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ISSUES OF TECHNOLOGY TRANSFER IN SELECTED INDUSTRIES OF EAST AND SOUTH-EAST ASIAN DEVELOPING COUNTRIES

by

Dr. Sikander Khan

Associate Professor

University of Stockholm

Department of Business Administration

Stockholm, Sweden

Prepared for the UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO), Vienna, Austria

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Dollars ($) refer to United States dollars.
Yens (¥) refer to Japanese yens.
Crowns (SKR) refer to Swedish crowns.
A comma (,) is used to distinguish thousands and millions.
A full stop (.) is used to indicate decimals.
A slash (/) between dates indicates financial year.

China refers to the People's Republic of China.
Korea refers to the Republic of Korea.
Taiwan refers to the Province of Taiwan.

The following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

bn	billion
CAD	Computer aided design
CAM	Computer aided manufacturing
CD	Compact disc
CKD	Complete knock-down
CNC	Computer numeric control
FA	Factory automation
FDI	Foreign direct investment
GDP	Gross domestic product
GNP	Gross national product
HP	Horse power
IC's	Integrated circuits
INTIB	Industrial and Technological Information Bank
JPO	Junior Professional Officer
mn	million

MNE's	*Multinational enterprises*
MVA	*Manufacturing value added*
NIC's	*Newly industrialized countries*
OA	*Office automation*
OEM	*Original equipment manufacturer*
OJT	*On-the-job training*
QC	*Quality circles*
R & D	*Research and development*
SIDFA	*Senior Industrial Development Field Adviser*
SITC	*Standard International Trade Classification*
SKD	*Semi knock-down*
TIES	*Technological Information Exchange System*
TQC	*Total quality control*
VLSI	*Very large scale integrated circuits*

Organizational abbreviations

AMC	*American Motors Corporation*
ASEAN	*Association of South-East Asian Nations*
CNAIC	*China National Automobile Industries Corporation*
COCOM	*Coordinating Committee for Exports to Communist Areas, Paris (Members: France, Japan, UK, USA and West-Germany)*
ESCAP	*Economic and Social Commission for Asia and Pacific*
GATT	*General Agreement on Tariffs and Trade*
IDE	*Institute of Developing Economies, Tokyo*
IMF	*International Monetary Fund, Washington*
JETRO	*Japan External Trade Organization, Tokyo*
JICA	*Japan International Cooperation Agency*
MD	*McDonnel Douglas*
MITI	*Ministry of International Trade and Industry, Tokyo*
MOFERT	*Ministry of Foreign Economic Relations and Trade, China*
OECD	*Organization for Economic Cooperation and Development*

OPEC	Organization of Petroleum Exporting Countries
POSCO	Pohang Iron and Steel Company, Korea
SIDA	Swedish International Development Authority
Techimport	China National Technical Import Corporation
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VW	Volkswagen

EXECUTIVE SUMMARY

The present study throws light on the transfer of technology from the developed countries to the Newly Industrialized countries (NIC's: Singapore, Taiwan, Hong Kong and Korea); as well as the Association of South-East Asian Nations (ASEAN: apart from Singapore, Malaysia, Thailand, Brunei, Philippines and Indonesia); and the People's Republic of China.

The study examines elements of technology transfer in the following five technology-intensive industries: pharmaceuticals, iron and steel, heavy machinery, industrial electronics and transport equipment. The technology collaboration survey (carried out in field work) concentrates, in particular, on joint ventures and licensing.

The NIC's, which to a large extent lack raw materials, have succeeded more than the ASEAN countries and China in absorbing, modifying and improving the imported technology, and at the same time they have succeeded in exporting to both the developing and industrialized countries the capital-intensive manufactured products under review - with the results of rapidly growing world trade shares - by following a dual strategy i.e. giving equal priority to import substitution and to export industries.

The NIC's are, to a large extent, on their way to achieving technological self-sufficiency, whereas the others are facing problems in terms of price, quality and productivity.

One of the reasons for the countries being slow in adopting, modifying and improving the technology is due to the lack of a well developed sub-contracting system, and a sufficient number of small and medium size firms in the products under review.

In this respect the assistance of bilateral and trilateral organizations is recommended. These organisations could also be of assistance to these countries in acquiring the technology, training and in strengthening the negotiation and contracting capabilities of the technology recipients which have been so far rather weak.

The technology suppliers are hesitant to provide the leading-edge technologies, such as semi-conductors, robots, new materials, optics, aerospace and biotechnology to these countries, due especially to their fear of the boomerang effect.

The technology which has been transferred to this region has beyond doubt increased the indigenous technological capabilities of most of the countries under review. This is clearly evidenced by the mounting exports of manufactured goods to both the developing and industrialized countries during the period of 1975 - 1985.

However, practically all the countries surveyed are net importers of most of the products in this review. Therefore the boomerang effect, i.e. that the technology sold to developing countries could come back in the same or in an improved form to create severe competition in the home or export market of the technology suppliers, is over-emphasized, to say the least.

All the means of technology transfer in this study have advantages and disadvantages. However, it is important to know how to get the most from each type of technology transfer.

The countries have to also pay attention to the fact that attracting foreign investment or entering into a technology collaboration in certain of the products areas under review will be difficult to

do just on the basis of their cheap labour, since the savings arising from the development of advanced automation in OECD countries has practically overtaken the economic advantage of low labour costs in these countries.

The developed countries do not have a monopoly on most of the technology-intensive manufactured products under review, since the number of technology suppliers and middlemen (i.e. independent engineering consultants) is very large. Thus, it is a buyer's market for technology. However, most of the countries under review are unaware of this situation or are unable to use this as a lever for acquiring technology through negotiations and contracting.

In order to achieve technological self-sufficiency, the countries have to follow a long-term strategy in acquiring foreign technology and developing their own indigenous technological capabilities, similar to that followed by the Koreans. More importance has to be given to applied industrial research over basic research than is done at present.

Finally, benefits in technology transfer exist for both the technology recipients and the suppliers, leading to intensified competition, and increased efficiency and trade. Not only will the North-South trade increase, but also the South-South trade in technology-intensive manufactured products will increase substantially.

1. INTRODUCTION

Industrialized countries are transferring technology to developing countries to aid in their economic progress. However, the developing countries are urging the industrialized countries to step-up such technology transfer further. The developing countries, in particular those of East and South-East Asia, complain that industrialized countries are too slow to transfer technology.

The present study throws light on the transfer of technology by the companies of s' h industrialized countries as Sweden, Japan, the USA and Austria, in particular via joint ventures and licensing tc the Newly Industrialized Countries (NIC's : Singapore, Taiwan, Hong Kong and Republic of Korea); the People's Republic of China; and the ASEAN countries (apart from Singapore, Malaysia, Thailand, Brunei, Philippines and Indonesia). The study also makes some recommendations aimed at facilitating effective technology transfer for the surveyed nations' economic growth.

1.1. Research design and methodology

The approach of the study is as follows:

1. The study covers the industrialized countries of Sweden, Japan, the USA, and Austria, and their technology transfers to the NIC's, China and the ASEAN countries. The study examines elements of technology transfer in each of the following five industries: pharmaceuticals, iron and steel, certain types of heavy machinery, specific types of industrial electronic products, and transport equipment.

2. The study surveys some technology collaborations, mainly in licensing and joint ventures, in the countries mentioned above, in order to point out problems and explore industrialized and developing countries' approaches to technology transfers. Moreover, technology absorption, modification, improvement and the extent of the use of locally manufactured components are analysed.

3. In the case of each industry the paper examines not only issues of transfer but also the issues of trade friction which have arisen. Another aspect to be addressed is the impact of the countries' export performance in these industries.

4. The paper will also take into account the implications of technology transfer in terms of the possibility of creating new competitors in the developing countries for the technology exporters in each of these five industries.

5. Finally, the study touches upon some policy issues for effective technology transfer.

The data has been collected through field visits to the countries under study, from suppliers of technology from such countries as Sweden, Japan, the USA and Austria, and through secondary sources such as the data bases of UNIDO, World Bank and the Institute of Developing Economies (IDE, Tokyo, Japan).[1/]

1/ The technology exports from the centrally planned economies are not mentioned in this report, since their exports are limited to most of the countries under review.

1.2. Traditional, maturing and high-tech industries

The industrial sectors can generally be grouped into three groups according to the availability and level of technology used in them.

The traditional industrial sectors, such as the textiles industry, require rather simple labour intensive technology and this has already been transferred to most of the developing countries.

The mature industries, namely those of iron and steel, petrochemicals, and pharmaceuticals, are presently on their way to being transferred to certain developing countries. These capital intensive industries to a large extent and in many cases require both advanced and sophisticated technologies.

Finally, the high-tech industries, such as industrial electronics, robots, new material, optics and biotechnology - which use quite sophisticated and complex technology - are at present within the reach of only a limited number of developing countries.

The present study deals with the second and to some extent the third group of industries.

1.3. Technology transfer as viewed in this paper

Technology is indispensable to the production process. A transfer of technology involves the transfer of hard-ware and soft-ware. Hard-ware refers to machinery and equipment, whereas soft-ware refers to know-how, patents, marketing,and managerial techniques.

Technology can be transferred in many ways. It can be transferred through individual technicians or experts hired or employed by technology-recipient firms, through technical magazines or exhibitions, or through other organizations.

Moreover, technology can be transferred in package form such as with turn-key contracts (plant import), or in unpackaged form, i.e. licenses, designs, manuals, know-how, operational training, etc. The NIC's, China and the ASEAN countries are importing technology in both the packaged and unpackaged forms, although the NIC's and China show a higher tendency towards importing technology in unpackaged form, since most of the manufacturers in these countries are at an advanced technological level.

The technology can also be transferred by reverse engineering, i.e. a foreign product is disassembled secretly to study its construction and dead copies are made. However copying requires, in most cases, that the manufacturer be on a rather advanced technological level.

The media for the technology transfer are numerous: joint ventures, wholly owned subsidiaries, licensing, turn-key projects, franchising or management contracts. The present study, as indicated earlier, is largely limited to technology transfer via joint ventures and licensing. Technology as it

appears cannot be completely transferred, since it is difficult to thoroughly codify it in blueprints and/or embody it in capital equipment.

There are practically no institutions in the world which systematically gather information on the current situation of technology transfer. 1/

1.4. Forms of technical collaboration

Foreign investment mostly involves transfer of technology. The common forms of technical collaboration and foreign investment are as follows:

* *wholly owned subsidiaries*
* *joint ventures* 2/
* *licensing* 3/ 4/
* *compensation trade (e.g. buy-back arrangements)*
* *turn-key projects*

1/ *According to UNIDO estimates, developing countries' technology imports - in terms of royalties, know-how fees, engineering and consultancy payments - amounted to approximately US$ 2 to 3 billion in 1978 and by 1985 they had been expected to have reached US$ 6 bil. However, according to many experts, the actual figures for 1985, which have not yet been collected, may be as high as US$ 10 billion, if not higher.*

2/ *A foreign local joint venture is defined as a corporate entity or partnership created under local law between the parent and local interests. See: Vernon and Wells, Economic environment of international business, New Jersey, 1985. For more details see also, Franko, 1985; Tomlinson, 1970; and Young & Bradford, 1977.*

3/ *The licensing agreement or technical assistance agreement is defined as an arrangement between the foreign licensor and the entity created under the local law of the host country; the licensor provides a combination of management services, technical information or patent rights and receives payment in money. See: Vernon and Wells, ibid.*

4/ *There are several forms of licensing agreements such as: exclusive license, sole license, non-exclusive license, sub-license, cross-license, field of use, secrecy agreement, option agreement, right of first refusal. For details see: Lindström, G. and Petersson, L., Marknadsföring av licenserkanaler för marknadsföring av licenser i USA, STU, Stockholm, 1981 (in Swedish).*

Table 1.1. offers a few costs and benefits ordinarily associated with various forms of foreign investment.

Table 1.1. Costs and benefits from the viewpoint of a foreign parent enterprise, ranked according to the form of the local link

(1 is the lowest and 4 the highest cost of benefit)

	Licensing Arrangement	Foreign-Local Joint Venture	Foreigners' Joint Venture	Wholly Owned Subsidiary
Costs				
1. Cost of capital commitment	1	2	3	4
2. Cost of management commitment	1	2	3	4
3. Restraint on strategic and operational flexibility of rest of multinational firm	4	3	2	1
Benefits				
1. Amount of payment to parent	?	?	?	?
2. Stability of payment to parent	?	?	?	?
3. Political security for parent	4	3	2	1
4. Contribution to parent's store of knowledge	1	2	3	4
5. Contribution to value of parent's trademark and trade name	1	2	3	4
6. Future availability of local outlet to parent	1	2	3	4

Source: Vernon, R. & Wells, L.T., Economic Environment of International Business, New Jersey, 1985, p.21.

Furthermore, Table 1.2. shows the actual criteria used by the suppliers of technology in evaluating joint venture or licensing alternatives in, for example, China.

