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Technology and Indonesia's Industrial
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THEE KIAN WIE
VISITING FELLOW
ASIAN DEVELOPMENT BANK INSTITUTE

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TECHNOLOGY AND INDONESIA'S INDUSTRIAL COMPETITIVENESS¹

by

THEE Kian Wie²

DRAFT

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² Senior Economist, Economic Research Centre, Indonesian Institute of Sciences (P2E-LIPI), Jakarta, and currently Visiting Fellow, Asian Development Bank Institute (ADBI), Tokyo. The views in the paper are those of the author not of the ADBI or ADB.

Introduction

During the first half of the 1990s (1990-96) the Indonesian economy grew rapidly at an average annual rate of 7.7 per cent, which was mainly driven by rapid growth of the manufacturing sector, which during the same period was growing at an average annual rate of 11.1 per cent. Following the end of the oil boom era in 1982, since the late 1980s the manufacturing sector, specifically the non-oil and gas manufacturing industries, had gradually replaced the oil sector as the major engine of growth and as the major source of export revenues. In turn, the rapid growth of the manufacturing sector was driven by the even more rapid growth of manufactured exports.

This rapid growth of manufactured exports was the result of a shift in industrial policy from an import-substituting pattern during the oil boom era of the 1970s to an export-promoting pattern after the oil boom era had ended as a result of a steep drop in the price of oil because of the weakening of the world oil market. This shift to an export-promoting pattern of industrialisation involved the introduction of various deregulation measures to improve the investment climate for the private sector, including foreign investors, and a series of trade reforms to reduce the strong 'anti-export bias' of the protectionist trade regime.

However, the manufactured export surge lasted only a few years, as since 1993 the growth of manufactured exports slowed down, raising concern among Indonesia's policy-makers that Indonesia's comparative advantage in labour-intensive and resource-intensive manufactured exports was eroding because of the competition of lower-wage developing countries in the region. As rapid economic growth since the late 1980s depended to a large extent on sustained manufactured export growth, the challenge of raising Indonesia's apparent weak industrial competitiveness became pressing.

Before the Indonesian government could adequately deal with this challenge, the country was severely hit by the Asian financial and economic crisis in 1997. The crisis had a devastating effect on the Indonesian economy, which contracted by almost -14.0 per cent in 1998, while the manufacturing sector contracted by almost -12.0 per cent. Indonesia's economic recovery also took a much longer time than in the two other worst-affected countries, the Republic of Korea and Taipei, China, because the Indonesian government's inability to deal effectively with the crisis led to a serious political crisis, which in May 1998 forced President Soeharto to resign after a reign of 32 years. The ensuing political turbulence and economic downturn also led to a worsening investment climate and a sharp decline in fixed investment from around 30 per cent of GDP during the Soeharto era to only 17.8 per cent in 2003, the lowest level since the early 1970s (World Bank, 2004: 2).

As positive net foreign direct investment (FDI) inflows into the country before the crisis turned into net FDI outflows, with very little investments flowing in, Indonesia descended further into a downward spiral of rising unemployment and declining investments in manufacturing and the physical infrastructure (Watanabe, 2005: 3). In fact, in 2003 and 2004 there was concern that Indonesia was prematurely 'de-industrialising', as foreign and even domestic firms were relocating to neighboring countries, including Malaysia and Viet Nam. That concern has now abated, as the available empirical evidence does not support this concern.

After the Asian economic crisis, the challenge of raising Indonesia's industrial competitiveness has become even more pressing than it was before the crisis, particularly as Indonesia was losing its market share in no less than 30 products to other developing countries, particularly to the People's Republic of China (PRC) and Viet Nam, which have a

similar structure of manufactured exports, notably textiles, garments and footwear. Moreover, the volume of Indonesia's non-oil exports, particularly its manufactured exports, in 2002 was not higher than its level in 1995-6, while its world market share remained at a miniscule 0.8 per cent (Pangestu, 2005: 5-6.).

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 industrial competitiveness. The paper will first give an overview of Indonesia's industrial development before and after the Asian economic crisis. The paper will then discuss some recent assessments on the country's industrial competitiveness. The paper will then discuss in greater detail the determinants of Indonesia's industrial technological development, including the policies which the government should pursue to encourage this development, particularly by strengthening those determinants through judicious intervention or by removing constraints hindering the effectiveness of these determinants. The paper will end with conclusions and policy-implications.

