Technology Transfer from Japan to Indonesia*

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1. Introduction

Although since the early 1890's the Dutch colonial government had already started a modest program of import-substituting industrialization as one of the ways to overcome the adverse impact of the Great Depression on the Indonesian economy, the development of a modern manufacturing sector in Indonesia only started in earnest from the late 1960's after the New Order Government under President Soeharto was able to achieve political stability after a tumultuous decade-and-a-half of political upheaval. To a large extent the rapid progress in industrial development which Indonesia has been able to achieve during the past two-and-a-half decades has been the outcome of a vast increase in new investment by both domestic as well as foreign investors that was spurred by the substantial improvement in the investment climate created by the New Order Government, and reflected by the promulgation of Foreign Investment Law in 1967 and a Domestic Investment Law in 1968. Both these laws offered new investors a host of incentives, including fiscal incentives and the right to transfer profit overseas.

Over the period since Indonesia opened its doors to foreign direct investment (FDI), Japan has, together with the United States, emerged as one of the two major source countries of FDI in Indonesia and, in fact, has become the major investing country in the manufacturing sector. As FDI constitutes the transfer of a package of capital, technology, managerial and organizational skill, and access to foreign markets from the source to the host country, Japanese FDI in

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Indonesia has also involved the transfer of industrial technology from Japan to Indonesia. Since Japanese companies are, as noted above, by far the major foreign investors in Indonesia's manufacturing sector, they therefore constitute also a major foreign source of industrial technology to Indonesia.

In addition to FDI, foreign industrial technology can also be acquired by Indonesian manufacturers through technical licensing agreements with foreign manufacturing companies. Through this unpackaged channel, Japanese industrial technology has over the years also been transferred to Indonesia.

Another source through which foreign industrial technology can be transferred from a developed to a developing country is through the foreign aid programs of these developed countries, specifically through the technical assistance programs. As Japan has, since the beginning of the New Order Government always been one of the major source countries of foreign aid to Indonesia and, in fact, over the past few years has emerged as by far the most important donor country, a significant part of Japanese industrial technology has also been transferred through Japan's technical assistance program to Indonesia.

Though Japan has been and will still remain a major source of industrial technology to Indonesia for many more years to come, no major study has yet been carried out on this important aspect of Indonesia's industrial development. This paper does not pretend to provide a comprehensive picture of the transfer of industrial technology from Japan to Indonesia. At most it will describe the various aspects of technology transfer from Japan to Indonesia and, wherever possible, will try to assess the relative significance of the various channels through which industrial technology has been transferred from Japan to Indonesia. More important, the issue will be to address the extent to which the transfer of Japanese technology to Indonesia has led to the acquisition of local industrial technological capability. Before doing so, however, we will first briefly discuss the role which Japan's foreign aid and foreign direct investment have played in Indonesia's industrial development. Subsequently, the various public and private channels will be described through which Japanese industrial technology has been transferred to Indonesia. The paper will conclude with a tentative assessment of the relative significance of this transfer of industrial technology from Japan to Indonesia.

2. Channels of International Technology Transfer

There are various ways in which international technology transfer can take place. In the *private* sector technology transfer can take place between firms through foreign direct investment (FDI) or through technical licensing agreements

independent of equity investments. In the latter case the firm selling the technology (licensor) provides the firm purchasing the technology (the licensee) with a license to use the former's production technology and produce its products under the former's brand name. A technical licensing agreement can also involve the provision of technical assistance in a less formal way by overseas suppliers of equipment, raw materials, and finance. A similar technology transfer can can also take place between *public sector* enterprises (Hill & Johns 1983: 61-62).

Technology can also be transferred through the technical assistance programs of donor countries in the form of manpower training programs and other spin-offs. Similarly technology transfer can also take place through the technical assistance programs of international or multilateral aid agencies, such as the various specialized agencies of the United Nations (UNDP, UNIDO, etc.) and the World Bank. Another interesting case of international technology transfer has been the unique historical experience of Japan where copying, through the imports and disassembly of machinery and equipment, was also one of the important ways in which Japan was able to acquire new industrial technology (Hill & Johns 1983: 62).

In considering the case of transfer of technology from Japan to Indonesia the most relevant cases of this transfer has been those of Japanese direct investment in Indonesia, technical licensing agreements between Japanese and Indonesian firms, and technical assistance programs provided by the Japanese government to Indonesia. Before discussing these various ways of technology transfer, however, it is important to bear in mind that there are several levels of industrial technological capability. This distinction is important in order to assess to what extent international technology transfer has contributed to the development of local technological capabilities. For our purposes we will use the following types or levels of capability as used by two Thai economists in their study on the technological capability of a number of Thai manufacturing industries (Kritayakirana & Srichandr 1989: 6).

