujitsu is one of the world’s largest suppliers of computers and information systems solutions, telecommunications and semiconductor products, software and services. The Fujitsu Group has over 180,000 employees worldwide and operations in more than 100 countries.

\(^{29}\) Out of its total registered capital, 70% is owned by Fujitsu Ltd, and the remaining 30% is divided equally among FDK Corporation, Fujitsu Isotec Ltd. and Copal Co. Ltd.

\(^{30}\) It had applied for BOI promotion for the manufacture for 20 products and obtained the same for 15.
FTC has four distinct divisions for its products.

9.4.3.1 Transmission division
This division produces various kinds of key components for telecommunication equipment such as coil, transformers, functional modules, high speed optical interface modules, data service unit modules and optical fibre cords. All these products are shipped to Japan and used in Fujitsu’s modern ISDN optical transmission equipment. The firm has introduced modern high technologies such as Bare-chip Mounting Technology (COB), Surface Mounting Technology (SMT) and optical fibre assembly technology in their production process, which ensure compatibility and reliability of telecommunication equipment. In the telecommunication field, we thus find that the parent firm is using Fujitsu (Thailand) not for final assembly of the product with imported components, but for assembling sophisticated components, which are then exported to the parent factory for use in the final assembly there. While this is internalisation of component production by the parent firm, this process does imply imparting of better process technologies and skills to Thai engineers and workers than what is possible at end-product assembly-level operations, and thus appears promising in building certain technological capabilities.

9.4.3.2 Storage products division
This division currently manufactures HDD, including its key components such as printed circuit board assembly, flexible printed circuit assembly, and rotary voice coil read/write transducer with actuator assembly. Subassemblies such as head and media are purchased from its contracted facilities. By following a vertical integration strategy in manufacturing, Fujitsu, as in the case of Seagate, ensures that they are able to maintain control not only over production costs, but over proprietary designs as well. Prior to 1990, the parent firm had focussed on high-end drives with low volumes (but high margins), with high-capacity products being produced in Japan and the Philippines. Fujitsu’s Thai HDD operations were started following the parent firm’s decision to expand into higher volume lower-end drives.

9.4.3.3 FDK division
FTC’s FDK division, whose parent company is the Japanese FDK Corporation, manufactures rotary transformers, stepper motors, HDA or head assembly and various kinds of EMI components, including coils for noise suppression, linearity coils, and noise filters. FDK has a 45% market share in rotary transformers, components which are

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31 Vertical integration manufacturing enables them to ensure high product quality and reliability absolutely necessary to maintain their competitive position in the dynamic HDD market. It is number one in the computer field in Japan and number two in the world.

32 Brimble and Doner, opcit., p.7.
used inside the rotary head of video recorders. FDK also produces various kinds of transformers for switching power supply. The head sub-assembly for HDD along with its part thin film slider are manufactured within this division, which is then sent to the Storage products division for HDD assembly.

9.4.3.4 Printer Division
FIT (Fujitsu Isotec Thailand)’s printer division produces scanner equipments such as bar code reader and image scanner, as also printers and printer heads. Printer heads are the key component of printers and are operated on the magnet release technology and moving coil with permanent magnet structure. Technology and know-how are transferred from Fujitsu Japan to the division to produce printer heads with high speed and high quality of printing. Meanwhile, the manufacturing know-how for making printers has been transferred from Fujitsu Isotec Ltd. (FIT Japan), the division’s parent company, which is one of the world’s leading printer manufacturers. Thus, the FIT division uses the transferred technology to produce serial dot matrix printers and high speed and high resolution laser printers from heads to the complete set. It is discernible that Fujitsu Isotec (FIT, Japan) is a Fujitsu Group firm, and while Fujitsu Japan retains the most crucial head technology, FIT (Japan) makes the group’s printers. FTC [Fujitsu (Thailand)] therefore obtains the advantages of both the parent firms’ technological competence. This is typical of an MNC which retains strong control over its suppliers by having firms in its own fold and develops and markets products internally among these firms.

9.4.3.5 Copal division
This division under the parent firm Copal Company, manufactures camera shutters for single reflex cameras and lens shutters with auto focussing features for compactly designed cameras including for Advanced Photo System (APS) Cameras. The division also produces micro motors for cameras as well as vibration motors for pagers.

9.4.3.6 Mechanical parts division (MPD)
This came into existence in 1990, as Fujitsu needed to ensure that the components that go into the assembly of their high-tech products should be of the best quality. Given this reason, a fully automated mechanical parts division has been established for the production of precision stamping, lathing, milling, plastic moulding and plating/coating of parts for high-tech products. This division thus provides the high quality mechanical parts to the assembly plants of all FTC’s divisions. Since 1991, it has also been supplying precision mechanical parts to other companies in Thailand, mainly Japanese information processing device makers and electrical home appliance makers.

While obtaining BOI promotional privileges the company can sell 20% of its output domestically, it was remarked that there was not much domestic demand for
Fujitsu’s products. 30% each of Fujitsu’s HDD was exported to Japan, US and Europe. The 30% exports to Japan goes to the Fujitsu HQ for fulfilling its orders as well as to other Asian countries including Thailand, imported from Japan. The US customers are Fujitsu’s competitors in the computer market such as Apple and Unisys, which use Fujitsu’s HDD in their computer systems.

9.4.3.7 Sourcing Arrangements

While the head sub-assembly for disk drives are mostly done in-house as already mentioned, heads are imported from the parent firm’s facility in Japan, and from TDK in China. While most of the media sub-assembly was done in Fujitsu, Japan, some are imported from its subcontracting facility with another Japanese firm Hoya in Singapore. Spindle motors for the hard disk drives are purchased equally from Nidec (Thailand) and Minibea (Thailand). Suspensions are imported from Fujitsu’s plants in Philippines and China, and also from TDK (country of origin not known). ICs for the disk drives are all imported from Fujitsu’s US facility and also from other US companies. PCBA is imported from Fujitsu’s Vietnam plant to the extent of 70%, and the rest is sourced from Thai companies. Smaller components are all bought from Singapore. Thus, only final assembly of HDDs occur in Thailand.

In the case of printers, the integrated circuits (ICs) are all imported from Japan, while some other electronic parts are imported from Singapore. It was emphasised that design specifications for PCBs and ICs make it imperative for the firm to import them from Japanese or other companies, as suppliers capable of making such custom-specified components were not easily available in Thailand. While tooling and heat treatment are done in-house in Japan, the smaller mechanical and plastic parts are purchased locally, but mostly from Japanese, US or Singaporean joint ventures.

9.4.3.8 Technological Capabilities

There was absolutely no R&D carried out in the Thai facilities. In the case of manufacturing of rotary transformers and video machine, FDK Corporation takes care, while Copal Company takes care of camera shutter and Fujitsu Isotec takes care of printer operations. Each company brings the design and parts and the only the assembly is done in the Thai facilities. In the case of HDD, the products are designed in Japan with technological input from Fujitsu’s tech centre in Singapore. Ramp up occurs in Fujitsu’s Yamagata plant, a process taking less than a month, and only then the product

33 While Hoya has a plant in Thailand too, this facility makes media for 2.5" drives, while Fujitsu Thailand’s requirement is for 3.5" drives.

34 It was pointed out by Fujitsu’s manager also that the company has a strategy of procuring its supplies from plural sources for all the major components and parts, for ensuring the requisite quantity as well as to prompt competitive pricing among its various suppliers. Singapore is the international procurement office (IPO) for Fujitsu.
is handed over to the Thai facilities. Although Fujitsu’s HR program includes asking their employees and operators to suggest ways to improve the operations or even suggest design changes or modifications so that the good ideas of the people directly on the shop floor can be incorporated in the next phase of product development, it was pointed out that Thailand does not have enough number of engineers to start an independent R&D unit there. Further, it was claimed that it was cost-effective to send Thai engineers to Japan for the requisite training, rather than to set up another R&D unit here. However, the underlying concern became apparent in the discussion in that if the parent firm were to transfer the technology too just as it had earlier transferred manufacturing and assembly to such developing countries, then Japan would have to face ever higher unemployment problem for their skilled labour. Thus, all R&D units have been confined to Japan while IC design alone is being done in the US.

Fujitsu (Thailand) employs about 9000 workers 85% of whom are women. However, with the planned expansion for doubling HDD production, which is projected to raise HDD’s contribution in total output to 98%, the total employment figure is projected to go up. Devaluation helped in Fujitsu’s short-term expansion plans. Thailand’s average salary was given as 20% higher than that of Philippines. Although the salaries are high at the operator level also, the main factor that might hinder technological upgradation is the higher salaries of the Thai engineers who are in short supply. The deputy manager with whom the interview was conducted pointed out that during 1994 and 1995, there was a big problem of shortage of good engineers and other skilled personnel, which the company continued to face even after the crisis-induced consolidation in Thai electronics industry and the resultant loosening of the labour market.

However, Fujitsu still considers Thailand as one of their better sites, as the productivity is rather high. Speed and quality are maintained and rejection rates are low as well. Vietnam is cheaper than Thailand and China, but productivity is low. Therefore, Fujitsu’s Vietnam operations are confined to purchasing small electronic components from Singapore and assembling them. In the case of China, although export tax makes the overall cost very high, there are four Fujitsu factories in China as the labour cost advantage is considerable. There is no plant in Indonesia, while there is a factory for transmission equipment in Malaysia, and facility for high capacity drive products in Philippines. Fujitsu plans to expand their Thai facilities and make Thailand the regional focal point for HDD production in Southeast Asia. However, this expansion will mostly be in volume capacity. Although they hope to transfer some processes that are currently done in Japan, like media and suspensions to Thailand which grade higher on

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35 Ibid.
36 Ibid.
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the technology scale than the current assembly processes, and create a technical support centre, the plan does not include undertaking any R&D locally.

9.4.4 Melco Manufacturing (Thailand) Co. Ltd.

Melco Manufacturing (Thailand) Co. Ltd. or MMT, was established in 1987 for the production of floppy disk drives (FDD)\textsuperscript{37}, as a joint venture between Mitsubishi Electric Corporation (Japan), Mitsubishi Electric Sales Singapore Pte. Ltd., and Kang Yong Electric Public Co. Ltd., in the shareholding ratio of 70%, 28.5%, and 1.5% respectively. It may thus be considered a subsidiary of Mitsubishi.\textsuperscript{38} Significantly, while Mitsubishi Japan has sales headquarters in the US, Europe, Australia, Singapore, Hong Kong and Taiwan, Thailand is its only overseas production facility for producing FDD.

9.4.4.1 Product Line Evolution

Melco started in 1987 with BOI promotion; initially with production test runs for carriage assembly for 5.25" floppy disk drives (FDD) with imported machinery. The full-fledged production of FDD started in the same year, after Mitsubishi was satisfied with the quality performance. In 1989, it started production of the 3.5" floppy drives in a new factory. Currently, it produces 120 MB high density FDD for PCs, as well as those for laptops and notebooks. The notebook FDD which is a higher priced product, was started in 1997. Melco also produces the key components of FDD in-house, namely magnetic and carriage assembly, PCB assembly, and spindle motors. Melco received ISO 9002 certification in 1995.

It was pointed out that before 1987, FDD manufacturing took place in Mitsubishi Electric (Japan). When the Thai factory was set up, FDD manufacturing was completely shifted to the latter. And in this process of relocation, it is in fact revealing to note that a Mitsubishi subcontracting firm in China has begun producing the older 5.25" FDD models, which has been phased out from the Thailand factory since then.

Melco is a 100% exporting company, with 70 percent of its sales going to the USA, 10 percent to Europe, 10 percent to Singapore, and the remaining divided between Japan and Taiwan. While Melco is allowed to sell up to 20 percent of their output in the domestic market, they have no domestic sales, as there are no domestic customers for

\textsuperscript{37} While the basic mechanical and electronics technologies for FDD are similar to those for HDD, the former are less sophisticated than the latter. BOI, 1993, Investment Opportunities in the Electronics Industries in Thailand, Bol, Royal Thai government, Bangkok.

\textsuperscript{38} This is true if we take account of the fact that the Mitsubishi Group holds as much as 98.5% and that the Thai partner Kang Yong Electric Public Company itself is a Mitsubishi joint venture with 49% ownership.
FDD. Further, the BOI policy of tax on imports for domestic-oriented production was pointed out as leading to highly cumbersome tax accounting procedures.

9.4.4.2 Sourcing Arrangements
Originally, the assembly of FDD was carried out with 100% imported parts from Japan and Singapore, and only final assembly, testing and quality control were done at Melco. Import from Japan was as high as 80 percent of total supplies in 1996. Imports from Japan increased drastically in 1997, when there was a rise in the parts needed from there for the production of the new model LS-120 for laptops. However, by 1998, the ratio of components imported from Japan to locally procured components was down to the lowest level of about 37 percent, while imports from other countries constituted about 40 percent and local procurement accounted for about 22 percent.

All machines are imported from Panasonic, Japan. One of the most important components, namely PCBA, has been made by Melco itself from the very beginning. However, 60% of the PCB requirement for PCBA is imported from Japan, and the rest are imported from Japanese companies in Philippines. The company started making magnetic heads in 1990, and spindle motors in 1996. Before 1996, parts for spindle motors namely, rooter and stator, were imported from the Japanese company Sankiyo-Seiki, however, Melco started their in-house production in 1996 in an attempt to reduce production costs. In 1998, Melco applied for BOI approval for a new project to start the in-house production of stepping motors, but the proposed project has been postponed due to the Japanese economic downturn. Another electronic part flexible lead, is imported from Singapore and also bought from Japanese joint ventures in Thailand. Coil is bought from the Fujitsu affiliate company Ltec in Thailand. Subcontracting to Thai companies exists only in the case of frame and plastic parts, which is for 5-6 years sometimes. In these subcontracting arrangements, Melco’s Thai engineers go to those companies to provide the specifications, and give the necessary training. It was pointed out that Thai companies did not have the capability to produce the high technology components needed by the company.

9.4.4.3 Technological Capabilities
Melco does not have any R&D division as R&D support is provided fully by Mitsubishi Japan’s Koriyama plant which handles the R&D single-handedly. Thus, designing is done there, after which the new designs are sent to the Thailand factory. If any problems are encountered, Thai and Japanese engineers together make minor appropriate changes.

39 In fact, the surface mount machine used in PCBA has to be bought newly every three years or so, as the design of PCB keeps changing quickly.
Currently, Thai engineers are sent abroad for the necessary training. Japanese engineers also are sent from there to the Thailand factory. Each level of worker is provided regular training in the factory also. It is difficult to have R&D in Thailand, as engineers are not qualified enough, and equipments are not of high quality. It was pointed out that the Thai university laboratories are equipped with old machines, and the graduates who are recruited by companies do not have enough know-how or experience to handle new technology and new machines. Among the faculty too, majority are old professors with no exposure to the new electronic technologies.

There are three Japanese at the managerial level, and five Japanese at the engineer level out of a total of fifteen engineers. In the process of increasing productivity and investing in new machines, about 2200 workers have been cut down. At present, there are about 1900 employees at Melco, of whom 1600 are women. The division of job responsibilities between parent firm Mitsubishi Electric’s Disk Drive business Division and Melco is indeed revealing in understanding the Thai facilities position in the value chain. While DDD is in charge of R&D, engineering, quality assurance, sales activity and customer support, Melco is responsible for only purchasing, manufacturing, quality control, and shipping. This reflects the high operative capabilities Melco has achieved in operation, rather than any high level capabilities for adaptation or innovation.

In 1996, there was a sharp fall in sales recorded by Melco due to the fall in FDD (PC) prices. In fact, the baht devaluation in 1997 added to their woes soon after, as they had borrowed heavily, amounting to three times their registered capital. Thus, in 1998 Melco made losses, and did not expect much improvement in the performance in 1999 also as Japanese economy was still in recession. Following the crisis, Mitsubishi’s plan to begin FDD production in Vietnam also did not take off after the initial survey, although it has many operations in China.

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40 In fact, some of the companies donate their old machines and equipment to some universities to facilitate their studies and because of the speed of the technological changes happening in this industry, many universities are stuck with machines using redundant technologies.

41 Until 1997, there were 12 Japanese engineers staying at Melco. Following the economic crisis in Japan, their number was reduced to five and the number of managerial level expatriate staff to three, to reduce the overall costs of operations.

42 Only Japan makes FDD in the world, and Mitsubishi ranks fourth or fifth after Mitsumi, Panasonic, Sony etc. The technology standards and requirements are getting more and more sophisticated and the technology is also changing too quickly. Each time the design of FDD changes, most of the components also have to be changed to fit the new model. So, currently, trial is going on in Japan to make a standard model which can accommodate all model changes.

43 The price war in computer field started after Intel sold PCs with high speed, good quality, and more memory, for prices under US$ 1000.
9.4.5 Samsung Electro-Mechanics Co. Ltd.

Samsung Electro-Mechanics Co., one of South Korea’s second largest business group Samsung Group’s seven factories in Thailand, was set up in 1992 for supplying parts to mainly Samsung’s TV assembly factory in Thailand. The TV assembly factory, Thai Samsung Electronics Ltd. is a Samsung majority-owned joint venture with the Thai CP group. This is a typical case where a multinational company set up its own manufacturing affiliate in Thailand for making their core parts and components. Thus, while this enables them to capitalise on promotional privileges, the parent firm is able to retain the hold on its core component technologies. Samsung Electro-Mechanics, a 100% subsidiary of Samsung, produces TV parts, namely monitor, fly-back transformer, etc. Majority of its sales go to the Samsung TV factory in the same province. Since this constitutes indirect exports, it is considered to be a 100 percent export-oriented company and receives BOI privileges such as duty exemptions etc. Local sales to other companies are only marginal, in which case too the customers are foreign affiliates.