Table 1.2. Criteria used by foreign companies in going for joint venture or licensing in China

Criteria	Joint venture	Licence
1. Equity Contributions of capital or in kind	yes	no
2. Management responsibility	yes	no
3. Administrative/production responsibility	yes	no
4. Responsibility for adaption of technology	yes	no
5. Responsibility for final product	yes	no
6. Infrastructure - Dependency	yes	no
7. Buy back undertakings (export)	yes	no
8. Component deliveries	yes	yes
9. End customer contacts (service)	yes	yes
10. Training/assistance	yes	yes
11. Initial fee	yes export	yes no export
12. Royalty	yes export	yes no export
13. Dividend	yes export	no

China is an exceptional case in the sense that foreign investors can only repatriate profits if the goods manufactured are exported, i.e. only through exports can foreign investors realize returns on their investment. 1/

The developing countries in East and South-East Asia see joint venture and other forms of foreign investment as a means for obtaining among others:

* advanced technology
* research and development (R & D) co-operation
* managment know-how
* capital
* foreign exchange earnings
* access to world markets (distribution and service network)
* long term mutual benefits

1/ See: MOFERT, Collection of laws and regulations of the People's Republic of China concerning foreign economic affairs, Volume 2, Beijing, 1985.

The trade frictions between the East and South-East Asian countries and suppliers of technology are mainly due to the different perspectives regarding investment in the region.

This subject is discussed in more detail in Chapter 4.

2. A country-wise analysis of industrial progress in East and South-East Asia 1/

2.1. An overview

Table 2.1. on the next page provides some of the vital economic data for the countries under study. Table 2.2. provides the factors which are impediments to economic development. Finally, Table 2.3. touches upon some of the industrial strategies and policies followed by the countries in East and South-East Asia for their economic development. For further details regarding industrial strategies and policies consult the sources mentioned under each table.

2.2. Newly Industrialized Countries (NIC's)

2.2.1. Hong Kong

Hong Kong is similar to Singapore (see 2.2.3.) in being a free port, however, their technological progress is not great when compared with Korea or Taiwan. Some of the principle exports of Hong Kong include electronic components and parts, and metal manufactures.

2.2.2. Korea

In the developing world Korea is one of the most industrialized countries. To a large extent, Korea has developed its industry with imported high technology. Korea has not, however, relied heavily on foreign investment. This is quite contrary to the other three NIC's, examined in this survey. The manufacturing sector consists of, among others, petrochemicals, iron and steel, machinery, electronics, helicopters, aircraft and automobiles - all employing the latest technology. Electronics, machinery and transport equipment have led production upwards in Korea during the 1980's.

1/ A very brief discussion concerning the countries and products under review occurs in this chapter. However, space considerations allow such issues as industrial strategies and policies to be addressed only peripherally.

Table 2.1. Inter-country comparision of selected indicators in the countries under review

	N I C ' s				A S E A N					C H I N A
	Hong Kong	Korea	Singapore	Taiwan	Brunei	Indonesia	Malaysia	Philippines	Thailand	
Area, '000 km²	1.1	99	0.6	36	5.8	1,920	330	300	514	9,600
Population, mn [1]	5.7	43.3	2.6	19.6	0.2	163.4	15.8	58.1	52.8	1,050
GDP, bn US$ [2]	34.2	81.2 [4]	17.7	60.1 [4]	7.5	80.7	25.4 [4]	31.9 [4]	37.2 [4]	264.9
GDP/capita US$ [2]	6,311	1,954 [4]	5,647	3,142 [4]	33,931	540 [3]	1,574 [4]	535 [4]	579 [4]	220
Manufacturing % of GDP	24.6	30.7	25.0	40.7	9.9	11.4	19.1	24.7	19.8	55.1
Total export, bn US$ [1] (est.)	34.0 [5]	31.7	22.8 [2]	30.5 [2]	2.9 [2]	18.8 [2]	13.8	4.7	7.9	35.6
Exports of, bn US$ [2]										
Electronic products	1.1 [12]	2.9	1.4	4.9	...	...	...	0.9	0.3	0.02 [3] [12]
Metal products	...	...	...	1.8	...	...	...	...	...	...
Iron and steel	0.2	2.09 [3]	0.21	...	...	0.01 [8]	0.02 [9]	0.05 [9]	0.04 [3]	0.12 [3]
Ships incl. re-exports	...	5.0	...	...	...	...	...	...	...	...
Telecommunications, sound recording equipment, etc.	1.5	...	...	...	...	...	...	...	...	0.33
Medicinal and pharmaceutical prod.	0.02	0.03 [3]	0.14	...	...	0.01 [8]	0.02 [11]	0.01 [8]	0.01 [3]	0.26
Electrical apparat, machinery and appliances	1.3	...	8.0 [6]	4.1 [6] [7]	...	...	...	...	...	0.08 [1] [10]

1/ 1986
2/ 1985
3/ 1984
4/ GNP at current market price
5/ incl. re-exports
6/ incl. transport equipment
7/ excl. electronic products
8/ 1983
9/ 1980
10/ only transport equipment
11/ 1982
12/ mainly office machines
... negligible or not available

Sources: Far Eastern Economic Review, Asia 1987 Yearbook, Hong Kong, January 1987 and Economist Intelligence Unit, London, various issues, 1985 - 1986.

Table 2.2. Impediments to economic development and foreign investment in the countries under review

	N I C ' s				A S E A N					CHINA
	Hong Kong	Korea	Singa-pore	Taiwan	Brunei	Indo-nesia	Malay-sia	Philip-pines	Thai-land	
* Scarcity of energy	1	1	1	1	1	2	2	3	2	3
* Inadequate infrastructure	1	1	1	1	3	3	3	3	3	3
* Underdeveloped management skill	1	1	1	1	3	3	3	3	3	3
* Low productivity and motivation of labor	1	1	1	1	3	3	3	3	3	3
* Quality of products	1	1	1	1	3	3	3	3	3	3
* Other factors such as political stability	1	1	1	1	2	2	2	3	2	2

1 2 3 →

low/minor obstacle — high obstacle

Sources: Based on information available from UNIDO/IS.458, April 84, Indonesia; UNIDO, PPD/R.1, November 86, Report from the UNIDO Industry Sector Assessment Mission to the Philippines; UNIDO/IS.527, April 85, The Philippines; UNIDO/IS.545, July 85, Malaysia; UNIDO/IS.548, August 85, Thailand; UNIDO/IS.582, December 85, The People's Republic of China; Far Eastern Economic Review, Asia 1987 Yearbook, Hong Kong, January 87 and Economist Intelligence Unit, London, various issues, 1985 - 86.

Table 2.3. Industrial policies and strategies in the countries under review

	N I C ' s				A S E A N					C H I N A
	Hong Kong	Korea	Singa-pore	Taiwan	Brunei	Indo-nesia	Malay-sia	Philip-pines	Thai-land	
* Import substitution	1	2	1	2	1	3	3	2	3	3
* Export market oriented	3	3	3	3	2	2	2	3	2	3
* Dual strategy (equal priority to import substitution and export industries)	2	3	2	3	1	3	3	3	2	3
* Development of large scale and heavy industries	2	3	2	2	1	3	2	2	2	3
* Promotion of small scale industry	3	2	2	3	2	3	3	3	3	3
* Promotion of foreign investment	3	2	3	3	2	2	3	3	3	3
* Promotion of domestic capital sources for industrial investment	3	3	2	3	1	3	3	3	3	2
* Development of industrial estates, economic zones, science-based industrial parks, etc.	3	2	3	3	1	2	2	2	3	3
* Incentives to investors:										
Tax relief	2	1	3	3	1	2	2	2	2	2
Investment allowances	2	1	3	3	1	2	2	2	2	2
Accelerated depreciation incentives	2	1	3	3	1	2	2	2	2	2
Tax exemption on interest on approved foreign loans	1	1	3	2	1	1	1	1	1	1
Concessionary tax rates on royalties	1	1	3	3	1	1	1	2	2	1
Duty free import of equipment	1	1	3	3	1	1	1	2	2	1

1 — 2 — 3

low/minor importance → high importance

Sources: Based on information available from: UNIDO/IS.458, April 84, Indonesia; UNIDO/IS.545, July 85, Malaysia; UNIDO/IS.527, April 85, The Philippines; UNIDO, PPD/R.1, November 86, Report from the UNIDO Industry Sector Assessment Mission to the Philippines; UNIDO/IS.548, August 85, Thailand; UNIDO/IS.582, December 85, The People's Republic of China; Far Eastern Economic Review, Asia 1987 Yearbook, Hong Kong, January 87 and Economist Intelligence Unit, London, various issues, 1985 - 86.

2.2.3. Singapore

Singapore is the only NIC nation which has totally relied on foreign investment for its industrial development. Moreover, Singapore has followed a high wage policy which has limited technology imports. Recently, this has led to a decline in foreign investment. Singapore produces a range of industrial electronics, components and consumer products. 1/

During the 1980's electrical and electronic manufacturing has provided the main growth in that sector. Older sectors, such as petroleum refining, chemicals, ship-building and repair, remain important but are constrained by weak international markets and strong external competition. Singapore has been highly successful in attracting significant foreign investment mainly due to a two-tier strategy: first, through the creation of a cluster of promotional and financing agencies, and second, through a panoply of fiscal incentives (see Table 2.3.).

2.2.4. Province of Taiwan

Taiwan has one of the strongest economies in Asia. However, it relies heavily on imported technology. Taiwan's exports of electronic and metal products are on a rise. With the rising Yen and the imposition of import quotas by the US Government, some Japanese companies are seeking to expand their productive capacity by opening plants in Taiwan to produce items for export to the USA. For example, Taiwan Hitachi has just started to produce high-fidelity units in Taiwan, and is scheduled to make most of the compact disc (CD) players there that Hitachi will export to the USA.

Moreover, Philips NV has a joint venture there and is producing 10,000 very large scale integrated circuits (VLSI) a month. Well known companies with manufacturing facilites in Taiwan are, among others, Nissan and Hewlett Packard.

1/ Singapore is one of the few countries where exports and imports are larger than GDP.

2.3. Association of South-East Asian Nations (ASEAN)

2.3.1. Brunei

Brunei got its independence in 1984 and industrialization has not yet fully begun. However, the country has the highest per capita income in Asia, including Japan. This is mainly due to its large oil revenues.

2.3.2. Indonesia 1/

Indonesia has been able to develop its industry to some extent through using its oil revenues. The industrial sector in Indonesia is rather inefficient, mostly due to the highly protected environment in which it has been nurtured. Regarding exports, given the low wage-rates prevailing in Indonesia, it is widely recognized that Indonesia enjoys a considerable comparative advantage over many of its competitors (e.g. China) in labour intensive manufactured exports.

At present, Indonesia is manufacturing a wide range of products, such as aircraft, motor vehicles, machinery, and chemicals. However, very low quantities are exported, mainly due to low quality and high price.

The economic outlook remains gloomy, mainly due to the slump in international oil markets.

2.3.3. Malaysia

Malaysia, as compared to other ASEAN countries, is also in the early stages of industrial development. At present, high-tech areas such as electronics and transport equipment are given priority.

1/ See also, Prospects for Industrial Development and for a Capital Goods Industry in Indonesia, Volume I, II, III, UNIDO/IS.479, and Add.1, 2, 1984.

2.3.4. Philippines

The Philippines is in the early stages of industrial development as well. Still, the Philippines does export, among other things, semi-conductors and electronic microcircuits. The Philippines' trade deficit is rising and the industrial estates are threatened. The incentives accorded in the past to manufacturing industry are being reconsidered.

2.3.5. Thailand

Here, the industrial situation is more or less similar to that of the Philippines, although the country is more politically stable than the Philippines. Thailand relies heavily on imported technology and foreign investment for its industrial development.

Thailand and other East and South-East Asian countries are seeking to benefit from a prospective surge in Japanese outward investment due to the strength of the Yen. Thailand recognizes the vulnerability of dependence on the narrow home market. At present, production costs are high, and exist behind a wall of protective tariffs.

Japanese automobile makers have assembly plants for several vehicles there. Thailand is getting assistance from Korea for the manufacture of TV tubes. Thailand is facing problems in exporting its products to several countries, due to the regulations defining the country of origin of imports assembled from parts imported from a third country. At present Thailand is examining its own policy on local content.

2.4. China

China, with an estimated population of 1.1 billion persons, is the largest producer of manufactured goods in the developing world, and ranks as the sixth largest contributor to world manufacturing value added (MVA). It has the world's largest industrial labour force with over 60 million persons. 1/

China is also the world's largest producer of cotton yarn and textiles, the third largest producer of cement and sulphuric acid, and ranks among the top six in the production of steel.

China has in the past relied mainly on its own resources for its economic development. This policy of self-reliance and self-sustained development has led to the stagnation of its economic and technological development. Since 1978 China has followed an "open-door" policy. According to this policy, a dual strategy for industrialization is followed, which gives equal priority to import substitution and export industries i.e. to inward and outward-looking industrialization.

From the beginning of July 1979, when the joint venture law was announced and up to the end of 1985, the approximate number of contracts signed by category was as follows:

3,100 contractual joint ventures
2,300 equity joint ventures
1,500 compensation trade
120 wholly foreign-owned enterprises, and
35 off-shore oil projects for joint prospecting and exploration. 2/

1/ Source: UNIDO, The People's Republic of China, Vienna, Dec. 85.

2/ Khan, S., Problems in Technology Transfer via Joint Ventures and Licensing in the People's Republic of China: American, Japanese and Swedish Experiences, Results of a fact-finding survey, Research Report No. R1986:7, University of Stockholm, Stockholm, October 1986.