Industrial Development During the Soeharto Era

During the 32 years of 'New Order' rule (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' (HPAEs) in the early 1990s, along with Japan, the four 'Asian Tigers', and Indonesia's two Southeast Asian neighbours, 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-industrialising economy (NIE) in the World Bank 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, which were growing at single digits, the Indonesian economy also underwent a rapid transformation, as reflected by the rapid decline in the relative importance of agriculture in the economy and an equally rapid rise in the relative importance of the manufacturing sector (Table 1). In fact, by 1991 manufacturing's contribution to GDP for the first time exceeded the contribution of the agricultural sector (Aswicahyono 1997: 25). As a result of this rapid industrial growth, Indonesia in 1996 had the seventh-largest manufacturing sector in terms of gross manufacturing value added among the developing countries after PRC, Brasil, the Republic of Korea, Argentina, Mexico, and India (World Bank, 1999: 196-8), even though its manufacturing sector in the mid-1960s was miniscule and backward.

Table 1 Economic growth and transformation in Indonesia, 1965-1997

	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
Industry	11.9	6.9	9.9	13	43
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*, Oxford University Press, 1992, table 2, p. 220; table 3, p. 222;
2. For the periods 1980-1990 and 1990-1996: *World Development Indicators 1999*, Development Data Center, 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 liberalisation of economic policies, particularly 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 the import-substituting policies which enabled domestic producers and foreign investment projects to replace imported light consumer goods and consumer durables.

However, 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 booms, 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.

However, by 1983 the end of the oil boom sharply reduced Indonesia's export earnings and the government oil tax revenues. As a result, the government was forced to defer, if not cancel outright, the establishment of several large-scale, state-owned 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, 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 the direction of 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 actually imported or locally made, at international prices. This scheme turned out to be a crucial factor in encouraging foreign and domestic firms to export.

The various deregulation measures and trade reforms, 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 the manufacturing sector since 1987 generated a rapid surge in manufactured exports. In fact, this surge 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, since the mid-1980s emerged as the country's major 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 the period 1989-92 the manufacturing sector surged 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).

Since 1993, however, up to the crisis year of 1997 the growth of the manufacturing sector slowed down to an average 12 per cent, as the growth of manufactured exports grew only at a sluggish 7 per cent (Dhanani 2000: 28). One major reason why the growth rates were high was that they started from a low base (HIID 1995: 1).

Nevertheless, the concern of policy-makers and academic economists alike about the slowdown in the growth of manufactured exports since 1993 was understandable, 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 the sustainability of manufactured export growth, the Indonesian government commissioned some studies to look into this problem. A study conducted by the Harvard Institute of International Development (HIID) in 1995 for the Department of Industry and Trade found that Indonesia was behind its international competitors in laying the foundation for developing skill- and capital-intensive exports (HIID 1995: 7).

Based on the experience of the successful Asian newly-industrializing economies (NIEs), the HIID study suggested the following core elements of a strategy for developing Indonesia's manufactured exports, namely deepening the export base, particularly by increasing the domestic content of exports; expanding the number of exporting firms; encouraging firms oriented towards the domestic market to start exporting; and building a base for more sophisticated exports, by developing the capacity of manufacturing firms to acquire, adapt, and build on new, imported technologies. Developing these technological capabilities would need government support, particularly in ensuring that the necessary scientific and engineering skills are available, in strengthening quality control efforts and in ensuring that property rights are duly protected (HIID 1995: 5-7). Like the NIEs, the only basis for modernising Indonesia's export base was to achieve continued gains in the productivity of workers, capital, and the firms themselves (HIID 1995: 1). Hence, the challenge facing Indonesia's manufacturing sector was to achieve a sustained increase in total factor productivity (TFP).

A few studies have indicated that TFP growth rates in Indonesian manufacturing are greatly affected by the policy environment, as shown by the findings of Hill, Aswicahyono, & Bird; and Timmer on TFP growth in Indonesian manufacturing during the 1980s and 1990s (Table 2).