Table 9.2: Sourcing arrangements of Samsung Electro-Mechanics (Thailand) Co. Ltd. (80% of total inputs are imported) making TV parts

<table>
<thead>
<tr>
<th>Product/part</th>
<th>Supply Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Machinery/equipment</td>
<td>Imported through the head quarters</td>
</tr>
<tr>
<td>2. Monitor</td>
<td>100% In-house</td>
</tr>
<tr>
<td>3. Deflection yoke</td>
<td>100% In-house</td>
</tr>
<tr>
<td>4. Fly-back transformer</td>
<td>100% In-house</td>
</tr>
<tr>
<td>5. PCB &amp; ICs</td>
<td>Imported</td>
</tr>
<tr>
<td>6. Capacitors, resistors, transistors etc.</td>
<td>Imported</td>
</tr>
<tr>
<td>7. Oil condenser</td>
<td>100% In-house</td>
</tr>
<tr>
<td>8. Tuners</td>
<td>100% In-house</td>
</tr>
<tr>
<td>80% of total inputs imported</td>
<td></td>
</tr>
</tbody>
</table>

9.4.5.1 Sourcing Arrangements

Samsung Electro-Mechanics started producing oil-condenser, fly-back transformer, monitor and deflection yoke in 1995. In 1996, it started producing electronic tuners, and the latest expansion was the RF-unit started in 1998. Among these, the most advanced product is the colour monitor. All the major parts and components are imported and imports constitute up to 80 percent of total supplies. The main reason for importing such a large ratio of supplies was pointed out as the BOI import duty concessions, which make it cheaper for them to import. All the raw materials are also imported from Korea itself. In fact, the South Korean Samsung Display Devices of the Samsung Group, is the world’s largest producer of cathode ray tubes (CRTs) for TV sets and computer monitors, and it is only natural that the CRTs, which is the most important part of the

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44 Samsung Group makes a range of products such as colour TV, mobile phones, microwave oven, vacuum cleaner etc. in Thailand.
monitors are imported from this South Korean affiliate. As the sale orders are placed with the head quarters, it is also they who decide the quantity of production, and thus the amount of raw materials to be purchased. It also follows that they choose the suppliers.

9.4.5.2 Technological Capabilities
There are about 1700 workers and 46 engineers in the factory. Sixteen of the engineers are expatriates. After a few months initial training in the factory, most of the engineers are sent to South Korea for training, and once they are back, there is further on-the-job training in the production sections. It was pointed out that the management is careful in assessing a new recruit’s plans to stay on with Samsung for long, before they decide to send him/her to South Korea for training. However, occasionally, some engineers do leave the company later on.

For the initial training during the setting up of operations in the factory, Korean experts had come to impart the necessary training after which they left, in accordance with the BOI regulation. However, the top managerial positions in each main department including factory manager, finance manager, and the Managing Director are all occupied by Koreans. There are overall twenty Koreans at the managerial level in the company. Most of them have engineering backgrounds and have even upto fifteen years of experience at many levels in the Korean headquarter factory production section, and therefore are adept in handling second level of trouble shooting, when Thai engineers are not able to solve particular problems. This enables the company to save the time and cost involved in bringing Korean engineers from Korea in case of trouble shooting requirements.

There is no R&D division in Samsung Electro-Mechanics. All the designing is done at the head quarters. The company has licensing and marketing agreements with the parent firm. Hardly any minor design changes also occur here. The main areas of technical capabilities are in assembling techniques, operating methods, quality control, repair and maintenance, and product and process improvement. They also focussed on managerial and organisation methods.

Samsung has two factories in China for electro-mechanics, which were set up about four years ago. While the regional economic crisis did not have much effect on their sales, the Thai subsidiary expected competition from China and Philippines to affect their market share. There was no retrenchment of workers from Samsung because of the crisis, however the company decided not to replace any “resigning” workers with new persons until the situation had got better.45

45 In effect, this meant that the remaining workers have to put in more number of hours.
9.4.6 Tatung (Thailand) Co. Ltd.

Tatung (Thailand) was established in 1990 as a 100% subsidiary of the Taiwanese Tatung company, for manufacturing monitors for colour TV and computer. For the first few months, only PCB assembly was done here and full final monitor assembly was begun later on. Currently, monitors constitute 82% of total turnover at Tatung (Thailand), while monitor chassis (PCB) makes up 13%, and CTV chassis makes up 4%.

9.4.6.1 Sourcing Arrangements

The most important component of the monitor namely cathode ray tube (CRT), which consists up to 80 percent of a monitor’s total production cost, is bought from Tatung’s Malaysian factory for the sizes 14”, 15” and 17”, since the time the latter was set up in 1995. Before that the picture tubes were imported from the Tatung headquarter factory. However, 19” and 20” picture tubes are bought from a Japanese company. There is a Tatung factory for picture tubes in China as well. In fact, picture tube production has expanded and spread from Taipei to Malaysia and to China, and in the last year to Scotland in the UK, which supplies the UK Tatung factory. ICs are generally bought 100 percent from Philips factories in Korea and Japan. This year, however, ICs are being bought from Samsung’s and JVC’s Thailand facilities. Transformers were imported 100 percent last year from Taiwan. Some of the small electronic components like capacitors, resistors, etc. are bought from local companies, mostly Taiwanese companies like Yageo. There is both import and local procurement in the case of diodes. Cable is bought 100% from local Taiwanese companies. This is the case with plastic for making the cabinet also. The supplier is the Taiwanese company called Chi Mei. In both these cases, it was pointed out that Thai companies, which could provide the Tatung specifications at comparable costs, were not available. Most of these Taiwanese supplier companies had come to Thailand during 1989-90, around the same period as Tatung, and similar to Japanese practice, while there is no company policy as such, the language and cultural affinity was mentioned as bringing Tatung closer to Taiwanese suppliers than Thai companies. Overall, Tatung (Thailand)’s total imports comes to about 80 percent of total supplies. This import covers Taiwan, Japan, Korea and also Europe.

Table 9.3: Sourcing arrangements of Tatung (Thailand) Co. Ltd. for TV Monitor

<table>
<thead>
<tr>
<th>Product/part</th>
<th>Supply Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Machinery/equipment</td>
<td></td>
</tr>
<tr>
<td>2. Cathode ray tube (CRT)</td>
<td>Imported from Tatung (Malaysia) for 14&quot;, 15&quot; &amp; 17&quot; monitors. Bought from Toshiba Display Devices (T) for 19&quot; &amp; 20&quot;</td>
</tr>
<tr>
<td>3. Fly-back transformer</td>
<td>Taiwan</td>
</tr>
<tr>
<td>4. Ics</td>
<td>Korea &amp; Japan</td>
</tr>
<tr>
<td>5. Capacitors, resistors, etc.</td>
<td>Taiwanese companies in Thailand</td>
</tr>
<tr>
<td>6. Diodes</td>
<td>Some imports and some local procurement</td>
</tr>
<tr>
<td>7. Cable</td>
<td>Taiwanese companies in Thailand</td>
</tr>
<tr>
<td>8. Plastic (for cabinet)</td>
<td>Taiwanese company in Thailand</td>
</tr>
</tbody>
</table>

80% of total inputs imported
Chapter IX

9.4.6.2 Technological Capabilities
An R&D unit was set up in Tatung in 1990 itself, however this is only for quality testing for the second source of suppliers. It is Tatung’s policy to keep R&D at the headquarters, further, there are not enough Thai engineers experienced enough for starting R&D locally. The company has five production engineers handling process design. It was mentioned that there are about 5 mainland Chinese engineers among the 39 engineers working at Tatung at present. This happened when it was difficult to get experienced engineers about four years back. Tatung has training for its workers at all levels. When there is a new design or model, first Taiwanese engineers come to give training to the Thai engineers, following which Thai engineers are able to handle the operations.

The design support for computer monitor comes from the Taipei headquarters, while that for CTV comes from the Tatung factory in UK. Thailand factory makes the same products as the Taipei factory, except for the minor modifications undertaken to adapt the product to local conditions. However, while the Thailand facility produces 14” to 17” models, Taipei makes 17” to 21” monitors. And currently, Thailand is starting the production of the 19 and 20” models, following which Taipei will be scaling down their production, and focussing totally on the 21” monitors. Taipei is also planning to come out with bigger monitors at lower costs.

The main customers for Tatung’s PC monitors are Tatung’s PC factories in Taipei and Netherlands. Computer monitors are also exported to Compaq and HP in the US and Packard Bell in Europe.\textsuperscript{46} As for TV monitors, Tatung’s TV factories in Taipei and UK\textsuperscript{47} are the main customers, and only 1-2 percent is sold domestically.\textsuperscript{48}

Tatung’s major capacity expansions took place in 1993 and 1998. The next expansion was to occur when one more floor became operational in 1999, and more workers are added to the factory. Currently, there are about 2100 employees, while during the peak demand period in October, they hire almost 1000 workers on temporary basis.

9.4.7 Toshiba Display Devices (Thailand) Co. Ltd. (TDDT)
Toshiba Display Devices (Thailand) is a leading manufacturer of colour picture tubes and colour display tubes of various sizes. TDDT was established in 1988 in the

\textsuperscript{46} HP buys both monitors and PCs from Tatung.

\textsuperscript{47} One of the overseas rules that influenced Tatung’s production strategy was the EEC Anti-dumping law, because of which they stopped exporting TVs to Europe, and now sends only PCBs, because of the high tax imposed. This was behind Tatung’s decision to start a TV unit in the UK.

\textsuperscript{48} Two of Tatung’s main competitors for computer monitors are the Taiwanese companies ADI (Thailand), and Lite-On, while for TV monitors, Samsung is the major competitor.
Bangkadi Industrial Park alongside other factories of the Toshiba Group in Thailand. Under the parent firm Toshiba Corporation headquartered in Japan, TDDT was set up in Thailand as a 100% export-oriented firm with a 93% stake, while the balance 7% is held by Japan’s Mitsiam International Ltd., Mitsui and Co. Ltd. and the Thai-Japanese joint venture Sumitronics (Thailand) Co. Ltd. Thus, Thai ownership is a meagre 2.5% in the company, and as such it can be considered a subsidiary of Toshiba for all practical purposes.

The company was granted BOI promotion in 1988 for 100% exporting. It cannot sell to TV makers distributing domestically, as the agency had to protect the interests of the government-promoted Thai CRT company, selling CRTs in the domestic market. However, although Thai CRT makes CRTs for TV, TDDT is the only company making CRTs for both TV and PC in Thailand.50

9.4.7.1 Product Line Evolution
TDDT commenced its operations in 1990 with the manufacture of small-sized cathode picture tubes - CPTs (Phase-I) of 14 and 15 inches for TV sets. Initially, only the bare tube was produced and it was later in 1991 that the full monitor was started. Later, the company expanded to produce 21 inch i.e.; medium-sized CPTs (Phase-II) for TV sets in 1992, and the 25 inch CPTs were begun in 1992. TDDT’s product profile further expanded to small-sized cathode display tubes - CDTs for computer monitors (Phase-III) in 1995. TDDT now has three factories and it was the first factory that was modified for the production of CDTs, as the company is in the process of phasing out lower-end CPTs from Thailand. Production of small-size (14 inch) CRT was discontinued after 1998 because of increased price competition and dropping profits.

In the early 1990s, more than 60% of the colour TV CRTs was exported to Japan. However, with increase in domestic sales (which is actually indirect exports to 100% export-oriented local firms), currently only about 20% of the CPTs are directly exported to Japan. The remaining is sold to the Thai factories of Japanese TV maker JVC (already discussed) and the Hong Kong-Japanese joint venture TV maker World Electric (Thailand). The fact that about 80% of TV picture tubes is being met by

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49 The Toshiba Group of companies in Thailand consists of TDDT, Toshiba Semiconductor (T), Toshiba Consumer Products (T), Thai Toshiba Electric Industries, Thai Toshiba Fluorescent Lamp, Thai Toshiba Lighting, TLT Wako (T), and Control Component Co. Ltd.

50 Its main international competitors are Taiwanese and Korean companies such as world number one Samsung and also Chungwa, the latter having technology assistance from Toshiba itself. In fact, beginning 1998, TDDT has had to accept a price cut of 50% on an average to face the increased competition in the market.

51 Both cathode picture tubes (CPTs) and cathode display tubes (CDTs) are cathode ray tubes (CRTs). The former refers to TV and the latter to computer.
domestic demand may be seen as a remarkable achievement of the heavy protection (successful import-substitution) being given to CRTs in an attempt to bring down the import of this major TV part, as well as the large number of TV sets being manufactured domestically. On the other hand, 80% of CDTs is directly exported, while the remaining 20% is exported indirectly through sales to 100% export-oriented local customers such as Taiwanese-British joint venture Delta Electronics (T) Co. Ltd, and the Taiwanese-owned Chinteik Electronics and ADI. Since 1995, such indirect exports have increased and direct exports have come down to 70%. About 30% of the direct exports are destined to Malaysia, and about 20% each go to Mainland China and Korea. Some other foreign destinations are to Hong Kong, Taiwan, Mexico and UK. Indeed, the significantly lower percentage of computer display tubes (CDTs) being sold domestically reflect the low volume of local computer monitor production (which provides the demand for CDTs) in contrast with the huge domestic demand for TV picture tubes. However, as the domestic manufacture of computer monitors expand, indirect exports of CDTs are also likely to increase.

9.4.7.2 Sourcing Arrangements
TDDT has direct contracts with all its suppliers for major components.52 It has also been the strategy of the HQ to have two suppliers each for all the major components and parts required for the CRT production, so that in case of any problem encountered with one of the suppliers, the firm could turn to the other for immediate solution. The high quality custom-specialised glass for the front panel and backside funnel of the cathode ray tube which makes up about 80% of its production cost used to be imported from Asahi in Singapore and NEG in Japan and Malaysia, in the beginning. But, since 1992, after Asahi set up its subsidiary in Thailand, TDDT buys it fully from its Thai facility. In fact, Asahi (Thailand) can be seen as a typical example of ‘follow-the-customer’ kind of FDI into Thai electronics components industry, as Asahi established its Thai operation under Toshiba’s influence. It should be noted that the Mitsui Group of Japan is the parent firm for both Toshiba as well as Asahi. Shadow mask which constitutes about 10-12% of the production cost is imported from Toshiba’s main factories in Japan (80%) as well as from the Toshiba’s joint venture plant in China. 70-80% of the deflection yoke which constitutes 5-8% of the total production cost is bought from Matsushita’s Malaysian facility and the rest was bought from Samsung’s Thai facility. The company buys its supplies from Thai companies only in the case of jigs and fixtures made of metal and

52 In general, for both TV and computer picture tubes, TDDT procures orders three months in advance from its customers and gets their forecasted demand. The demand for TV picture tubes is usually more stable than that for computer display tubes.
plastic. It was pointed out by the company that Thai companies do not have the capability for producing precise and sophisticated parts. Since the Thai petrochemical industry was not so developed (?), even chemicals are bought from Thai joint ventures or from Thai companies importing from abroad.

Thus, while all of the components for the cathode ray tube were initially 100% imported, TDDT has gradually increased local procurement. However, all of such local suppliers are foreign-owned and controlled by either Japanese or other Asian MNCs. Thus, while it claimed that the Japanese management is willing to increase the local procurement and that it does not matter to them whether they buy from either foreign or Thai companies as long as the quality is maintained, TDDT’s complete procurement can be seen to have been either imported from the parent firm in Japan itself or from other foreign firms, or has been bought from foreign companies’ factories located in Thailand. There is also some evidence in confirmation of the trend observed among Japanese MNCs which seem to restrict their supplies to their historical suppliers, which in their case are mostly Japanese firms.

Table 9.4: Sourcing arrangements of Toshiba Display Devices (Thailand) Co. Ltd. for Cathode Ray Tube (CRT)

<table>
<thead>
<tr>
<th>Product/part</th>
<th>Supply Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Machinery/equipment</td>
<td>Japan (bought by the Japanese HQ and imported by the subsidiary)</td>
</tr>
<tr>
<td>2. Glass for front panel and backside funnel (80% of)</td>
<td>100% from Japanese joint venture Asahi (Thailand)</td>
</tr>
<tr>
<td>3. Deflection yoke (5-8% of the production cost)</td>
<td>70-80% from Matsushita (Malaysia) and the rest from Samsung</td>
</tr>
<tr>
<td>4. Shadow mask (10-12% of the production cost)</td>
<td>80% from Toshiba (Japan) and 20% from Toshiba’s joint venture in</td>
</tr>
<tr>
<td>5. Electron gun (10% of the production cost)</td>
<td>100% in-house assembly using 100% imported components</td>
</tr>
<tr>
<td>6. Chemicals</td>
<td>Joint ventures in Thailand or imported through Thai chemical trading</td>
</tr>
<tr>
<td>7. Plastic &amp; metal jigs &amp; fixtures</td>
<td>Thai companies</td>
</tr>
</tbody>
</table>

The only major component that TDDT has successfully manufactured in-house is the electron gun, which contributes 10% of the production cost of a picture tube and 25% to that of a computer display tube. While it was imported from Japan in the initial years, since 1992, electron gun assembly is being done in-house 100% in order to reduce the production cost. In fact, TDDT is currently exporting electron guns to both Japan as well as to Toshiba’s subsidiaries in other East Asian countries. It should however, be kept in mind that even for electron gun, the production process involves not more than the assembly of the imported parts and components and is a highly labour-intensive process. It was pointed out that TDDT had attempted to find suppliers for parts of the electron gun, which however turned out unsuccessful, as the company could not find suppliers which could provide the specifications suiting Toshiba’s products. Another hindrance was the inability and unwillingness of the company to break away from long-term suppliers and change over to new ones.
9.4.7.3 Technological Capabilities

It was confirmed by the management that in the case of both TV picture tubes as well as computer display tubes, Thai production began with the transfer of older standard-demand models that were being phased out from Japan. However, in 1999, the Thailand factory hoped to start parallel production for some new models of picture tubes, along with Japan. It was pointed out that the Thai engineers have developed the necessary higher skills required for start-up production of new models now, without having to wait for the HQ to transfer ramped-up models. However, this might remain restricted to low to mid-end products and especially labour-intensive ones, in view of the fact that the labour cost has been lower in Thailand compared to Japan. While the HQ facilities concentrate on the production of larger CRTs of 17 and 19 inches and has stopped the production of 15-inch tubes, the Thai factory has expanded the production volume for 15-inch tubes.

CRT production is labour-intensive in some processes, while for some others, it has highly automated lines. The front processes namely shadow mask and coating are mainly automatic, as is testing and adjusting, while the back process, namely electron gun assembly, is highly labour-intensive. It was pointed out that Thailand’s labour cost is higher than that of Indonesia, Philippines and China, while compared to Malaysia, it is still lower. In fact, in 1997, Toshiba shifted the production of 14 inch CRTs to Indonesia, while production of 20 inch CRTs was started here.