1. *Operative capability*, which includes the ability for efficient operation and control of machinery and other equipment as well as their maintenance, skill development through training, general management, production planning, and quality control;
2. *Acquisitive capability* refers to a manufacturing firm's ability to search, assess, negotiate, and procure relevant technologies as well as transfer operational know-how and install and start up plants;
3. *Adaptive capability* is the ability to acquire knowledge, digest technology, and conduct minor product and process modifications;

4. *Innovative capability* is the ability of a firm to carry out in-house research and development, make major or radical product and process modifications, and invent new products and/or processes.

In general, the above four levels of technological capability indicate the various steps in the order in which technological capability can be achieved by a manufacturing company. Hence, in the course of developing its technological capability, the relatively easiest level of capability to master is usually the operative capability followed by the acquisitive and adaptive capability. Not many firms, particularly in developing countries, are able to achieve innovative capability, which can only be achieved with a determined technological effort.

3. Japanese Investment in Indonesian Manufacturing

In terms of equity investments, foreign companies in general play a relatively modest role in Indonesian manufacturing. Excluding the very large oil and gas processing operations, foreign firms as a group accounted for only 16.7% of total manufacturing value added in 198 5, and for an even smaller 12.4% if these oil and gas processing facilities are included (Hill 1992: 232). This relatively low significance of foreign firms can be attributed to the large importance of staged enterprises (SOEs) in Indonesia's manufacturing sector and the highly regulatory investment regime which has governed investment activities for much of the High Order era, except for the short period after the enactment of the Foreign Investment Law in 1967 and the period since 1986 when the Indonesian government again began to relax its restrictive policies towards foreign investment.

While American companies are dominant in the oil sector, Japanese companies are by far the most important investors in the non-oil sector, particularly in the (non-oil) manufacturing sector. The data in Table 1 show that in terms of *realized* investment Japanese companies as a group are indeed by far the dominant investors in Indonesia's manufacturing sector, accounting for almost 60% of total realized foreign investment in this sector. As a group, the second largest group of foreign investors in this sector are the European countries (13%), the Asian NICs (7.5%), and the U. S. (4%).

The data in Table 1 also show that Japanese investors are the dominant investors in several industries, namely the basic metals industry (85%), the textile industry (61%), and the metal goods industry (61%). Moreover, Japanese investment is also significant in the non-metallic minerals industry (48%) and the food industry (33%). The only industry in which Japanese investment is negligible is the paper and paper products industry (4%).

Table 1.
Japanese cumulative realised investment, in Indonesian manufacturing, 1967-31 March 1991 [1]
(millions of US$)

Industry	Japan	East Asian NICs [2]	USA	Europe [3]	Australia	Others [4]	Total
1. Food	70.0 (33.1)	51.9	8.0	68.2	5.8	7.9	211.8 (100.0)
2. Textiles & textile products	399.0 (61.1)	94.4	.4	15.4	–	143.3	652.5 (100.0)
3. Wood and wood products	12.9 (20.4)	47.6	.9	1.8	–	–	63.2 (100.0)
4. Paper & paper product	3.3 (4.2)	37.0	1.9	26.8	–	10.3	79.3 (100.0)
5. Chemicals	110.6 (16.0)	76.2	108.8	135.0	16.2	246.1	692.9 (100.0)
6. Non-metallic minerals	238.5 (47.5)	2.8	16.4	8.6	3.3	232.7	501.7 (100.0)
7. Basic metals	1,551.9 (84.7)	4.0	–	255.3	4.8	17.2	1,833.2 (100.0)
8. Metal goods	246.2 (60.7)	15.9	39.6	71.4	1.2	31.2	405.5 (100.0)
9. Other manufacturing	1.8 (19.4)	3.1	–	3.4	–	.9	9.3 (100.0)
Total	2,634.2 (59.2)	332.9 (7.5)	176.0 (4.0)	585.4 (13.2)	31.3 (0.7)	689.5 (15.5)	4,449.4 (100.0)

Notes : General note: Figures between brackets denote percentage.

1. Realised investment includes realised equity investment and foreign loans.
2. East Asian NICs include Korea, Taiwan, Hon g Kong and Singapore.
3. Europe includes the EC (European Community) and non-EC countries.
4. Others includes all other countries and investments by more than one country (combined countries).

Source : Bank Indonesia : *Penanaman Modal Asing dari Tahun 1967 s/d 31 Maret 1991* [Foreign Investment from 1967 through 31 March 1991] (Jakarta 1992) 12-16.

Actual Japanese direct investment in Indonesian manufacturing is even larger if their investment in the "combined countries" category (included in the "other" column in Table l) is included. This category includes investments by

firms from more than one home country. Unfortunately, the Indonesian official data do not present a detailed specification of the Japanese share in this category, although we can safely assume that Japanese investment in this category is quite important.

The data in Table 1 understate the Japanese commercial presence in another way, as Indonesia's automotive industry (included in the metal goods industry) in which foreign direct investment is prohibited, is highly dependent on the product and process technologies provided by Japanese automotive firms through technical licensing agreements (Hill 1988: 50). In view of the great importance of Japanese direct investment in Indonesian manufacturing, a keen observer of foreign investment in Indonesia noted that foreign investment in Indonesian manufacturing since the enactment of the Foreign Investment Law in 1967 can be described as basically Japanese investment (Hill 1988: 59-60).