It is reported that the majority of the Chinese companies are utilizing labour intensive production schemes. [1/] *However, Chinese electronic products cannot compete with those of the Japanese or of the Koreans in terms of price and quality.*

China's tremendous efforts to promote exports have led to a situation where several countries, in particular the ASEAN block, feel threatened not only by the Chinese primary products but also by their manufactured goods. In East and South-East Asian countries the boomerang effect is widely debated. [2/] [3/] *This subject is discussed later in the report.*

2.5. The Japanese experience in technology transfer

It is interesting to note that, in the past, Japan was a net importer of technology and at present Japan is a net exporter of technology. See Figure 2.1.

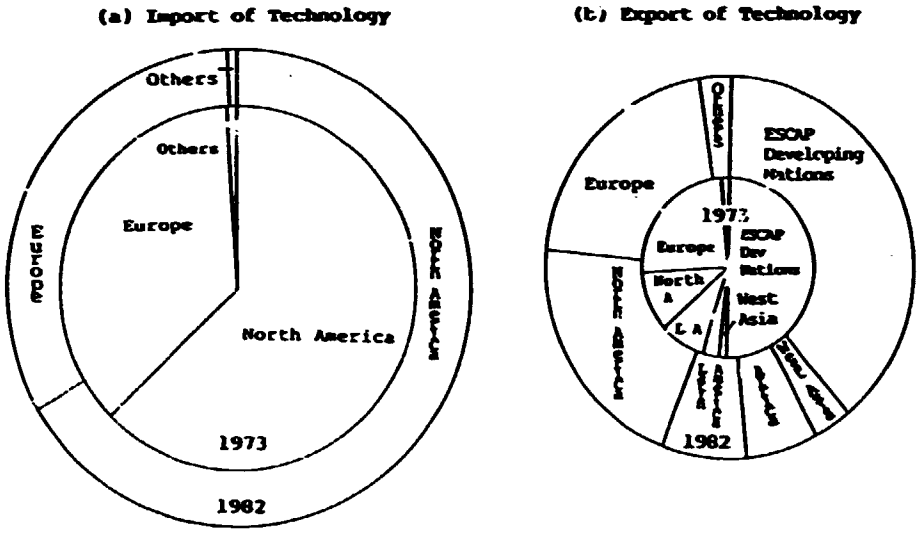
1/ See, United States International Trade Commission, China's economic development strategies and their effects on US trade, Washington D.C., USITC, February 1985 and

World Bank Country Economic Report, China - Long term development issues and options, Washington D.C., September 6, 1985.

2/ Concerning trade frictions in East and South-East Asia see: JETRO, The Third ASEAN Roung Table, October 23-24, 1985, Proceedings, Tokyo, 1986 and MITI, White paper on international trade 1985, Tokyo, November 1985.

3/ The Economist, Still learning to learn the tricks, London, February 9, 1985.

Figure 2.1. Japan's technology imports and exports by region 1/ 2/



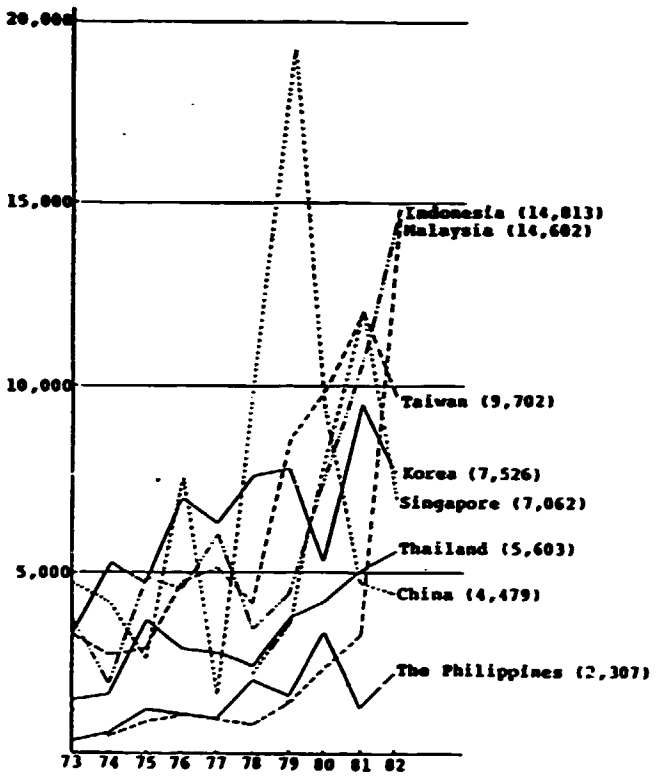
Source: Institute of Developing Economies (IDE), The study on technology and trade frictions between Japan and developing nations and on international division of labor in the future with special reference to technology transfer from Japan to ESCAP developing nations, Tokyo, 1985 and Statistics Bureau, Management and Co-ordination Agency, Tokyo, 1985.

1/ The size of circles is proportionate to the total value, e.g. in Figure (a), the import value in 1982 came to 282.6 billion yen, while in Figure (b), the export value in 1973 stood at 41.5 billion yen.

2/ Inclusive of new and on-going agreements.

Moreover, OECD countries on the whole export technology to one another, whereas Japan exports technology mainly to the developing countries. The technology exports to the countries under study have occupied the largest share in overall worldwide technology exports (see Figure 2.2.).

Figure 2.2. ***Technology exports from Japan to Asian nations***
(all industries, in millions of yen)



The figures in brackets show those for 1982. Separate data for Hong Kong were not available. The increase of export to Malaysia in 1981-82 was mainly due to construction

Source: IDE, op.cit., page 4

Recent figures indicate that East and South-East Asia (39 %) topped the list as recipients of technology from Japan followed by South America (7 %) and West Asia (6 %). 1/

1/ *See, Hoffmann, L., Problems and perspectives of the transfer of technology between the countries of the European Communities and India, Forschungsanstalt für Alternative Technologien und Wirtschaftsanalysen mbH, Regensburg, 1984 and IDE, op.cit.*

It is useful to look at an industry-wise breakdown of Japan's technology exports to all the countries under review. The following industries hold considerable shares: electricals, transport equipment, chemicals and iron and steel as well as construction. The breakdown, however, differs greatly from country to country.

Table 2.4. indicates that Japan ranks first in technology imports by all the countries under review (excepting Hong Kong). 1/

Table 2.4. Japan's technology exports to Asian nations
(cases on a cummulative basis)

	Korea	Taiwan	Hong Kong 1/	Singapore 2/	Thailand	Malaysia 3/
Period	1962-83	1952-83	1970-82	-1983	-1981	1976-83
Japan	1.486 (56.3%)	1.226 (65.5)	(13.0)	135 (25.0)	141 (36.4)	227 (31.3)
U S A	609 (23.1)	401 (21.4)	(32.1)	132 (24.4)	73 (18.8)	75 (10.3)
U K	97 (3.7)		(15.7)	51 (9.4)	30 (7.7)	96 (13.2)
W Germany	127 (4.8)	206 (11.0)	(2.7)	32 (5.9)		54 (7.4)
France	73 (2.8)		(0.7)	5 (0.9)	144 (37.1)	18 (2.5)
Others	249 (9.4)	38 (2.0)	(35.8)	186 (34.4)		255 (35.2)
Total	2.641	1.871		541	388	725

1/ Each nation's cumulative investment value in percentage.

2/ cumulative number of investments in manufacturing industry.

3/ The cases include contracts to provide technology, managerial services, trade mark, patents and basic engineering as well as financial collaboration agreements.

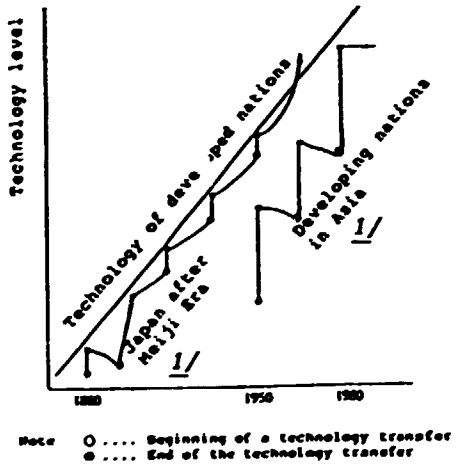
Source: IDE, op.cit., page 6

1/ *The country-wise share is discussed here in terms of number of technology imports, the data in value being not available. For those countries whose technology import data are available even in terms of number, value or number of foreign direct investments is taken as roughly representing the trend of technology imports.*

Two NIC nations,namely Korea and Taiwan, depend on Japan for 50 to 60 percent of their technology imports. The two nations' import of capital goods from Japan has accounted for 40 to 50 percent of the total for the past 20 years.

Figure 2.3. illustrates a contrast between Japan and several other Asian countries. Japan, which was technologically backward in 1860, has gradually risen to be one of the most technological advanced nations. The Japanese experience over the past one hundred years illustrates that it is possible for late-comer countries to successfully acquire developed countries' technology by absorbing, modifying and improving the imported technology.

Figure 2.3. Technology catch-up patterns against developed nations



1/ technical level goes down after expiry of contract

Source: IDE, op.cit., page 22

East and South-East Asian developing countries can learn a lot from the Japanese experiences of technology absorption, modification and improvement. This subject is discussed in detail in the next chapter.

3. Technology transfer progress in selected industries

This chapter will look at how and what technological elements have been transferred in the industrial sectors under investigation and the impact of technology transfer on the technological development of the countries under review.

The capabilities needed to acquire, assimilate, use, adapt, change or create technology can be placed into three categories, namely, production, investment, and innovation.

Promotion capability is needed to operate productive facilities, whereas investment capability is needed to establish new productive facilities and expand existing facilities. Innovation capability is needed to create new technology.[1/]

3.1. Iron and steel industry

A survey of the world's top 50 steel producers revealed that Korea's Pohang Iron and Steel Company (POSCO) was the most efficient plant in the world, as measured by tons of steel produced per employee [2/] (see Table 3.1).

Japan's Kobe Steel Company came in second place and Taiwan's China Steel Corporation ranked third, whereas the rest of the countries in this review possess only small size, highly inefficient plants (refers to ASEAN and China) and are obviously not on the list of the world's 50 top steel producers.

1/ For details, see Dahlman, C.J., Ross-Larson, B & Westphal,E.L., Managing technological development - Lessons from the newly industrializing countries, IBRD/The World Bank, Washington, D.C., 1985.

2/ See, Iron Age, US, April 16, 1984.

Table 3.1. World's Top Ten Steel Producers in 1983

Ranking	Company	Country	Tons/Employee
1	Pohang	Korea	689.3
2	Kobe Steel	Japan	463.8
3	China Steel	Taiwan	451.6
4	NKK	Japan	450.4
5	Sidmar	Belgium	446.1
6	Nippon Steel	Japan	418.9
7	Kawasaki Steel	Japan	363.1
8	Sumitomo	Japan	359.2
9	Rautaruukki	Finland	293.5
10	Nisshin Steel	Japan	288.3

Source: IRON AGE, April 1984, USA

The above mentioned survey revealed that Korea and Taiwan with Japan were extremely competitive in world-terms.

In terms of total crude steel production in 1985, the production of those three countries under review was as follows:

* *China 46.5 million metric tons 1/*
* *Korea 13.5 - " -*
* *Taiwan 5.1 - " -*

At present China has only one integrated steelwork, namely Bao Shan Integrated Iron and Steel Complex. This is located in Shanghai and boasts a production of around 3 million metric tons of crude steel. By 1990 the capacity is expected to reach 6.5 million tons.

1/ See, Stahl und Eisen, no. 5/106, West-Germany, March 1986

The major suppliers of technology to this plant have been Nippon Steel, Hitachi and Mannesmann Demag. At present the plant is facing problems due to an unsuitable site choice and high overhead and production costs.

The China Steel Corporation of Taiwan is expected to complete its third-phase expansion by early 1988, which will raise its annual output of crude steel to 5.652 million metric tons. 1/

3.1.1. The experience of Korea in acquiring the latest iron and steel technology

The Korean experience in iron and steel production is of major interest to Third World countries. Therefore, a brief discussion concerning the Korean iron and steel industry is presented below.

In 1970 Korea was producing only half a million tons of crude steel but by 1985 the production had reached 13.5 million tons. By 1987 the domestic annual steel making capacity is expected to reach 15.2 million tons. This tremendous increase in production is all the more noteworthy in that it has been carefully planned in its entirety by the Koreans.

POSCO was formed in 1968 and the first phase, with a capacity of 1.3 million tons of crude steel, was completed in 1973 at Pohang with Japanese financial and technical co-operation. The Japanese government provided a loan financed through the Japanese Overseas Economic Corporation Fund and the Japanese Export-Import Bank. Technical collaboration was provided by Nippon Steel and Nippon Kokan.

1/ See, Board of Foreign Trade, Ministry of Economic Affairs, Foreign Trade Development, Taipai, Province of Taiwan, 1986.

Some 300 Japanese engineers did the engineering and project management for establishing the plant and provided technical guidance and supervision at the site. The Koreans worked closely with them from the beginning and a number of Korean engineers were provided long-term training in operation and maintenance at steel works not only in Japan but also in many other Western European countries. The Koreans acquired the new knowledge with enthusiasm and singleness of purpose. They mastered the equipment selection, installation, construction, start-up, operation and maintenance of the plant.