As is the practice with more or less all foreign subsidiaries, all the product designs for TDDT are provided by the HQ. New models come out every year, and sometimes every six months. For the starting period of the introduction of a new product, Japanese supervisors come down and provide training. Thai engineers are sent to Japan for training as well. Further, there is on-the-job training by Japanese engineers who use documents that are provided by the HQ. Such documents though, are in Japanese and are translated into Thai only in case of extreme difficulty in understanding instructions provided otherwise. [This tendency for absolute ownership over their proprietary knowledge even in their own subsidiaries reveals a desire for total control.]

While the product design keeps changing, only some degree of improvement or modification takes place locally for any problems encountered in the production process. There was no R&D undertaken by the Thailand factory otherwise, though testing was done locally. Even in the case of small development undertaken, strong design support is needed from the HQ, and so the management did not think it feasible to have its own full-fledged R&D unit in the near future. While the interviewee pointed out the huge

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53 While the initial purpose was really to cater to the Indonesian domestic market, as the domestic scene remains depressed following the crisis, Toshiba has started exporting these products from the Indonesian factory as well.
costs involved in purchasing the equipment needed as hindering the setting up of an R&D unit, it was further admitted that may be the HQ does not want to transfer the technological details fully to the Thai affiliate, which it would be warranted if an independent R&D unit is founded in this factory. The rationale was also provided in the very high (4.5% then) unemployment rate prevailing in Japan. The argument is that if Japanese parent firms start transferring the higher-end technology also which is its only present preserve in the division of labour in many an electronics industry segment, it would lead to a worsening of the employment opportunities in Japan, and thus it ought to carefully guard and keep its technological advantages to itself.

There are a total of 3100 employees in the TDDT factory, of which 2600 is direct production-related workers with 60% constituting of women workers. About 500 are employees at the supervisory and management levels. There are about 65 engineers of which Japanese engineers constitute 33%. At the managerial level too, there are about 15 Japanese, which constituted around 3% of the total number of managerial level staff. It was mentioned that the company had not faced any labour shortages either before (which many other interviewed firms talked about) or following the economic crisis. It was reported that TDDT currently does not have any regular training programme for its employees, but claimed that from the coming quarter onwards they would be sending 3-4 engineers to Japan for six months’ training.

9.5 FIRMS SOURCING FROM UN-AFFILIATED FOREIGN FIRMS

9.5.1 Thomson Television (Thailand) Co. Ltd.
Thomson Television (T) is a 100% subsidiary of the Singapore-based Thomson Multimedia-Asia, which in turn is a member of the world-wide group of Thomson companies based in Paris, France. It was set up in 1989 with BOI promotion as a 100% export-oriented company. The Thailand factory employs 3000 out of the 50,000 strong world-wide employees of Thomson, 90 percent of the former being women.

9.5.1.1 Product Line Evolution
Thomson started with the assembly of colour TVs in 1989, for which the components were prepared in Thomson’s Singapore factory and shipped to Thailand as semi-knocked-down (SKD) kits. This meant that even the printed circuit board (PCB) was assembled at the Singapore facility, and merely assembly of the TV set was carried out at the Thailand factory. It was after three-four years that Thomson Thailand moved into the next logical step, namely completely-knocked-down kits (CKD), where in it started

54 In electron gun assembly, the ratio of women workers are at 90%, as it requires fine and concentrated work, (though not heavy).
PCB assembly. This increased the value-added in Thai operations. The design and technical support for PCB assembly was provided by Singapore, and there was heavy training programme before the PCB assembly was undertaken in the Thailand facility. It was only in 1993 that the actual production of colour TVs began in the Thailand factory, and this was pointed as a normal evolution period needed for a completely new manufacturing facility to grow up the learning curve. During 1993-94, the Thailand facility became an independent manufacturing unit. In 1995, it also started the production of the colour VCR Combo, which combines a VCR with TV.

9.5.1.2 Sourcing Arrangements
Initially, when the production was shifted to Thailand from Singapore, the machines and equipment were transferred from the Singaporean facility. At present, new machines are bought from the US, Germany, Japan or France, as the case may be. The components for PCB assembly are purchased from all over the world directly by the Thailand factory. One of the major parts of TV viz.; the picture tube, is sourced both locally and from abroad. The local supplier is Mitsubishi’s joint venture in Thailand, Thai CRT Co., from which around 20-25 percent of total requirements are bought.55 The remaining 75-80 percent used to be sourced from Malaysia, Indonesia, and Korea. At present, Malaysia is the main outside supplier of colour picture tubes- around 60-70 percent. Fifty percent of the integrated circuits are bought from Thomson’s European subsidiary, and the rest are bought from Japan and Singapore. Another major component, deflection yoke is shared between a Mexican and Asian source. Smaller components such as capacitors, transistors etc. are bought from big groups like Toshiba’s facilities in Taiwan and China. Resistors are from big companies in the US, Europe, Japan and Korea, while speakers and cables are bought from China. In the case of switches, some are bought locally from Japanese companies’ factories in Thailand, and some are imported from Japan, procured through the Singapore office. Only mechanical components such as cartons, cabins etc. are bought from Thai companies locally. It was pointed out that when one is a global player56, one needs to ensure the quality of components and parts carefully, and only big players of comparable size in components manufacturing can support the supplies needed to maintain Thomson’s competitiveness in the world market. Even for plastic, the market is global and not local.

55 Thai CRT is a protected Thai majority-owned joint venture with Japan’s Mitsubishi Corporation and several other TV manufacturers operating in Thailand. It is promoted by the government for the manufacture of cathode ray tubes (CRT) for the domestic market, after long-proclaimed localisation efforts for consumer electronics products’ major components. The major local partner is the Thai conglomerate Siam Cement Group. The venture started commercial production in 1990.

56 It was pointed out that while the global TV industry is fifty years old, the French Thomson Company is 100 years old, which began production with electric razors, disc players etc.
Table 9.5: Sourcing arrangements of Thomson (Thailand) Co., Ltd. for Colour TV

<table>
<thead>
<tr>
<th>Product/part</th>
<th>Supply Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Machinery/equipment</td>
<td>US, Germany, France &amp; Japan</td>
</tr>
<tr>
<td>2. Cathode ray tube (CRT)</td>
<td>Thai CRT Co. (20-25%), Malaysia (60-70%), Korea and Indonesia</td>
</tr>
<tr>
<td>3. Deflection yoke</td>
<td>Mexican and an Asian source</td>
</tr>
<tr>
<td>4. PCB components</td>
<td>World market</td>
</tr>
<tr>
<td>5. ICs</td>
<td>Thomson, France (50%) &amp; Japan &amp; Singapore (50%)</td>
</tr>
<tr>
<td>6. Capacitors &amp; transistors</td>
<td>Toshiba factories in Taiwan &amp; China</td>
</tr>
<tr>
<td>7. Resistors</td>
<td>US, Europe, Japan &amp; Korea</td>
</tr>
<tr>
<td>8. Speakers &amp; cables</td>
<td>China</td>
</tr>
<tr>
<td>9. Switches</td>
<td>Japanese companies in Thailand, or imported from Japan</td>
</tr>
<tr>
<td>10. Cartons &amp; cabins</td>
<td>Thai companies</td>
</tr>
</tbody>
</table>

Sourcing agreements are done on a yearly basis by Thomson, depending on volume and price. Usually, it is only in the case of ICs that Thomson provides the design and specifications. Most of the other components are standard products for which only minor specification changes are required to comply with Thomson’s requirements. In all these cases, the company works closely with the supplier companies to help ensure the product quality.

9.5.1.3 Technological Capabilities

In the case of trouble-shooting, the first level is handled by Thai engineers, and it is only when they are unable to fix the problem that Thomson’s European or US engineers are called in. It was observed by the Thomson management that both in TV and VCR, the technical capability of Thai engineers had reached that of Singaporean engineers after the initial three-four years of operation. However, design and development are done in the Singapore facility or the European facility, as the design is for the world market. After product development at Singapore, the process development takes place efficiently with the local team. However, 50% of the personnel at the director and executive levels of Thomson (Thailand) are expatriates.

Thomson’s number one market for TV is the US, while for VCR it is the European market. Thomson used to have some sales domestically in Thailand. However, when the company failed to capture a strong market position in the brand name, domestic sales were stopped.

Thomson’s spread of manufacturing facilities from its European and US operations to Asia occurred as follows. In the end of the 1970s, it shifted to Singapore for TV, and to Hong Kong followed by Taiwan for audio products. It was after about 10-15 years that Thomson began establishing manufacturing facilities in Thailand and

57 It was pointed out that Singapore has the same designing capability and quality as those of Europe.
58 In fact, it occupies the top most position in the US TV market, competing with Philips, Sony, JVC and Matsushita. In Europe, it is at the number three or four position where as the top position is enjoyed by Philips.
Philippines, and later on in China and Indonesia. The Philippines and China facilities are both only about five years old. Among the Southeast Asian countries, Thailand was chosen first for its low labour costs, its educated workforce (compared to the other countries at that point of time) and relatively developed infrastructure facilities. Currently, in this segment of electronics production, China offers the cheapest labour.

9.5.2 KangYong Electric Public Co. Ltd. (KYE)

KangYong Electric Public Company, established in 1964 under the name KangYong Electric Manufacturing Company Ltd. as a manufacturer and exporter of electrical appliances and parts, belongs to the first generation investors in Thai consumer electronics (and electrical appliances) industry. It is a Thai-majority joint venture with the Mitsubishi Group of Japan owning 49% of the 100 million baht registered capital. The majority shares constituting 51% are held between Thailand Securities Depository Co. Ltd. (for depositors), Phodhivorakhun Co. Ltd., K.Y. Intertrade Co. Ltd., Kang Yong Co. Ltd. and others.

9.5.2.1 Product Line Evolution

KYE's initial 1964 operations were confined to simple assembly of 100% imported CKD kits for electric fan under the Mitsubishi trademark. Although initially, it lacked the necessary ability to produce the various components independently, after technological improvements, it started manufacturing some critical components of fan like blade, and motors, in 1966. In 1968, the production of air conditioner was begun, which was followed by refrigerators and black & white TVs in 1971. Production of colour TVs began in 1978. In 1987, a second factory with new technology for the manufacture of 2-door refrigerators was introduced along with sophisticated production systems. TV manufacturing was shifted to this new factory, together with commencement of the production of washing machines and water pumps. Since 1989, it has been undertaking the entire design and manufacture for all its products.

In 1990, the manufacture of air conditioners was transferred to Melco Consumer Products (Thailand) Co. Ltd., an affiliate of Mitsubishi Electric.\(^6\) In 1991, KYE became a public limited company. The production of electric rice cooker was started in 1994. Its affiliate company Mitsubishi Electric Consumer Products Ltd. began the manufacture of refrigerators also, the production of which went considerable expansion in 1995 and

\(^59\) Of the 49% held by Japanese, Mitsubishi Electric Corporation holds about 36% and the rest is held by Mitsubishi Corporation Ltd.

\(^60\) KYE holds 10% of the registered capital in Melco Consumer Products, Siam Cement holds 20%, and the remaining 70% is held by Mitsubishi Electric.
1997. Colour TV was stopped in March 1998, following financial losses suffered by the TV unit for four consecutive years. With high competition and not being able to adjust its price strategy, the company had to accept the high cost of production, as the electronic parts were all imported. It used to produce carriage for floppy disk drives. It has stopped this product also subsequently. While initially it was completely oriented towards the domestic market, since 1989, it has also been exporting to Japan, other ASEAN countries as well as some South Asian countries such as Bangladesh and Sri Lanka.

One of the remarkable aspects about KYE has been its links with the other Mitsubishi Group companies in Thailand. For example, KYE bought the compressors for its refrigerators from Kulthorn Kirby, a Thai-majority refrigerator maker, and evaporators from Thai Refrigeration Co., which is again a Thai-Japanese joint venture. Rest of the components are made either in-house or through subcontracts to either Thai companies or to joint ventures. Thus, while a total 95% of all components are sourced locally and only 5% of the electronic components are being imported from Japan and Singapore, the local suppliers were mostly foreign affiliated firms or its own parent group affiliates.

9.5.2.2 Technological Capabilities
KYE was planning an R&D unit for refrigerators, initially with training from Japan. For air conditioners, it already has its own R&D section. When questioned about the hesitant nature of the Japanese to transfer technology to their overseas subsidiaries and affiliates, it was admitted that indeed Japanese are more reluctant than the Americans. However, in the case of KYE, more than average transfer has taken place, due to the fact that the Thai factories were manufacturing the older models of the products with Mitsubishi, which they had discontinued production in Japan completely. Thus, in most of the earlier models the parent firm had set up R&D and transferred the technological skills, so as to keep Thai facility independent of the parent support. However, it was unmistakably maintained that this willingness to support affiliate R&D was evident in the case of such standardised products alone, for which the Japanese parent company had stopped the production in Japan, so as to move on to higher VA and technologically much more sophisticated products/models.

In 1996, the Thai economy had to cope with lower rate of growth, increasing rate of inflation, tightening monetary market, lack of confidence from investors - both foreign and local, and a sluggish stock market. All of these had a direct impact on KYE’s operations in terms of higher cost of raw materials, a deficiency in the supply of major components, especially steel and plastic in the world market, declining purchasing
power among consumers, and an increasing interest rate that caused retailers to hold a smaller inventory than usual. Moreover, there was increasing competition in the industry, which forced everyone to lower their prices in order to gain larger market share, with a Korean newcomer also fighting for market share. To add to the woes, the home electrical appliances market that had grown by around 15-20% in 1995 grew very little in 1996.

In 1997 also, the company faced greater problems with the economy collapsing under recession. The floating of the Baht and its devaluation helped boost the company’s exports, but at the same time, drove up the cost of its imported raw materials and components. With the emphasis continuing to be on cost savings aiming at increased efficiency and effectiveness, the company has altered its market plans both domestically and overseas, and plans to expand exports to Hong Kong, Singapore, Taiwan, China and Indo-china. Simultaneously, it has been claimed that working with local parts manufacturers, the company designed products that used more local content, thus saving cost on imports.

Another challenge was that of tariff reduction under AFTA, which will permit products from the neighbouring countries to be sold in Thailand without import taxes. However, the company has prepared strategies to uphold the local market share. Further, KYE views AFTA as an opportunity for the company to penetrate into neighbouring countries’ home electrical appliances market, which are 9-10 times larger than the domestic one, and plans to become the regional market leader.

Kang Yong’s major products are electrical home appliances and as such TV was not an important product for them. Further, it might be said that having begun TV production under the highly protected import regime for the domestic market, this company had become too comfortable and relaxed. And since, under a lopsided tax structure when taxes levied on raw materials for use in components manufacturing was in several cases far higher than those on finished products, it was relatively much cheaper for the company to import these components than produce them in-house or procure them locally. Although the company began exporting a portion of its output in 1989 under the subsequent export-oriented regime, despite being a Thai-majority joint venture, Kang Yong is seen unable to increase the local sourcing of TV components. This is probably also because the parent company’s focus in Thailand seems to be on electrical home appliances for which it did successfully localise component sourcing as the parent firm set up affiliates in most of the major component manufacturing, or started producing them in-house. However, in the case of TV there is no such effort seen and thus, over dependency on imports eventually forces it to withdraw from the highly

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competitive and overcrowded TV market. In any event, this case adequately brings out the importance of local sourcing of parts and components from the point of view of the foreign affiliate itself. For, despite the fact that it might have gained in the short-run from importing, it is manifested that the long-term survival of the company is affected critically by it.

9.6 SUB-CONTRACTING COMPONENT FIRMS

9.6.1 Delta Electronics (Thailand) Public Co. Ltd.

Delta Electronics is a UK-Taiwanese joint venture, with ownership holding distributed among the Deltron Holding Ltd. of the U.K. (56%), its affiliate Delta Electronics Inc. of Taiwan (6%), and State Street Bank & Trust Company, Boston USA (3%). After having obtained promotional privileges from the BOI for the manufacture and export of electronic components, it was founded in 1988, and also enjoys the privileges of being in an industrial estate.62

9.6.1.1 Product Line Evolution and Technological Capabilities

Delta started its operations in 1990 with the manufacture of magnetic transformers - a low-technology labour-intensive product, and other kinds of magnetics namely line filters, drivers, width coils, and choke. It also produced electro-magnetic interference (EMI) filters.63 These products together employed 700 people in 1990, and the sales revenue in 1990 was 90 million Baht. The other product was switching power supply (SPS).64

The move up technology ladder towards independent design began with the establishment of the R&D department for magnetic transformers and EMI filters in 1991. Currently, there are 60 production lines for magnetic transformers, with over 1200 operators. Magnetics production is mainly for the company’s own consumption for other product lines. As for EMI filters, with expertise in design and development, DET’s team currently has capability to produce EMI devices for as many as 450 different types for specific purposes. Production process is mainly done by the computerised machines

62 Delta’s factory is situated in the export processing zone (EPZ) of Bangpoo Industrial Estate under the Industrial Estate Authority of Thailand (IEAT), and thus already enjoys complete duty exemption on imports (and exports), and exemption from VAT (but, there’s a tax on domestic sales). The benefit of being under BOI promotion is the additional exemption from corporate income tax for the promoted activities for a period of three to eight years from the date income is first derived from the promoted production.

63 EMI Filter is a component, which reduces interference of the electro-magnetic field in electronics devices with high sensitivity to such interference, such as computer, monitor, telecommunication, office and medical equipment, power supply, as well as consumer products such as TV, etc.

64 SPS provides stable direct current (DC) power supply from AC voltage to electronic equipments.
which were also designed by Delta’s own design engineers. Automation process ensures quality of the product, fast service, and requires fewer operators. At present, Delta is a world leader in this area, with an output of around 14 million units per year.

Engineers in R&D were trained by Delta Electronics Inc.(DEI) of Taiwan, who is their shareholder and is also considered their mentor. By 1993, Delta was capable of designing own SPS products as well. The product is now one of the core businesses in Delta Group and is supplied to many well-known computer makers. With excellent performance in product quality, delivery flexibility and business support, they are able to be at the top position despite the fierce competition in this market. There are 17 production lines with an output of about 6.1 million pieces per year, employing over 1500 operators and over 400 skilled technical staff and managers.