Table 2 Average annual TFP growth in Indonesian manufacturing, 1975-95

Period	Average annual TFP growth (%) (1)	Period	Average annual TFP growth (%) (2)
1976-81	0.7	1975-81	1.0
1982-85	1.1	1982-85	0.1
1986-91	2.1	1986-90	7.9
		1991-95	2.1
		1975-95	2.8

Source: For (1), Hill, Aswicahyono, and Bird (1997), table 3.8;
and for (2) Timmer (1999), table 4, p. 87.

Hill's, Aswicahyono's and Bird's study found that TFP growth rates in Indonesian manufacturing varied according to three distinct policy periods, namely the period of import-substituting industrialisation during the oil boom (1976-81), the immediate post-oil boom period when existing policies were reassessed (1982-85), and the period marked by a more decisive shift to export-promotion policies (1986-91). Average annual TFP growth was low during the first period, then rose during the second period, and then rose faster during the third period (Hill, Aswicahyono and Bird 1997: 78). Evidently, the more favourable policy environment since the mid-1980s had a positive impact on TFP growth.

A more recent study by Marcel Timmer on aggregate TFP growth in Indonesian manufacturing came up with largely similar findings. Subdividing the period studied into five-year intervals, Timmer found, like Hill, et.al., that average annual TFP growth rate was low during the import-substituting phase of the late 1970s-early 1980s. After the policy reforms introduced since the mid-1980s, TFP growth accelerated steeply in the late 1980s (Timmer, 1999: 84-7). During the first half of the 1990s TFP growth declined again, although it was still higher than during the import-substitution phase of the 1970s - early 1980s.

Despite the soundness of the recommendations of the HIID and other studies, the government had on the eve of the Asian economic crisis not yet completed the necessary deregulation of international trade, including further tariff reductions and relaxation of non-tariff barriers (NTBs), which would have reduced the production costs of manufacturing firms and raised their international competitiveness (World Bank 1997: 112). In addition, extensive regulations and restrictions on domestic competition also added to the costs of doing business in Indonesia, thereby further reducing the efficiency of private firms (World Bank 1997: 118).

One major reason why the Indonesian government had by 1997 not yet taken the necessary steps, obvious to economists, to further deregulate international trade and lift the policy-generated barriers to domestic competition, was the influence of Dr. B.J. Habibie, the powerful Minister of State for Research and Technology. Unlike most economists, Habibie, an aeronautic engineer by training, held that Indonesia should no longer depend on labour-intensive industries, which in his view were 'sunset industries', the international competitiveness of which were declining (Thee 1998: 33). To compensate for the decline of these 'sunset industries', Habibie instead promoted the development of 'strategic industries', particularly the state-owned, 'hi-tech' aircraft industry, which in his view would yield considerably more foreign exchange earnings than the 'sunset industries'. To develop these 'strategic industries', these industries needed to be temporarily protected and subsidised (Thee 1998: 133).

Habibie's views on promoting costly 'strategic industries' were strongly criticized by economists, since these industries were very costly, not economically viable within the foreseeable future and imposed high social opportunity costs on the country. However, because of Habibie's strong influence on President Soeharto, his views prevailed in spite of the strong reservations of Indonesia's economic technocrats. Hence, during the 1990s up to the crisis of 1997/98 the Indonesian government pursued a '*dual track*' industrialization strategy by pursuing both the 'broad spectrum' policy of outward-looking industrialization, as pursued by a more export-oriented Department of Industry and Trade, and the promotion of

the costly 'strategic industries' as promoted by Habibie and his fellow 'technologists' (Thee & Pangestu 1998: 262).

Industrial Development after the Asian Economic Crisis

After the onset of the Asian economic crisis, growth of Indonesia's manufacturing sector slowed down sharply. While manufacturing in 1996 grew at almost 12 percent, it slowed to 5.3 percent in 1997 and in 1998 contracted by -11.4 percent. (Table 3)

Table 3 Growth of Indonesia's GDP and Manufacturing Sector, 1997–2004

	1997	1998	1999	2000	2001	2002	2003	2004	2005 (Q-1)
GDP	4.7	-13.1	0.8	4.9	3.5	3.7	4.1	6.7	6.3
Manufacturing	5.3	-11.4	3.9	6.0	3.1	3.4	3.5	7.2	7.0
Oil and gas industry	-2.0	3.7	6.8	-1.7	-3.5	1.2	0.6	-	-
Non-oil and – gas industries	6.1	-13.1	3.5	7.0	4.0	3.7	3.8	8.7	8.1

Source: Badan Pusat Statistik (BPS), Jakarta.