After the completion of the first phase, four more phases were planned and subsequently completed. With this, the total annual capacity of POSCO rose to 9.1 million tons by 1982. Surprisingly, the major suppliers of technology were not only Japanese, but also European and American companies. The rapidity with which the five stages were completed is without parallel in the history of the steel industry. 1/

In 1984 POSCO started construction on a second integrated steel plant at Kwangyang which is scheduled for completion in early 1988. It will have an annual capacity of 2.7 million tons and is currently considered to be the most modern plant in the world. The bidding for the construction contract was extremely competitive and thus the costs involved in building the major facilities were rock bottom. This was the only integrated steel project in the world on which construction was started in 1984.

Right from the beginning, the Korean strategy has been to seek close technical collaboration between foreign suppliers of technology and local partners.

1/ *See, D'Mello, B., South Korea: Pointers to a new international Division of Labour, Economic and Political Weekly, September 21, 1985.*

In the case of PASCO's plant at Kwangyang the contracts were awarded to the following companies:

	Technical collaboration 1/	
	Foreign	Local
* Hot strip mill	Mitsubishi (Japan)	Korea Heavy Industries
* Blast furnace (13.2 metres)	Davy McKee (US/UK)	- " -
* Sinter plant and LD melting shop	VOEST-Alpine (Austria)	Hyundai Heavy Industries
* Continuous casters	Mannesmann Demag (West-Germany)	- " -
* Lime plant	BKMI (West-Germany)	- " -
* Oxygen plant	Air Liquide (France)	- " -
* Dust removal and recovering equipment	VOEST-Alpine (Austria)	- " -
* Port and materials handling facilities	Mitsubishi/IHI (Japan)	Samsung Heavy Industries

The three main reasons for the close technical collaboration with foreign/local partners from 1968 have been as follows:

* the savings in foreign exchange
* the development of indigenous technical capabilities, including creation of a research centre in the company
* the Korean plans for building similar plants, both in Korea and abroad

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1/ See, Metal Bulletin Monthly, Construction underway at Kwangyang, US, December 1984.

We shall also note here that for the Kwangyang plant the Koreans themselves did the following, with only occasional advice from a few foreign technology suppliers:

* designing
* technology selection
* equipment specifications
* calling for bids
* choosing the winner
* negotiating the details of the specifications
* controlling all the work of installation and start-up

By this method, the Koreans have been able to cut down considerably the construction cost and start-up time.

The import content of hardware was 95 % in POSCO's first stage at Pohang in the early seventies. At the same time, the Koreans started building up a ferrous metallurgical machinery manufacturing sector with three major local firms, namely:

* Samsung Heavy Industries
* Daewoo Machinery
* Hyundai Heavy Industries

The licensing agreements (after tough negotiations) were made with General Electric (US), Creusot-Loire (France), Krupp (West-Germany), Mannesmann Demag (West-Germany), Dary McKee (US/UK), VOEST-Alpine (Austria), etc. The purpose of the licensing agreement was among other things to manufacture capital goods for the steel industry.

For the Kwangyang plant, the foreign exchange component of hardware costs is between 63 and 79 percent for the various units of the plant. The assembly, erection and construction costs are also low due to low wage rates. Additionally, the Koreans have been

able to obtain favourable finance credits from foreign suppliers: 6 - 6.95 percent with maturity periods from 8 - 11 1/2 years. The plant cost is estimated to be US$ 750 per ton of finished product (1984 US$), whereas in the US, the corresponding cost would be approximately US$ 1,500. 1/

We should also note here that POSCO produces internationally competitive steel in spite of Korea's importation of 100 percent of the steel-making raw materials. Due to this reliance on foreign raw material, POSCO has invested large amounts of capital in coal mines in Pennsylvania, New South Wales and British Columbia.

The Americans and the Japanese strongly protested when POSCO announced its plans to build the Kwangyang plant and the Japanese, in particular, held back from bidding on the early stages for the supply of equipment, fearing that the new capacity would be in excess of Korean domestic demand, leading to a flood of Korean steel eroding their home and East and South-East Asian markets. However, POSCO eventually managed to allay such fears as most of the new production was and has been meant for an increasing home demand.

The reason for the Korean success has been that the steel industry is currently characterized as a buyer's market, especially in the area of iron and steel technology, for the following reasons:

* *an overcapacity in the world steel industry; since 1974 - 75, capacity utilization has been less than 75 percent.*

* *a low demand for ferrous metallurgical equipment*

* *an oil and world debt crisis in developing countries leading to a decline in or cancellation of steel plant construction in Brazil, Mexico and the OPEC nations.*

1/ *See, D'Mello. B., op.cit.*

The factors mentioned above have shifted the industry's business centre to East and South-East Asia, where the Japanese plant suppliers have traditionally been in a strong position. Since the competition is severe, the plant suppliers from the OECD countries are on the defensive.

The Koreans have exercised their options and taken advantage of extremely competitive bidding through the international tendering of contracts.

The Koreans have been extremely successful in absorbing, improving and modifying the imported technology by following a long term strategy of developing indigenous technical capabilities with the assistance of foreign technology suppliers. The Koreans have also started exporting technical services to other developing countries including setting up and operation of R & D departments.

Referring to the low wage rates and low capital charges in countries such as Korea and Taiwan, there is a possibility that in the near future a large proportion of the crude or semi-finished steel production units will be located in certain developing countries. A similar situation is found in the automobile industry. These factors are creating friction between the developed and developing countries, and are discussed in the next chapter. 1/

1/ *Regarding iron and steel industry see also following UNIDO publications: Importance and possibilities of financing of infrastructure and personnel training in the iron and steel projects, ID/WG.458/2; Integrated development between the iron and steel and capital goods sectors: concrete case studies, ID/WG.458/9; Normative guidelines for the mastering of technology in iron and steel through training, Part 1 and 2, ID/WG.458/1 and Add.1; The world crisis of the iron and steel industry and its impact in the development of this industry in developing countries, ID/WG.458/3.*

3.2. Industrial electronics

In the case of industrial electronics itis mainly the NIC's who are making IC's,digital IC's,linear IC's,microcomputers and peripheral devices, microprocessors, computer numeric control (CNC) systems etc., either on license or through joint ventures, or through wholly owned foreign subsidiaries.

The NIC's and the ASEAN countries are facing difficulties in obtaining up-to-date technology in certain product areas such as industrial robots, computer aided design (CAD/CAM), optical devices (such as optical module) and electronic devices (such as Hybrid IC's and Quartz Crystal units).

One of the main reasons for this is that it is a seller's market in the high-tech area and those firms are not willing to give away their technology, which has often been developed at tremendous cost. Much of this technology can be obtained, but at a very high price. The question which ca be raised is whether this high-technology for the domestic and/or export market is suitable,given the prevailing high prices and tough competition which these developing countries will face from the products of the original equipment manufacturers (OEM) on the world market. This subject is discussed later in detail. Certain countries,such as China,can not easily obtain this kind of leading-edge technology, due to the COCOM and US Department of Commerce restrictions.

Some countries, such as Korea and Singapore, are exporting capital to USA in an effort to gain access to the latest technology there. Samsung Semiconductor set up Tristar Semiconductor in Sunnyvale, California in July 1983, and hired 50 Americans and Korean/Amerian engineers. National Iron and Steel Mills of Singapore have planted US$ 3.5 million in seed money in four new electronics firms in Silicon Valley, and in an American venture capital fund, to learn more about the high-tech business. 1/

1/ See, Economist, op.cit.

The ASEAN countries do manufacture electronic products, but mainly consumer electronics and in many cases with no attention being paid to backward and forward integration of the products being manufactured.

These countries are facing problems in this industry, mainly due to increased robotization in the OECD countries.

Indonesia's microchip industry has practically closed down with the announcement by Fairchild and National Semiconductor of their plans to leave Indonesia before the end of 1986.

According to the suppliers of technology in certain product areas, the savings arising from the development of advanced automation (i.e. factory automation (FA) and office automation (OA) in OECD countries has practically overtaken the economic advantage of low labour costs, particular in China and the ASEAN countries. Due to this reason several foreign investors are hesitating in making investments in this region.

3.3. Heavy Machinery

The major products in this field are power-generating equipment, electric motors, heavy machine tools, metallurgical and mining equipment. All the countries under review,excluding Brunei,are manufacturing more or less these kind of products. Korea and China in particular are emphasizing the development of machinery for the production of capital goods for light and heavy industries. Complete machine building plants, transmission and transformation substations are already being exported by these countries.

The NIC's, in particular Korea and Taiwan, are manufacturing various types of machineries. These include precision machineries such as microprocessor controlled/CNC machines and industrial robots, which are very competitive in both quality and price. These products are exported to both the industrialized and developing countries.[1/]

3.3.1. The experience of China in acquiring the latest diesel engine technology

The Chinese engine manufacturing industry is known to be 20 to 30 years behind the American and European manufacturers. The Chongquing factory for example was producing 1960's vintage French Berliet engines:

a) 6-cylinder, 180 - 250 horse power (HP); and

b) 12-cylinder, approximately 700 HP (turbo-charged).

This technology was acquired in 1965 under a "static" licensing agreement. This type of licensing agreement is quite common, in particular in the developing countries. The licensor supplies the design and manufacturing information once without any further obligation.

1/ For details concerning the machine tool industry in ASEAN countries, see also UNIDO publications:
The machine tool industry in the ASEAN region: options and strategies. Main issues at regional level, UNIDO/IS.634 and Analysis by country, IS.634/Add.1; and
World Non-Electrical Machinery, An Empirical Study of the Machine Tool Industry, ID/290.

The Chinese were aware of their backwardness in this sector. Development of the infrastructure, energy, and natural resources had been given high priority when the Chinese, in late seventies, contacted several major engine manufacturers, namely Mercedes (West-Germany), Caterpillar Tractor Co. (USA), Komatsu (Japan) and Cummins Engine Co. (USA).

Caterpillar and Mercedes pulled out of the negotiations at an early stage as they were not willing to transfer technology without maintaining a controlling interest. Further, Komatsu was problematic to the Chinese as they were manufacturing engines on license from Cummins. Eventually the Chinese decided to continue negotiations with the OEM, i.e. Cummins engine. These proved to be tough and lengthy. Cummins was interesting to the Chinese from another point of view, i.e. beyond that of the quality of their engines. They had previously successfully transferred technology not only to Japan, but also to Mexico, India and Korea.

In 1981, the China National Technical Import Corporation (Techimport) and the China National Automobile Industries Corporation (CNAIC) succeeded in concluding a 10 year licensing agreement with Cummins Engine Co. for the manufacture of two lines of Cummins diesel engines (250 plus HP).

Moreover, in 1984 an agreement for the establishment of a Technical Service Center in Beijing was also signed. In 1985, the Chongqing Engine plant was producing these same engines with a local content of approximately 30 percent. The Chinese envisage in the near future being able to carry out joint design of new lines of engines with Cummins, since a considerable number of Chinese have already been trained both in the US and in China.

In order to get the maximum value from received technology transfers, the Chinese concluded a dynamic licensing agreement. Under this agreement Cummins Engine will keep the Chongqing Engine Plant informed concerning all the changes in and updating of the licensed technology. The developing countries can learn a lot from this Chinese experience with a "dynamic licensing agreement".

Under the licensing agreement China is constrained from exporting engines produced under license. On the other hand there is no restriction on indirect exports, namely on exports of equipment containing the engines built as components in products such as trucks and tractors.

Finally, a common problem faced by China under this agreement which is also common, in particular, in the ASEAN countries, is that some of the technology contained in the Cummins engines is not owned by that company, but by other companies who also own the patent rights. This is primarily a result of the subcontracting system existing in the OECD countries mentioned earlier.

The Chinese have had difficulties understanding why Cummins is unable to provide details concerning such technology. Similar problems were reported by the multinational Swedish company Atlas Copco which manufactures among other things advanced mining equipment (see section 3.7.).

To overcome this problem, both Atlas Copco and Cummins have adopted the strategy of facilitating the licensee contacts with the original suppliers of the parts concerned, so that the licensee can negotiate directly with them concerning production and/or supply of parts.

3.4. Transport equipment

All the countries under review except Brunei are manufacturing a wide range of transport equipment, such as automobiles, trucks, tractors, motor cycles, aircraft and helicopters. In the case of the ASEAN countries, and to some extent the NIC's, major components such as engines and various other parts for vehicles, aircraft and helicopters, are imported in the form of complete knock-down (CKD) or semi knock-down (SKD) kits. In some of the countries only assembling activities are carried out. 1/

The automotive industry in ASEAN countries is in the grip of a deep recession. One of the causes is tough competition in terms of price, quality and durability. In Indonesia four car assemblers ceased operation during 1985. On the other hand Korea's automobile industry is expanding very rapidly, in particular, through sales by two manufacturers, namely, Daewoo Automobiles Co.Ltd. and Hyundai Motor Co. The models "Le Mans" and "Excel" are considered to have excellent quality and durability. The plants have installed robots and other automated manufacturing equipment with the technical collaboration of Japanese, American and the West-European equipment manufacturers. The automobile industry can be also characterized as a maturing industry and a buyer's market. 2/

In China recently a technical collaboration agreement for the manufacture of aircraft with McDonnel Douglas (MD) has been carried out. Initially the production will be based on assembling CKD/SKD kits.

1/ See, Khan, S., op.cit.

2/ See, Time Magazine, The Honda way, New York, Sept. 8, 1986 and Korean Business Review, various issues, Seoul, 1986.