In 1993, the R&D department was expanded to accommodate the necessary activities of four additional products, with new promotional certificates granted by the BOI. The training of personnel was done by DEI and other Delta group members abroad. Thus, the company began volume production of colour monitors for computers in 1993. Two years later it became the main manufacturing centre of colour monitors within global Delta group of companies. At present, there are four production lines which manufactures about 1.6 million units per year. The rapid and continuous growth of monitor sales makes it the largest contributor to the company’s total turnover currently.65

The company grew further in 1995 and 1996, by when it had built four plants. Delta received the ISO 9001 Quality System Certification in 1994 and got listed in the Stock Exchange of Thailand (SET) in 1995. Further expansion took place in 1997, when Delta set up Delta Electronics (Cambodia) Ltd. for manufacturing Magnetics and EMI Filter. Owing to the economic crisis the Cambodian company was suspended until the situation became more stable. In 1997, Delta also established a joint venture with Susumu Co. Ltd. of Japan and Cyntec Co. Ltd. of Taiwan, to set up Delta Microelectronics Co. Ltd. to make thin-film chip resistor and temperature sensor. It also started production of nickel metal hydride rechargeable battery in Thailand in the same year, licensed from Delta Green Energy Ltd.

In 1998, new investment of around Baht 408 million, with 51 percent stake was made in Delta Axxion Technology (Thailand) Co. Ltd. to make bare-bone. Bare-bone is metal case of different sizes, used for protecting the parts and components in CPU. By March 1999, the production of bare bone had already started, So, the company has made

65 In 1997, the sales revenue were 40% from SPS and 53% from monitor, changing from that in 1996, where 36% was from SPS and 61% was from monitor.
an extremely strategic investment as it hopes that the savings on cash and time ensured by buying bare bone with parts and components as an integrated product from Delta, will prompt existing customers also to source the integrated product from them.  

9.6.1.2 Sourcing Arrangements

In terms of procurement of parts/components and raw materials, Delta has a policy to keep local sources as first priority as far as possible, in order to keep costs down. About 60 percent of its procurement is local. These are mainly plastic and metal parts such as wire, etc. The 'local' definition does not mean only Thai companies; they look for the quality and ability of the company to provide the supplies, and their financial and technical strength. High technology components such as ICs, thin-film resistors, capacitors etc. are imported, as they are not available in Thailand. It was pointed out that the locally present joint venture IC manufacturers make low- and medium-end products and do not match Delta's requirements. Machinery and equipment parts are obtained either locally (but, not necessarily Thai companies) or imported.

The company has long-standing sub-contract relationships with its suppliers. The company inspects the supplier factory on a regular basis every six months, and the factory and products have to be certified as meeting the quality standards.

9.6.1.3 Technological Capabilities

In the case of design for new products, it is done on a partnership basis between Delta and the customer company, which needs the new model for its own new product. This means that there is active technology sharing between the company and its world-wide customers, which enhances its technological capabilities and competitiveness. The Delta management strongly believes in undertaking strict quality assurance measures at both the design and production stages, to gain customers' satisfaction. In addition, the company introduced computer-aided manufacturing processes to reduce manufacturing lead time and cost. Also, the R&D department has been able to provide the optimal design to reduce the number of components used and improve product quality. It spends about 2 percent of annual sales on R&D.

Currently, there are a total of 7500 employees in the company. Ninety five percent of direct operators and 25 percent of technical and engineering staff are women.

Delta claimed to have a good record in training its employees. It has regular courses everyday, and a minimum of sixteen hours of training mandatory for salary

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66 Whereas existing customers who buy metal case and other parts and components separately will have to bear many costs, it makes it less expensive to buy bare bone with parts and components. Such savings include design costs, parts and components sourcing costs, and shipping costs, as bare bone is very bulky if shipped alone.
increase or promotion at each level. About 450 Thai engineers, technicians and operators have been sent abroad this year for training of varying duration from 3 months to two years. The cost of training is born fully by the Delta (T) Company.

In the R&D department, there are about 170 engineers, more than 50 percent of whom are foreigners, mainly Taiwanese. The head of the department is a French. At the executive level too, there are a large number of foreigners, including from Taiwan and Singapore. The manager of the monitor division is also Taiwanese. It was pointed out by the manager that a company of Delta’s size needs more well-trained managers to handle the operations than is catered to by Thai managers’ supply and this met by recruitment from abroad.

On the demand side, 1998 was not a bad year for Delta unlike firms such as Melco, despite the adverse economic conditions especially in Asia. This was due to the main trends in the PC market. At the beginning of 1998, there were major price cuts in the low-priced range of the PC market, in order to capture the demand for low-priced products. Thus, sales in this segment did not suffer much, though the price cut had to be accommodated. In addition, the server and networking business whose prices has not changed much, was expected to increase drastically, leading to a growth forecast of about 10-20 percent in the PC market. Balancing its clientele, the company is a major supplier for most of the top players in different segments of the PC industry, and this ensures that the company has growing business from whoever is successful.

Delta has a wide spectrum of customers world over. Forty percent of its sales are in the US, while 30 percent each go to Asian and European customers. Some of its sales are local- to the Thailand factories of 100 percent export-oriented customers like Mitsubishi, Sony, Tatung, Fujitsu etc. Thus, direct and indirect exports constitute 100 percent of Delta’s sales.

Delta’s other Asian operations include the Cambodian factory that has been mentioned above. The Cambodian facility was started for the manufacture of low-end transformers to be phased out from the Thailand factory, so that Thailand can focus on the other higher-range products. Apart from its much lower labour cost, the other significance about Cambodia is that it has quotas and thus easy export access to Europe, US and Japan, and easy access to Communist countries like Russia, Belgium etc. Delta Thailand also has a subsidiary in Singapore, which was set up four years ago. This was an expansion of capacity for monitor production from the Thailand factory. Further, exports to Islamic countries are easier from Singapore (as in the case of Malaysia). It was mentioned that Delta Thailand would be buying monitors from the Singapore facility as soon as the bare bone production reaches higher capacity.
Delta considers itself occupying the medium-end of the technical market in electronics, as its products monitor, SPS, EMI filter and magnetics are all capital-intensive, but skilled labour-intensive products. However, Delta is an original design manufacturer (ODM), which reflects a larger degree of independence in design and development than in an OEM. Therefore, to this extent Delta can be considered a successful case in technological upgradation with FDI. Part of this success lies in the fact that it is run by engineers who have been ex-employees with other multinational firms. They believe in the endurance of building up independent technological capabilities and were responsible for persuading the parent firms to set up R&D units in the Thai facility. This has enabled them to develop into an ODM, combining their engineering experience and technical skills, with the designing skills of their R&D expatriate staff.

9.6.2 Electronics Industry (USA) Co. Ltd. (EIC)

Electronics Industry (USA) Co. Ltd. (EIC) is a member of the world wide family of companies of EIC Semiconductor Inc. based in California, and is a manufacturer of discrete semiconductors. It is a Thai-majority joint-venture project with the Hong Kong sales office of EIC, namely, EIC International Co. Ltd. holding 25% of the shares, and Thai owners holding 75%.

EIC started in 1984 with a subcontract for diodes from Hong Kong, and is now a consistent supplier to the world’s leading OEM manufacturers of electronic products. EIC started manufacturing its own diodes from 1990, bridges in 1992, and now offers a wide range of products, including silicon rectifiers from standard to super fast recovery, varieties of diodes, transient voltage suppressor, bridge assemblies and related devices. The fact that it currently offers over 8,000 parts in 25 package types reveals its reputation and well-established operations. EIC is in the export processing zone (EPZ) of the Industrial Estate Authority of Thailand (IEAT), and enjoys the privileges and benefits offered by the IEAT. It exports 95 percent of its total output, which mainly goes to the USA and Hong Kong. The rest of its output are sold in the domestic market.

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67 The low-end in technical market consists of high labour-intensive and highly manual assembled products, and the high-end consists of high capital-intensive products such as semiconductor, IC and wafer fabrication.

68 EIC Semiconductor Inc., is the exclusive sales office for the markets of Northern and Southern America. It handles exports to Europe also, the main countries being Germany and France, while the Hong Kong Sales Office handles sales in Asia.
where the customers are the Thai plants of foreign companies like Samsung, Di-Star (Japanese), and Alphasource Electronic Co. Ltd., etc.\(^{69}\)

### 9.6.2.1 Sourcing Arrangements

Solder wafers, one of the important components in diode production, is imported from Taiwan or Japan.\(^{70}\) The same holds true for lead also, which is a major raw material for both diodes and bridges. For the diode manufacturing process (assembling technique) itself, the technology is from Taiwan, from where many other component parts are also imported.\(^{71}\) In the case of bridge, which is made from four diodes, the case is imported from Taiwan. It is only some chemicals and packaging materials that are locally procured by EIC. EIC also makes surface mount diodes (SMD), which are technologically very advanced. The technology for SMDs are bought from Germany and there was difficulty with skilled workers until the German engineers came down for two months to impart the necessary training for the new technology.

### 9.6.2.2 Technological Capabilities

EIC has about 280 workers, reflecting the high capital-intensive nature of the production process. They have regular training schedules for each of the thirteen sections in the assembly line. They have their own R&D division which handles design for new models also, when some new orders have specifications which are not already produced by the factory. Its modern and extensive design and manufacturing facilities are registered to ISO 9002, and they have process control and quality insurance. They are trying to implement the ISO 9001 conditions, while also attempting to implement the ISO 14001 related to environmental protection standards. The company was planning further expansion into more sophisticated products (like DO-35, TO-220, and TO-3P packages) as well as wafer diffusion and fabrication of glass-passivated chips, the latter being a very technically sophisticated process.

EIC is one of those joint-venture companies in electronic component production that has achieved high degrees of adaptive capabilities, apart from strong operative capabilities. Starting as a component supply subcontractor for OEM manufacturers, EIC has become an OEM itself, moving up the technology learning curve with extensive

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\(^{69}\) World Electric (Hong Kong-Japan joint venture) and Faie-Chi Electric (USA) are also among its customers. General Semiconductor Co. Ltd. of France also has currently placed orders, for which they provide the raw materials and buy back the complete output.

\(^{70}\) It was also pointed out that while there is a better technology in the US, which is more suitable to the environment, EIC is unable to implement it as there is a serious problem in finding the necessary skilled staff for it.

\(^{71}\) In the event that there is a problem with the technology provided by Taiwan or Japan, the Hong Kong office contributes to the technology requirements.
technical support from parent affiliates in both Taiwan and Hong Kong. However, it imports all major components and the production process is basically capital-intensive assembly-based, where the shortage of skilled labour was pointed out to be a hindrance in introducing certain higher technologies. Further, while the firm seems to have been effectively utilising learning possibilities from its overseas foreign customers, there is no linkage between the firm and any prospective Thai customers, and unless this happens, wider diffusion of EIC’s technical knowledge base will not occur.

9.6.3 GSS ARRAY Technology Public Co. Ltd.

GSS ARRAY Technology is an American majority holding joint-venture with Thais, with an interesting history. GSS Company founded in 1985 was the original American-Thai joint venture, which used to make head gimbal assembly (HGA) for disk drives under subcontract to Fujitsu and Read-Rite. This was a very small operation with 20 employees, and an essentially low-value-added labour-intensive assembly process. ARRAY Technology was a California company founded in 1982, which designed and manufactured array/ASICs. After merging with Wercon Technologies in 1983, ARRAY became a market leader in surface mount technology (SMT - the leading edge technology for PCBA at the time), but was bought by Fujitsu group’s Imperial Chemical Ltd. (ICL) in 1986. During 1989-90, while GSS was looking for strategic technology partners, ICL decided to sell ARRAY, and thus in 1990, GSS ARRAY Technology Company was formed. Currently, the company has two manufacturing facilities, the biggest factory being the one in Thailand. The other one is in Wales, UK, whereas the research headquarter remains in San Jose, California. It also has an international procurement office (IPO) in Singapore.

9.6.3.1 Product Line Evolution

In 1990, GSS ARRAY began with simple assembly of PCB for various products on sub-contract basis, and started full assembly of complete products on contract basis around 1993. That is, GSS has evolved from being a component supply sub-contractor to an original equipment manufacturer (OEM) making finished products on a contract basis, which are then sold under its customers’ brand names. It calls itself an electronic manufacturing “service” company, providing services ranging from design support to distribution in world-wide locations, to support their customers in the global markets. Their products range from high mix-low volume to high volume-low mix products.
These market sectors include telecommunications—both wired and wireless,\textsuperscript{72} embedded computers,\textsuperscript{73} consumer electronic products (like electronic dictionary, thesaurus), industrial controls (testing/control equipments, print sharer etc.), networks (ATM, token ring, ethernet, hubs, LANs) and health care (home diagnostics, defibrillators) products.\textsuperscript{74} The company supplies to many big companies in the US, and also to most of the Asian regional companies of the Bell and Nortel Groups. Other major customers are from the U.K., Denmark, and Singapore. Thus, in terms of exports, the top three are US, Denmark, and Singapore, with the Singapore office re-exporting most of the output to customers around the world.

Separate customer teams in charge of meeting each customer's product needs handle this impressive range of products. Such a team consists of program manager, manufacturing manager, material control manager, production control manager, process engineers, test engineers, quality engineers, cost accountant, and service engineer. Each team is expected to function like small factory units within the company, and this arrangement makes it possible for the company to handle the widely varying product groups. This diversified product mix ensures the company's good performance throughout, as even when one particular product goes through the trough of its demand cycle, the company is able to balance the overall operations with better production in other products.\textsuperscript{75} This flexibility was pointed out as one of the big advantages of having a subcontract system with different types of customers, when compared to an independent manufacturer who will have to face redundancy of all production-related staff during such demand pattern.\textsuperscript{76}

9.6.3.2 Sourcing Arrangements
Since GSS ARRAY is an OEM sub-contractor, the principle or the customer provides all the related necessary and relevant information to the OEM firm, as well as product

\textsuperscript{72} These include complex infrastructure system build and test, components for RF-radio frequency- and microwave infrastructure equipment, high volume subscriber units- commercial and consumer, broadcast studio editing systems, modems etc.

\textsuperscript{73} Embedded computers are those in which the functions of a computer are encompassed in a single multi-layered PCBA, for applications in industrial controls etc., where such control functions as those performed by a computer are essential, but cannot be supported by an external computer and need to be inside the instrument itself.

\textsuperscript{74} As a percentage of global sales in 1997, computer networks and peripherals had the largest share of 38\%, followed by communications products with 32\%, consumer electronics with 17\%, industrial controls with 8\%, and health care with 5\%.

\textsuperscript{75} For instance, it was pointed out that consumer electronic products like electronic dictionaries have a typical pattern of demand which peaks around X'mas-New Year months in the US, and then there is no demand as the customer itself will be engaged in making a design and new model for the next season. In such a situation, GSS/ARRAY rearranges its staff from that particular customer team into other production lines and units after providing brief training.

\textsuperscript{76} This is a preferred option also when the technology of the product keeps changing fast.
specifications. The customer provides the bill of materials (part numbers, description and quantity), product structure and drawing tree, approved vendor (components manufacturers) list, component drawings, assembly drawings, equipment list, quality requirements, test specifications, procedures, time, yields etc., component programming requirements, packaging requirements, and quotation quantity. In short, the 'a to z' of the product and production process requirements are provided by the customer. The contract manufacturer or the OEM has to find out the means of meeting all these specifications, starting with product and process development, manufacture and assembly, testing and quality control, delivery and distribution, as well as after sales service. When process and product development technology is not already available with the company, the technology transfer unit handles it with support from the California office. It is the responsibility of this unit to search around and find out the methods for doing it. It was clarified that the company did not have any formal technology sharing or technical assistance program with any other company.

Machines and equipment come from mainly Japan (Panasonic, Yamaha) and Singapore, while some very specific equipments also come from the US. The PCB for the PCB assembly is bought mainly from Taiwan and China, mostly from joint venture companies. Most of the other smaller electronic components is purchased through the Singapore IPO, and thus is sourced from various parts of the world, depending on the specifications and price, quantity quotations. Only metal parts, plastic parts etc. are bought from local companies, while they are again joint ventures or foreign subsidiary companies. For instance, cables are bought from Fujikura, and HR Silvine etc. where the former is a Japanese subsidiary, and the latter is a Thai-Japanese joint venture.

9.6.3.3 Technological Capabilities
Thailand factory employs about 2800 of the total 3200 people employed by the company worldwide. There are 80 engineers. While there are only four expatriates in the Thailand factory, this include all the top important positions namely in program management, Engineering & QA, technology transfer and the Chairman, while Thai managers are heading administration, materials & manufacturing, and finance. In terms of training, it was pointed out that all new workers are provided the necessary training and orientation in the beginning for a couple of weeks, and later on, the workers gain experience mainly through on-the-job training. Some Thai engineers are sent to the California factory for training, while engineers from there are sent here too. It was mentioned that currently, a Thai engineer is stationed at the California factory to give them an understanding of volume production, making good use of the extensive experience gained in the big Thai factory. The production and manufacturing expertise of Thai engineering and technical staff was highly appreciated by the management. It
was agreed that due to the tight labour market conditions during the boom period of 1993-96 the staff turn-over rate was rather high, while it is one of the lowest at present.

In this case too, there is no direct technology transfer and diffusion benefits as the company is owned and mostly managed by the majority shareholders and the entire production is for the foreign markets using mostly foreign-supplied parts and components. Thus, there is no diffusion of technology taking place in such cases of OEM production, while indirect spillovers through worker turnover, etc. cannot be ruled out.

### 9.6.4 Intronics Co. Ltd.

Intronics is a 100% Thai-owned company formed by a group of Thai electrical engineers in 1987. They started with sales of a few million baht, and when it became evident that the original small in-house factory could not sustain the growth of their business, Intronics invested in a new factory called Team Tronics in 1990. This was an electronic assembly facility, which enjoyed BOI promotion. Team Tronics did the entire assembly for their products until 1996, when Intronics set up its own factory in Prachinburi, which is located in Zone III under BOI locational categories. While this was rather far from Bangkok, the factory was set up there in order to obtain all the concessions that were being given by BOI to Zone III firms.