Japanese direct investment came to Indonesia (and the other Southeast Asian countries) in two waves, namely during the so-called 'old' wave from the late 1950's up to 1985, and more recently in the 'new' wave since the substantial yen appreciation *(endeka)* of 1985 (Phongpaichit 1990: 29).

During this 'old' wave, much of Japan's export-oriented investment went to the East Asian countries which later became the NICs, while import-substitution and resource-oriented investment went to the Southeast Asian countries, particularly to resource-rich Indonesia. Japanese investment in Indonesian manufacturing started on a modest scale in 1968 at a time when, as noted earlier, Indonesia's manufacturing was still relatively underdeveloped—compared to the other large Southeast Asian countries, namely Thailand and the Philippines. During the first three years Japanese investment in Indonesia increased only slightly, but in 1971 started rising more rapidly so that by early 1972 Japanese investment in Indonesian manufacturing was already bigger than in Thai manufacturing (Yoshihara 1978: 67).

Most of the Japanese investments in Indonesian manufacturing during the early 1970's was focused on the textile industry (primarily in synthetic fibres and integrated textile mills), construction materials (non-metallic minerals), agricultural inputs, resource-processing activities, transportation machinery (excluding ships), and electrical machinery (Yoshihara 1978: 67). Many of these industries, such as the textile, processed steel, consumer electronics, and metal products industries, can be classified as relatively labour-intensive industries in which Japan, since the early 1960's, had been losing its comparative advantage because of rapidly rising labour as well as land costs (Thee 1984: 99).

As noted above, the bulk of the 'old' wave of Japanese investment in Indonesian manufacturing has been of the import substitution type of investment.

In a study conducted by a team of Indonesian economists in the late 1970's, a large majority of Japanese firms surveyed (81%) stated that they had come to Indonesia primarily for the purpose of producing finished goods for the domestic market (Siahaan, Thee, et. al. 1978: 99).

A later study conducted in the mid 1980's on Japanese investment in Indonesian manufacturing confirmed that it was still overwhelmingly oriented towards the domestic market, as indicated by the fact that of the 113 affiliates, not less than 105 or 93% of the total were import-substitution projects (Kinoshita 1985: 21).

A 'new' wave of Japanese direct investment into Southeast Asia, including Indonesia, took place after the steep yen appreciation in 1985. Unlike the 'old' wave of mostly import-substituting investment, much of the 'new' wave of Japanese investment was taking place in export-oriented projects. While the steep yen appreciation of 1985 was indeed the direct cause for why many Japanese firms, including may small- and medium-scale firms, felt the need to relocate their operations overseas, the real underlying forces at work in Japan have been the transformation of the Japanese economy from an industrial country relying on labour-intensive manufactured exports into a more technology-intensive economy (Phongpaichit 1990: 29-34).

The need for many Japanese companies to relocate their labour-intensive operations to lower-cost sites in Southeast Asia after the 1985 yen appreciation coincided with the increasing shift to export-oriented industrialization policies of the South-east Asian countries, notably in Indonesia. While Indonesia's investment climate until the mid 1980's was still being perceived as less attractive to foreign investors, compared to Thailand and Malaysia, a series of deregulation packages introduced by the Indonesian government to drastically simplify the cumbersome investment licensing procedures considerably improved the investment climate. As a result, foreign investment, notably Japanese and Asian NICs' investment, began to increase very rapidly from 1987.

The data in Table 2 show that the 'new' wave of Japanese investment after 1985 did not come to Indonesia immediately as it did to Thailand. However, as further deregulation measures and trade and industrial policy reforms to reduce the 'anti'-export bias of Indonesia's highly protectionist trade regime were introduced in the course of the late 1980's, more and more Japanese investment flowed into the country, much of it in export-oriented projects.

Table 2. Approved Japanese Direct Investment in Indonesian Manufacturing, 1968 – 1991

Year	Approved Investment	
	No. of Projects	*Newly Approved Amount* (millions of US $)
1968	3	4.2
1969	8	20.5
1970	20	27.9
1971	18	101.3
1972	13	55.7
1973	33	216.9
1974	22	399.1
1975	12	907.8
1976	5	32.7
1977	6	29.4
1978	7	26.2
1979	1	10.1
1980	4	28.8
1981	4	74.8
1982	11	532.2
1983	11	421.0
1984	2	31.1
1985	6	57.9
1986	5	232.9
1987	14	212.4
1988	14	121.3
1989	46	1,913.4
1990	48	976.6
1991	62	781.7

Source: JETRO: *List of Japanese Investment projects in Indonesia, 1991* JETRO Jakarta Center (Jakarta April 1992) 312-316.

