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ADB Institute Discussion Paper No. 43

Technology and Indonesia's Industrial Competitiveness

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Introduction

The rapid economic growth from the late 1980s until 1996 based on a sustained growth of manufactured exports raised the prospect of the economy following the path of the newly industrialized economies of the region. However the Asian financial and economic crisis of 1997 had a devastating effect on the Indonesian economy and also illustrated the underlying weakness of its industrial sector.

This paper will discuss the major factors, which affect Indonesia's industrial competitiveness, specifically the determinants of its industrial technology development, which is crucial to raising Indonesia's competitiveness. After a brief overview of industrial development before and after the Asian economic crisis, the paper discusses some recent assessments of the country's competitiveness. It considers the determinants of Indonesia's industrial technological development, including policy options open to the government.

Industrial Development During the Soeharto Era

During the long Soeharto era (1966-98) the Indonesian economy experienced rapid and sustained growth, which enabled Indonesia to graduate from the ranks of one of the poorest low income countries in the mid-1960s to one of the eight 'high-performing Asian economies' in the early 1990s, along with Japan, the four 'Asian Tigers', and Indonesia's two Southeast Asian neighbors, Malaysia and Thailand ((World Bank, 1993: 1, 37). With the economy growing at an average annual rate of 7.0 per cent over the period 1965-97, Indonesia's real gross national product roughly doubled every 10 years over this period. Because of the surge in manufactured exports since the late 1980s, Indonesia, along with Malaysia and Thailand, was also referred to as a second tier newly-industrializing economy (NIE) in the World Bank 'Miracle' study (World Bank, 1993: 1, 37).

As the manufacturing sector throughout this period was growing at double digits, much faster than the two other main sectors, agriculture and services, the Indonesian economy underwent a rapid transformation, as reflected by the rapid decline in the relative importance of agriculture and an equally rapid rise in the relative importance of manufacturing (Table 1). By 1991 manufacturing's contribution to GDP for the first time exceeded the contribution of the agricultural sector (Aswicahyono 1997: 25).

Table 1 Economic growth and transformation in Indonesia, 1965-97

	Average annual growth rate (%)			% of GDP	
	1965-80	1980-90	1990-97	1965	1997
GDP	7.0	6.1	7.7		
Agriculture	4.3	3.4	2.8	51	16
Manufacturing	12.0	12.6	10.8	8	26
Services	7.3	7.0	7.2	36	41

- Source: 1. For period 1965-80: World Bank: *World Development Report 1992*, table 2, p. 220; table 3, p. 222;
 2. For the periods 1980-1990 and 1990-1996: *World Development Indicators 1999*, table 4.1, p. 189; table 4.2, p. 193.

During the late 1960s and early 1970s Indonesia's rapid industrial growth was initially fuelled by the liberalization of the trade and foreign investment regimes, and the return to normal economic conditions after the political turmoil and economic chaos of the early 1960s. During the oil boom period (1974-81) rapid industrial growth was also facilitated by import-substituting policies, which enabled domestic and foreign investment projects to replace imported light consumer goods and consumer durables.

During the oil boom era of the 1970s the liberal economic policies became more interventionist, as the Indonesian government, flush with windfall revenues from the oil boom, initiated an ambitious, second phase import-substituting, state-led industrialization after the 'easy' phase of import-substitution had been largely completed by the mid-1970s (McCawley 1979: 13). This second phase of import-substituting industrialization largely involved the establishment of various upstream, state-owned, basic industries, including a steel industry and an aluminium smelter.

Academic economists, however, were concerned about this second stage import substitution program, as it omitted any reference to efficiency, comparisons of costs with border prices, and the exportability of the products of these basic industries (Gray, 1982: 41-2).

However, by 1983 the end of the oil boom sharply reduced Indonesia's export earnings and the government oil tax revenues. Hence, the government was forced to defer or cancel the establishment of several large-scale industrial projects, and shift gradually to export-promoting policies. This was achieved by introducing a series of deregulation measures to improve the investment climate for private, including foreign, investors, and to encourage them to invest in export-oriented projects. The government also introduced a series of trade reforms to reduce the '*anti-export bias*' of the highly protectionist trade regime. A significant step in encouraging an export-promoting path of industrialisation was the introduction in May 1986 of a '*duty exemption and drawback scheme*', which provided export-oriented firms with the opportunity to purchase inputs, whether imported or locally

made, at international prices. This scheme turned out to be a crucial factor in encouraging foreign and domestic firms to export.

However, unlike the Republic of Korea, where the government from the outset pushed export promotion by constantly pressuring corporate leaders to meet specified export targets, the Indonesian government in its export promotion policies never resorted to exerting a similar pressure on manufacturing firms. Through its control over commercial banks, the Korean government was able to allocate large credits to big firms able to meet export targets (Amsden, 1989:16). By offering firms protection and subsidies and imposing discipline by limiting the number of firms the Korean government was also able to lure firms to enter new industries. This ensured the realization of economies of scale and the rise of the big industrial conglomerates (*chaebol*) which, however, were subjected to yearly negotiated price controls to curb monopoly power (Amsden, 1989: 17) and to prevent the excessive growth of monopoly rents.