Although manufacturing growth recovered to a sluggish 3.9 percent in 1999 and to 6.0 percent in 2000, it grew sluggishly from 2001 through 2003. However, in 2004 it rose sharply to 7.2 per cent in line with more rapid economic growth.

The growth of the non-oil and -gas industries, which generate the bulk of the surge of non-oil exports since the late 1980s through 1996, has also declined from a high of 7.0 percent in 2000 to 4.0 percent or less from 2001 through 2003. However, in 2004 the non-oil and gas manufacturing sub-sector grew at 7.8 per cent, which was the highest rate after the crisis. During the first quarter of 2005 manufacturing kept growing at 7.0 per cent.

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 unfavourable business environment. This is reflected by an inflexible labour market (characterized by high severance costs and mandatory annual increases in minimum wages), excesses of regional autonomy in which local governments impose various new local taxes and levies and restrictive regulations, discretionary tax assessments by corrupt tax officials, inadequate physical infrastructure and traffic congestion from the plants to the ports (Kuncoro, 2005: 8). These problems need to be solved to achieve a stronger recovery of the manufacturing sector and improve its competitiveness.

Some Assessments of Indonesia's Industrial Competitiveness

Since the early 1990s policy-makers and academic economists were arguing that Indonesia had to develop a more sustainable source of comparative advantage, primarily by raising

industrial technological capabilities (ITCs) and associated organizational capabilities, as the technological base in general is shallow and backward compared to that of the East Asian newly-industrialised economies (NIEs), particularly the Republic of Korea and Taipei, China. Compared to these NIEs, Indonesia's capacity to absorb and improve upon complex imported technologies is narrow and weak; its capital goods sector, a crucial element of industrial deepening, is relatively underdeveloped, and its relatively modest technological effort (even before the Asian economic crisis) was distorted and concentrated (Lall 1998: 136), mostly on the 10 state-owned strategic industries, in particular the costly, state-owned aircraft assembling enterprise PT Dirgantara Indonesia (DI).

Although Indonesia's rapid industrial growth and transformation during the past three decades was undoubtedly accompanied by technological upgrading, as reflected by rising TFP levels (table 2), particularly since the mid-1980s, the development of Indonesia's industrial technological capabilities (ITCs) has lagged behind that of the Asian Tigers, particularly the Republic of Korea and Taipei, China. These low ITCs are, amongst others, reflected by the low percentage of high technology exports of Indonesia's manufactured exports, as compared to those of the other East Asian countries (table 4)

Table 4 The amount and percentage of high technology exports of selected East Asian countries, 2003

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

Note: High technology exports are products with 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 laying the foundation for developing skill- and technology-intensive industries.

Indonesia's relatively low ITCs have also been confirmed by more qualitative firm-level surveys conducted by, amongst others, international consulting firms (SRI International,

1992) and in 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 comparative study indicated that Indonesia's ITCs, even in export-oriented textile, garment and electronics firms, were 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. The study also found that the ITCs of local personnel in FDI projects was mostly limited to the basic production or operational capabilities to ensure the smooth operation of the plants. As in several FDI projects the local employees had not been involved in the search for and procurement of the required technologies and in designing and setting up the plant, their investment or acquisitive capabilities had also not been developed adequately. In most of the FDI projects the local employees had also not been much involved in introducing minor changes in the process or process technologies of these projects, thus giving them little opportunity to develop the basic adaptive or minor change capabilities. However, in domestic firms without foreign equity, the local employees had a better opportunity to develop both the basic operational as well adaptive and acquisitive capabilities, as they had to do these activities themselves (Thee & Pangestu, 1998: 236-51). None of these firms, including FDI 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. However, as FDI projects could keep track of recent technological developments because of their links with their principals, developing these innovative capabilities was not required. In the case of domestic firms producing under technical licensing agreements with foreign principals, developing innovative capabilities was beyond their reach, as the technologies they had purchased were mature technologies (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. This has, amongst others, been reflected into increased labour productivity. However, since 1992 the competitiveness of the garment industry has declined because of the lack of new investments in machinery since 1992. Since 1998, however, the garment industry again regained competitiveness in the world market because of the steep *rupiah* depreciation. It has been estimated that if the *rupiah* strengthens below Rp. 9,000 to the US dollar, the industry will lose competitiveness again. If other factors, such as the high capital and bureaucratic costs, poor infrastructure, and business-unfriendly labour regulations, are not adequately solved, the garment industry will be further diluted (Aswicahyono, Atje & Thee, 2005: 136-7).