In the automobile sector two foreign manufacturers, namely, the American Motors Corporation (AMC) and Volkswagen (VW) have established joint ventures. AMC is currently manufacturing the 40 year old jeep (CKD units), whereas VW is manufacturing a 10 year old model (Passat) called the "Shanghai car".

Finally, the demand for motorcycles in China like other countries in the review,is tremendous and at present demand exceeds supply. However, the Chinese-made motorcycles are of low quality with high fuel consumption. In order to improve the quality, fuel efficiency and to bring this industry to world standards, the Chinese contacted Honda of Japan with the purpose of their providing technical collaboration in the form of a license or joint venture.

After lengthy negotiations no agreement could be reached, mainly due to the following reasons:

* *modest or lack of profitability for Honda, both in the short and long run;*
* *low consumer market potential in the next 15 - 20 years because of low living standards;*
* *licensing risks, such as the risk of loss of technology and damage to licensor's reputation, due to the licensor having no effective control over the quality of motor-cycles sold by the licensee;*
* *Chinese insistence on very low royalties and licensing fee payments in spite of a dynamically-natured licensing agreement;*
* *Honda's insistence on making minor equity investment while maintaining a controlling interest*
* *Chinese insistence on no or limited constraints on the export of motor-cycles, i.e. Honda worried about competition on the international market between licensor and licensee.*

After Honda's withdrawal, the Chinese purchased a static license from Honda via a Hong Kong firm in 1984 for a period of five years and established an equity joint venture with a Thai-Chinese firm in Shanghai (Shanghai-EK Chor Motor Cycle Co. Ltd.). As can be seen from this example, Honda made a strategic decision to not directly sell a license, nor to establish a joint venture due to risks of losing their technology without earning sufficient profits. They on the other hand minimized their risks by selling a static license via a third party which prohibits the Chinese firm from using Honda's trade mark. At the same time, Honda expects to receive the licensing fee, royalties, and other earnings by selling parts and training programmes both in China and Japan.

3.5. Pharmaceuticals

In the pharmaceutical sector all the countries under review except Brunei are manufacturing most of the basic medicaments such as analgesics, tranquilizers, vaccines, antibiotics and vitamins. Some countries, such as China and Singapore, are even exporting large amounts of pharmaceutical products.

China for instance exports complete pharmaceutical manufacturing plants to developing countries, although the technology is out dated.

The pharmaceutical products in the ASEAN and NIC nations are mostly manufactured under a licensing agreement or via joint ventures with foreign companies or wholly owned subsidiaries of multinational enterprises (MNE's). The value added by local

manufacturing in several of these countries is rather low, which is mainly due to a lack of backward integration, e.g. a minimal use of naturally occurring local ingredients.

In ASEAN countries and China, competitive pharmaceuticals are not being manufactured, mainly due to infrastructural constraints and a lack of qualified personnel.

An example is worth mentioning here. In 1982 a joint venture was established between a consortium of five Swedish pharmaceutical manufacturers (namely, Astra (MNE), Kabi Vitrum, Leo, Ferrosan and Ferring) and a group of Chinese manufactuerers.

The plant of the Sino-Swedish Pharmaceutical Corporation was located at Wuxi, some 120 km from Shanghai at an estimated cost of over SKr 200 million (US$ 30 million). The purpose for establishing this plant was to transfer high technology in manufacturing pharmaceuticals from Sweden to China, however, due to infrastructural and personnel constraints, the plant is not expected to start production before the end of 1987 or some time in 1988.

According to plans, the main construction and installation should have been completed by the end of 1985. Similarly, the running-in, tests and validation should have been completed by early 1986. The suppliers of technology claim that even after the plant has gone into operation, the products will not be competitive on the world market, due to the constraints mentioned above and the lack of understanding of Swedish standards of quality control. The same kind of problems are encountered by the technology suppliers in the other countries under review.

The question which can be asked is: "Knowing all the bottlenecks, why do the Swedes make investments in China ?" The main reason for this Swedish investment appears to be to block competitors from entering the market, due to the policy of import substitution currently prevailing in China, and a long term version of the market potential.

On the other hand, the Chinese expect to obtain and master the latest technology via joint venture. The Chinese are also working side-by-side with the Swedes in order to learn every aspect of technology involved in manufacturing pharmaceuticals according to Swedish standards. The Chinese are confident that after the completion of this plant, they will be able to build similar plants in China and elsewhere without foreign assistance.

Finally, the technology transfer of biotechnology is at present rather limited in this region. Some advancement through foreign technical collaboration has been made by the NIC's, however, it is too early to make any evaluation.

3.6. Absorption, modification and improvement of technology

Concerning absorption, modification and improvement of technology, a recent survey carried out by IDE [1/] covering 74 technological collaborations among the Japanese and several East and South-East Asian countries could be of interest.

1/ See, IDE, op.cit.

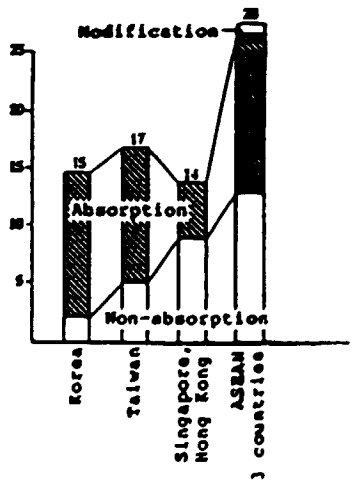
Out of 74 technical collaborations only 7 were in the textile and apparel industries and the rest in chemicals, machines, automobiles, electricals, etc. The nature of the collaboration varied from joint ventures to pure licensing collaborations.

The leading-edge technologies, such as semi-conductors, new materials, and biotechnology were not provided to these countries, due especially to the fear of the boomerang effect.

The transfer of technology is fully successful when it is not only fixed at the recipient firm, but also is able to be maintained or even improved upon and modified with,at most,a minimum of assistance by the supplier.

Figure 3.1. shows the results of the Japanese survey. Korea shows the highest absorption rate, while Taiwan ranked second, followed by Hong Kong, Singapore and three ASEAN countries (Philippines, Thailand and Malaysia). Some of the reasons for the low absorption rates in the countries under review was frequent job-hopping during and after technology transfer and lack of "on-the-job-training" (OJT). This factor also leads to friction among the foreign and local partners in, for example, a joint venture.

Figure 3.1. ***Absorption and Modification of Technology of the countries under review***



Source: IDE, op.cit.

As the results indicate, the absorption rate is, in general, related to the indigenous technological capability of the recipient country. In Korea and Taiwan the indigenous level is considered to be high - more so than in Hong Kong or Singapore, which are higher in turn than that of the ASEAN countries. Moreover, the spin-offs from each technology transfer to various other industrial sectors have been tremendous, in particular, in Korea and Taiwan.

Some of the reasons for the countries under review (especially the ASEAN countries) being slow to improve or modify technology are attributable to:

* *the widening technology gap between the industrialized countries and the developing countries*
* *the currently short live-cycle of the technology*
* *the policy of import substitution i.e. elimination of competition*
* *the lack of applied industrial research, rather than basic research, for applying scientific knowledge to problems identified in practice.*

These countries' need for imported technology is tremendous. However, they have been facing difficulties in obtaining the foreign technology fulfilling the following criteria:

* *that the technology be of the latest proven level*
* *that the price be reasonable*
* *that the technology be suitable to local conditions (i.e. appropriate, adequate, middle-range, or intermediate)*

* that the technology bring the recipent country's products up to a par with those of the supplier country

* that the licensing be dynamic, i.e. that the licensor continously provide to the licensee during the period of agreement information on all improvements made in the technology.

An example (taken from the field study) regarding technology transfer friction concerned the latest technology in television set production, which requires five Integrated Circuits (IC's). The Chinese obtained this technology from a Japanese MNE but by the time the Chinese firm had started production, the suppliers had improved the technology to the point of utilizing only two IC's and later on, only one IC. The Chinese, it seems, had aquired the latest technology without understanding how or why it worked, and where rapid advances were taking place in this industry.

Regarding technology absorption, in particular by ASEAN countries, the technology suppliers found that the countries have been slow in absorbing foreign technology fully. This conclusion is drawn primarily from the fact that, until now, foreign firms have been unable to observe major modifications or improvements to technology exported to most of the countries under review. 1/

Some of the suppliers of technology observed that in ASEAN countries and China the technical level goes down drastically or is not maintained, after the expiry of a contract or technology transfer.

1/ See also, Taddesse, M., The Experience of Japanese Joint Business Ventures in Developing Countries, IDE, January 1986, Tokyo.

Several technology suppliers mentioned that these countries have not been successful in upgrading, nor in downgrading, the imported technology according to the home or export market requirements. This is a good example of a failure in technology absorption, and recipient countries would benefit greatly by thinking about it. Fixation of technology does not always create technological self-sufficiency, rather the reverse.

Finally, major innovations stemming from industrial R & D in the countries under review have been minor. This is mainly because most of the technology can be purchased on the world market with relative ease, leading to savings for the purchaser in the short run.

3.7. Local content requirement

The countries under review, aware of the importance of technology absorption, have made local content provisions in most of the technology import contracts. In most of the contracts the yearly quotas are set up with the aim of replacing imported components with locally manufactured components.

Most of the countries under review have not yet been successful in meeting the minimum quotas set up for locally manufactured components in CKD, licensing, or joint venture agreements. The countries are very uncomfortable and concerned about this slow progress in step-wise technological transfer.

The issue of local content is furthermore crucial since many countries have the same basic regulations on the definition of country of origin of imports assembled from parts imported from a third country and, to penetrate such export markets, the East and South-East Asian countries have needed to have stringent local content provisions in technology import contracts.

Most of the foreign suppliers of technology mentioned that local content requirements, which demand an increasing annual percentage of locally produced components, are over-emphasized and should be relaxed, since the present technologcial level of, in particular the ASEAN countries and China, is such that it is difficult to manufacture high quality and low price products with current machines and equipment. This is in contrast to the latest CNC machines in use in the exporters' parent firms. 1/

Lack of a sub-contracting system in most of the countries under review has been found to be another impediment to the manufacture of high quality local components. The countries are aware of this, and have been requesting the exporters to assist them in developing a sub-contracting system. Since Japan is the major trading partner of and major source of technology for most of the countries under review, these countries have requested Japanese firms to bring their sub-contractors to their respective countries.

It is important to note here that the countries under review, in particular Korea, have found in numerous instances that technology imported from Japan was better suited to the Korean industrial situation than was technology imported from Europe or the USA. The Japanese technology suppliers, due to several failures connected with linking their own sub-contractors with technology transfer, were reluctant to take their sub-contractors with them. They preferred to assist the technology recipients in developing a local sub-contracting system.

In capital and technology intensive industries, in particular in China and the ASEAN countries, there is a lack of sub-contracting systems similar to the ones which in all the industrialized countries are prevalent.

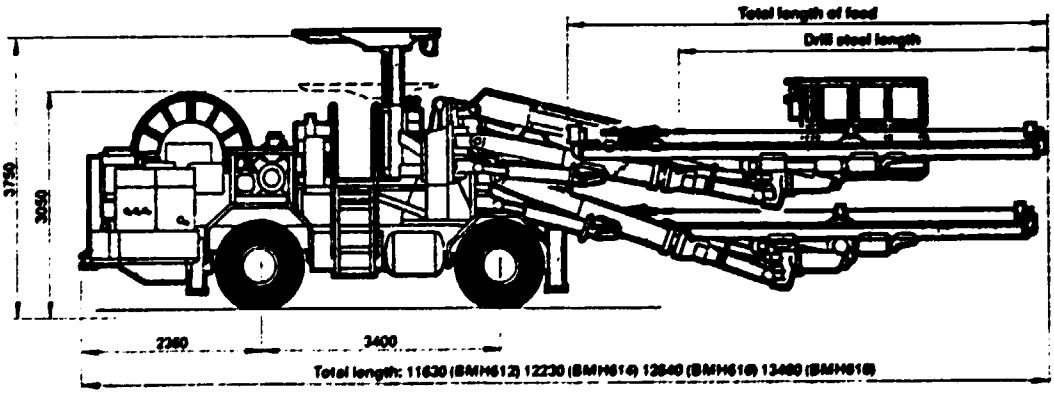
1/ For UNIDO reports dealing with this issue, see, Industrial policy in the developing countries. An analysis of local content regulations, UNIDO/IS.606

In reality it is known that the strength of industrialized countries relies on the existance of many small and medium size companies which represent approximately 80 percent of the total industrial sector. A large proportion of these companies are sub-contractors to large size companies.

An example worth mentioning is the Swedish MNE Atlas Copco which manufactures, among other things, advanced mining equipment. Nearly 60 percent of the drill-rig (boomer), which consists of several hundred sophisticated components, is produced through sub-contracting to small and medium size companies (see Figure 3.2.). The Chinese obtained licenses on this equipment over three years ago but very few components are sub-contracted by the licensee, mainly due to lack of a sub-contracting system in China.

The Chinese are uncomfortable with the fact that after three years, out of a contract period of seven years, less than 30 percent of the equipment components are manufactured in China.

Figure 3.2. Atlas Copco's drill-rig (Model: Boomer H 175), manufactured on license in China



Moreover, the countries under review have faced difficulties in obtaining sufficient technical documents and manuals, especially from the Japanese companies. The technology suppliers have found that the Chinese are extremely anxious to take into their possession technical documents, in many cases out of all proportion to their ability to assimilate the information contained therein.