In contrast to the Korean government's policy of strongly promoting manufactured exports by linking the various incentives (principally access to subsidized credit and import protection) offered to the large groups to their export performance, the Indonesian government when providing similar incentives, never resorted to imposing a similar export performance target on favoured business groups. Not surprisingly, the contribution of the top 50 business groups in Indonesia in the mid-1990s was a mere 16 per cent of total manufactured exports (World Bank, 1994: 59). In fact, the bulk of these manufactured exports were generated by foreign-controlled firms (particularly from the East Asian NIEs) and by domestic small-and medium-scale enterprise, which exported garments and other low skill labor-intensive exports.

However, the various deregulation measures and trade reforms since the mid-1980s, combined with a supportive exchange rate policy aimed at keeping the real effective exchange rate at a competitive level, and underpinned by sound macroeconomic policies, proved to be successful as since 1987 the manufacturing sector generated a rapid surge in manufactured exports. This was the first broad-based expansion of manufactured exports in Indonesia's modern economic history (Hill 1987: 29).

As a result of the surge in manufactured exports, Indonesia's manufacturing sector, specifically the non-oil and gas manufacturing sub-sector, emerged as an important engine of economic growth (World Bank 1994: 1). During the period 1985-88 the manufacturing sector grew at an average annual rate of 13 per cent, while manufactured exports grew at an average annual rate of 27 per cent. During 1989-92 the manufacturing sector grew at a much faster rate of 22 per cent, while manufactured exports continued to grow at an average of 27 per cent (Dhanani 2000: 28).

However, since 1993 up to the crisis year of 1997 the growth of the manufacturing sector slowed to an average of 12 per cent, as the growth of manufactured exports grew only at a sluggish 7 per cent (Dhanani 2000: 28). This slowdown aroused concern among policy-makers, as it was feared that a sluggish growth of manufactured exports would adversely affect the prospects of continued rapid economic growth, which for the period of the Sixth Five-Year Development Plan (1994/95-1998/99) was projected at 6-7 per cent per annum.

Concerned about this slowdown, the Indonesian government commissioned some studies to look into this problem.

A study conducted by Sanjaya Lall and Kishore Rao in 1995 for Indonesia's National Planning Board (Bappenas) found that the recent surge of manufactured exports had been led by relatively few products, the competitiveness of which was mainly based on low wages and access to natural resources. Although these advantages can be improved and extended, they are vulnerable to competition from new entrants notably the People's Republic of China (henceforth PRC) with lower wage costs, and to low rates of demand growth. In view of the emerging international environment of accelerating technical change and globalization of production, and the entry of other low-cost producers. The study recommended that the sustainability of Indonesia's manufactured exports required a broadening and deepening of the base of Indonesia's competitive advantages, with an upgrading of existing export products, greater local content in export activities, and broad entry into more high value-added projects (Lall and Rao, 1995: 1).

The authors argued that these recommendations required policy reforms to give greater play to market forces, but also remedial policies and a carefully crafted export development strategy, as Indonesia's manufacturing firms also faced market failures. These market failures were holding back upgrading, local procurement and diversification into more complex activities (Lall and Rao, 1995: 1). The authors also pointed out that the experience of the East Asian Tigers showed that a strong and pro-active role for the government would be necessary, particularly by removing policy-induced distortions and costs which reduce the competitiveness of the private sector (Lall and Rao, 1995: 2).

Despite the merit of these recommendations and of the largely similar points made contained in a report by a team from Harvard university for the Department of Industry (HIID, 1995), on the eve of the Asian economic crisis the government had not acted on these recommendations. Instead, it mainly relied on keeping the real effective exchange at a competitive level. It had also not completed the necessary deregulation of international trade, including further tariff reductions and relaxation of non-tariff barriers, which would have reduced the production costs of manufacturing firms and raised their international competitiveness (World Bank 1997: 112). Extensive regulations and restrictions on domestic competition also added to the costs of doing business in Indonesia, thereby further reducing the efficiency and competitiveness of private firms (World Bank 1997: 118).

One major reason why the Indonesian government had not proceeded further with deregulating international trade was that in the period following 1990 the momentum of deregulation had weakened, when oil prices rose again steeply and domestic concerns returned to the foreground. These concerns included problems in the domestic banking sector as a result of reforms in 1991 and 1992, and a sharp increase in short-term debt. Consequently, the government sought to curb off-shore borrowing by both private and state-owned enterprises and stepped up prudential regulation of commercial banks (James & Stephenson, 2002: 37).

Industrial Development after the Asian Economic Crisis

The Asian economic crisis led to a sharp slowdown of economic growth, including the manufacturing sector. While manufacturing in 1996 grew at almost 12 percent, it slowed to 5 percent in 1997 and in 1998 contracted by over 11 percent. (Table 2)

Table 2 Growth of Indonesia's GDP and Manufacturing Sector, 1997–2005 (Q1-Q2)

	1997	1998	1999	2000	2001	2002	2003	2004	2005 (Q-1)	2005 (Q-2)
GDP	4.7	-13.1	0.8	4.9	3.5	3.7	4.1	6.7	6.3	5.5
Manufacturing	5.3	-11.4	3.9	6.0	3.1	3.4	3.5	7.2	7.1	6.7

Source: Badan Pusat Statistik (BPS), Jakarta.