Against these unfavourable factors, there are some favourable factors, as Indonesia has a relatively complete industry structure, with a strong upstream fibre industry due to Indonesia's oil resources. Moreover, despite the steady rise in mandatory minimum wages, unit labour costs in the industry are still competitive. However, while the garment industry's engineers are generally quite capable in the investment, production management and engineering, and the repair and maintenance capabilities, they lack the more demanding major change, marketing and product diversification capabilities to upgrade the industry's technological capabilities. 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 & Thee, 2005: 137-8).

The study on the auto parts sector found that the dependence of most auto part firms on the domestic market oriented car assemblers has constrained the industry from developing into an internationally competitive industry. Unfortunately, because of the high dependence of the car assembling industry on their foreign principals, it is unlikely that the industry will be allowed into an export-oriented industry, because these foreign principals (TNCs) in the advanced countries have imposed restrictive conditions, specifically a ban on car exports by the car assemblers. For this reason, the auto parts industry is also unlikely to develop into an export-oriented, internationally competitive industry in the near future. For this reason, the technological upgrading of this industry will also require more FDI in this industry. To achieve this objective, however, the government must take more determined and effective steps to substantially improve the country's poor investment climate (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 neighbour, as it responded rather slowly to moves by the electronic firms in the industrial countries, such as the US, Japan, the Republic of Korea and Taipei, China, to relocate their factories to Southeast Asia. A sustained development of the electronic components industry only started in the early 1990s, but in 1991 its share was only around 0.6 per cent of the world market. The Asian economic crisis shattered Indonesia's hope for inflows of new FDI, particularly because of the poor investment climate. In fact, in recent years no significant investment has been made in this sector. However, like the garment and auto parts industries, the technological upgrading of the electronic components industry also requires more FDI which, in turn, requires a substantial improvement in the poor investment climate (Aswicahyono, Atje & Thee, 2005: 140-41).

In a critical assessment of Indonesia's ITCs, Sanjaya Lall also pointed out the relatively low level of the country's ITCs. 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 pages the basic and enabling conditions to enhance Indonesia's industrial competitiveness through improved technological capabilities will be discussed.

Enhancing Indonesia's industrial competitiveness through industrial technological development

International experience, particularly of the East Asian NIEs, has indicated that raising Indonesia's export 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 thus far its manufactured exports has mainly consisted of resource- and low skill labour-intensive products, which generally involve less effort, risk, and externalities. On the other hand, 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 Sanjaya Lall's study on the determinants of industrial technology development (Lall, 1996a) and the World Bank's 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. International experience, particularly of the East Asian NIEs, has shown that an industrial technology development strategy requires that certain basic and enabling conditions are met or created (World Bank, 1996: 2-5).

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, diffuse new technologies, and make an effective choice and efficient use of new technologies;
3. The upgrading of the quality 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:

1. Improve the manufacturing firms' access to foreign technologies through foreign direct investment (FDI), technical licensing agreements, capital goods imports, and foreign trade;
2. Improve the availability of adequate finance for industrial technology development;
3. Improve the effectiveness and performance of the technology support services.

The pursuit of sound macroeconomic policies and pro-competition policies constitute the *incentive system*, which would stimulate a firm's *demand* for improved ITCs, while upgrading human resources, improving the access to more advanced foreign technologies, finance and technology support services would improve the *supply-side capabilities* of a firm.

The policies to meet the above conditions are discussed below.

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.