The expansion of new Japanese investment in Southeast Asia, including Indonesia, after 1985 has been characterized by the strong presence of companies from the various machinery industries, including general machinery, electric machinery, and transport equipment (Tran 1990: 88). This shift in the pattern of Japanese investment, reflecting Japan's shift in comparative advantage from relatively labour-intensive, low or medium-technology to more capital-intensive, high technology industries, is indicated by the data in Table 3.

Table 3. Japanese Investment in Indonesian Manufacturing By Intensity and Type of Technology, 1970 and 1991

Intensity and Type of Technology in Industry	Number of Projects	
	1970	1991
a. *Low Technology Industries*		
1.Food and Beverages	2	3
2. Textiles	5	16
b. *Medium Technology Industries*		
1. Basic Metals and Products	–	2
c. *High Technology Industries*		
1. Chemicals	1	11
2. Metal Goods (Electrical Goods & Machinery)	5	22

Source: JETRO *List of Japanese Investment Projects in Indonesia, 1991* JETRO Jakarta Center (Jakarta 1992) 213-216.

Following the same classification of industries by the intensity and type of industrial technology, as used by Luis Wells (Wells 1983: 44), the data in Table 3 show that while in 1971 a slightly larger number of Japanese projects were in the 'low technology' industries, and by 1991 the bulk of Japanese investment projects was located in the 'high technology' industries.[1] This observation, though needs to be qualified, as Wells' classification was based on the proportion of R & D expenditures of manufacturing industries in the U. S. in the late 1970's rather than on the actual observation of process technologies being used in the various manufacturing industries in Indonesia. Moreover, the various categories of industries used by Wells were also highly aggregated, which did not make any distinction between the different levels and types of technologies being used in the various sub-sectors of an industry. A case in point would be the textile industry, where highly capital- and technology-intensive technologies are being used in the upstream synthetic fibre industry, whereas the downstream garment industry generally employs labour-intensive, low technologies. Wells' classification, based on developments in the mid 1970's, also could not take account of more recent technological developments in the garment sector in the developed countries which in the pre- and post-assembly stages of production have witnessed the increasing adoption of micro-electronics related innovations (MRIs) which has

[1] Louis Wells defined 'low technology' industries as those industries where the industries' expenditures on R & D in the U. S. were less than one (l) percent of the sales of those industries. In 'medium-technology' industries R & D expenditures in the U.S. ranged between 1 to 2.5% of sales, while in the 'high technology' industries R & D expenditures were in excess of 2.5% of the industries' sales. Luis T. Wells *Third World Multinationals* (Cambridge, Mass. 1983) 45.

made this subsector an increasingly technologically sophisticated industry. With these qualifications in mind, the data in Table 3 nevertheless do show that in 1991, unlike twenty years earlier, the Japanese investment in Indonesia was largely concentrated in the high-technology industries. On the other hand, the large number of new Japanese projects in the textile industry does not mean that these investments were 'low technology' operations, as they have taken place in the technology-intensive upstream and mid-stream (spinning, weaving, and finishing) subsectors of the industry rather than in the more labour-intensive, low technology garment industry. As such, the recent new Japanese investments in Indonesian manufacturing are obviously making an important contribution to the modernization and increasing technological sophistication and export-orientation of Indonesia's manufacturing sector.

The recent Japanese investments in various modern, technology-intensive, export-oriented operations, notably in the electronics industry, have involved the establishment of modern new plants with state-of-the-art capital equipment and machinery, much of it highly automated. Following Chee and Lee (1979: 40), this transfer of modern machinery and equipment can be described as one major channel for the transfer of modern industrial technology from Japan to Indonesia. While this is undoubtedly true, a more pertinent question would be whether or not this type of direct investment and technology transfer is making a substantial contribution to the development of indigenous technological capability? Equally important, have these new Japanese investments also led to a consumensurate increase of the other forms of technology transfer, notably the transfer of technical skills and technological know-how to Indonesian nationals? Before discussing this issue, however, Japan's official, technical assistance program to Indonesia will be discussed, as this program also contains a technology transfer component.

4. Japan's Technical Assistance to Indonesia

The Japanese government's overseas development assistance program puts a particular emphasis on the importance of technology transfer. Its stated policy in this regard is that Japan's official development assistance (ODA) should contribute to the ultimate self-reliance of the receiving countries. To this end, the development of the human resources of the developing countries through the transfer of technology is to be given particular emphasis in the effort to promote this self-reliance (Overseas Economic Cooperation Fund 1987: 1).

An important part of Japan's ODA is provided through technical assistance to the developing countries. This technical assistance focuses on the 'software' aspects of the various needs of the recipient countries, and technical cooperation is

therefore targeted toward the development of the human resources of the recipient countries. This is to be achieved by imparting Japanese technology, including industrial technology, and know-how to a core group of local staff who play a guiding role in their respective fields in the developing countries. In technical assistance jargon, these local staff are known as 'counterparts'. Japan's stated goal of its technical assistance program is to contribute to the progress of the developing countries by using those 'counterparts' as interfaces to spread technology throughout these developing countries (Ministry of Foreign Affairs 1992: 81).