Although manufacturing growth recovered to a sluggish 4 percent in 1999 and to 6.0 percent in 2000, it grew sluggishly from 2001 through 2003. However, in 2004 it rose sharply to 7 per cent in line with more rapid economic growth, which was sustained during the first two quarters of 2005

Although the current prospects for a recovery of the manufacturing sector seem slightly better than in the past few years, its prospects are still cloudy because of the unfavorable business environment. This is reflected by an inflexible labour market (characterized by high severance costs and mandatory annual increases in minimum wages), excessive regional autonomy in which local governments impose various new local taxes and restrictive regulations, discretionary tax assessments by corrupt tax officials, crumbling physical infrastructure and traffic congestion from plants to the ports (Kuncoro, 2005: 8). These problems need to be solved to achieve a stronger recovery of the manufacturing sector, as the unfavorable business environment unnecessarily raises the costs of doing business in Indonesia and thus reduces the competitiveness of the manufacturing firms. The government has also not studied the continued relevance, let alone acted, on the recommendations of the Lall and Rao and the Harvard studies to raise Indonesia's industrial competitiveness.

Some Assessments of Indonesia's Industrial Competitiveness

Since the early 1990s policy-makers and academic economists were arguing that Indonesia's manufacturing sector had to develop a more sustainable source of comparative advantage, primarily by raising its industrial technological capabilities and associated organizational capabilities. Indonesia's technological base in general is shallow and backward compared to that of the East Asian newly-industrialised economies, particularly the Republic of Korea and Taipei, China.

Indonesia's low industrial technological capability is, amongst others, reflected by the low percentage of its high technology manufactured exports, as compared to those of the other East Asian countries (table 3)

Table 3 The amount and percentage of high technology exports of selected East Asian countries, 2003

Country	High-technology exports (millions of US\$)	Percentage manufactured exports of total exports (%)
Indonesia	4,580	14
Malaysia	47,042	58
Singapore	71,421	59
Thailand	18,203	30
China	107,543	27
Republic of Korea	57,161	32

Note: High technology exports are products with a high R & D intensity, as in aerospace, computers, pharmaceuticals, and scientific instruments.

Source: World Bank: *World Development Indicators, 2005*, table 5.12, pp. 314-8.

Although definitions of what constitute high technology exports are not perfect, as they also include assembled products with low local value added, such as electronics, they can still serve as a rough indicator of technological competence. The above data on the much lower percentage of Indonesia's manufactured exports as compared to the other East Asian countries does indicate how far Indonesia still has to go in developing skill- and technology-intensive industries.

Indonesia's relatively low technological capability has also been confirmed by more qualitative firm-level surveys such as a comparative study sponsored by UNCTAD's Technology Program on the link between manufactured exports and technological capabilities in the Republic of Korea, Taipei, China, Indonesia, Thailand, and Viet Nam (Ernst, et al., 1998). This study indicated that Indonesia's technological capability in the export-oriented textile, garment and electronics firms, including both domestic and foreign-controlled or owned firms, was mostly limited to the basic production or operational capabilities required for the smooth functioning of the plants and, to a lesser extent, to adaptive or minor change capabilities, specifically in regard to introducing minor changes in process or product technologies to adapt to local conditions (Thee and Pangestu, 1998: 236-51).

None of these firms, including foreign investors as well as domestic firms, however, had as yet developed the more demanding innovative or major change capabilities that enable firms to make major changes in process or product technologies. Development of these latter capabilities, the study concluded, was essential to the ability of Indonesian firms to achieve and maintain international competitiveness (Thee and Pangestu, 1998).

A more recent study on Indonesia's industrial competitiveness, specifically that of firms operating in the garment, auto parts and electronic components industries, conducted for

the World Bank, indicated that in the case of the garment industry, the industry to a certain extent has already moved up the technological ladder, as reflected in increased labour productivity. However, since 1992 the competitiveness of the garment industry has declined because of the lack of new investments in machinery (Aswicahyono, Atje and Thee, 2005: 136-7).

While the garment industry's engineers are generally quite capable in the investment, production management and engineering, and repair and maintenance capabilities, they lack the more demanding major change, marketing and product diversification capabilities to upgrade the industry's broader technological capability. For this reason the industry may require infusions of new FDI, as FDI provides a major channel for international technology transfer, besides the machinery suppliers and international buyers (Aswicahyono, Atje and Thee, 2005: 137-8).

The study on the auto parts industry found that the dependence of most auto part firms on domestic market-oriented car assemblers has constrained the industry from developing into an internationally competitive activity. Because of the high dependence of the car assembling industry on the foreign principals, the industry is unlikely to develop into an export-oriented industry, because these foreign principals have imposed restrictive conditions, specifically a ban on car exports by the car assemblers. Hence, the local auto parts suppliers are also unlikely to develop into an export-oriented, internationally competitive industry. At present the technological upgrading of this industry can only be achieved with more foreign investment (Aswicahyono, Atje & Thee, 2005: 139-40).

Although the Indonesian electronics industry, including the electronic components industry, emerged around the same time as Malaysia, it has lagged far behind its neighbor, as it responded slowly to moves by the electronic firms in the industrial countries, including the US, Japan, and the Republic of Korea, to relocate their factories to Southeast Asia. The Asian economic crisis shattered Indonesia's hope for new FDI inflows because of the poor investment climate, and no significant investment has been made in this sector. Like the garment and auto parts industries, the technological upgrading of the electronic components industry requires more FDI, which requires a substantial improvement in the investment climate (Aswicahyono, Atje and Thee, 2005: 140-41).