Although during the Soeharto era the Indonesian economy experienced several major shocks, such as the debt crisis of Pertamina, the large state-owned oil company, in early 1995, the two oil booms of the 1970s (1973/74 and 1978/79), and the crisis caused by the end of the oil boom in 1982, the Indonesian government took immediate steps to tackle these shocks and restore macroeconomic stability. As a result, during the Soeharto era Indonesia's record on controlling inflation has been fairly good, although Indonesia's inflation during the mid-1980s through the mid-1960s was always slightly higher than that of its East Asian neighbours, 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 steeply to 80 per cent in early 1998. However, in the course of 1998 the hyperinflation was gradually brought under control because of tight monetary policies. As a result, inflation flattened out quite suddenly, and from late 1998 to mid-1999 inflation dropped to only 5.2 per cent (Hill, 1999: 29).

Whatever the political differences between the post-Soeharto governments (Habibie, Abdurrachman Wahid, Megawati Sukarnoputri, and currently Susilo Bambang Yudhoyono), all these governments realized the great importance of sound macroeconomic policies to maintain macroeconomic stability. Under the able stewardship of Dr. Boediono, Minister of Finance in the Megawati administration (2001-04), macroeconomic stability was strengthened, as reflected by a stable inflation rate of 6 per cent in 2004, while fiscal sustainability was strengthened, as the government debt to GDP ratio continued to fall from 59 per cent in 2003 to 51 per cent in September 2004 (World Bank, 2005: ii; 5) Although the recent large increases in fuel prices has raised inflation, it is likely that just like in early 2005, inflation is likely to 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 has been an important prerequisite for technology upgrading. In these countries competition has been 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. As noted earlier, after the end of the oil boom 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, and product design and product quality in order to compete in the export markets (World Bank, 1996: 7).

After the mid-1980s the 'New Order' government introduced a series of trade reforms involving a steady reduction in tariff protection and non-tariff barriers (NTBs), specifically quantitative import restrictions. However, by the time the 'New Order' government had introduced its last trade reforms in early 1997, the trade regime still had a lower, but still significant 'anti-export bias' because of remaining import protection (Thee, 1998: 118-9).

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

Only after the onset of the Asian economic crisis was the Indonesian government forced, as part of its first assistance 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 provided for a further deregulation of the foreign trade and foreign investment regimes as well as the domestic competition regime (Thee, 2002: 332).

Aside from the deregulation policies which were intended to promote competition in the local and national markets, in early 1999 the new Indonesian government under President Habibie enacted a competition law, the Law Banning Monopolistic Practices and Unfair Competition, as part of its third agreement with the IMF. This competition law was intended to establish guidelines for fair business practices and act against anti-competitive behaviour by firms. In 2000 the government also established a Business Competition Supervisory Commission to implement and enforce the law (Thee, 2002: 332-3).

Since the appointment of a Business Competition Supervisory Commission, many cases, particularly bid rigging or closed tenders, have already been investigated by this Commission. While some of its decisions have been criticized, it has been quite active in pursuing and investigating cases where anti-competitive business conduct was suspected.

Unfortunately, the deregulation policies of the recent past have been offset by the proliferation of new regulations and restrictions by local governments since decentralisation (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 in 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, where they face a level playing field.

Upgrading the quality of human resources

A well-trained labour force, an effective training system, good quality science and engineering faculties of universities, and good management training and development programs are key elements for sustaining Indonesia's industrial technology development (World Bank, 1996: ii). However, despite the undeniable progress which Indonesia has made during the Soeharto era in expanding education at the primary, and to a lesser extent at the secondary and tertiary levels, the quality of education and training at all levels needs to be raised substantially.

Despite the progress in expanding education during the Soeharto era, 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 5).

Table 5 Education inputs, participation in education and education outcomes in the East

Asian countries, 2002/03

Country	Public expenditure on education (% of total government expenditure, 2002/03)	Gross enrollment ratio, 2002/03			Adult literacy rate, 2002	
		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
Singapore	--	--	--		97	89
Thailand	28.3	98	83	37	95	91
China	-	116	67	13	95	87
The Republic of Korea	13.1	104	90	85	--	--

The data in table 5 shows that both in terms of education inputs (public expenditure on education), and participation in education, Indonesia in general lacks behind its South East Asian neighbours, the Republic of Korea and PRC. In regard to public expenditure and the gross enrollment ratio in secondary and particularly in 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, as a result 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 or Rp. 12 trillion in absolute terms. However, in 2004 public expenditure on education accounted for only 10 per cent of central government expenditure (table %) or Rp. 25 trillion in absolute terms (Ninasapti, 2005). 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 reason is that 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).