Most government-to-government technical assistance under inter-governmental agreements is implemented through the official Japan International Cooperation Agency (JICA). Japan's official technical assistance program is provided in various forms through various projects. Japan's official technical assistance program for Indonesia started in 1969, and was initially administered by the Overseas Technical Cooperation Agency (OTCA). In 1974 this Agency was subsequently reorganized into the present Japan International Cooperation Agency (JICA), which has since then been administering Japan's official technical assistance to Indonesia.

However, among JICA's various technical assistance projects in Indonesia, only a very few involve some form of the transfer of industrial technology and skills. Among these one should mention the establishment of the Electronic Engineering Polytechnic Institute of Surabaya (Politeknik Elektronika Surabaya or PES) in 1988. The purpose of establishing this polytechnic institute was to train Indonesian students to become practical field engineers in the field of electronics who could upon graduation work in the electronics and telecommunication industries (JICA 1992: 2).

Other JICA projects providing the transfer of industrial technology and skills to Indonesia include the Chemical Industry Training Development Centre in Medan, North Sumatra, (which provides training to students planning to work in chemical industries), the Sulawesi Industrial Vocational Training Centre in Ujung Pandang, South Sulawesi, and the CEVEST Vocational Training Development Project, (Japan International Cooperation Agency 1991/92: 2-3).

The CEVEST Vocational Training Development Project located in Bekasi, West Java, now in its second phase and running from January 1, 1992 through March 31, 1997, and conducted in cooperation with the Department of Manpower, provides an interesting example of the kind of technological assistance provided by Japan to Indonesia under which Japanese instructors sent to Indonesia train their local counterparts, namely the Indonesian instructors, with a view to upgrade their expertise in the fields of industrial electronics and information

processing at the Diploma III level. Upon completion of these training courses, the Indonesian instructors will themselves teach the courses in these fields. Another objective of the CEVEST Project is the establishment of a training system to up-grade the technical skills of personnel (skill-upgrading training) working in the fields of machining, electricity, and electronics.

The CEVEST Project thus provides an appropriate example of how industrial technologies are being transferred from Japan to Indonesia through official channels, that is through Japan's official technical assistance to Indonesia. In view of Indonesia's relatively narrow base of industrial skills, JICA's support of the above polytechnic institute and the various vocational training centers meets an obvious need of Indonesia to expand and upgrade the numbers of highly skilled industrial workers. The great need for such polytechnic institutes and vocational training centers is at present already becoming quite evident, as the shortage of highly skilled industrial engineers, technical experts, and industrial workers, together with inadequate physical infrastructure, are already becoming serious constraints to Indonesia's further industrial growth.

In view of Indonesia's obvious need to expand its narrow industrial skills base, an expansion of the type of technical assistance provided by JICA would be most opportune, particularly as Japan has the necessary financial resources to expand such a technical assistance program. However, in expanding such a technical assistance program within a short time, JICA might run into some problems. For instance, Japanese technical experts sometimes tend to be weak in foreign languages. At a more general policy level, the Japanese government appears not to have taken the necessary long-term measures for building up a large pool of technical experts (Rix 1990: 26-27). This problem, however, should not be too difficult to overcome in view of Japan's very large pool of technical experts in the private sector who could be persuaded to work in JICA's technical assistance programs, if JICA manages to arrange a cooperation program with the private sector (Yamashita 1992: 27).

5. Technology Transfer through the Private Sector

5.1. Contrasting Views on Technology Transfer through Japanese TNCs

As noted earlier, industrial technologies can be transferred from one private firm to another firm located in another country, either through foreign direct investment (FDI) or through technical licensing agreements without any equity participation. In the case of the transfer of industrial technologies from Japan to developing countries, including Indonesia, there appears to be what a Japanese

economist has described as a 'recognition gap' between the donor country (i.e. Japan) and the recipient countries, including Indonesia. In the case of Southeast Asia, including Indonesia, this 'recognition gap' arises from the fact that many government officials, engineers, and economists in these countries believe that Japanese-affiliated firms operating in these countries are often unwilling to carry out technology transfer to nationals in these host countries, at least if compared to the practices of U.S. and European firms (Yamashita 1992: 6). Conversely, Japanese entrepreneurs and technical experts attached to these Japanese-affiliated firms often tend to be surprised hearing these critics, as they firmly believe that they not only conducted technology transfer to the local employees in a thorough way, but also in a way better suited to the long-term needs of the developing country.