In a critical assessment of Indonesia's industrial technological capability, Sanjaya Lall observed that Indonesia's industrial structure had several weaknesses in terms of technology. These weaknesses, if not overcome, would hamper Indonesia's long-term industrial growth and upgrading (Lall, 1998: 136). Among the technological weaknesses cited were the shallow and backward technological base, particularly compared to that of the East Asian Tigers; weak and narrow domestic capabilities for absorbing and improving upon complex imported technologies; an underdeveloped capital goods sector; and the relatively small amount of technological effort, which during the Soeharto era was concentrated and distorted, because of the focus on highly subsidized and protected "hi-tech" industries, particularly the aircraft assembling industry, promoted by Dr. Habibie, the then State Minister for Research and Technology) (Lall, 1998: 136).

In the following sections we consider Indonesia's technological capability, and what the government can do to improve this, from the perspective of the basic and enabling conditions required for improved technological capability.

Enhancing Indonesia's Industrial Competitiveness through Industrial Technological Development

International experience, particularly in East Asia, has indicated that raising industrial competitiveness requires investments in various kinds of technological capabilities, including procurement, production, design, engineering, marketing, and other kinds of capabilities (Lall, et.al., 2000: 20). Developing these technological capabilities is particularly important for raising Indonesia's export competitiveness, as its manufactured exports has mainly consisted of resource- and low skill labour-intensive products, which generally involve less effort, risk, and externalities. However, rapid and sustained manufactured export growth requires moving from easy to complex products and processes within activities, and across activities from easy to complex technologies (Lall, et.al., 2000: 20).

Following Lall, (1996a) and a World Bank study on the conditions affecting Indonesia's industrial technology development (World Bank, 1996), we identify the basic and enabling conditions influencing a developing country's industrial technological development.

The *basic conditions* for industrial technology development in Indonesia are:

1. The pursuit of sound macroeconomic policies, as low inflation encourages firms to make long-term investments in technology development;
2. The pursuit of pro-competition economic policies, as a competitive environment is conducive to drive firms to rapidly adopt and diffuse new technologies, and make an efficient use of new technologies;
3. The upgrading of human resources, as the technical human resource base is a key input into the process of acquiring, using, improving, and developing technologies.

In addition to these basic conditions, a number of *enabling conditions* should be met or created through policies that:

4. Improve manufacturing firms' access to foreign technologies through various channels;
5. Improve the availability of finance for industrial technology development;
6. Improve the effectiveness and performance of technology support services.

Governments have to create the policy environment for 1) and 2). The pursuit of sound macroeconomic policies and pro-competition policies constitute the *incentive system*, which stimulates a firm's *demand* for improved technological capability. Points 4), 5) and 6) help to improve the *supply-side capabilities* of a firm. Governments clearly have a role in

investing to upgrade human resources, and in ensuring an adequately functioning financial system. They may also need to invest directly in technology support services and in some R and D. On the critical issue of access to foreign technology their role will largely to ensure there are no serious administrative barriers for national firms, who seek this technology.

The Basic Conditions

Pursuing sound macroeconomic policies

From the outset Soeharto's 'New Order' government (1966-98) put a high priority on pursuing sound macroeconomic policies. After the reckless deficit-financing policies of President Sukarno, which led to hyperinflation in the mid-1960s, the 'New Order' government realized that achieving and maintaining macroeconomic stability was crucial to encourage firms to undertake the long-term capital investments necessary for rapid and sustained economic growth. Hence, during the Soeharto era Indonesia's record on controlling inflation has been fairly good, although Indonesia's inflation during the mid-1980s through to the mid-1990s was always slightly higher than that of its East Asian neighbors, except for the Philippines (Hill, 1996: 7).

Macroeconomic stability in 1997/98 was severely disrupted because of the Asian financial and economic crisis. As a result of the steep depreciation of the *rupiah*, inflation rose to 80 per cent in early 1998. However, in the course of 1998 the hyperinflation was gradually brought under control by tight monetary policies. As a result, inflation flattened out quite suddenly, and from late 1998 to mid-1999 inflation dropped to only 5 per cent (Hill, 1999: 29).

Whatever the political differences between the post-Soeharto governments (Habibie, Abdurrachman Wahid, Megawati Sukarnoputri, and currently Susilo Bambang Yudhoyono), they all realized the great importance of sound macroeconomic policies to maintain macroeconomic stability. Although the recent large increases in fuel prices has raised inflation, it is likely that just like in early 2005, inflation will fall again, as individual price increases have only a transient effect on inflation in conditions of slow growth of the money supply (McLeod, 2005: 137).

Pursuing pro-competition economic policies

The experience of the East Asian NIEs has shown that a competitive environment for firms is an important stimulus to drive firms to invest in their technological development (World Bank, 1996: 3). The overall competitive environment is determined by the foreign trade regime and domestic competition.

After the end of the oil boom era in 1982, the 'New Order' government introduced a series of deregulation measures, including the deregulation of the restrictive trade and foreign investment regimes. These policies played an important role in promoting industrial technological development by encouraging many manufacturing firms to improve their

productivity and efficiency, product design and product quality in order to compete in export markets (World Bank, 1996: 7). However, even after the 'New Order' government had introduced its last trade reforms in early 1997, the trade regime still had a significant 'anti-export bias' because of the remaining import protection (Thee, 1998: 118-9).