Intronics makes a range of products such as air conditioner controls, electronic bedside control panels, electronic safe, PABX etc. Air conditioner controls ranging from simple-wired thermostats to LCD (liquid crystal display) wireless remote controls are OEM products of the company. However, except for electronic safe that uses medium range microprocessor technology, the other products are closer to the bottom end on the technology scale. Presently, air conditioner controls constitute about 80% of their products, while bedside controls and PABX make up about 10% each, as electronic safe has been discontinued from production due to the limited market for it. While originally they used to make old standardised models of PABX, currently they have introduced new more sophisticated models.

#### 9.6.4.1 Technological Capabilities

In 1991, Intronics was granted BOI promotional support as a research and development operation. Subsequently, in 1992, the Royal Electronics Co. Ltd. was founded as the company’s R&D and marketing arm. Thus, all the products have been completely designed and developed in the company’s own software and hardware laboratories, with computer-aided design programs applied to make optimum use of development time. They have also started designing and developing building automation systems.

The most consequential part of the company’s successful history and growth seems to be the contribution of their founding engineers who have had long experience with the Thai factories of companies such as Philips, Daikin, Carrier, York, Trane etc. The knowledge and experience thus acquired by these senior engineers has been the
engine behind the technological expertise of the company. Thus, they did not have any regular technical assistance program from other companies, while they reported to have continuous training programs for their employees. In fact, they had received ISO 9000 for their human resource development standards.

The company works closely with its customers whenever possible. In the OEM manufacturing of electronic thermostat, for example, they co-operated with the air conditioner manufacturers on the design of the new products for them. It was pointed out that such relationships indeed help the company in understanding the new criteria and requirements of their customers and help them ensure delivery of the most appropriate products to them. For instance, when the air conditioner manufacturer Carrier came out with a new concept for AC controller, they asked Intronics to develop the new model under joint patent between the two companies. Again, when new models of ICs are to be introduced, they got initial training from the IC makers.

9.6.4.2 Sourcing Arrangements

As has been the case with other companies, Intronics imports the machinery and equipment for manufacturing and testing, mainly from America and Japan. As much as 60% of ICs, which are major components of all its products, are imported from the Intel's Singapore subsidiary, Japanese NEC, and the French SGS Thomson, through their trading houses or RHQs (regional head quarters). The rest are also imported from big companies in Japan and Hong Kong. Suppliers are chosen depending on the model of IC required as well as its price, as there are many firms to select from in each model. It was pointed out by the manager that no Thai firm produced the highly sophisticated ICs required by the firm, which entailed very huge investment and technological capabilities. Its attempt to buy from the joint-venture local IC maker Alphatec failed, due to the BOI binding on them which required them to export 100%, and thus, Intronics had to import from many firms' trading houses in Singapore. Occasionally, these were the very firms, which have their assembly factories in Thailand and were exporting 100% of their produce from Thailand, enjoying BOI concessions.

LCD or liquid crystal display, which is a major component of the AC control, is imported 100% from Hong Kong, from a China-based company. Another major component PCB is procured from local sources such as local joint ventures Draco PCB and Circuit Electronics Industry to the extent of 90%, while 10% is imported from Hong Kong. Resistor is bought from a Taiwanese company in Thailand and also imported from Casio, Japan. Another component relay is imported 100% from Singapore. The story of the IC gets repeated here also. That is, Intronics imports its relays from the Singapore trading houses of Matsushita's Thai joint venture National

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77 Draco is a medium-sized Thai majority (59%) joint venture with Taiwan.
78 Circuit Electronics Industries is a very large joint venture having assets worth 5936 million Baht with 99% Thai holding.
Thai and another Japanese multinational Omron's Malaysian subsidiary. This again brings out the weakness of the BOI regulation which in its promotion of 100% EOUs, has led to a situation of forced dependence on imports. Although 100% EOUs can sell to other 100% EOUs, in the case of non-100% exporting firms like Intronics, this rule also does not help, as they also sell in the domestic market.

Intronics experienced a 30-40% drop in its domestic sales in 1997 and 1998, following the economic slowdown subsequent to the crisis and expected the decline in demand to continue for another four-five years (from 1998/99). As a consequence, wages that have been continuously increasing every year have also stabilised a bit since 1998. The company had faced a shortage of adequate number of qualified engineers prior to the crisis, but this supply situation has eased out following layouts by many electronic companies that were hit by the crisis. The company plans to begin production in China and even in India in the future, in order to capture the markets there and remain profitable, as increased local competition is conceived when tariff rates are brought down under WTO commitments.

9.6.5 KCE Electronics Public Co. Ltd.

KCE is one of world's leading manufacturers of printed circuit boards (PCB). It is a Thai majority-owned joint venture (with 90% Thai shareholding and some UK investment as well) started in 1983, with an initial registered capital of 12 million baht, and 600 workers. It receives BOI promotional benefits for its 100% export-oriented production.

KCE started with the manufacture of double-sided PCBs, plated-through-hole boards using quite simple technology, which it sold under its own "KCE" trademark. After the new factory started operation in 1984, production was expanded to multi-layered PCBs and total capacity expanded. Multi-layered PCBs are more complex products, and are used for applications in computer, telecommunications, and automobile industries. During the same period, three more advanced manufacturing plants were constructed, with longer term plans already in place. The company got listed in the Stock Exchange of Thailand in 1988, and the conversion of its status form a Limited Company to a Public Company took place in 1992, when the registered capital was increased to 450 million baht, with a paid-up capital of 210 million baht. Paid-up capital increased to 250 million baht in 1997, after issuing more shares in 1996-97. It was able to increase production capacity further in 1994, in which year it also received the ISO 9002 certification. The other factory in Samutprakarn, producing double-sided PCBs is known as KCE International Company Limited. It is a subsidiary company with 99.99% shareholding by KCE. The factory of KCE at Lat Krabang has about 1100 workers, and is larger than the Samut Prakarn factory.

The main export markets of KCE are America and Europe for multi-layered PCBA. Singapore and Australia are also other export markets. It was pointed out that
the European market has grown substantially, particularly in the U.K. KCE is reputed for its high quality and their ability to manufacture to ever more complex technology, deliver on time at keen prices, etc. It has an outstanding commitment to sales services through its sales offices world wide-mainly the affiliate companies viz.; KCE America (with 25 percent holding), and KCE Singapore (with 24.5% holding).\textsuperscript{79} They are suppliers to one of the world’s leading manufacturer of computer networks, 3COM, from whom they have received Supplier Appreciation Award more than once.

9.6.5.1 Sourcing Arrangements and Technological Capabilities
One of the major competitive pressures in the PCB industry is the downward pressure on price. KCE is able to face this head on due to its efficient and strategic planning in reducing costs. It established the subsidiary Thai Laminate Manufacturer Company Limited in 1995 with 99.99 percent shareholding,\textsuperscript{80} to supply copper clad laminate (lamine) and pre-impregnated fibre glass (Prepreg) to both KCE and KCEI. This crucially enables the company to keep the raw material costs at a reliable low level. By 1997-98, this associate company had reached to 80 percent of the capacity, giving KCE a great degree of control in the raw material costs. KCE also has another affiliate company, called Avatar Co. Ltd. with 41% shareholding, which manufactures removable cartridge and disk drives and which is KCE’s main domestic customer base.\textsuperscript{81}

KCE was planning to open a factory in Taiwan in 1998, as it would make it nearer to the raw material source in Taiwan. However, it is not clear whether this would materialise, considering the financial position of the company which ran into trouble recently, owing to its investment in Avatar. (See footnote 75).

The technology for all its PCBAs is from Germany, and there is both training by German engineers, and also by sending Thai engineers to Germany. While Thai engineers generally do trouble-shooting, one German consultant is also permanently staying in Bangkok.

KCE imports approximately 45% of its raw materials and also has borrowed in US dollars. Since the major part of the sales is in US dollars, it reduces the impact on currency exposure of imported raw materials to some extent. KCE and one of its subsidiaries had a policy of borrowing in US dollar on a long-term basis in order to reduce foreign currency exposure. However, another subsidiary company had no policy to hedge foreign exchange exposure prior to the introduction of the managed float of the currency.\textsuperscript{82} Thus, at the end of 1997, loans in American dollars increased in amounts due, by as much as 80%, amounting to a total of approximately 750 million baht. (They

\textsuperscript{79} KCE International also has an equal amount of equity holding in KCE America and KCE Singapore.
\textsuperscript{80} This has been reduced to 83.33% in 1997.
\textsuperscript{81} However, since Avatar is an exporter, KCE’s sales to it are counted as indirect exports.
\textsuperscript{82} This subsidiary has since made a policy to hedge foreign exchange exposure by increasing sales in US dollars.
have a capital-loan ratio of 1.1:1.) Thus, although KCE’s (consolidated) revenue increased from 2,142 million baht to 3,046 million baht in 1997, its net profits posted a decrease of 28 percent (after accounting for about 407 million baht in foreign exchange losses).83

Following the economic crisis in the region, there has been a 30 percent reduction in production during 1998-99. About 25 percent of the decline in demand was due to price competition from countries like China and Taiwan. Well known for its ability to make multi-layered PCBs, KCE is a leading firm in the area and has no competitors among Thai companies. Further, a major part of its strength lay in its strategic decision to invest in raw material production domestically, to keep imports down to less than half its total purchase. However, it is pointed out that unless KCE consolidates itself in its core PCB area and disengages itself from the financial misadventures, it might end up in deep trouble.

9.6.6 Technology Applications Computer Systems Ltd. (TACS)

Technology Applications (Thailand) Public Co. Ltd. (TATL) was incorporated in 1986 as a Thai majority joint venture with 72% Thai holding, 23.4% Australian holding, 3.87% by others and 0.2% by Singapore, to undertake manufacturing and sub-contract manufacturing of telecommunications equipment for overseas and local customers. It is the manufacturing arm of an essentially Singapore-based company. Technology Applications Computer Systems (TACS) was incorporated in 1988 as a 100% Thai subsidiary of TATL for work separation as well as for obtaining BOI privileges. TACS undertakes PCBA for computer and telecommunication-related electronic parts. It has a registered capital of 40 million baht and has total assets worth about 236 million baht.84

In 1997, before the company was de-listed, it had paid-up capital of 538.7 million baht. Both TATL and TACS receive promotional privileges from the BOI.85 Since both the companies are on the same site and do not represent two separate factories, we shall henceforth refer to the company as TATL, when not specifically mentioning the operations of TACS.

83 Further, the company has got into serious trouble with respect to its concern in Avatar Company. In 1994, KCE had bought 47.5% stake in the US-based Avatar which needed cash to bring its product to the market, with the plan to get a foothold in the disk drive market that would create synergy with KCE’s core PCB business. However, despite the fact that Avatar had a strong and fast technology well suited to mobile solutions, the firm cracked under competitive price-cutting by Iomega in the US, which had superior marketing power, distribution channels and solid brand name recognition. Thus, Avatar is in bankruptcy proceedings and KCE is trying to divest itself of the firm upon which KCE’s long-term health and performance are predicated to be contingent. KCE’s attempt to finance a US sales and marketing organisation with Thai baht gained from the local stock market was also seen as harmful to its core PCB business health. See ‘Asia Gets Rolling’, in Electronics Business Asia, February 1999, p. 44.

84 Figures from BOI Directory 1994-95.

85 TATL receives full tax exemption for imported components for export assembly, and has to pay only 5 percent tax on equipment imports.
TATL makes corded phones, cordless phones (digital and analog), telephone answering machines, facsimiles and car radios, as well as high quality PCBA for computer, automotive, consumer, and telecommunications products, under both turn-key and subcontract arrangements for a large number of very big foreign companies, for their assembly plants in Thailand, and also for direct exports. The manufacture of PCBA constituted 35 percent of TATL's total revenues in 1997.

It used to export to the extent of 70 percent of total production earlier, which has declined drastically since 1997. Cordless phones went mainly to Korea, and corded phone went to Taiwan. Digital answering machines also were exported to Taiwan. The Korean exports were directed not only to the Korean market, but also for the US and European (mainly Spain) markets. (It had also done telephone design for Netherlands earlier). However, after 1997, TATL was forced to stop the production of telecommunications-related finished products, due to the drastic drop in demand following the crisis. As the crisis had gripped Korea also soon afterwards, and since the exports to the non-Asian markets were through Korea, this affected TATL badly. Its current focus therefore, is on PCBA, and intends to concentrate on the PCB assembly operations for another two years, before it hopes to get back to telecommunications exports. It also exports car radios to Germany (Bosch), and computer game accessories to Japan (ASCII Corp).

TATL has strong marketing strength. In fact, another 100% subsidiary of TATL, TA Sales (Singapore), which was established in 1993 with a registered capital of one million baht, takes care of the sales and marketing of TATL products by using channel management for both international and domestic markets.

9.6.6.1 Technological Capabilities
The management claimed to have undertaken big investments in engineering as well as R & D. While it has no separate R&D unit, the engineering division handles the design division also. For 900 Mhz digital telephone, the design was originally provided by the Korean telephone company, Hanchang, and the Korean engineers came to provide training for 3-6 months. Singaporean engineers also have provided training at various points. Thai engineers have thus been able to obtain training and experience and are able to manage the designing itself now, according to the Director of Engineering. As for PCBA, it is undertaken mostly as consignment-material job, where the customer provides all the materials, and TACS has to do only assembling and testing. That is, it has a standard sub-contracting arrangement with its customers. Their PCBA capabilities include fine pitch surface-mount, pin-through-hole (PTH), chip-on-board (COB), and also RF expertise. Its manufacturing lines include single and double sides SMT, flex

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86 However, TATL is already expecting orders for some new telephone designs from Pakistan and Nepal.
87 Marketing and distribution of TATL products in Thailand and overseas brought 5% of TATL 's revenue in 1997.
circuit SMT, and mixed technologies. Further, TATL has capacity for sub-systems assembly, full product integration and also testing capabilities at component level, PCBA -ICT & Functional, Radio frequency (RF), sub-systems, and full product. It also has capacity for injection moulding and metal fabrication (through co-subcontractor) as well as packaging and logistics management.

The following list of their customers and products is revealing:

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<tr>
<th>PCB ASSEMBLY</th>
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<td>CUSTOMER</td>
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<td>NEC</td>
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<td>Mitsubishi</td>
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<td>Sharp</td>
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<td>Minibea (NMB) (Lop-buri, Bangpa-in Plant)</td>
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<td>ADI</td>
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<td>Capetronic</td>
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In addition, TATL also has a number of smaller customers, most of whom are foreign companies again. It is evident that while TACS has such an impressive array of sophisticated products for which it provides the high-quality PCBA, all its customers are foreign firms. This was one of the important firms in the present sample, which actually involved sub-contracting by a Thai majority-owned joint venture with many very large foreign companies, established locally. It could be seen that TATL was one of the technologically advanced firms in PCBA. It in fact, had obtained quality assurance standard ISO 9002 from TRADA (UK), in 1993 itself. It however, has no significant Thai customers, who could have benefited from indirect technology spillovers or leaks.

9.6.6.2 Sourcing Arrangements

In machinery, the SMT machine is from Yamaha, Japan, and it has seven SMT lines. There is training on-the-site, while engineers are also sent to Japan for training in SMT devices. All the other machinery and equipment are also imported mainly from Japan, the US or Europe, and also Singapore. In fact, TATL has a 100% owned subsidiary in Singapore namely, TA Singapore Ltd. with registered funds of one million Singapore dollars, which is operating as a sourcing house for raw materials and machines from overseas for TATL, and also provides support in terms of improving the machine quality and product quality.

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88 TACS is currently planning to design a new PCB for car control (for US imported cars), for which it will be doing the design in its own factory. This again shows the higher than average technological capability of the company.
The pattern of sourcing of the materials is indeed very interesting in this case. The main part for the assembly, namely, PCB is imported from many companies in Malaysia. When questioned why TACS was not procuring from Thai PCB manufacturers, the main reason given was that the Malaysian PCBs are cheaper than Thai ones. It was also pointed out that Thai PCB makers are slow and technologically weaker to keep up with the fast changing design needs of PCBs for the high-end electronic components. In addition, there are major problems with Thai PCB makers’ delivery commitments as very often they delay the orders, while in today’s technologically advanced and fast-moving electronic industry, such delays cannot be born by a PCBA maker who will in turn lose his own customers. Obtaining PCBs from Malaysia works out to be much faster as it can be ordered through the internet, and they are able to get the supplies in 5-7 days.

Another of their major components namely ICs, are imported from NEC in Singapore, which are actually manufactured in NEC’s Thailand factory. This contradiction arises again because NEC is a BOI-promoted company and hence is required to export 100% of its output. Another factor is the problem with the direct procurement policy of the government, which makes it cumbersome to obtain parts locally, and importing becomes cheaper than local procurement in the majority of cases. Import cost worked out to be around 80 percent of total production costs. The high percentage of import-content was also attributed to the fact that in the US and Europe, there are import-tax regulations which require imports of final electronic products into those countries to have 80 percent ‘local’ content.

Capacitors and resistors are bought from Korean and Japanese (some fully-owned and some joint-ventures) companies, which have their factories in Thailand. In the case of solder bar, which is an indirect raw material, TACS sources 100% of its requirements from Thai companies. This was owing to the fact that this is a very heavy product, and thus importing becomes expensive. As for chemicals (a lot of which are needed for PCB), while some are imported, majority are provided by Thai suppliers. In fact, chemicals are the only major component which are being procured mainly from Thai companies. Apart from the latter and solder bar, supply linkages with Thai companies are non-existent, as most of the parts and components are either imported or procured from foreign firms’ factories in Thailand. It is reported that operating as a CEM or Contract Electronic Manufacturer, TATL needs to manufacture according to the customers’ specification of materials and other concerned matters. The source of components must be approved by the customer, which thus has led to a general scenario that most of the suppliers are related to TATL’s overseas customers.
TATL has a total of about 600 production workers, 21 engineers, and about 34 technicians, most of whom are graduates. At the operator level, an unusually high of 20 percent or more are graduates, and the rest 80 percent are high school pass-outs. This combination of better educated workers at the assembly line level was due to the fact that TATL is located in a central area of Bangkok (unlike the other firms in Industrial estates on the outskirts), and so TATL has been able to get higher educated daily workers than is usually the case. It was pointed out that all workers are given two weeks' training room training, and then training on the assembly line for one or two months, before they are actually taken into the production schedule. Workers are also given technical training for ISO required production standards, every year. In fact, it was also mentioned that some workers leave after gaining experience and get better (higher positions) jobs in other companies. Although telecommunications-related production has been cut down, there has been no lay off of workers, where as some administrative staff have been laid off during that period.\(^{89}\)

On export competition front, it was pointed out that while China has cheaper products, its quality is lower than that of Thailand, and hence the two countries products belong to different quality categories. Thus, there was no direct competition faced by it. In fact, it is important to note how the company achieved this. From the early to mid-1990s, TATL had started experiencing loss of competitiveness in the sub-contract manufacturing business of PCBA (especially for consumer products) to China and Vietnam, which were offering 3 to 5 times lower wage rate than Thailand. The high wage rate in Thailand also affected the prices of standard parts and components such as resistor, capacitor, coil, adapter, and switch by making the price of these standard components increase significantly. The company adjusted to this competition by adjusting its strategies and focussing on increasing efficiency, quality, and by moving to higher grade technology. This shift in strategy in order to survive were implemented starting around 1994, and the company has been moving from the moderate technology to higher level technology over the past few years. The company has been purchasing state-of-the-art machines that can assemble complex products with high accuracy and efficiency. Additionally, personnel have been sent abroad for training in Surface Mount (SMT) and RF technologies. Thus, the competitor group for the company has moved from China\(^{90}\), Vietnam etc. to the group consisting of Singapore, Hong Kong and

\(^{89}\) It was pointed out by a source that the management used the crisis as an excuse to get rid off some of the staff who had tended towards trade unionism in the company.