One of the reasons that the Chinese are so cautious and concerned about the dissemination of documents is their historical experience of technical documentation with the Soviet Union. In 1960, when the Chinese and Russians were in conflict, the Russian experts and advisors left China abruptly and took all documentation with them.

The foreign companies, in particular the Japanese, have had difficulties understanding the detailed manual requirements, since they are not always necessary in Japan. One of the reasons for this is the life-long employment system in Japan.

Most of the countries under review have found that the foreign licensor has been too slow in providing information regarding the licensed products as current as the dynamic nature of the licensing agreement required. On the other hand very few companies have been successful in obtaining a truly dynamic licensing agreement.

3.8. Labour productivity and motivation

Regarding productivity and motivation, the ASEAN countries' and the Chinese workers are generally considered to be poorly motivated, leading to low productivity. This factor is one of the major disadvantages for these countries, who compete for foreign investment with those NIC's whose motovation and productivity is considered to be higher.

In the case of the automobile industry it was reported that the annual vehicle production (ca.) per employee in 1985 for the following four countries was as follows:

* *China ca. 5*
* *USA " 35*
* *Sweden " 50*
* *Japan " 65*

Although,we should note here that China started its campaign of modernization only after 1978 and has been trying since then to steadily shift from labour-intensive sectors to technology and capital-intensive sectors.

The NIC's vehicle production per employee is considered to be closer to that of the USA or Sweden, whereas the Indonesian vehicle production is considered to be closer to that of the Chinese.

3.9. Export performance

Table 3.2. gives the export figures for some of the selected products under study. 1/ A tremendous increase in the export of most of the products under study, during the period 1975 - 1984/85 is found mainly for the NIC's. However, Thailand also shows an increase in its exports of electric power and switch-gear during the same period.

As expected, the NIC's have substantial amounts of exports to both the industrial and developing countries with the following characteristics:

* Pharmaceuticals: (541) mainly exported to developing countries; exceptions being Korea, Singapore and Indonesia, which have substantial exports to the industrialized countries (50-60 %) 2/

* Iron and Steel: (67) mainly exported to developing countries; the exception being Korea which has substantial exports of tubes, pipes and fittings (678) to the USA (70 %)

* Capital goods: (71) mainly exported to industrialized countries, (70 - 94 %) such as the USA and the EEC with the exception of China.

* Transport equipment: (732) mainly exported to industrialized countries (70 - 85 %) with the exception of Singapore, China, Malaysia, and Thailand.

1/ Detailed export figures are available from UNIDO's Statistics and Survey Unit. Some of the other products under study, but not included in Table 3.2., are non-electrical machinery (SITC 711), other specialized machinery (718), Telecommunications (724), electrical machinery (729), and instruments and apparatus (861).

2/ The figures in the brackets give percentage figures for the latest available year.

Table 3.3. Selected export products of the countries under review (in million US$) 4/

	N I C's 2/									A S E A N 3/												C H I N A
	Hong Kong			Korea			Singapore			Indonesia			Malaysia			Philippines			Thailand			
	1975	80	85	1975	80	84	1975	80	85	1975	80	83	1975	80	82	1975	80	83	1975	80	84	84
Pharmaceutical																						
- Medicinal and pharmaceutical products (541)	10	33	38	10	20	32	73	151	134	13	12	14	7	11	15	2	6	7	5	16	18	260
Iron and Steel																						
- Bar, rods, shapes, sections (673)	3	10	12	47	148	382	12	52	11	0.1	0	...	1	1	3	...	0.5	0.1	...	0.2	0.3	...
- Iron and steel wire (677)	0.1	0.3	2	4	37	46	1	3	19 1/	...	...	...	...	0.5	1	...	...	...	...	...	...	...
- Tubes, pipes and fittings (678)	...	0.4	3	60	362	501	54	80	120	0.2	2	0.1	1	9	5	1	2	2	4	49	40	...
Capital goods																						
- Office machines (714)	71	417	1,139 1/	44	88	439	88	160	1,201 1/	0.1	0.1	0.1	12	2	4	0.3	1	1	0.4	3	12	19
- Electric power machinery and switchgear (722)	7	111	449 1/	40	151	263	54	286	842 1/	6	1	...	86	88	55	0.1	1	17	3	306	356	...
Transport equipment																						
- Commercial road vehicles (732 less 7321)	0.4	0.8	2 1/	3	69	98	50	122	130 1/	0.2	4	...	10	5	11	2	30	23	1	11	11	} 80
- Passenger motor cars (7321)	...	...	...	0.1	50	174	31	89	73 1/	0.1	...	...	3	2	2	...	1	0.2	...	...	1	

Source: UNIDO data base: Information supplied by the United Nations Statistical Office

1/ 1983

2/ Detailed data for Taiwan not available

3/ Brunei's exports are nil or negligible

4/ Data and SITC descriptions refer to SITC revision 1;

All the figures are approximate and in current values.

... negligible or not available

Moreover, all the countries under review are net importers, i.e. total imports exceed total exports of the products listed in Table 3.3. with the following exceptions: 1/

* *Pharmaceuticals: Singapore is a net exporter*
* *Iron and steel: Korea is a net exporter of SITC 673, 677 and 678*
* *Capital goods: Hong Kong, Korea and Singapore are net exporters of 714 (office machines, etc.); Singapore is also a net exporter of 722 (electric power machinery and swithgear)*
* *Transport equipment: Korea is the only net exporter of 7321 (passenger motor cars).*

Furthermore, if we look at the origin of imports, we will find that the EEC in the pharmaceuticals (541) is most successful in their export to this region (20 - 45 %). In the case of iron and steel (67) and transport equipment (732) Japan is the major exporter (30 - 90 %), whereas the USA has a substantial share of the market in office machines, etc (714) (30 - 65 %). Finally, the USA, Japan and the EEC have nearly the same market share (with minor exceptions) in electric power machinery and switchgear (722).

1/ *Table 3.3. provides data for some of the selected products for the latest available year. However, if we analyse the data for earlier years, the results are more or less the same, i.e. the countries are in most of the products a net importer.*

Table 3.3. Selected imported products of the countries under review for the latest available year 3/

(in million US$)

	A S C A												A S E A N											
	Hong Kong, 1985				Korea, 1986				Singapore, 1985				Indonesia, 1982				Malaysia, 1982				Philippines, 1981				Thailand, 1981			
	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.	Imp.	% from Ind.C.	MIP	Trade bal.
Pharmaceutical																								
- Medicinal and pharmaceutical products (541)	253	64	20 EEC	-235	119	98	37 EEC	- 87	109	71	40 EEC	- 33	111	91	45 EEC	- 93	83	87	34 EEC	- 68	79	89	38 EEC	- 73	114	85	43 EEC	-1
Iron and Steel																								
- Bar, rods, shapes, sections (673)	412	88	31 Jap.	-400	340	87	76 Jap.	-142	134	93	46 Jap.	-101	99	89	79 Jap.	- 99	324	73	63 Jap.	-331	32	67	50 Jap.	- 33	109	92	77 Jap.	-1
- Iron and steel wire (677)	34	72	51 Jap.	- 22	33	96	91 Jap.	- 15	31[1]	73[1]	44 Jap[1]	- 3	10	74	49 Jap.	- 10	13	58	37 Jap.	- 12	7	58	45 Jap.	- 7	9	76	62 Jap.	-
- Tubes, pipes and fittings (678)	105	66	43 Jap.	-102	335	90	59 Jap.	-176	176	91	68 Jap.	- 58	345	89	56 Jap.	-345	141	93	80 Jap.	-134	45	91	59 Jap.	- 43	43	99	81 Jap.	-
Capital goods																								
- Office machines (714)	600[1]	84[1]	44 US[1]	-238[1]	388	93	48 Jap.	- 51	603[1]	97[1]	65 US[1]	-140[1]	83	89	32 US	- 83	78	83	37 US	- 64	57	66	43 US	- 56	165	57	33 Jap.	-1
- Electric power machinery and switchgear (722)	506[1]	68[1]	37 Jap[1]	-135[1]	644	95	59 Jap.	-301	603[1]	80[1/2]	40 Jap[1/2]	-142[1]	374	95	34 Jap.	-374	268	79	31 Jap.	-213	148	87	33 EEC	-122	147	66	68 US	-
Transport equipment																								
- Commercial road vehicles (732 less 7321)	428[1]	90[1]	83 Jap[1]	-426[1]	196	99	68 Jap.	- 98	315[1]	95[1/2]	60 Jap[1/2]	-195[1]	477	99	88 Jap.	-477	303	87	69 Jap.	-293	160	88	78 Jap.	-137	393	99	90 Jap.	-3
- Passenger motor cars (7321)	128[1]	99[1]	76 Jap[1]	-128[1]	17	99	41 US	-137	177[1]	95[1/2]	70 Jap[1/2]	-130[1]	177	99	69 Jap.	-177	345	100	82 Jap.	-344	61	100	88 Jap.	- 61	114	100	66 Jap.	-1

Source: UNIDO data base: Information supplied by the United Nations Statistical Office

1/ 1984 2/ own estimates 3/ Data and SITC descriptions refer to SITC revision 1;
Data on Taiwan is not collected by UNIDO;
All the figures are approximate and in current values.

Imp. = Imports; Ind.C. = Industrialized countries; MIP = Major importing partner; Trade bal. = Trade balance (exports less imports)

That Japan is a major trading partner and exporter of technology to this region is not surprising, since the products under study require considerable amounts of close interaction between the supplier and recipient of technology. Thus, the short distance between Japan and the East and South-East Asian countries plays an important role, i.e. in short delivery time and low freight cost of parts and equipment, and quicker post-sales service, etc.

We should also not forget the close historical and cultural distance (psychological distance) and the Japanese ability to understand the special requirements of these regions in terms of providing technology more suitable to the recipient needs and requirements.

It is estimated that the share of direct MNE's' exports in the total manufactured exports of the countries under review varies from at least 10 % (e.g. Hong Kong and Korea) to as high as 70 % (Singapore). 1/

Since the products under study are technology intensive, it is expected that MNE's who usually possess technically advanced products or processes play even greater role in exports of these products. 2/

We should note here that the countries under review also have considerable exports of primary products, such as crude oil, textiles, tin, timber, palm-oil, rubber, etc. The imported products are mainly capital goods, and in the case of the NIC's the list also includes raw materials.

1/ See also, Parry, T.G., Technology transfer and international trade opportunities for the developing ESCAP region, Centre for Applied Economic Research, The University of New South Wales, Working Paper, 1986, and IMF, Foreign private investment in developing countries, Occasional paper no.33, Washington, Jan.1985.

2/ See ECE/UNCTC, Industrialization and trade of developing countries: some reflections on the participation of transnational corporations, Geneva, 1983.

Recent studies have shown [1/] that China and the ASEAN countries have a comparative advantage in labour-intensive manufacturing and in natural resource-based manufacturing. As indicated earlier, primary products, less sophisticated capital goods and intermediate products dominate their exports. This means that these countries' advantage is in products which are experiencing declining shares in world trade.

Further, China and ASEAN have the lowest comparative advantage in capital and technology-intensive products with rapidly growing world trade shares.

The NIC's, on the other hand, have succeeded in substituting technology-intensive manufactures for traditional labour-intensive exports, even though they did not enjoy an advantage in the production of natural resource-based manufactures at an earlier stage of their industrialization.

The potential for rapid growth of manufactured exports is to be found primarily in the OECD markets, however, several barriers have to be overcome. These include protectionism, product design improvements, quality, durability, price and the updating of industrial technology. This matter is discussed in detail in the next chapters.

In terms of export performance of the products under study, it is mainly the NIC's which have progressed the most during the period 1975 - 1984/85.

1/ See, Yeats, A., China's recent export performance, development and change, Volume 15, no.1, 1984, and

UNIDO's, International Comparative Advantage in Manufacturing. Changing Profiles of Resources and Trade, ID/334.

Finally, the inter-firm trade and dependence on MNE's or foreign suppliers of technology leads to frictions with the recipients of technology. However, it varies from country to country, depending on the media used for technology transfer. At one extreme are the countries which are heavily dependent on technology inflows via foreign direct investment (FDI), such as Singapore, and at the other extreme are countries such as Korea and China, where the reliance is greater on importing technology via licensing arrangements. The trade frictions are discussed in detail in the next chapter.

4. *Trade frictions among the technology suppliers and recipients*

4.1. *Boomerang effect*

All of the countries under review are of the opinion that the industrialized countries are cautious about technology transfer for fear of the boomerang effect, i.e. the technology sold to developing countries could come back in the same or an improved form to create severe competition in the home or export market of the technology suppliers.

Some of the areas where the boomerang effect has taken place are textiles, shipbuilding, and iron and steel technology transfers from Japan, among others, to such countries as Korea. This phenomena has not gone unnoticed by other industries in the industrialized countries. They are now less anxious to transfer technology to this region. For example, Japan did not take part in the earlier stages of the bidding for the Kwangyang Integrated Iron and Steel Plant, mainly due to a fear of the boomerang effect.

The USA and Japan, among others, protested strongly to Korea when the plans for the Kwangyang plant were disclosed. The accusations by the industrialized countries that the countries under review are dumping, giving high subsidies, or using other unfair competitive practices which are restricted under the GATT regulations have not been substantiated. More than that, the charge is an exaggeration, as can be seen in Tables 3.2. and 3.3. which show that, despite the high exports of the manufactured products under study, practically all the countries in this review are net importers of both these products and/or technologies.