While the trade reforms from the mid-1980s through to 1997 did lead to greater import competition, domestic competition and trade were still subject to extensive regulation and restrictions introduced by the central and provincial governments, and occasionally by officially sanctioned trade and industry associations (Thee, 2002: 332). These restrictions included entry controls, price controls, provisions for public sector dominance, the sanctioning of cartels, and ad hoc interventions favoring specific firms or sectors (Iqbal, 1995: 14), which provided lucrative 'rent-seeking' opportunities for corrupt officials and their business cronies.

Only after the onset of the Asian economic crisis was the Indonesian government forced, as part of its first agreement with the IMF in early November 1997, to lift the many policy-generated barriers to domestic competition and trade. In its second agreement with the IMF in January 1998, a wider range of structural reforms were included, which stipulated a further deregulation of the foreign trade and foreign investment regimes and the restrictive domestic competition regime (Thee, 2002: 332).

Unfortunately, these deregulation policies have recently been offset by the proliferation of new regulations and restrictions by local governments since regional autonomy was introduced in early 2001. Many of these regulations restrict or tax trade within or between districts (*kabupaten*) and provinces. Obviously, these taxes and restrictions interfere with domestic trade and undermine domestic competition and internal market efficiency (World Bank, 2005: 41). Hence, these new restrictions on domestic trade and competition have undermined the pro-competition policies of recent years. Only by abolishing these restrictions can a competitive business environment be created for all players, so they face a 'level playing field.'

Upgrading the quality of human resources

A well-trained labor force, an effective training system, good quality science and engineering faculties of universities, and good management training and development programs are key elements for improving Indonesia's industrial technology development (World Bank, 1996: ii). Despite the progress which Indonesia has made during the Soeharto era in expanding primary education and to a lesser extent secondary and tertiary education, the quality of education and training at all levels is generally rated as low compared to the other East Asian countries.

Despite the progress in expanding education, Indonesia still lags behind in educational progress compared to the other East Asian countries in terms of education inputs, participation in education and education outcomes (Table 4).

Table 4 Comparative education statistics 2002/03

Country	Gross enrollment ratio, 2002/03			Adult literacy rate, 2002		
	Public expenditure on education (% of total government expenditure, 2002/03)	Primary (% of relevant age group)	Secondary (% of relevant age group)	Tertiary (% of relevant age group)	Male (% ages 15 and older)	Female (% ages 15 and older)
Indonesia	9.8	111	58	15	92	83
Malaysia	20.0	95	70	27	92	85
Philippines	14.0	112	82	31	93	93
Thailand	28.3	98	83	37	95	91
Republic of Korea	13.1	104	90	85	--	--

The data in table 4 show that both in terms of education inputs (public expenditure on education), and participation in education, Indonesia in general lacks behind its East Asian neighbors. In regard to public expenditure and the gross enrollment ratio in secondary and particularly tertiary education, Indonesia lags far behind its South East Asian neighbors and the Republic of Korea. Only as regards the adult literacy rate for both adult males and females is Indonesia on a par with the other East Asian countries because of the vast expansion in primary education during the Soeharto era.

In 1995/96, just before the Asian economic crisis, central government expenditure on education accounted for 15 per cent of total central government expenditure. However, in 2004 public expenditure on education accounted for less than 10 per cent of central government expenditure (table 4). Considering the tight budget caused by the huge amount of foreign and domestic debt service payments and the large fuel subsidies, there is little possibility that the Indonesian government in the next few years will be able to substantially increase its expenditure on education.

Aside from the fact that Indonesia's public expenditure on human resource development is even lower than the average low income country, let alone the average middle income country, the current education and training system in general also does not meet the needs of industry. The general secondary education system relies on rote learning, and does not develop adequate mastery of basic literacy, basic numeracy, and thinking and creative skills. Hence, high school graduates are not adequately equipped with the knowledge and skills required for a more complex and diversified manufacturing sector, and also cannot take advantage from on-the-job training (Dhanani, 2000: 11).

Aside from the above basic conditions required to promote industrial technology development, enabling conditions should be in place to facilitate technological development.

The Enabling Conditions

Improving manufacturing firms' access to foreign technologies

International experience has shown that the acquisition of foreign technologies, the assimilation and adaptation of these technologies to local conditions, and the subsequent improvement of these imported technologies have been crucial in raising these countries' technological capabilities. Hence, the international transfer of technology has been an important source of technical progress (Chen 1983: 63).

In view of the economic importance of imported technologies, it is important to identify the major channels through which these technologies have been transferred to Indonesia, particularly to its manufacturing sector. Studies on international technology transfer to Indonesia's manufacturing sector indicate that foreign direct investment (FDI), technical licensing agreements, capital goods imports and the related transfer of skills by technical experts of foreign supplier firms, and technical and marketing assistance by foreign buyers of some of Indonesia's manufactured exports, have been the major channels for international technology transfer. While several firms have obtained technical and managerial consultancies from foreign experts, no reliable data are available on these consultancies (Thee, 2005). Unlike the Republic of Korea, however, reverse engineering as a major means to raise industrial technological capability has not played a significant role in Indonesia.

The major channels of international technology transfer are discussed briefly below.