\(^{90}\) China also has a more cumbersome export-import procedure. Further, product quality varied and their delivery also is not prompt. As for Philippines, the company which used to be a leading one four-five years ago, has since become a non-competitor. Technologically, Thailand came third in the ladder following Singapore, and Malaysia, and is followed by Philippines and China.
Malaysia, compared to whom Thailand has advantage as Thailand can still offer lower wage rates in comparison to these countries. For PCBA, TACS currently faces competition also from Sakata (Japanese) and SVI.

For finished products assembly, as in telephones, bigger companies such as Alphatel is the main competitor, and not China or Vietnam, as TATL has been producing high frequency 900 Mhz cordless telephones (in addition to low frequency 46/49 Mhz corded/cordless phones), which are currently not produced in China and Vietnam. Alphatel can produce 6 million units per year (according to 1997 figures), while TATL’s annual output for finished product assembly in telephones, answering device, and facsimile combined is only 1 million. Other competitors such as NEC, Sharp and Goldstar in Thailand are foreign subsidiaries, which produce under their own parent company brand name, which differ from TATL which is an OEM in finished telecommunications products assembly.

Thus, while the market share of TATL is relatively small, its success as a subcontractor in the medium-end and high-end PCBA points to its prospects also for becoming an OBM producer of PCBAs. However, it has no linkage with domestic firms, and thus there has been no scope for other indigenous firms to benefit from technology spillovers.

9.7 STRUCTURAL WEAKNESSES IN THAI ELECTRONICS INDUSTRY

Combining the above discussion of firm-level case studies with the analyses in Chapters VII and VIII, Thai electronics industry is seen to reflect three very significant structural weaknesses in production structure. Firstly, as we already identified in Chapter VII, the major changes related to production upgradation observed in the product profile of the electronics industry have been at the level of foreign enterprises. Independent indigenous enterprises have largely lagged behind in this process. This is the dichotomy that prevailed in Thai electronics industry production structure in the second half of the 1990s. In fact, we had identified three separate categories of firms in the Thai electronics industry (See Section 7.9 in Chapter VII). The first set is that of wholly owned and joint venture foreign firms, producing/assembling finished electronic products or parts & components, for 100% export. The second category of firms is that of low-, medium-end technologically competent Thai component manufacturers (in PCB assembly, or in other less sophisticated electronic parts), who export their 100% output as subcontractors to foreign firms abroad. All the remaining firms operating in the industry make up the third minor category namely, Thai-owned firms and some joint ventures, which cater to domestic demand for both finished electronic products as well as electronic components.
The discussion of cases studies in the first part of this chapter corroborates the differences in the levels of operations of these different groups.91

As we saw, in the case of fully-owned subsidiaries and majority-owned foreign affiliates, the width and depth of the technology transfer process are solely determined by the parent firms and the local managers do not have significant influence on this decision making process. The headquarters will decide the extent of technology to be transferred depending on their global strategies. In all these cases, since the host factory production is undertaken for export to the world market, in order to compete in the highly competitive world market, productivity and quality will not be sacrificed and as such, all the relevant assembly and operative capabilities will be positively passed on to the affiliate. Whether it is final product assembly or manufacturing of important parts & components, it can be seen that all the foreign affiliated firms have earnestly endeavoured to provide regular and special training to the employees and have achieved high levels of such operative technological capabilities. Where relatively high adaptive capabilities are observed in certain cases, these mostly involve companies where the presence of expatriate engineers was very strong. Therefore, while it should be appreciated that the learning process has not been stagnant, it has not been dynamic either, as it has remained limited to lower or middle levels of capability development due to the division of labour strategy of parent firms. This is a failure of the factor market for technology with its associated externalities, where the parent firms have no incentive to transfer deeper levels of technology to their affiliate firms and thus, intra-firm technological capability development remains at moderate levels.

Secondly, the discussion of the cases studies clearly reveals that each of these groups are characterised by an absence of linkages between themselves, or have very inadequate links. This has reduced the scope for inter-firm technology transfer domestically. This comes out clearly from the analysis of sourcing arrangements of these firms. While local production of a large number of parts and components which used to be imported earlier has led to some industrial deepening, the following scenarios are apparent, as discussed in more detail in Section 9.3 above: 1) In most of these cases, the foreign-affiliated end-product manufacturers themselves have integrated backwards into parts and components production. This could be done in-house or in affiliates spread around the region/world. These include the technologically advanced core components, as well as even core mechanical parts and components in some cases. This

91 Clearly, case studies of more purely domestic market-oriented firms would have strengthened this analysis.
was the group of vertically integrated firms. 92 2) In another case, the import content of a particular foreign firm is brought down through purchase from the score of independent foreign parts and components makers who came into Thailand, especially since the early nineties, to supply the end-product manufacturers. 3) The large majority of the rest of parts & components, as well as machinery & equipment are imported from abroad. 4) Where indigenous component makers in PCB and other electronics parts and components have been operating, they have in general operated in the low and medium-range product segments, or in the low- or medium-end ranges of high-technology products, and have also been sub-contract export manufacturers, with no links to the foreign firms existing domestically. 5) Procurement by foreign affiliates from indigenous parts and components makers has occurred mainly in metal and plastic parts.

This lack of intra-firm linkages has given rise to the predilection that the foreign and indigenous firms in the three important sub-sectors of Thai electronics industry, namely, computers and peripherals, consumer electronics, and parts and components, seem to exist and develop along their own separate paths with almost no interrelation among themselves, but interact with the external markets mainly. (This is true for telecommunications products as well). This seems to be leading to a perpetuation of their differences in technological capabilities.

Thirdly, local production of parts and components in both foreign firms with indirect exports, and in indigenous or joint venture firms that enter international sub-contracting, has been enabled only through imports of the required raw materials and components. This has led to continuing import dependence.

Thus, the industrial deepening process is still limited to no more than an assembly-based production of parts and components, again of imported raw materials and more assembly equipment. This implies that the technological upgradation that seems to be taking place in end-product manufacturing is also limited to only assembly-based production technologies. 93 Thus, ultimately, it seems that mainly more and more assembly technologies for a wider and more advanced range of electronics products only have been introduced in the Thai electronics industry since the late eighties or early nineties. This could be considered as industrial diversification, which is still mostly limited to assembly technologies involving high acquisitive and operative capabilities, rather than industrial upgradation.

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92 A special case here is when instead of in-house production, the end-product foreign affiliate concerned sets up a separate local subsidiary or affiliate facility for the production of such parts and components locally.

93 Since the interviews were carried out with the companies' managerial staff and have not been cross-checked with independent sources, it should be kept in mind that at some places the actual capabilities of the firm may be overestimated.
Here in the following sections, we examine the various policies related to the electronics industry, in order to examine how the policy framework contributed to these structural weaknesses. Previous studies on Thai electronics industry mostly authorised by the BOI itself\textsuperscript{44} have recognised many of the issues identified in the following discussion. However, the continued relevance of these and additional issues in explaining the prevailing structure of the electronics industry during the second half of the nineties, prompts a critical review. This enables us to identify the possible conflicts in interests between the various players involved in the industry, which led to the persistence of these problems. Further, since the future potential for industrial deepening of an industry is path dependent, an understanding of these issues is crucial in assessing the sustainability of Thai electronics industry growth performance.

9.8 POLICY-RELATED EXPLANATIONS OF THE DICHOTOMISED STRUCTURE

Overall, government policy towards the electronics industry was not very different from that of other industries. However, given the potential of this high technology industry, the electronic industry did not receive the required priority from Ministry of Industry (MOI). But, among several government measures geared towards the development and promotion of industrialisation, the electronics industry was given recognition primarily for its export potential. Thus, the two important policy instruments that have been of consequence are the import tariff, and the promotional privileges provided by the BOI. Even though tariff policy falls under the Ministry of Finance's jurisdiction, in the case of promoted companies, it is the BOI that sets the incentive structure. Thus, practically the main policy maker in electronics industry has been the BOI.\textsuperscript{95} Since BOI's main objective has been to induce investments from abroad and from the domestic private sector using incentives, with the shift in policy paradigm to export-led growth since the early seventies, these incentives themselves became tied up with export promotion.

Because of the investments in the IC assembly industry which had immediately made huge amounts of figures in the export data, the huge export potential of electronics assembly operations was recognised and BOI began paying increasing attention to the electronics industry in the years to come.\textsuperscript{96} BOI set up its Sub-Committee for Development of Electronics Industry for Exports in 1986. To create more export

\textsuperscript{94} This includes FIAS report of 1991, which is the most extensive study of the linkage issues. Again, two other important studies have been the 1993 and 1995 studies from the series on Electronics Industry Investment Opportunities Studies sponsored by the BOI.

\textsuperscript{95} This is true not only for electronics industry, but also for most other industries as well. Based on an interview with Dr. Chatri Sripaipan, Director, Science, Technology and Innovation Policy Research Project, NSTDA, Pasu Chaisak, Director, APEC Centre for Technology Foresight, National Science and Technology Development Agency (NSTDA), Bangkok, 2000.

\textsuperscript{96} Ibid.
potential for the electronics industry, this sub-committee proposed "contract manufacturing" for electronic products. It was hoped that Thailand could offer a more competitive location for producing electronic products due to the country's cheap labour cost, and benefit from the unfavourable conditions in two of the major electronics producing countries, namely the high cost of production in Japan due to the revalued yen, and the change in the tax system in the US which discouraged local production.\(^\text{97}\) It was also expected that as the contract-manufacturing firms matured, they would start to develop their own products and could compete internationally.

With the focus on the promotion of an export-oriented components industry, for a long time, BOI did not consider in its mandate to concern itself with the various other interrelated industrial policy issues. The massive thrust and enthusiasm in providing incentives for export-oriented investments outweighed all the others. Thus, the assembly operations set up by foreign firms attracted by the various incentives provided by the Board\(^\text{98}\) which made use of the large supply of cheap labour to produce for the world market, were considered sufficient to address the two main concerns driving government's demand for FDI: the first being the level of employment generation and not the skill level of those employed; and the second, the level of absolute exports and not the value added. The lack of depth in linkages with the domestic economy did not get their attention or was not found to be of concern by the authorities for a long while. While with hindsight, this seems to have been a wrongful strategy and the indifference with which the linkage issues were completely neglected was unwarranted, it was hardly inconsistent with the predominant mindset of the authorities at the time.

In a study conducted for the BOI more than a decade ago, Prayoon and Waranya (1987)\(^\text{99}\) had established the case for adequate linkages between the parts and components and the end-product sub-sectors. They rightly argued that in addition to the fact that the lack of linkages leads to the scenario where domestic value addition is very

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\(^{97}\) The types of contract manufacturing that should be established were divided into three phases: a) Phase one consisted of contract system for six products - PCB assembly, cable and harness manufacturing, IC bonding and packaging, PCB manufacturing, electronic product assembly, electronic mechanical product assembly. b) Phase two contained two products - electronic component manufacturing (capacitors, switches, speakers etc.), and liquid crystal display (LCD) manufacturing. c) Phase three was to manufacture five products - IC manufacturing, industrial electronics, test instrumentation, medical electronics, computers. Phases two and three were to be implemented after the electronic support structure grew and local expertise developed. (Prayoon and Waranya, 1987, opcit.) However, it is clear that the plan has not materialised beyond Phase two. Further, the entire industry has become dominated by foreign firms, rather than leading to an upgradation of indigenous production capabilities.

\(^{98}\) See the detailed discussion in Chapter III.

low, the excessive import dependence also creates two major obstacles in the proper
development of electronics industry in the country. Firstly, it prevents a build-up of
domestic demand of electronic parts and components, therefore pre-empting any
possibilities for the development of the electronics components industry here. If there is
a link between the various sub-sectors, a growth in the demand for say, a consumer
product, would lead to increased demand for existing component firms. The increasing
production of electronics components would in turn lower unit price and eventually
result in lowering production cost of consumer and other end products, making them
more competitive. It was suggested that policy measures should be taken to motivate
and induce local firms into using locally available components. This was rightly
perceived to trigger a more active linkage between component makers and electronics
products manufacturers so as to eventually lead to an increase in local content of the
products and increase their competitiveness.

Subsequently, the essence of these recommendations seems to have been
interwoven into a policy framework overwhelmingly dominated by the continuing
export-promotion agenda. This has been due to the fact the industry has traditionally
been dominated by assembly makers (which itself has been brought about by the nature
of incentive policies) and therefore, their interests and bargaining power weighed
heavily in the BOI's decision making, whose priorities in export promotion
corresponded with the interests of the former. This is brought out by a detailed
discussion of the BOI promotional incentive structure, which has prevailed in the
industry at various points of time.

9.8.1 Tax Policies and the Emergence of an Assembly Production Base
Rationalisation of the tariff structure has been a long stated policy of the government,
bu the import duties on completely-knocked-down (CKD) kits have been frequently
lower than the import duties on the individual components, leading to the emergence of
an assembly production base. We illustrate with the case of the TV industry.

In 1976, the import duty on CKD kits for colour TVs was at 80 per cent, as high
as that on colour TV itself. However, while the import duty on colour TV was decreased
to 60 per cent by 1985, the former was reduced drastically to 20 per cent. The beginning
of the tendency for the promotion of assembly makers' interests could be observed at
this point itself, consequent to the export promotion thrust which had gained ground by
the mid 1980s. By 1986, BOI's special sub-committee on electronics was advocating
policy and tax reforms to encourage the growth of the electronics industry.100

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100 BOI, 1993, p. 15.
Thus, a new tax structure for electrical and electronic products was announced in 1988 to encourage the development of the domestic components industry, in addition to promoting specific component makers such as the Thai CRT. Meanwhile, while the import duty on colour TV was at 40 per cent, the import duty on CKD kits for colour TV was brought down to 10 per cent during 1988-92. Having a 10 per cent duty on CKD units and 40 per cent duty on CBU provided a sufficient enough gap for the local TV assembly industry to survive.\(^{101}\) Thus, while the tariffs on completely built units (CBU) of colour TVs was reduced gradually and substantial competition was faced by the domestic market only by the mid-nineties, tariffs on CKD kits was brought down drastically by the mid eighties itself to meet the requirements of the assembly industry for cost competitive imported inputs. Such a tax structure unequivocally favoured the local assembly of colour TV using such imported kits, and was responsible for the surge of new investments into TV assembly manufacturing in the late eighties. Further, the long period of protection enjoyed by them definitely helped the local TV industry to reap economies of scale domestically before entering the export market.

However, this bias in tariff structure favouring assembly producers worked against the interests of indigenous parts and components makers and local TV makers who wanted to manufacture their parts and components in-house. A very good example of this is the case of the indigenous firm Tanin Industrial, one of the very first companies to manufacture radios and TVs in Thailand. Early in the industry’s history, Tanin was successful in exporting a limited quantity of monochrome TVs on an original equipment manufacturer (OEM) basis to Asia and Europe. However, that was not followed by further success.\(^{102}\) Tanin had tried very hard to urge the government to support them. They tried to manufacture a fairly large number of components in-house. But, at that time, the government still did not pay any attention to the importance of components, and they did not receive sufficient support from the government. (It was only in the mid-1980s that the import duty on CKD units for colour TVs was brought down to make it sufficiently competitive for colour TV makers to survive). The reduction in the import tax on CKD to 10 per cent in the eighties actually penalised Tanin, because other plants used to import the whole kit and get this gap as profit. While tariffs on CKD kits was brought down drastically by the mid-eighties itself, the average tariff on both spare parts and raw materials was retained at about 35 per cent. When a

\(^{101}\) The tariff on colour TV was however, further brought down to 30 per cent in 1993, 25 per cent in 1995 and further to 20 per cent in 1997, one of the reasons for this being the initiation of the ASEAN Free Trade Area (AFTA) agreement which resolved to bring down the member countries’ tariff range to 0-5 per cent by the year 2008. See Kriengkrai Techakanont, opcit., p. 11 and 13.

\(^{102}\) BOI, 1993, p. 18.
company like Tanin tried to manufacture these components in-house, the high import cost of raw materials and parts actually worked against their competitiveness.\textsuperscript{103}

The government’s side apparently was that it was much simpler to categorise the huge number of TV components into two broad categories of CKD and CBU and apply a simpler 10 per cent and forty per cent, making it much easier to handle. Even in 1997, the tariff rate on imported parts of TV sets in CKD kits was 10 per cent while the tariffs on the raw materials and spare parts were 35 per cent on average. This has not helped the manufacturers though, as has become evidently clear in the case of Tanin. Tanin TV still can be found; but the original family no longer owns Tanin Industrial Co.\textsuperscript{104}

Currently, Tanin TVs are imported from Taiwan with Tanin brand name. The present owners of the company use a Taiwanese factory to manufacture TV under Tanin’s name and import them for sales in Thailand. This succinctly captures the essence of the struggle of indigenously owned electronics firms with the government policies regarding the electronics industry.\textsuperscript{105} Basically, it can be argued that the Thai government never perceived the importance of a national electronics industry, as it may be said to have had in the case of the automobile industry in Thailand.