Therefore, the accusations are groundless. In reality, the transfer of technology has intensified competition, and increased trade and efficiency. Moreover, it has increased the living standards and welfare of these nations, in particular the NIC's.

The technology which has been transferred to this region until now has beyond doubt increased the indigenous technological capabilities, in particular where this concerns the NIC's. This is clearly evidenced by the mounting exports of manufactured goods to both the developing and industrialized countries during the period 1975 - 1985 (see Table 3.2.).

However, the countries under review have mostly established a comparative advantage in products employing labour intensive technology in the traditional and maturing industries, not in products of capital intensive technology or high-tech, with a few exceptions, including:

* *Iron and steel products, especially some varieties of special steel (mainly by Korea for export to the USA);*
* *Automobile export by Korea, mainly to the USA and Canada and competing at the lower end of the price segment with imported automobiles from, for instance, Japan;*
* *Exports of industrial electronic products. Most of the exports are inter-firm, i.e. subsidiaries or joint venture exports to their headquarters; or third countries;*
* *Exports of various types of machine tools.*

It is also important to know that most of the trade activities in the products under study are heavily dependent on inter-firm trade requirements of MNE's. This itself present problems for the countries under study, due to their expectations associated with technology transfer being not always the same as the MNE's.

The technology suppliers reported that, for China and the ASEAN countries, the boomerang effect is over-emphasised, since the Chinese and ASEAN markets are so big and their productivity is so low, with a lack of absorption, modification and improvement of technology. Moreover, the export price of their manufactured products is non-competitive. This is combined with a poor level of local-component quality and a lack of distribution and servicing channels to the export markets.

Several of these countries are also considered to be politically and economically unstable, with huge trade deficits, frequent devaluations, and facing tremendous marketing problems.

Some technology suppliers mentioned that China, within the context of South-South cooperation, is already providing technology to developing countries and that the on-going campaign of moderization and the hard working nature of the Chinese will, in the next ten years, bring China to the same level as the NIC's. 1/

Already in certain sectors such as aerospace, satellites and military hard-ware China is ahead of the NIC's. The ASEAN countries in the manufacturing sector are generally considered to be lagging behind the NIC's and China.

1/ *One of the technology suppliers mentioned that a survey carried out in the Silicon Valley in the USA indicated that at least 25 % of the computer specialists involved in the development of computer soft-ware were originally from mainland China. Moreover, these companies' experience in South-East Asia has confirmed that a substantial number of Chinese are working in this field there also. The Chinese may soon prove to be tough competitors in the high technology market. A computer soft-ware development centre has been opened in China and already, after two years, the results are very positive. Therefore, China is expected to be at par in this field with the NIC's far earlier than the year 2000.*

Another important factor to be taken into consideration when dealing in the international market for technology is that there is not a cartel among the technology suppliers. Similar technologies are available with competing firms in various industrialized countries who are willing to provide technology at a reasonable price. Some of these firms are willing to provide favourable supplier credits, with low or heavily subsidized interest rates. This is mainly due to employment and recession considerations in their home markets.

If a certain supplier of technology is reluctant to transfer technology, the developing countries can always look to another holder for similar technology, e.g. Korea's acquisition of high technology in iron and steel and automobiles. However, most of the developing countries are unaware of this situation or are unable to use this as a lever for acquiring technology through negotiations and contracting.

A monopoly of technology by suppliers of technology only exists in high-tech. Even here, developing countries have certain options: e.g. hiring independent consultants or qualified fellow-ethnics. 1/ This subject is discussed in more detail in Chapter 5.

1/ e.g.:
- the head of the computer division of Korea's Hyundai Electronics worked for 16 years at IBM's headquarters in the USA and
- the former vice-president of the West-German aircraft makers Messerschmitt-Bölkow-Blohm, Mr. Buchruddin Habibie, is now Indonesia's Minister for Technology.

Another factor to be noted is that it is rarely the suppliers of machinery and plant technology who feels the boomerang effect, but other manufacturers employing similar machinery and plant in the technology supplier's home country or third countries. However, if this supplier is prevented from exporting machinery due to governmental measures, then his competitors in other parts of the world will do so.

As mentioned earlier, practically all the countries under review are net importers of the products under study. The reasons are that in the traditional and maturing industries the industrialized countries are still net exporters. For example:

* *Textile industry in most of the industrialized countries is at present heavily automatized and robotized, and the industrialized countries are the major exporter of technology in this area.*

* *The shipping industry provides a similar example in that most of the engines and electronic gadgets are still manufactured in the industrialized countries e.g. Korea is heavily dependent on the import of engines and electronics used in ship-building from Japan.*

* *The automobile, aircraft, and helicopter industries show a similar picture.*

However, the restrictive rules and regulations regarding certain types of technology transfer to China, among other, by the US Department of Commerce and COCOM are enforced mainly due to this fear of the boomerang effect, according to some of the technology recipients.

Finally, the boomerang effect is most feared by those firms who are negligent in their R & D efforts, slow in developing new products, and who are not keeping pace with advances in their sector.

4.2. Criticism raised by the technology recipients in the countries under review

The technology recipients found that bundled packages containing technology, management, training, capital, etc. made it difficult to determine charges for individual items. Most probably this kind of package has included some hidden charges.

Some of the criticism raised by the technology recipients was as follows:

* foreign companies are not doing their utmost to transfer the technology concerned;
* costs of plant and equipment, parts and other inputs are often excessive;
* obtaining detailed manufacturing manuals is sometimes difficult, in particular from Japanese companies;
* technology exports are restricted, e.g. restrictions by the US Department of Commerce and COCOM.

According to the technology recipients, some technology suppliers are making unfair proposals, e.g. for a very low equity while demanding total management control of the joint venture.

The technology recipients were uncomfortable with the restrictions imposed on their activities related to, in particular, licensing agreements, e.g.:

* export restrictions to the areas which the licensee could export;
* limits on sales in the home market of the licensee;

* *tied purchase requirements from licensor;*

* *price fixing;*

* *discouragement of local R & D or local diffusion of technology;*

* *free access of any improvements made by the licensee, i.e. royalty-free access to improvements made by the licensee, etc. and at the same time denying access to information about the technology and about improvements or new developments made abroad.*

Furthermore, in several instances the technology suppliers were requiring the technology recipients to pay or undertake obligations for patents which were unused or no longer effective. To prevent and uncover such violations, the developing countries must develop their own technological data base, with assistance from bilateral and/or trilateral organizations. This subject is discussed in detail in Chapter 5.

It has been observed that, due to differences regarding the objectives and expectations of technology suppliers and technology recipients, trade frictions have resulted (see Chapter 2). Some of the misunderstandings are considered to be largely due to a lack of knowledge of social and cultural characteristics of the countries under review and the short-sightedness of some of the technology suppliers.

4.3. Criticism raised by the technology suppliers

The technology suppliers mentioned numerous problems encountered by them in the countries under review. The following are some of the main criticisms voiced by the suppliers, mainly in China and the ASEAN countries:

* *Lack of infrastructure*
* *Lack of raw material, and poor quality of local components*
* *Low productivity and motivation of the workforce*
* *Lack of proper legal and commercial codification (mainly in China)*
* *High political risks*
* *Lengthy negotiations prior to reaching agreement and lack of well qualified negotiators*
* *Unfair demand for exports in order to obtain foreign exchange (mainly in China)*
* *Excessive taxation on technology transfer earnings*
* *High cost of stationing an expatriate (with annual expenses running to over US$ 200,000 for one expatriate in China)*
* *Difficult realization of short-term profits*
* *Difficulties for technology recipients in understanding that a licensor does not possess patents to all the components in a product*
* *Difficulties in providing up-to-date technology by world standard and at the same time suited to local environment*
* *Lack of sub-contracting system*
* *Cumbersome bureaucracy*
* *High amount of corruption at local level (bribes and flourishing black market)*

As can be seen, most of the suppliers of technology are rather critical of the general economic and political climate, mainly in China and the ASEAN countries. Similar criticism is also voiced by technology suppliers in other developing countries. On the other hand, technology recipients find that technology transfer is playing a critical role for their industrialization.

5. Policy issues for effective technology transfer

All the countries under review have emphasized technological self-sufficiency. However, some of the countries are on their way to achieving this self-sufficiency in the products under study, whereas others are facing problems in terms of price, quality and productivity. The countries in this survey are trying hard to combine foreign and local technological elements in order to reach their goals, which include not only technological self-sufficiency but also reducing their dependence on:

* their narrow home markets,
* exports of primary products,
* exports of labour intensive traditional manufactured products, as these are all experiencing declining shares of the world trade.

The NIC's, which to a large extent lack raw materials, have provided the most successful example of countries exporting capital intensive manufactured products under study - with rapidly growing world trade shares - by following a dual strategy, i.e. giving equal priority to import substitution and to export industries.

The NIC's, in particular, have acquired the production and investment capabilities, however, the stage of major innovations has not been achieved. One of the causes for this could be the MNE's inter-firm trade in the products under study, i.e. MNE's high exports from this region to their mother company, which leads to major industrial R & D being carried out in their countries of origin. However, minor innovations by the countries under review are also important since their cumulative impact can lead to benefits in quality and productivity.

It has also been observed that the countries, in their drive to acquire high technology, have most probably not fully evaluated the costs and benefits of different choices of technology, including the spin-offs from each technology transfer to various other industrial sectors. This is more clearly apparent when observing the lack of:

* *sub-contracting system and*
* *small and medium size firms.*

This comment holds true even for the NIC's. For instance Korea has heavily emphasized the development of large size manufacturing enterprises, whereas Taiwan has over-emphasized the small size firms and to some extent the large size firms, by neglecting the medium size firms. In the last chapter mention was made of the fact that the success of the industrialized countries depends largely on the existance of sub-contracting systems and small and medium size firms.

There are advantages and disadvantages that are associated with all technology transfer, whether the transfer is through licensing, joint venture, wholly owned subsidiaries, turn-key project or purchasing the various technological elements separately. It is important that the countries under review have the negotiation capabilities to acquire the right technology at a fair price and that they can absorb, adopt, modify and improve upon it, i.e. that they should know how to get the most from each type of technology transfer. The managerial and organizational aspect have to be also improved with the removal of bottlenecks in such areas as energy, skilled labour, transport, capital, supply of raw material and intermediate inputs.

5.1. Suggestions to technology recipients

Some of the suggestions for the technology recipients indicated in this report are:

* *More effort be made to absorb, modify and improve foreign technology so that it suits the local and/or export market.*

* *Establish industrial research centres and acquire R & D by formal and informal means. Another possibility is to hire or buy an engineering firm in an industrialized country to do some industrial R & D in order to complement their local R & D capabilities e.g. as Korea and Singapore have done.*

* *Obtain technology not only from MNE's but also through the use of outside or independent engineering consultants. These consultants can act as middlemen in the technology search and transfer process.*

* *Improve training by building shadow project groups, i.e. by working side by side and taking part in all aspects of a project, with technology suppliers (home and abroad), including OJT.*

* *More emphasis be placed on acquiring capabilities in project management, project engineering, project execution and procurement.*

* *Attention be paid to imitation or reverse engineering, which would also be useful in producing machines locally, in particular, by copying unpatented equipment and processes, or by studying patents and then doing R & D with the aim of inventing peripheral patentable technology around them.* 1/

1/ *This is one of the reasons why many firms do not register patents. It is sometimes difficult to copy unpatented technology since this requires special types of machines, know-how, etc. The product composition is rather easy to find out, but it is extremely difficult and costly to produce or manufacture such a product without technical collaboration with the supplier.*

* *An informal mechanism for obtaining technology is to "poach" or hire skilled or qualified personnel from abroad, including fellow ethnics.*

* *Much needs to be done in improving the quality and productivity of the workforce, which after all is the greatest asset these countries have. Low wages still constitute a great attraction to foreign investment including joint ventures. But low labour cost must be accompanied by incentives, work discipline, and team work, as well as "bottom-up" management that encourages innovation by the workers in increasing productivity and product quality.*

* *Dynamic licensing agreements and joint industrial R & D has to continually sought, so that the recipients can keep abreast of technological development in other parts of the world.*

* *Increase equipment maintenance including quality circles (QC) and total quality control (TQC) similar to those practiced in Japan.* 1/

* *Set up a close and extended exchange of information and co-operation with engineering firms, intermediate and capital goods producers, research institutes, etc.*

* *More importance should be given to applied industrial research than to basic research, as is done at present.*

1/ *See also, Abegglen, J.C. & Stalk, G., Kaisha - The Japanese Corporation, Basic Books, Inc., New York, 1985.*

5.2. Assistance from the technology suppliers

It appears that several technology suppliers have distorted the picture of what the process of undertaking a joint venture, licensing agreement or other technologcial collaboration in this region entails. The companies which are facing problems in this region are doing so as a result of their primary concentration on short term profits to their mother company.

An important reason given by technology suppliers for not sharing technology with the countries under review is the fear of a boomerang effect. This fear, as mentioned in the previous chapter, is exaggerated. The boomerang effect forces industrial adjustment and it takes place in some sectors due to an increasing number of technology suppliers.

The technology suppliers should seriously consider providing a broad range of technology and actively taking part in joint research and development with the companies in the region for long term mutual benefit.