Foreign direct investment (FDI)

Indonesia since the late 1980s through to 1996 experienced steadily rising net FDI inflows, but after the Asian economic crisis it experienced net FDI outflows which have persisted to 2003 (Table 5). Even the positive net FDI inflow in 2004 was much smaller than the earlier large net FDI inflows pre-1996. The lack of interest of foreign investors to undertake new investments after the Asian economic crisis is caused by Indonesia's poor investment climate noted above (MacIntyre and Resosudarmo, 2003: 146; World Bank, 2003: 29).

Table 5 Net FDI in- and outflows into and out of Indonesia, 1990-2004

Year	Net FDI in- and outflows (millions of US\$)
1990	1,093
1991	1,482
1992	1,777
1993	2,004
1994	2,109
1995	4,346
1996	6,194
1997	4,667
1998	- 356
1999	-2,745
2000	-4,550
2001	-2,978
2002	145
2003	-597
2004	423

Note: Revised net FDI inflows include privatization of state-owned enterprises, specifically to non-residents, and banking restructuring, specifically the sale of bank assets to foreign investors.

Source: Bank Indonesia: *Indonesian Financial Statistics*, successive issues through February 2005.

The fact that a small amount of FDI only flowed into the country since 2004, while the Republic of Korea and Thailand, the two other worst-affected East Asian countries, saw a revival of inward FDI since 1999 meant that these countries experienced not only a strengthening of their currencies, but also an acceleration of much needed corporate restructuring, and important infusions of new technologies and modern management methods (World Bank, 2000: 6). Indonesia, on the other hand, was not able to obtain these benefits, as FDI instead flowed out of the country.

Technical licensing agreements

In Indonesia a major 'unpackaged' (non-equity) mode of technology transfer from advanced country firms to Indonesian firms has been technical licensing agreements. Although no quantitative data are available on the number of these, circumstantial evidence indicates that they often involve the transfer of older and mature technologies that do not offer the recipient country a long-term competitive advantage in the global market (Marks 1999: 6). However, for a late-industrializing economy like Indonesia, acquiring and mastering these older technologies first is a good way to develop the

important basic industrial technological capabilities, namely production, investment and adaptive capabilities.

Imports of capital goods

Imports of capital goods provide another way of acquiring the means of production without the transactional costs involved in FDI or licensing agreements (Dahlman, Ross-Larson and Westphal 1987: 768). Capital goods imports are actually embodied technology flows entering a country. They introduce into the production processes new machinery, other capital equipment and components that incorporate technologies which do not necessarily incorporate high or frontier technologies, but are nevertheless new to the recipient firm (Soesastro 1998: 304).

Capital goods imports also contain a significant disembodied element, as the foreign suppliers of these capital goods, specifically machinery, often send technical experts to Indonesian firms to train the workers of these firms how to operate, maintain and repair the imported machinery. This training is crucial as the mere import of capital goods does not automatically lead to an enhancement of local technological capability, if local employees do not know how to operate, maintain or repair the imported machinery (Thee, 2005).

Technical assistance by foreign buyers/consultants

Since the mid 1970s an important informal channel of international technology transfer for Indonesian firms, including small and medium-scale enterprises, has been provided by their participation in world trade, specifically through exporting their products. This informal channel was utilized effectively by local firms, particularly electronics firms, in the East Asian NIEs through technical assistance provided by foreign buyers (Hobday, 1994: 335; World Bank 1996: 4). This process of coupling exports with technology development was called '*export-led technology development*' (Hobday, 1994: 335).

Although not as technologically advanced as the East Asian NIEs's '*export-led technology development*', the remarkable export performance which the garment industry and other export industries in Bali and Jepara, Indonesia, have experienced since the mid-1970s is somewhat similar to the experience of these East Asian firms. The remarkable growth of Bali's export industries, starting with the garments industry in the mid-1970s, and subsequently the silver jewelry, wood carving, quilting, leather products, bamboo furniture, ceramics, and stone carving industries, was based on vital information flows which these Balinese firms, received through strategic business alliances with foreign firms and businessmen (Cole 1998: 257).

Through the information transfer and technical and managerial assistance (for instance in plant lay-out, and advice on the purchase of the most appropriate machines) including strict quality control, provided by the foreign buyers, who often acted also as technical consultants to the largely small Balinese firms, these firms were able to achieve high levels of efficiency and accuracy. The ongoing interaction of these two

parties started a virtuous cycle of technological improvements and learning that was self-replicating and largely self-financing, which led to rapid and sustained export growth (Cole 1998: 275).

A similar type of information transfer and assistance by foreign buyers who also acted as technical consultants, is found in the development of the export-oriented furniture industry in the town of Jepara, Central Java. As a result, the quality of Jepara furniture has been steadily upgraded (Sandee, Andadari and Sulandjari, 2000: 5-7), as has been the case with Bali's export products. Unfortunately these successful cases remain relatively rare.

The availability of finance for technology development

Another important element of industrial technology development is the availability and access to finance. The availability and access to term finance for investments in technology upgrading is facilitated if the capacity of the banking system to appraise such investments could be strengthened. In Indonesia during the late Soeharto era the government also attempted to improve the tax treatment of venture capital funds (World Bank, 1996: iv).