So, the tax structure benefited those firms, which simply wanted to use the cheap Thai labour force to assemble their imported CKD kits at a competitive price compared to their competitor countries. And as we have seen, these have been mostly foreign assembly houses. Not a single completely Thai-owned company has managed to survive in the TV industry. Di-Star, the Thai-majority owned TV maker with around 28% Singaporean investment is the only major company having a Thai presence.\textsuperscript{106} However, Di-Star is not a very popular brand. Currently, in the consumer electronics industry (the one with the oldest history) there are a number of small Thai firms making TVs, recorders, radios, amplifiers etc., which basically operate along similar lines as

\textsuperscript{103} This discussion on Tanin company’s experience is based on the interview with Dr. Chatri at the NSTDA.

\textsuperscript{104} Tanin’s original owners were three brothers- Udom, Anek and Anang with surname Withayasirinam. Udom has apparently gone into food industry. Anek is still running a small company making microwave device and solar cell panels. Even though the three ex-owners of Tanin probably have differences of opinion, in general, they would blame the government for the lack of sufficient support. Based on the interview with Dr. Chatri, NSTDA. BOI’s 1993 study reports that during 1986-92, the large local conglomerate Saba Union group, took majority control of the financially troubled Tanin Industrial ans injected a new management team to get it back on its feet. BOI, 1993, p. 8.

\textsuperscript{105} The 1995 JICA study had observed that the tax structure in the first half of the nineties still encouraged the importation of semi-or completely knocked down kits for assembly instead of raw materials. It was pointed out that the duty on electronic parts were very high. For example, if a finished tuner is imported a duty of 25 per cent is imposed. But, when tuner parts are individually imported the total duty reaches a higher levcl of 65 per cent, and this discrepancy makes it difficult to increase the local production of tuners.

\textsuperscript{106} This information on Di-Star is based on an interview with Dr. Pansak, NECTEC.
Tanin.\textsuperscript{107} They ask some foreign manufacturer to make a specific number of TVs or radios for them, and then import them to sell these under their own Thai brand names. However, it has been pointed out that this is quite different from a sub-contracting arrangement by a firm where the principal provides the sub-contractor with the designs and know-how. Although these Thai firms sub-contract the CKDs and then assemble it, the imported units are almost like CBUs which can be assembled very quickly with very little technical facilities. This is basically not much more than trading. These products are very cheap coming at a fairly good quality and usually sell well at the countryside, where people are not a brand conscious as in Bangkok, but rather, are price conscious.\textsuperscript{108} This clearly shows how the lack of a government policy regarding the development of a national industry, lead to the failure of efforts by indigenously owned companies to manufacture their own branded products even in the case of consumer electronics products.

\textbf{9.8.2 Export-Oriented Incentive Structure and the Persistence of Lack of Linkages}

While the tariff structure hindered the development of a local production base of parts and components by directly contributing to a lack of competitiveness of indigenously produced parts and components on the one hand and led to the high import dependence of export-oriented assembly-based investments on the other, it was the BOI's overall incentive structure driven exclusively by export promotion objectives which created the ground for these.

In general, majority foreign-owned projects had to export at least 50\% of output and wholly foreign-owned projects had to export 80\% per cent.\textsuperscript{109} But, in the case of completely assembled products, all production had to be exported and these were eligible for a five-year tax holiday, including import duties and business taxes on machinery and raw materials. Since the import duty on parts and raw materials were very high, the access to a reduction or exemption of import duties was a rich reward\textsuperscript{110}, and as we saw above, this essentially established Thailand into a foreign-dominated assembly production base of electronic goods made of freely imported parts and components. Although firms having at least 75\% Thai ownership also had become eligible for promotion since 1990, they had to export at least 50\% of their produce, (except where in the case of TV sets, radio sets, and tape/radio sets, all production under promotional benefits had to be exported), and only the export production became

\textsuperscript{107} These firms do not come under the BOI list which is analysed in the earlier chapter, as they do not receive promotion.
\textsuperscript{108} Based on the interview with Dr. Chatri Sripaiphan.
\textsuperscript{109} BOI, 1995, p. 4.
\textsuperscript{110} Amsden, 2000.
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eligible for privileges. This again led even Thai majority-owned firms also to export their production rather than cater to the domestic market.

It was only by the late-eighties that concerns about growing import dependence came to be recognised in the policy circles, and the ever growing need for the parallel development of supply industries was recognised by the BOI. However, this recognition of the importance of developing a local supplier industry also occurred as part of the need to ensure international competitiveness of the existing foreign assembly base, and not so much from a national capability development perspective.

Beginning in early 1990, the BOI offered special promotional incentives for export-oriented investments of over one million Baht in electronics assembly and component manufacture. For the first time, component manufacturers and Thai national investors were offered preferential incentives in terms of import and business taxes for raw materials and parts. Although in the case of components, there was no export requirement (except in the case of 12” and 27” colour TV tubes to protect CRT) as such, electronic components manufactured for exports were offered a five-year tax holiday, including exemptions of import duties and business taxes on machinery and raw materials (under the duty suspension scheme just as in the case of complete products for export). While duty exemptions were given only for machinery and other inputs not made in Thailand, since mostly not many parts were being manufactured locally at the time, it was a big boost for the promoted companies to start parts assembly, using freely imported machinery and components. Subsequently, a lot of the foreign investment that flowed into the electronics industry during the early 1990s has been in parts and components assembly production, as we have already seen. Additionally, a number of indigenously owned component production facilities were also set up. However, since on the one hand the incentive structure suited assembly production and all assembly production had to be exported, and on the other hand only export production was eligible for promotional privileges, both foreign-owned and owned-owned component producers embarked on direct exports and a thriving export-oriented component assembly production base has emerged without any domestic backward linkages to locally established final product firms, as the case studies established.

This is because BOI’s export promotion policies did not facilitate backward linkages for a long time, as they discriminated against domestic subcontractors and impeded backward linkages. Promotional privileges were available only to companies exporting their products. In the case of promoted firms selling domestically, this did not

111 Differential investment incentives were also offered to promote the decentralisation of industry, but only a few large electronics investors have availed of these. Bol, 1993, Investment Opportunities Study for Electronic Industries in Thailand, Office of the Bol, Thailand, p. 15.
apply. Potential indirect exporters, that is, firms which could enter into backward linkage arrangements to produce intermediate goods as inputs to locally established exporters, faced impediments in establishing such linkages. It took a long time for the BOI to get the mechanism of indirect exports to work. Eventually, firms selling to other domestically established exporting firms could also obtain the same concessions as those exporting directly, as the former are considered indirect exports. This enabled many final electronic product manufacturers to source some of their parts or components from some locally established foreign affiliated firms, as they could not find Thai-owned firms making products of similar quality, or because they already had previous sourcing experience with the latter in their home countries (or though imports) and preferred to continue it. Although this created backward linkages, since this was taking place between foreign-affiliated firms, this still did not offer significant benefits to the domestic economy and to the indigenous films. At the same time, some other final producers set up separate subsidiary facilities in Thailand itself to make their parts and components, which was essentially backward integration.

During 1996-97, the Investment Promotion Policy of 1993 was the one still being followed. Accordingly, if a promoted company in manufacturing in Zone 1 and Zone 2 wanted to be 100% foreign owned, it had to export at least 80% of their sales and could sell only 20% domestically. However, as mentioned already, domestic sales to other locally established (100%) exporting firms was permissible as part of this 80% export requirement, as this was counted as indirect exports. Sales purely for domestic consumption were permissible only for firms that had Thai majority ownership that is, a minimum Thai ownership of 51%. However, in Zone 3, full foreign ownership without this export requirement was considered on a case-by-case approval basis (in compensation for their decision to cooperate with the national decentralisation policy for regional development). That means that some of the 100 per cent foreign firms in Zone

113 In fact, the 1991 FIAS study which was meant to advise the government on the issue of backward linkages remarked that the importance of indirect export promotion to the development of backward linkages, let alone to the export promotion did not seem to have gotten the attention of the Thai authorities, although the connection had been made in a 1985 World Bank study. See FIAS, 1991, p. 19. It should be emphasised that in all these studies, the attempt was to draw their attention to the benefits of linkages to improve the competitiveness of export-oriented firms, and not from any deeper national capability development perspective.

114 Although there was a three-year 50% tax reduction (import and business taxes on raw materials) for companies with at least 75% Thai ownership manufacturing for the domestic market, Thai-owned component production was mostly restricted to the low-end. Without adequate support from the government, Thai producers were hardly forthcoming in the high capital/high technology component segments, which tended to have secure markets with high cost of entry.

115 Location was the main condition for electronics industry. Since 1993, decentralisation became the main thrust in the locational conditions. Thus, while parts and components firms could set up their plants in any Zone, consumer final products could only be located in Zone 3 and all other final products had to be in Zone 2 or Zone 3.
3 got permission to sell freely to the domestic market while some others did not. Later on in 1995, the export requirement for 100 per cent foreign firms in Zone 3 was completely removed, doing away with the arbitrary nature of the permission granting process.\textsuperscript{116} Thus, since 1995, a 100 per cent foreign-owned manufacturing firm in Zone 3 could sell up to 100 per cent of its output domestically creating the scope for backward linkages.

This did not materialise however, as most of the export-oriented companies were not willing to sell to the domestic market, simply because they did not want to go through the trouble of separating accounts. When promoted firms undertook pure domestic sales, that is, sales to domestic firms selling domestically, they had to pay import duty on that portion of raw material inputs which went into the production of the share of output sold domestically. Therefore, for companies, which both export and sell domestically, this BOI policy led to highly cumbersome tax accounting procedures, discouraging them from undertaking domestic sales. Especially, component companies which originally exported all of their output (that is, 100 per cent foreign-owned companies which were subject to the eighty per cent export requirement earlier and generally exported at much higher ratios) would not find it worthwhile to supply to one or two domestic companies which wanted to procure from them even after the export requirement liberalisation, as this might not come to more than one per cent of their total sales and for that just one per cent the company would have to keep separate invoices, separate accounts, which made it all so cumbersome for them.\textsuperscript{117} This meant that many joint-venture and fully Thai-owned firms especially dominant in the consumer electronics sub-sector, which could have gained substantially through backward linkages with foreign-affiliated component suppliers found it difficult to persuade their potential suppliers to sell to them and were therefore, still dependent either on their in-house production of parts and components, or on imports, or on sourcing from the technologically less sophisticated Thai-owned firms selling solely to the domestic market.

On the other hand, although in the case of components, there was no export requirement (except for some protected components such as 12” and 27” colour TV tubes, which had to be exported so as to protect Thai CRT), and majority Thai-owned companies (at least 75% Thai-owned) manufacturing components for the domestic market could avail a further three-year 50% reduction on import and business taxes on

\textsuperscript{116} This paragraph is based on a discussion with Duangchai Ajanant, Senior Investment Officer, International Division, Board of Investment, Bangkok, March, 20, 2000.

\textsuperscript{117} Based on discussions with Dr. Duangchai Ajanant, opcit., and Khun Seksan, Investment Promotion Officer, Electronics Division, BOI, on March 20, 2000.
raw materials,\textsuperscript{118} due to the dominance of foreign-owned firms in the component production base by this time, it became extremely difficult for indigenously owned firms to break into the production-supplier networks of the foreign-dominated consumer and industrial electronics products buyers. Thus, Thai-owned component manufacturers in general also preferred to avail the privileges for export promotion and become subcontract exporters, rather than establish linkages with locally established foreign buyers and sell domestically (or could only become suppliers to the very few Thai-owned end-product manufacturers at the low-medium end of the product profile). Thus, the BOI policies kept Thai-owned firms in both component supplying and final product sub-sectors from establishing meaningful linkages with foreign-affiliated end-users and supplier firms respectively. Only through the existence of such linkages could the potential for technology transfer and diffusion take place, between the foreign-affiliated production base established through FDI and the Thai-owned production capacities.

Until the mid-nineties, the competition in the domestic market was mainly between fully Thai-owned firms and joint venture firms, and the export requirement for 100 per cent foreign-owned firms was thought to be a protection mechanism for firms selling in the domestic market. However, the analysis clearly shows that this long period of protection did not help the domestic firms to develop. One basic reason behind this has been a lack of government vision regarding the development of a strong indigenously owned electronics industry. The aggressive export promotion policies and the incentives offered to attract such investment outweighed all other considerations. Thus, as we saw above, while there was extensive promotion of exporting firms under heavy subsidies (with attendant huge revenue loses to the national exchequer which could not have been made up for by their export revenues, as the export revenues were inadequate to cover the huge imports themselves), domestically selling firms faced full import duties on their raw material inputs (except in some cases where BOI had made special tariff reductions for domestically selling promoted firms, complete duty exemption on raw materials is given preferentially only to exporting firms,\textsuperscript{119} which made them uncompetitive against foreign producers.

\textsuperscript{118} BOI, 1995, opcit., p. 3.
\textsuperscript{119} While the tariff rates are decided by the Ministry of Finance (MoF), if the import tariff rates on some components or raw materials are higher than that on a finished product made by a promoted company, the company can approach the BOI to seek help and the BOI does have some discretionary power to reduce tariff rates on intermediate goods. While tariff rates may be brought down to a level which is lower than the duty on the finished product, such lowering of the duties are allowed only up to 90 per cent of the normal rates on those intermediate products. Since complete duty exemption on raw materials is given preferentially only to exporting firms, this special BOI intervention is supposedly designed to benefit promoted firms selling in the domestic market. (Bas'd on discussion with Khun Seksan, opcit.) However, it is clear that this is an exception rather than the rule.
This was exacerbated by the corporate income tax method, which prevailed until 1992. As discussed in detail in Section 6.3.1 in Chapter VI, the earlier method of business tax was levied on the full value of products transacted between firms and was considered a clear disincentive to backward linkage development and favoured imports and backward integration. Although this has been replaced by a value added tax (VAT) since 1992, it may be argued that the delay in implementing VAT along with the various other problems faced by indigenously owned firms in linkage creation meant that by the time VAT came into force, Thai firms had clearly lost a lot of time in catching-up. By then, the electronics industry had become completely dominated by foreign presence and it became difficult for indigenous firms to penetrate supplier networks consolidated around foreign firms.

Thus, the domestic market does not impose any constraint either on the MNC affiliates or on the Thai-owned firms making electronic components for the export market. However, neither do they contribute anything to the domestic market as they have few linkages with final products manufacturers existing in Thailand, especially those supplying the domestic market. They have existed in a compartmentalised system virtually separated from the domestic market and therefore, the standards of the domestically serving manufacturers have been unaffected.

At one level, this happened because foreign affiliated firms could not find Thai firms capable of meeting their product requirements—either in quality standards or in quantity (volume). At another level, firms did not make any serious attempt in searching for a Thai partner with such capabilities, as they could easily find other foreign firms who were making these parts or components for exports, and could purchase directly from them with or without fixed contracts.

9.8.3 Insufficiencies in the Linkage Development Program

The prevailing concept in the policy circles was that local industrial technology and component manufacturers would get automatically upgraded once foreign investments came into the electronics industry. However, for such an outcome, backward linkages have to materialise between foreign assemblers and indigenous component producers. Apart from recognising the ever-growing need for the parallel development of supply industries to ensure international competitiveness, BOI began giving serious consideration to the need to strengthen backward linkages between large export-oriented assemblers/producers and local subcontractors only much later. This became conceived in the special unit for industrial linkage development established by BOI in 1992. Its initial activity was to work with six major multinational electronics producers to
establish more linkages with local components and parts suppliers. (See Section 6.3.1 for details.)

However, successful linkages between foreign producers and indigenous suppliers are still very rare. For example, let us consider the case of Seagate. The easiest parts which Thai companies could manufacture for companies like Seagate were plastic and metal parts. There seem to have been very few attempts by foreign affiliated firms to establish a relationship with a Thai firm and help it in building up its capabilities. Where some local subcontracting has indeed taken place, it has largely been confined in most cases, to the level of production/simple assembly of less sophisticated electronic components or in the case of plastic or metal parts, or chemicals or packaging materials etc. Thus, the domestic industry has been able to learn and upgrade only to such levels as the MNCs have permitted them to. In the absence of linkage creation, economies of scale and learning have not been forthcoming in the higher value-added segments for indigenous component producers, and they have not been able to climb up the technology ladder.

Firms, which could however, access export markets, were enabled to realise scale economies, though remaining in the low-medium range on the technological scale. However, even those domestic firms which could upgrade themselves with a little technological input or a certain assured market, could not or were not willing to sink in the huge investments required to upgrade their production facilities, in the absence of the scope of scale economies, as firms using the higher-end components remained biased towards foreign suppliers. On the other hand, without adequate government support, indigenous firms could not bring themselves to set up facilities at a huge cost for a low-volume production demanded by one or two customers.

Difference in production systems of these two sets of firms due to the difference in the scale of operations, is one of the factors which lead to such a dual structure. It is also one of the reasons behind why these two sectors could not interact fruitfully. A domestic firm cannot invest in expansion and R&D unless a particular size of market is reached, however, that size of market will never be realised unless sufficient investment was made. Therefore, the government agencies concerned have to be prepared to intervene in such a case so that this vicious cycle can be broken and local firms can take off. And, as long as domestic end-users grow further and establish themselves and start procuring from local firms, the technological dichotomy vis-à-vis ownership pattern in the Thai electronics industry will remain.

The attempts to develop backward linkages are also affected by the anomalies in the tariff structure. Although there has been some improvement in this tax structure, this probably is not to the satisfaction of the private sector. The government is still facing
some difficulties in streamlining their tax structure and procedure. An example can be seen in the case of hard disk drive assembly (HDD). NECTEC authorities report that there is potential for HDD makers to source some advanced technology from Thai supporting firms, for e.g. the automation system for their assembly line or testing equipment (automation system machinery), where there are a few small firms. However, the tax system is such that importing is cheaper than when they buy from Thai supporting firms. Further, because of the tax system, the small Thai firms that want to make the automation system have to import the sub-systems like controller, motor etc. The tax on the sub-system is much higher than that on the automation system as a completed product, and this makes them uncompetitive compared to the imported systems. The tax system is still not much changed – components still having higher tariff rates than the final product.