5.2.1. Assistance in developing the small and medium size firms' sub-contracting capabilities

The suppliers of technology should assist the technology recipients in upgrading the quality of the locally produced parts and components. One way to do this would be to bring their sub-contractors to this region, as the Japanese have done in some of the NIC's, ASEAN and OECD countries. In order to facilitate this type of interaction, the technology suppliers have to be sincerely committed to the upgrading of local technology.

However, this assistance is not as simple as it might sound. Most of the sub-contractors in the industrialized countries are of small or medium size and specialise in manufacturing a narrow range of components. 1/ *Most of these companies lack exporting capabilities and/or human and financial resources to undertake export ventures. Thus, they require a considerable amount of assistance from the technology supplier or from their own government.*

Several of the Japanese technology suppliers mentioned failures of their sub-contractors in the region under review. The failures were mainly due to a lack of exporting experience and human and financial resources, as mentioned above.

There is, therefore, an urgent need for the countries under review to promote and develop the sub-contracting capabilities of small and medium size companies. China is known to be far behind in this area, since most of the companies developing similar products through intensive industrial R & D expenditures do not share this know-how with one other.

1/ *An example is to be found in the automobile industry where a few very large scale firms produce key parts and undertake assembly, while numerous often medium and small size firms, produce components and provide specialized services.*

5.3. Co-operation among the East and South-East Asian developing countries

The technological capabilities of the countries under review can be improved in a number of ways. First of all, improvement could be achieved through co-operation among the countries themselves. The NIC's' policies and strategies in acquiring foreign technology and investment are worth studying for China and the ASEAN countries.

Withing this context, Hong Kong is already providing a tremendous amount of technology to China and the ASEAN countries. The Singaporeans are also assisting the Chinese in formulating their policies and strategies to attract foreign investment. The Koreans have recently assisted the Thais in establishing a colour television picture tube plant.

However, inter-regional assistance has not been seen as sufficient, and the NIC's have acquired and are acquiring technology for the products under review from the industrialized countries.

Therefore, first and foremost, the countries under review have to initiate and improve their indigenous industrial R & D capabilities and obtain the necessary technology with assistance from the industrially advanced nations.

If the countries under review are successful in maintaining political stability, a rational economic policy and sustained economic growth, then the whole of East and South-East Asia will progress and become a market of great opportunity and potential. This in turn will facilitate the South-South and North-South co-operation in, among others, technology-intensive manufactured products.

5.4. The role of governments, bilateral and trilateral organizations in facilitating technology transfer

5.4.1. The role of the government

The governments of the respective countries should identify which industries to upgrade, and to assist local industrialists in finding new local and/or foreign technology through technical collaboration, as discussed earlier. In this respect the assistance of bilateral and trilateral organizations should be sought for acquiring technology, training, and the development of the small scale sector and subcontracting system. 1/

With severe competition on the world market, the countries whose aim is to increase their comparative advantage in technology-intensive products have to do the following:

* Production meant for the home market can be met by developing indigenous technology or purchasing adequate or middle range technology suitable to local conditions from foreign suppliers.

* Production meant for the export market has to be met through the best latest technology which has been successfully proven. The costs of aquiring this kind of technology are tremendous. However, the advantages, including spin-off effects, outweigh the costs.

1/ See also, UNIDO publications: Promoting small-scale industry in South-East Asia: selected support schemes in the Philippines, Thailand and Malaysia, UNIDO/IS.618, and Policies and strategies for small-scale industry development in Asia and the Pacific region, UNIDO/IS.617.

* *Moreover, most of the products under study, such as industrial electronics and medicines require high precision tools, robots,[1] a dust free or surgical theatre-like environment, in order to obtain perfect product quality. This is practically impossible to do with only skilled labour and labour-intensive technology. In this field these countries have no choice but to follow the leading manufacturers. Here the competition is extremely tough, mainly due to price, quality, and the limited number of manufacturers possessing such technologies.*

* *The requirements for local production of components need to be relaxed in the short run in order to attract foreign investors. In the long run, the local production of components should be stricter, i.e. that 90 percent or more local production of components be required within five years or less.*

* *The conditions for foreign investment should be improved (see Chapter 2).*

* *An attempt ought to be made to reduce taxes on technology transfers.*

* *Present regulations for the transfer of technology need to be simplified and the length of time now devoted to negotiations before decisions are made and contracts signed should be drastically shortened.*

1/ *Several suppliers mentioned that their intention of introducing robots is to increase quality and efficiency - not just to reduce labour cost.*

* *Foreign technology suppliers should be prevented from abusing their monopoly power e.g. through control of the price and terms of technology transfer.* 1/

* *Duplication needs to be reduced e.g. in industrial R & D.*

* *Transfer pricing used by foreign investors has to be carefully monitored (e.g. in joint ventures and wholly-owned foreign subsidiaries).*

* *More use needs to be made of bilateral and trilateral organizations as middlemen in technology searches, bargaining, transfer process, industrial R & D, and OJT.* 2/

In order to facilitate technology transfers there should be incentives as mentioned in Chapter 2. However, the local manufacturers should face pressure of international competition in order to induce economic and technical efficiency.

There is and urgent need to develop the sub-contracting system, and the training of small-scale entrepreneurs should be intensified. This is a prerequisite for developing indigenous technological capabilities in the capital-intensive manufactured products.

Most of the suppliers of technology from countries such as Sweden, the USA, Japan, and Austria mentioned that they are willing to supply technology, however the recipient countries in this region have to realize that technology is not free, i.e. it must be paid for. This can be done not only in financial terms, but also through opening their domestic markets to foreign sellers.

1/ *Sometimes, tied inputs are required by technology suppliers to ensure quality control, or royalty payments may be higher than normal to cover the particular costs of development of technology, or exports are restricted due to competition considerations.*

2/ *e.g. Korea Technology Development Corp., Korea Institute of Electronic Technology was established with the co-operation of the World Bank to promote industrial R & D.*

The policy of attracting foreign investment through cheap labour for (mainly) export activities will, in the next five to ten years, decline substantially. In most of the industrial sectors in the developed countries automation and robotization utilizing little labour is reducing the attractiveness of establishing in this region.

According to several technology suppliers, the only way for this region to obtain technology is to open their domestic markets: this holds in particular for China.

In the high-tech area (optics, robots, electronics, biotechnology, and new materials) most of the technology suppliers are hesitant to supply technology. The two important reasons for this hesitation are:

* *tremendous costs in developing this technology*
* *competition considerations.*

However, some of the suppliers mentioned that they were willing to share some part of this technology provided, as mentioned above, they are well paid for it. However, some of the countries lack the capability to absorb such high technology, therefore step-wise technological transfer is considered to be more appropriate.

The pressure by some governments on technology suppliers to reveal their high-tech know-how to potential rivals is bound to fail, since most of these technology suppliers are private companies and are not obliged to divulge proprietary information.

In mature industries, it is a buyer's market for technology since the technology suppliers are numerous. The developing countries are in a position to drive a hard bargain with "would be" suppliers of technology. These countries should not be seeking a bargain basement price however, but should concentrate on the actual transfer of technology. This is particularly necessary if a country has plans to build similar plants in the near future, which it hopes to be able to do with relatively littly involvement of foreign companies. 1/

The working relationship between the purchaser and the chosen contractor will have to be very close. In order to be successful in obtaining the maximum benefit out of the technology transfer, the bids have to stipulate that the designing of a plant should be done jointly (i.e. through a shadow project management group), although the responsibility for design flows, etc. should rest with the contractors alone. This may sound tough, however, NIC's such as Korea have succeeded in their demands for fulfillment of these conditions.

Outside assistance, where required, can be obtained in technology searches, subsequent negotiations and evaluations via bilateral and trilateral organizations and not only from the independent consulting engineering firms involved as middlemen in the technology market.

1/ *E.g. in projects such as iron and steel, engineering and contracting costs amount to 15 - 20 percent of the total costs of the project, mainly in the foreign exchange component. Developing a local capability here will lead to tremendous savings overall.*

5.4.2. The role of the bilateral and trilateral organizations

The bilateral and trilateral organizations can assist the developing countries in all aspects of technology transfer. Most of these aspects have already been mentioned in detail in the previous sections.

One more area where there is an urgent need for improvement is in the negotiation and contracting capabilities of the technology recipients, which have been rather weak. The suppliers of technology are usually reluctant to provide information on such aspects as the type of technology transferred to other countries, the size of royalties and the initial fee obtained and other provisions in the contracts they have made. This information, if available, would enhance the negotiation and contracting capabilities of the countries under review. This is especially true since the market in most of the industrial sectors is a buyer's one.

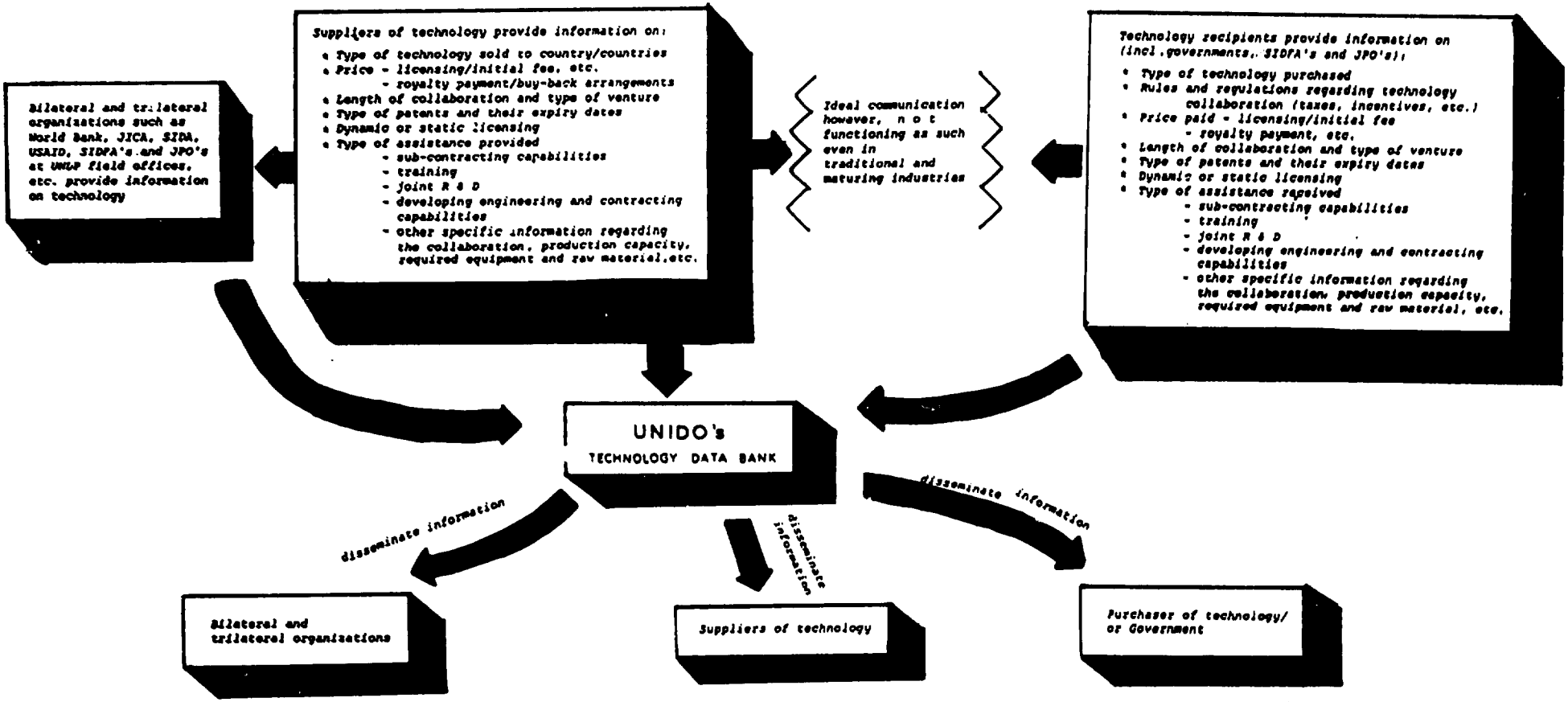
One possible solution could be to establish an international technological data base under the auspices of an international organization such as UNIDO, which would be able to receive information regarding technology transfers from various sources and could disseminate this information to its members. 1/

1/ *At present, assistance is provided by UNIDO to developing countries in, among other areas, negotiation and contracting. A "Technological Information Exchange System (TIES) Newsletter" is also published sporadically. The Statistics and Survey Unit supplies, among other things, statistical data on production, import and export of commodities, etc. See also UNDIO publications: The Industrial and Technological Information Bank's (INTIB) future work. The need for an international industrial information programme, ID/WG.450/14 and International technological information exchange mechanism technologies from developing countries: India, Yugoslavia, IPCT,4. 1986.*

Figure 5.1. provides one of the methods for establishing an international data bank to enhance the negotiation and contracting capabilities of the countries under review. The suppliers of technology are rather sceptical of establishing such a data bank, due to their theoretical adherence to the free market concept.

However, since the buyers don't have the means to obtain such information and are in a much weaker negotiating position than the developed countries, it is worth investigating the possibilities of establishing some sort of technological data bank in which suppliers of technology from the industrialized countries are also included.

Figure 5.1. International technology data bank to enhance negotiation capabilities of the East and South-East Asian Developing countries



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