Unfortunately, even before the Asian economic crisis, finance for investments in technology development was scarce. After the surviving banks had recovered from the Asian economic crisis, the bulk of their loans has been provided for private consumption, which indeed has been the main driver of economic growth during the past few years. Banks and non-financial institutions have preferred to provide large amounts of loans for housing and credit card lending (Soesastro and Atje, 2005: 35). Under these conditions little is left to finance technology development, even if banks were willing to overcome their risk aversion, caused by their bad experience during the crisis when many corporate borrowers defaulted on their loans.

Hence, the amount of funds available for R & D in Indonesia relative to national income is very small compared with the other East Asian countries (Table 6). Even before the Asian crisis, R&D spending in Indonesia as a percentage of GDP was barely one per cent.

Table 6 Spending on R & D as a percentage to GDP in Indonesia and other East Asian countries

Country	R & D spending as a percentage of GDP
Japan (2002)	3.12
Republic of Korea (2002)	2.91
Taipei,China (1999)	2.05
Singapore (2000)	1.89
PRC (2000)	1.00

Malaysia (2002)	0.69
Indonesia (2001)	0.05

Source: *Buku Saku Indikator IPTEK Indonesia* (Pocketbook on Science and Technology Indicators, Indonesia, Jakarta, 2004, table A.1, p. 3.

Improve the performance of technology support services

To assist firms to improve their technological capabilities, effective technology support services are needed. These technology support services include effective metrology, standards, testing and quality support services (MSTQ services). These services also include the dissemination of information on the strict international standards required to enter export markets, such as technical standards or sanitary standards, and assistance to firms to get ISO 9000 certification and other important certifications, for instance on eco-labeling. It also includes industrial extension services to assist firms to improve productivity, quality of products, product designs and delivery times. Other important technology support services include technology information services to provide firms with information on best practices, that is globally competitive technologies (World Bank, 1996: v).

During the Soeharto era the performance of the available public technology support services, particularly the MSTQ services, was rated as inadequate by many firms. Many firms also did not realize that their products needed to conform to strict standards (such as technical and sanitary standards) and performance requirements (for example ISO 9000 certification), both national and international, particularly if they wanted to enter export markets (Thee, 1998: 127).

After the crisis the range and quality of these public institutes have declined further, as public funds to maintain and upgrade these services have been reduced. It has therefore been suggested that these technology support services should be privatized, but it appears unlikely that at present the private sector would be willing to take charge of these services, as firms are not sufficiently aware of their importance.

The above overview of the state of basic and enabling conditions for industrial technology development in Indonesia indicates that in general these important conditions have not been met during the Soeharto era, and even less so after the Asian economic crisis. This raises the question of what else the government, in consultation and cooperation with the private sector, can do.

Other Possible Measures to Promote Industrial Technology Development

Tax credits for R & D expenditures

To encourage R & D activities, the Department of Industry has offered firms tax-deductible incentives for expenditures on R & D. However, this measure has not been

effective in stimulating R & D activities in view of the relative small scale of operations of most firms, including FDI projects, and the great shortage of scientists, engineers and technicians, which makes R & D infeasible. Instead of full-fledged R & D laboratories, most large and medium-scale firms have only small laboratories for materials testing and quality control of the products they produce.

Public funding of research and development

Most funding on research is financed by the government, as shown in table 7.

Table 7 Sources of funds for R & D, 2000

Source of funds	Amount (millions of US\$)	Percentage (%)
Government	65.9	69
Private industry	24.7	26
Universities	5.4	6
Total	96.0.	100

Source: Buku Saku Indikator IPTEK Indonesia, Jakarta, 2004, table B.1, p. 11.

The above table shows that unlike Japan and the Republic of Korea and Taipei, China, where the bulk of R & D spending is funded and conducted by the private firms, the bulk of R & D spending in Indonesia is financed by the government, which allocates these funds to the state universities, to the R & D sections of various government departments and to the so-called 'non-departmental government institutes', including the Indonesian Institute of Sciences (LIPI) and the Agency for the Assessment and Application of Technology (BPPT).

An important part of these government funds, however, is not spent on actual research, but used for routine purposes, notably to supplement the relatively meager incomes of the researchers working in the various public bodies. In view of the relatively low pay of government employees, including researchers, a considerable part of research in the state universities and non-departmental government institutes is actually consulting work for international organizations and government departments in view of the relative weakness in research capability of most R & D units of the various departments. For this reason little basic research is conducted in these research centers.

The research centers in the universities and non-departmental government institutes have in general not been able to forge effective linkages with private industry, as the bulk of their research have been *supply driven*, that is determined by the research centers themselves, instead of *demand-driven*, that is determined by the actual needs of private industry (Thee, 1998; Thee and Pangestu, 1998). There is little awareness on the part of the research centers of the universities and non-departmental government institutes about the actual needs of private industry, while private industry has little if

any knowledge about what these research centers have to offer or, worse, have little confidence in the ability of these research centers to assist them in their research needs. Attempts at joint public-private initiatives have largely been unsuccessful.

Coordination of enterprises in clusters

A major feature of many small-scale manufacturing enterprises operating in Indonesia, particularly on Java, is that they have historically been operating in clusters, specifically in rural areas, in which they have grouped together geographically and by economic sub-sector (such as food, garments, non-metallic minerals, metal goods or handicraft industries). This clustering offers agglomeration economies that allow small manufacturing firms to participate profitably and competitively in wide trade networks, and this accounts for the resilience of these small-scale industries. Research conducted on these small firms in clusters has indicated that they have a significant influence on productivity, due to economies of scale in the purchase of raw materials or machinery, sale of output, and the spreading of risk associated with demand fluctuations (Berry, Rodriguez and Sandee, 1999).