Apart from the persisting problems related to the tax structure, the problems in linkage development have to do with the various lacunae in the efforts in technological capability building, as identified in Chapter VI. Here, the discussion is restricted to issues directly relevant for the electronics industry.

9.8.4 National Perspective on Technology Capability Development

9.8.4.1 Perceptions on Technology Import- The Continuous Emphasis on FDI

While technology import per se, is not problematic and may be a rational choice available to a developing country’s initial technological base, the channel of technology transfer is of crucial significance in a country’s development approach. The fact that a reasonably significant level of indigenously owned production base has failed to develop within the Thai electronics industry points to several lacunae in the approach adopted by the policy makers. It also establishes that this role of the foreign investors has been enabled and abetted by the successive governments’ overall policy outlook. The latter were driven by two basic objectives, which underlined the demand for foreign investment by Thailand as perceived by the government and the private sector.

9.8.4.2 Domestic Content Policies

The electronics industry never had local content condition as part of their eligibility for promotional status. While the Ministry of Industry had imposed a local content requirement policy on the automotive industry, which included promoted firms to produce or locally procure certain specified compulsory parts, as early as in 1971\textsuperscript{120}, the electronics industry was not considered important at that point of time, as it was too

\textsuperscript{120} See Section 6.3.2 in Chapter VI also.
small an industry then. After it did become an important industry later on, the fact that
the technology changes in the electronics areas were faster than local firms could keep
up with, and only some very few low or medium technology intermediate goods could
be obtained locally, deterred BOI from succeeding in imposing any local content
requirement in the electronics industry. In such an industry, the BOI considered that if
the government imposed a local content requirement it would be a burden on the
companies; it would not help them enhance their competitiveness, it would only make it
more cumbersome to produce here. Thailand does not own the technology and is
dependent on foreign technologies, and so if the government imposes a local content
requirement, it would be a hassle. It was believed by the BOI that it was not feasible to
impose local content requirement on an industry like electronics industry, which was
highly import dependent to the extent of more than eighty per cent in some cases.

9.8.4.3 Growth Strategy Adopted by the Local Industry and Absence of Government
Intervention

It is recognised that for latecomer countries it is relatively easy to enter international
markets with standardised products. However, actual entry depends on whether the
enterprises are able to ensure certain product quality and price competitiveness. For
example, Korean chaebol-related enterprises entered into the international markets
successfully, mainly using TV production in consumer electronics and DRAMS in
components production, both of which were typically standardised commodities. While
a host of factors in the global consumer electronics industry at that point of time might
have been helpful in making pattern of establishing a mass production system for highly
standardised products and then starting up its industry aiming at overseas markets
successful as pointed out by Sato (1997)\(^ {121}\), the initiative from indigenous entrepreneurs
and the government and the choice of industries were crucial in these success stories.

Established market players with a broad range of traditional products and
processes always feel threatened by the introduction of new products and technologies:
as the profits from introducing a new product or process are to some extent offset by
reduced profits on obsolete products and processes which are displaced. The transition
to a new technological trajectory\(^ {122}\) would then require a radical restructuring of the
prevailing market structure of the Thai electronics industry, which would be hardly
possible as a result of market forces. As the dominant firms have no intention
whatsoever, to facilitate, let alone to push towards a new technological trajectory, a very
active industrial policy would be required in order to break their inertia and

\(^{121}\) Sato, 1997, p. 416.
\(^{122}\) Ernst and O'Connor, opcit., p. 61.
technological conservatism. In the US as much as in Japan, industrial policy has played a central role in the development of the electronics industry, contrary to conventional wisdom.\textsuperscript{123}

In Thai electronics industry, by contrast, in the first place, there were only isolated instances of significant entrepreneurial initiatives among indigenous entrepreneurs to establish production facilities of their own. It could be argued that there were no large firms comparable to the Korean chaebols, capable of making similar investments. However, one could still consider the relevance of Taiwanese model, which had similarly lacked big players that could mobilise large amounts of funds to enable the emergence of independent firms out of the assembly base established by foreign firms. In Taiwan, when no major players emerged from the existing private sector, it was the government-assisted R&D project members which set up two IC companies to engage in the fabricating process: United Microelectronics Corp. (UMC) in 1980 and Taiwan Semiconductor Manufacturing Co. (TSMC) in 1986 (as a joint venture with Philips). In Thailand, any such initiative from the government has not been considered appropriate.

More strikingly, in each of the isolated but significant cases of indigenous entrepreneurial efforts, it can be identified that their failures are traceable to specific government industrial policies of the time. The latter were biased to the interests of the dominant assembly producers in the industry, rather than producers who wanted to establish their own actual production bases.

The only successful case of indigenously owned production of a major electronic part locally namely, the cathode ray tube (CRT), can be attributed solely to the active government intervention in that industry. The most important initiative of the BOI subcommittee to coordinate the development of the electronics industry for export established in 1985 in the area of backward linkages involved the promotion of a joint venture called Thai CRT. This was a joint venture between Mitsubishi of Japan, the giant local Siam Cement Group and a consortium of locally based TV manufacturers to produce CRTs primarily for the domestic market. The final capacity of the facility is to be 1.4 million tubes per year. Thai CRT has been supplying all local TV manufacturers under the protection of an eight-year import ban. The enterprise is expected to eventually export a portion of its output and to generate significant backward linkages in

\textsuperscript{123} Indeed, taking the example of the transition from transistor and tube technologies to integrated circuit-based technologies, Ernst and Connor argued that it was such an active role the government played in breaking established market structures in the US electronics industry which enabled them to become market leaders, in contrast to what happened in Europe where, well into the 1970s, there was no comparable change in the structure of the electronics industry. See Ernst and O' Connor, opcit., p. 61.
the local electronics industry. Numerous companies were provided privileges to supply parts and components to Thai CRT. The entry in the market of the 90 per cent Japanese-owned Toshiba Display Devices (TDDT) to produce 1.6 million CRTs per year exclusively for the export market is providing the critical mass for sub-contracting in the CRT industry. However, other firms such as Toshiba Display Devices (TDDT) which is also promoted, are allowed to sell only models other than 12 inch and 27 inch tubes domestically, and have to export these models fully as they are being made by Thai CRT. Further, they get duty exemptions for only those CRTs sold domestically which are supplied to 100 per cent EOUs, which has effectively reduced the competition that might arise (as this effectively forces domestically-oriented TV makers to buy from Thai CRT). It is only such an active and selective intervention by the government that has enabled Thai CRT to become successful.

It could be argued that given the low technology base of Thai electronics industry, Thai policy makers' encouragement of assembly-based foreign investment was a rational (viable) choice to initiate further electronics-related production activities in the country. However, there had to corresponding or /and accelerating indigenous entrepreneurial initiatives and participation in production activities, development of indigenous engineering and design capabilities, and active efforts on the part of the government to induce/prod the industry onto higher value-added activities. Addressing these is of crucial importance in making latecomer strategies in the electronics industry viable. However, Thailand did not make any concerted /dedicated attempt to be anything other than an export-oriented assembly production base for foreign-affiliated enterprises. This was hardly a base for developing a viable electronics industry.

Even in the aftermath of the crisis, the Thai government failed to rise to the support of indigenous entrepreneurial efforts, as initiatives from the government were not considered appropriate. The most suitable example of this is the case of Charn Usawachoke's Alphatec Electronics, the most ambitious indigenous venture into a

124 FIAS, opcit, p. 43.
125 As a result of over-extension of company resources in non-core investments, and reduction in worldwide and regional demand, Alphatec Electronics (AE)'s total debts had risen to over US$ 360 million at the end of the fiscal year 1998. This forced the moribund company to undertake severe restructuring in light of potential bankruptcy. New equity investment to fund the restructuring and the establishment of Alphatec Holding Company was provided by the AIG Asian Opportunity Fund, L.P. (AOF), and Investor Asia Ltd. in Hong Kong, which is a subsidiary of Investor AB of Sweden. Investor AB is the largest industrial holding company in Sweden and a major shareholder in a number of Sweden's leading industrial companies, including LM Ericsson and ABB. With their contemplated $40 million US dollar investment in Alphatec, both organizations view their investment in Alphatec as strategic in the high growth semiconductor assembly and test industry in Asia. While Alphatec has emerged strong from this restructuring, Thailand has failed to capitalise on another opportunity for indigenous entry into a high-tech and strategic industry segment, as it witnessed the acquisition of an indigenous upgradation plan by MNCs. See Brimble and Sherman, 1999, p. 23-24 and Section 7.10.2 in Chapter VII, Newsweek International, July 12, 1999, The Nation, January 31, 2000, etc.
highly advanced product line (IC fabrication and other computer electronics), which could have heralded Thailand's entry into high-end electronics. Thai government's many pronouncements following its bankruptcy showed that its reluctance to intervene in an appropriate manner to rescue this indigenous initiative was due to the government's preoccupation with maintaining the image of a 'market-oriented' economy. In the fiercely competitive global market place, in order to sustain such an extremely critical and foundation-building investment in IC fabrication, Thai interests would have been well served by government support and/or domestic mergers. While even in the free-market champion, the US, anti-trust regulators never objected to vertical and even horizontal mergers between industry leaders in the face of heightened international competition (this being completely taboo before the 1980s), Thai government's priorities were not seen to be in the electronics industry. In fact, the Alphatec case contrasts sharply with that of the central bank-facilitated debt-restructuring merger deal in the steel industry, which was successfully carried out between the debt-ridden NTS Steel Group of Sawasdi Horrungruang and the conglomerate Siam Cement's two steel producing facilities.

9.9 ACCESS TO INTERNATIONAL PRODUCTION AND TECHNOLOGY NETWORKS: INCREASING COMPETITION

In the past, ease of access to new product technologies has been a key contributor to the competitive success of many electronics firms in the I-tier NICs. Through a combination of licensing, copying and reverse engineering, they were able to offer products virtually identical in terms of performance characteristics with those originally designed and developed in the OECD countries at highly competitive process. This entry strategy proved effective in both the consumer electronics and certain segments of the industrial electronics markets. In the case of consumer electronics, technology licensing has been fairly widely employed. In the case of personal computers on the other hand, the initial

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126 The Alphatec Group suffered a cash-flow crisis after the US-based Texas Instruments (TI) pulled out of a multi-million dollar microchip production venture with the company. TI had decided to withdraw from the project due to doubts that Alphatec could raise its share of the funds for the project.

127 Based on Bangkok Post reports.


129 This Thai steel tycoon owed creditors upwards of 20 billion baht (then $787 million) when the financial crisis struck. The politically influential Sawasdi opted for non-repayment. See Crispin, Shawn, "Steel Deal", Far Eastern Economic Review, August 15, 2002. A sharp debt-for-equity swap effectively eroded Sawasdi's previous 50% holding in NTS to a mere 2-3% in the merged entity-Millennium Steel, although he retains managerial control of his plants and has a favourable share-purchase option when the merged firm gets listed.
entry by NIE firms was on the basis of "unauthorised" copying of popular models like the Apple and the IBM PC.\textsuperscript{130}

That early success and a number of follow-on attempts at copying, has led to a backlash especially on the part of leading US electronics firms. The US government has acted to extent and tighten intellectual property legislation in its major developing country partners, while private US firms have sought more effective ways to safeguard their own intellectual property. They have become increasingly reluctant to license key technologies to potential competitors and have aggressively prosecuted those alleged to have violated their intellectual property rights, irrespective of nationality. Such prosecutions are likely to become more common in the future, as NIC governments respond to US pressures by strengthening their intellectual property regimes. Thus, even the most advanced of NIEs face the challenge of how to gain timely access to the new technologies they require to remain competitive in an industry characterised by rapid technological change.

While IP regimes are tightening worldwide, this does now necessarily pose an insurmountable obstacle to technology acquisition by NIE firms. There are reasons for OECD firms not to be overly protective of their technological know-how. Firstly, there is the issue of standards. Secondly, as discussed earlier, many firms are finding it increasingly difficult to bear all the development and commercialisation costs of new products on their own. With those costs rapidly escalating, firms are entering into strategic alliances which permit technology transfer and cost sharing, and provide access to marketing and distribution networks in foreign markets. However, for most electronics companies in NIS, especially for small-and medium-sized enterprises, cooperative agreements are unlikely to improve their access to core technologies.

As Porter has argued, pressure is often necessary for providing sufficient stimulus to generate technological capabilities in a late industrialising society. For example, in the case of high-speed, high-quality fax machines, the refusal of Japanese firms to license the core technologies to Korea resulted in the Korean government's initiating a national research project to develop the relevant technologies. The same applies to liquid crystal display (LCD) technology, where Japanese firms have a strong leadership position and have taken a very restrictive approach towards technology transfer. As a result, three types of reactive strategies have emerged which may well enable Korean and Taiwanese firms to bypass the technology restrictions imposed by Japanese firms. First, both Korean and Taiwanese companies are actively pursuing technology licensing deals with non-Japanese companies.\textsuperscript{131} Second, all the major

\textsuperscript{130} The discussion on increasing restrictions on access to technology is based on Ernst and O'Connor, 1992, p. 166-68.

\textsuperscript{131} Samsung Electronics Co. For instance, has licensed active-matrix LCD technology from Ovonic Imaging Systems, an innovative US start-up company. Other licensing sources which have reportedly been tapped by Korean and Taiwanese companies include the US-based Sarnoff Laboratories which now belongs to the French electronics multinational Thomson S.A., the Electronics Display Institute at the University of Stuttgart and the UK-based GEC.
Korean electronics chaebol are mounting major R&D efforts in active-matrix LCDs. Finally, the Taiwanese government's research laboratory for electronics (ERSO) has developed active-matrix LCD technology, which a consortium of Taiwanese firms planned to blend with licensed technology as a basis for supplying their LCD requirements to compete effectively in the notebook computer market.\textsuperscript{132}

While electronics firms in latecomers need a clear understanding of the opportunities and constraints present in different segments of the international technology markets for advanced electronics, access to the latest technology is at best a necessary but not a sufficient condition for success. What really matters is not access to technology \textit{per se}, but the time a firm needs to absorb, adapt and master a given technology, whether domestically generated or imported. The real issue then is how fast a firm can bring a given technology to the market at internationally comparable productivity levels. As long as they do not have the technological capabilities and complementary assets required to absorb and make effective use of the acquired technologies, they are unlikely to succeed. Even if the financial resources are there to purchase the technology, it does not ensure that the purchaser can successfully "digest" it. For that, R&D and engineering capabilities are required. As Fagerberg (1988) and Nelson (1990) have noted, even to be able to imitate advanced foreign technology effectively, a firm requires to commit substantial resources to its own R&D effort or to reverse engineering. Thus, what appear at first to be external constraints to technology acquisition by NIE electronics firms may on closer examination turn out to be internal constraints. This is why strengthening the technological capabilities of their electronics firms is a major strategic challenge facing countries like Thailand.

Second-tier NIEs however may have one potential advantage not enjoyed by their first-tier predecessors in attempting to acquire the technologies they require. The advantage of latecomers is that the technologies are more widely available from a variety of sources now than they were before the first-tier NIEs gained access to them. Firms from Korea, Taiwan, Singapore, Hong Kong, but also from Brazil and India, may provide alternative sources to OECD-based firms as suppliers of certain technologies. Their entry as suppliers has somewhat broadened the field of competitors and thus shifts the balance of market power to some extent in the direction of technology buyers.

\textbf{9.10 CONCLUSION}

The point of departure in this analysis is that the lack of technological deepening and diffusion existing in the Thai electronics industry is a direct consequence of Thai policy makers' decision to leave it to an FDI-dependent export promotion policy that is, to the foreign-dominated private sector. The main policy maker in the Thai industry namely, the Board of Investment (BOI), believes in providing a level-playing field for foreign

\textsuperscript{132} P. 169-70
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and indigenous firms and seem to have emulated Singapore in its liberal FDI policies. However, it does not believe in pursuing active industrial technology policies along the lines of Singapore, which formulated and carefully propelled industrial deepening and technology upgradation in their electronics industry. Remarkably, it was pointed out that even in 1997 the government has looked at the industry from a trade point of view rather than from an industrial one.133

This is illustrative of the kind of dependent technology development pattern in the host industry, when government does not step in to support indigenous producers to break into MNCs' production networks. Transfer of already mature technologies through FDI might help in introducing certain sophisticated operative capabilities into the host industry. However, it will not lead to technology upgradation of the indigenous production base through the creation of local supplier base and technology diffusion in such a competitive industry, without suitable government policies. The case for a much deeper and proactive industrial policy in supporting domestic producers derives from these weaknesses in technology development for a developing country.

The case studies reveal that while export-led FDI has led to low-middle level of direct technology transfer, there is very little in terms of technology diffusion, because of the pattern of backward linkages created by these foreign firms. Therefore, there is no substitute for national (indigenous) technology capability development and industrial policy. And, it is this concept for a national capability building that seemed to have been absent in Thailand's case until recently (because of the main policy maker's blind faith in FDI-led export growth to take care of everything else through market-mechanism). The present study also finds that although there has been increased concern and awareness in the policy circles about the need for a concerted approach to S&T development in the country, the attitude and perception among the domestic private sector has not changed significantly.

Thus, it may be observed that the Thai electronics industry has failed to develop in a sustainable way, essentially due to the lack of a vision regarding national capability development, and its dependence on the market mechanism, propagated through the 'flying geese' paradigm. Although several policies and efforts to improve skills and local industry's capabilities are currently underway by the NSTDA and the Department of Industrial Promotion (DIP) of the Ministry of Industry, since technology development takes time, in the changed international context of less scope for protective policies and increasing global technological and other strategic alliances between the major players in the electronics industry, Thai electronics industry might not be able to break out of its

133 Anupap, 1997, p. 12.
near total dependence on foreign technology in the short- or medium term. As assembly line advances such as automatic insertion techniques become widely adopted, it will lead to higher capital intensity for the current labour-intensive assembly operations. This would reduce the number of workers on the assembly line. In fact, as all stages of the electronic manufacturing process become more capital-intensive, there will be further reduction in the influence of labour costs as a factor in the FDI locational decision-making process. Further, since technology development is incremental and path dependent (that is; evolutionary in nature), the experience already gained by existing producers increases the speed with which they can adopt new innovations, and later innovations are incorporated and commercialised very rapidly. Therefore, efforts to improve the technological capabilities of the labour force become imperative more than ever before.