In the case of Indonesia, the views expressed by Mr. A. R. Soehoed, Minister of Industry during the period 1978-1983, on the transfer of technology through transnational corporations (TNCs) is quite representative of views generally held in the country regarding the performance in technology transfer of Japanese TNCs operating in Indonesia. Discussing the experience of Japanese investment projects in Indonesia's textile industry, particularly in the synthetic fibre industry, Soehoed stated that the speed of technology transfer in these projects were quite slow. Whatever technology transfer has taken place has mainly taken the form of training and employment of machine operators (Soehoed 1981: 135). Soehoed attributed the slow process, even reluctance, to transfer technology, in the Japanese controlled textile firms, to the Japanese concept of lifetime employment which demands loyalty from the employees. The problem in Indonesia, of course, was that the turnover rate in Indonesia can be quite high (Soehoed 1981: 135). It may thus not pay the Japanese to train their Indonesian technical staff and employees thoroughly, if the latter leave the Japanese company for another company.

Soehoed acknowledged, though, that the transfer of technology from Japanese to Indonesian nationals in the transport and heavy equipment industry was a bit more intensive. This was evident from the fact that Indonesian nationals working in the Japanese-controlled firms in these industries had been entrusted with carrying out modifications in design engineering and in the production process. However, Soehoed pointed out that these industries were still in the assembling stage.[2] This implied that other activities, such as material selection,

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2 It should be pointed out that Soehoed expressed these views in 1980 at a time when the so-called 'deletion program' (local content program) for the various engineering goods industries had just started. Since then, however, Indonesian manufacturing industries have made more rapid progress in mastering industrial technologies.

material balance, and manufacturing technology was still determined by the parent companies in Japan, and that important activities, such as production management, procurement, logistics, quality control, inspection, and testing analysis were still carried out by the Japanese expatriates rather than by the Indonesia staff (Soehoed 1981: 136).

The criticisms level led at Japanese, affiliated in developing countries, for not carrying out technology transfer or for not carrying it out at a faster pace is often based on comparisons with the practices of American or European firms. For instance, Soehoed argued that American and European TNCs operating in Indonesia operating under the broad policy of their head-quarters appeared to transfer as many skills as possible and as quickly as possible to the Indonesian nationals. He attributed this to the fact that the technologies in use may have already been known or may have been embodied in the capital equipment. Another likely reason was the high costs of maintaining expatriates (Soehoed 1981: 136). Be that as it may, the result has been that several European or American firms have given Indonesian nationals important executive positions and allowed them to carry out important strategic functions, such as production planning, process engineering, product design, and quality control. In addition, several of these firms have also been very active in recruiting Indonesian nationals for these strategic posts (Soehoed 1981: 136).

Unlike the American and European companies, the Japanese companies tend to keep their expatriate experts for a much longer time. For this reason Japanese firms are often criticized for being unwilling or tardy in transferring their technology and skills. As many Japanese managers themselves acknowledge that they tend to keep their technical experts for a longer time, it is important to know the reasons which they advance to justify their practices. In general, Japanese manufacturing companies tend to base their production management methods, and particularly their technical training on on-the-job training (OJT). Instead of relying on detailed job descriptions, as is the case with Western firms, in Japanese firms the workers generally lack detailed job descriptions and work standards. Instead, these firms tend to rely more on-the-job training or on the knowledge and experience of the Japanese technical experts (Yamashita 1992: 7).

The reason why Japanese technical experts tend to stay longer in the Japanese-affiliated companies is that these experts stay on, even after having trained the local employees in running competently the basic operations in the factory, with the purpose of training the local workers step-by-step in maintenance and repair, quality control, and in introduction of new methods and technology. The need for training local employees beyond the level of basic operations is considered important, as Japanese companies attach great

importance to the firm's ability to respond quickly to changes in model design, production methods, materials, and new product development (Yamashita 1992: 7-8). While this ability to respond quickly to external changes was not so urgent for Indonesia-based firms during the period of import-substituting industrialization of the 1970's and early 1980's, the need for it became much more urgent when Indonesia began to shift to export-oriented industrialization in the mid-1980's.

5.2. Training by Japanese Firms: An Overview of Some Research Findings

If training, particularly on-the-job training, is indeed an important element in the technology transfer from Japan to Indonesia, has this training been effective? In a survey conducted by Professor Tsurumi, in 1973, of 74 Japanese firms operating in Indonesia, it was found that the productivity levels of the Indonesian workers at the outset of the operations were only 50 to 60% of Japanese or Korean workers in comparable industries. However, after 12 to 18 months of work experience and closely supervised training, the Indonesian workers were able to achieve 80 to 90% of this level (quoted in Hill 1988: 124).

That Japanese firms indeed put an emphasis on training their local workers is indicated by the findings of a survey conducted in 1978 by this author and his colleagues on the operations of 23 Japanese-controlled manufacturing firms in Indonesia. The data in Table 4 show the number of Indonesian workers at all level of operations who were provided with various kinds of training opportunities within these Japanese companies.

The data in the table below indicate that training opportunities with the 23 sample firms were quite extensive, particularly on-the-job training. These findings suggest that Japanese firms indeed put a great emphasis on-the-job training. The data in Table 4 also show that training opportunities at company headquarters and other training opportunities, particularly for the plant workers, were quite significant too. Training at the company headquarters in Japan appeared to be particularly important for middle-level managers as well as plant supervisors, while on-the-job training was important for all levels, from middle-level managers down to plant supervisors and plant workers (Siahaan, et. al. 1978: 114-116).