The importance of these small firm clusters and the success of industrial clusters in countries like Italy has recently persuaded senior government officials, particularly in the Department of Industry, to advocate clustering for large and medium-scale enterprises. Thus far, however, not much progress has been achieved in realising this objective.

Public funding of strategic enterprises

During the late Soeharto era, Dr.Habibie, the then powerful Minister for Research and Technology, set up or designated already existing state enterprises as 'strategic industries', deemed of great national interest to Indonesia's industrial and technological development. These 'strategic industries' consisted of 10 state-owned enterprises, including the aircraft assembling enterprise IPTN, now renamed PT Dirgantara. All these 10 enterprises received lavish implicit and explicit government subsidies and strong protection with the blessing of President Soeharto.

Because of the tight fiscal situation after the Asian crisis, the four successive post-Soeharto governments, including the current government of President Susilo Bambang Yudhoyono, cannot afford to provide these 10 large state enterprises with lavish subsidies. Consequently, these 'strategic industries' have fallen on hard times, and can barely survive. PT Dirgantara, the jewel among the 10 'strategic industries, has laid off thousands of its workers.

Explicit Industrial policy

In response to strong public pressure, including from Parliament, to the Department of Industry to come up with an explicit industrial policy, this Department early in 2005

came up with a list of 32 strategic industries to be promoted. The criteria on which these industries have been identified are not very clear. The fact, however, that such a wide range of strategic industries have been selected has raised concern that the selection was not based on considerations of long-term economic viability and international competitiveness, but rather on the wishes of vested interests. For this reason there is concern that, just like during the Soeharto era, these industries will demand subsidies, government protection or assured government procurement, without good prospects that these industries will become economically viable and internationally competitive within a reasonable amount of time.

Conclusions

This paper has argued that past industrial policies in Indonesia have not been successful in nurturing an efficient and internationally competitive manufacturing sector. Industrial policy only shifted to export-promotion after the end of the oil boom era in 1982 forced the government to promote export-oriented industries to replace the declining oil sector as a new source of export revenues and as the new engine of growth. However, even during this export-promotion phase, the government did not have a clear idea about fostering an internationally competitive sector, as reflected in its not paying attention to the basic and enabling conditions necessary to promote the development of industrial technological capability required to develop highly competitive industries. Except for sound macroeconomic management and gradual trade reforms to reduce the 'anti-export bias' of the trade regime, it continued to rely more on Indonesia's traditional sources of comparative advantage in low skilled labor-intensive and resource-based industries as well as on keeping the real effective exchange rate at a competitive level. For this reason export-oriented industries kept on producing resource-based products (such as wood products) and low skilled, labor-intensive, low value added products, such as textiles, garments, footwear, consumer electronics, and toys, without shifting to higher value added products.

Under these conditions, the only realistic choice at present for Indonesia for the required industrial and technological upgrading of the manufacturing sector would be to attract more FDI, as was also evidenced by the recent study on Indonesia's industrial competitiveness conducted for the World Bank (Aswicahyono, Atje and Thee, 2005). Hence, for the government the most important policy priority is now to improve the poor investment climate if it wants to increase investment, particularly FDI, to raise economic growth and reduce absolute poverty. This will be an uphill struggle, as even modest efforts to improve the investment climate are running into strong resistance by vested interests (for example the customs and tax offices) and by the shortage of funds to rehabilitate the dilapidated physical infrastructure.

As economic growth picks up, Indonesia should not only rely on FDI as a source of new technologies and management methods, but also increase its own technological efforts to develop its technological base. This can be achieved by improving the *incentive system* for firms to encourage them to invest in upgrading their technological capability. This involves the removal of all restrictions on domestic competition and trade, which have adversely affected the business environment for firms. In consultation and

cooperation with the private sector, the government should also take steps to assist firms to improve their *supply-side capabilities* by raising its expenditures on education, including expanding educational facilities at all levels and improving the generally low quality of education, in order to increase the supply of well-trained workers required for industrial upgrading. A well-trained labor force will also improve the absorptive capacity for new and more advanced technologies imported by FDI and the other channels of international technology transfer.

With a better fiscal position as a result of more rapid growth, the government can also expand its expenditures on R & D, which should be more *demand-driven*, that is cater more to the actual needs of private industry rather than be *supply-driven*, that is determined by researchers' own preferences. In this way mutually profitable *linkages* can be established between private industry and the country's domestic science and technology infrastructure, which have been an important factor in the industrial technological development in East Asia, particularly in the Republic of Korea and Taipei,China.

As Indonesia's technology support services, specifically the public MSTQ services, have in general not performed adequately in meeting the needs of firms, privatizing these services would be advisable. This will not only lessen the fiscal burden, but more important, it will enable these important services to aim their services specifically at the needs of private industry.

These efforts, however, will only be successful if the government also manages to eliminate the various factors, which currently account for the poor investment climate which, in turn, imposes high costs on firms which reduces their competitiveness relative to firms in the other East Asian countries.

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