A more recent case study conducted by Professor Ikuro Yamamoto of Kinjôgakuin University, Nagoya, on skill formation in a Japanese-affiliated firm manufacturing motor vehicle bodies in Indonesia, also found that on on-the-job training is accorded high priority right from the start of the employment of a new worker. A newly-recruited worker learns from the start to operate one of the machines in the production section under the instruction of a group leader or

Table 4. Average length of time of training programs of selected Japanese firms
(number of months)

Position	On-the-job Training	Training at Company HQ in Japan	Training at Japanese Univ. or Institute	Training at Indonesian Univ. or Institute	Other Programs
Upper management	12	3/4 - 1	1	12	1/2 - 30
Middle management	3 - 24	1/2 - 5	1	1/4 - 12	1/2 - 60
Office workers	3 - 6	1/2 - 4		3 - 12	1 - 4
Plant supervisors	2 - 12	3/4 - 6		2 - 3	2 - 6
Laborers	1/2 - 12	9 - 18		1/4 - 6	1 - 3

Source: Luckman Siahaan, Thee Kian Wie, Ahmad Hamid, J. L. Tamba *Japanese Direct Investment in Indonesia-Findings of an Experimental Survey* (Tokyo1978) 68, Table 4.3. Derived from experimental survey returns.

senior worker (Yamamoto 1988: 101-109). The most notable feature of skill formation in the production section of the plant, that is the section where the motor vehicle body is being assembled, is that workers acquire wider abilities to operate various machines through job rotation within the work-place. This rotation is decided by the section chief after consultation with the foremen and the group leaders. The purpose of job rotation is to extend the range of skills of the workers, to improve teamwork, and to relieve the monotony of work. After a while the newly-employed workers are rotated from the small press shop to the big one. In this way workers after a few years acquire the ability to operate almost all the different machines in the press shop (Yamamoto 1988: 104).

The findings of the three above surveys indicate first, that Japanese firms indeed provide numerous training opportunities, notably on-the-job training, for their Indonesian employees, and secondly, that as a result, their productivity levels have increased appreciably. To the extent that some of these Indonesian managers, technical experts, and workers have moved to Indonesian companies, favorable technological spill-overs have taken place as a result of the presence of these Japanese firms.

A more recent comparative study by Professor Tran Van Tho, Ôbirin University, Tokyo, on technology transfer in Japanese firms in the synthetic fibre industry in South Korea, Taiwan, Thailand, and Indonesia has yielded some interesting findings on the efficiency of technology transfer by Japanese firms. To assess the progress in technology transfer, Tran divided the whole transfer process into three levels, namely:

1. The transfer of production technology;
2. The transfer of administration technology;
3. The transfer of management know-how (Tran 1990: 78).

The transfer of production technology involves the transfer of equipment as well as the knowledge and methods to operate them. This requires training the local plant workers to operate the machines and other capital equipment. The transfer of administration technology involves the training and education of the local engineers and middle-level managers to carry out various administration functions, such as inventory management, quality control, schedule control, and facility administration in order that the Japanese-affiliated firm can be run efficiently. The third level of technology is the management know-how which lies with the headquarters of the parent company in Japan. At the headquarters the overall management of the operations of the various plants is being conducted as well as the company strategies concerning planning, marketing, finance, R & D, and other strategic issues. Obviously, the transfer of such management skills and know-how is quite difficult, as these top-level managers must not only have high levels of managerial know-how to run the local subsidiary, but must also be aware of the global strategy of the parent company (Tran 1990: 80). Tran found that in regard to production and administration technologies, the Japanese-affiliated firms in the synthetic fibre industry in Thailand and Indonesia have been quite successful in transferring these two levels of technologies to respectively the local plant workers and local managers, This was generally achieved by on-the-job training for the local operators and by sending the middle-level managers to Japan for training courses. On the other hand, in regard to management know-how, the transfer to local personnel did not show any significant progress. Hence, while in several Japanese-affiliated firms, local middle-level managers have replaced the Japanese managers, this has not been the case with the top management levels (Tran 1990: 86).

Tran found a certain reluctance on the part of the Japanese firms to fill the top management positions with local managers as this might cause difficulties in the communications with the company's headquarters in view of language problems. Another factor militating against the promotion of local staff to the top positions was that promotion in Japanese firms is based on the seniority system. This implies that it would take a new employee about twenty years or more to achieve a high managerial post. Japanese firms also pointed out that in many developing countries, including Indonesia and Thailand, a serious shortage exists of qualified high-level managers (Tran 1990: 86-87).

6. Conclusion

The findings of Professor Tran appear to vindicate the perception of many Indonesians that there is a limit to what they can expect from Japanese companies in terms of technology transfer. While a considerable transfer of industrial technology from Japan to Indonesia has undoubtedly taken place, still is taking place, and will still take place in the foreseeable future because of the very large presence of Japanese companies in Indonesia's manufacturing sector, the important lesson from Indonesia's experience as well as the experience of other developing countries with foreign, including Japanese, investment is that foreign direct investment provides no simple short-cut to the acquisition of indigenous technological capability. In fact, Japan's and a few decades later (South) Korea's experience show that rapid industrial progress and the acquisition of indigenous technological capability was not dependent on foreign direct investment (FDI). Even though FDI did play a role in some fields of industrial activity in these two East Asian countries, their role was never dominant and in many ways quite restricted.

Korea's rapid industrialization during the past three decades has always been directed and controlled by the Koreans themselves. While foreign resources have made substantial contributions to Korea's rapid economic development, the economic transactions involved have generally been at arm's length. Although Korea did rely on substantial capital inflows, these flowed in the form of loans rather than as foreign direct investment. Consequently, industrial technologies were largely acquired from abroad through other means rather than through FDI. Initially, foreign process technologies were purchased from abroad through technical licensing agreements. Later, however, greater reliance was put on machinery imports and turnkey projects to transfer industrial technologies to Korea. In addition, a considerable amount of technological knowledge was acquired as Korean engineers and scientists returned home after having studied or worked overseas, particularly in the U.S. (Dahlman & Westphal 1982: 127). Over time further indigenous technological development was promoted through the huge investments which the Korean industrial conglomerates *(chaebol)* made in R & D, which in turn was supported by a good educational infrastructure and a strong domestic science and technology infrastructure.

It might be incumbent upon Indonesia, particularly Indonesia's indigenous manufacturing firms, to take Korea's experience to heart and to put in a greater effort to invest in the acquisition of indigenous technological capability. This would not mean that FDI, including Japanese FDI, should not be welcomed to Indonesia. In fact, Japanese FDI has contributed and is still contributing a great

deal to Indonesia's rapid industrial development and transformation. In terms of technology transfer, Japanese FDI has, as we have seen from the above overview of research findings, also contributed a great deal to the acquisition of the 'easier' technological capabilities, notably the operative and adaptive ability. It should, however, also be clear that FDI in general, including Japanese FDI, cannot be relied upon to transfer acquisitive, let alone innovative capabilities to local firms, For these capabilities there is no shortcut to indigenous technological effort to acquire domestic technological capability.

Hence, rather than engaging in a rather fruitless effort to criticize Japanese firms, continually for their failure or unwillingness to transfer advanced technologies to Indonesia, it might be a more productive exercise to maximize the benefits from Japanese FDI in Indonesia by encouraging the Japanese firms to transfer the operative and adaptive capabilities to Indonesian nationals in an optimal way. As pointed out earlier, technological diffusion would take place if some of these Indonesian employees, after having acquired these technological capabilities, leave their jobs with the Japanese firms to move to Indonesian national firms. To the extent that this occurs, Japanese FDI undoubtedly yields positive external benefits to the Indonesian economy. To expect more from Japanese FDI, however, particularly to expect that it would freely transfer its innovative capabilities to Indonesian nationals, would be naïve as this would never happen. In many fields Japanese manufacturing firms gained their competitive edge by continually strengthening their owner-specific advantages in technology. To expect that these firms, or any other foreign firm for that matter, would freely make these advanced technologies available would be futile, as new technologies, in contrast to 'mature' technologies, just cannot be purchased off-the-shelf.

A recent study on technology transfer through TNCs in Indonesia indicated that the degree of local technological efforts is generally greater with Indonesian national companies which acquired their technologies through technical licensing agreements than in the case of joint ventures between TNCs and national firms, particularly when management control still lies with the TNC (Thee 1990: 228-232). While Japanese firms have also transferred their technologies to Indonesian firms through these licensing agreements, Korea's experience, as noted above, has also indicated that this method may only be beneficial during a country's early industrial development. Over time, however, the Indonesian national firms should make their own technological effort to acquire more advanced technological capabilities.

In trying to achieve this goal, Indonesia should pay much greater attention than it has so far to the two major constraints which are currently hampering

Indonesia's sustained industrial growth. The first is Indonesia's inadequate physical infrastructure, and the second, the shortage of well-educated human resources. While Indonesia has made rapid progress in its educational development over the past two decades, it still has, in comparison with Korea, a long way to go to attain the levels of secondary and tertiary education required to support technological development. After all, a prerequisite for technological development would be the availability of industrial engineers who can understand and assess the imported technologies (Kakazu 1990: 56). In other words, technology transfer from Japan to Indonesia cannot take place in a vacuum. While it would undoubtedly require a greater willingness and confidence on the part of Japanese firms to transfer their technology on a wider scale to Indonesian nationals, it would also require a very serious effort on the part of the Indonesian government in cooperation with the private sector to expand and upgrade the quality of the Indonesian educational system, with a view to increase the output of industrial engineers which at present is still far from adequate.

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