Moreover, the senior secondary technical vocational schools, two thirds of which are privately-funded and –operated, are poorly staffed and equipped, and thus do not equip the graduates with adequate practical knowledge. Post-secondary vocational technical education, on the other hand, is mainly provided by the government (Dhanani, 2000: 11), which currently lacks the resources to expand education and improve the quality of education, particularly technical education.

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

The Enabling Conditions

Improving manufacturing firms access to foreign technologies

Like other developing countries, Indonesia is a net importer of advanced technologies developed in the advanced industrial countries. These advanced technologies are crucial to enhance a country's technological capabilities to produce more efficiently and competitively. The experience of Japan and the East Asian NIEs, particularly the Republic of Korea and Taipei, China, 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 to raising these countries' technological capabilities. Hence, the international transfer of technology has been an important source of technical progress in these countries (Chen 1983: 63).

In view of the economic importance of these imported technologies, it is important to identify the major channels through which these technologies have been transferred to Indonesia, particularly to its manufacturing sector. Some studies on international technology transfer in 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 to Indonesia. 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 ITCs has not played a significant role in Indonesia.

The major channels of international technology transfer will briefly be discussed below.

Foreign direct investment (FDI)

While Indonesia since the late 1980s through 1996 experienced large net FDI inflows, after the onset of the Asian economic crisis it experienced net FDI outflows, which have persisted through 2003 (Table 6). Even the positive net FDI inflow in 2004 was much smaller than the large net FDI inflows during the late 1980s through 1996. This positive figure was caused by the fact that Bank Indonesia has recently included the privatisation of state-owned enterprises (SOEs), specifically the sale of these SOEs to foreign investors,

and bank restructuring, specifically the sale of distressed banks to foreign investors, as part of FDI inflows.

The lack of interest of foreign investors to undertake new greenfield investments after the Asian economic crisis can be attributed to Indonesia's poor investment climate, which currently ranks among the worst in the East Asian region. Various factors account for this poor investment climate, including the lack of legal certainty, lack of safety, labour problems, mainly caused by a business-unfriendly labour law and regulations, confusion caused by the regional autonomy introduced in early 2001, widespread corruption, and crumbling physical infrastructure and traffic congestion from the plants to the harbour and vice versa. The net effect of these problems is uncertainty, higher costs and many demands for bribes (MacIntyre & Resosudarmo, 2003: 146; World Bank, 2003: 29).

Table 6 Net FDI in- and outflows into and out of Indonesia, 1986-2004

Net FDI in- and outflows into and out of Indonesia,

<u>1986 – 2004</u>	
(millions of US\$)	
<u>Year</u>	<u>Net FDI in- and outflows</u>
1986	258
1987	385
1988	576
1989	682
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 privatisation of state-owned enterprises (SOEs), 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 East Asian countries worst affected by the Asian economic crisis, saw a revival of FDI into these two countries 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 much less able to obtain these benefits, as FDI instead flowed out of the country.

Aside from the fact that only very small amounts of FDI have come to the country, the government as well as the Indonesian firms have also to learn how to obtain greater technological spillovers from the presence of the FDI projects than was the case during the Soeharto era. To a large extent the lack of success of Indonesian firms to develop greater ITCs from the presence of FDI may be due to the lack of a clear idea on the part of the Soeharto government how to utilise FDI for greater national benefit. This is clearly reflected by the shifts in foreign investment policy from a liberal to a restrictive stance in the 1970s, and then back again to an increasingly liberal stance since the mid-1980s to the onset of the Asian economic crisis.

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 (TLAs). Although no quantitative data are available on the number of these TLAs, circumstantial evidence indicates that these TLAs 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-industrialising economy like Indonesia, acquiring and mastering these older technologies first is a good way to develop the important basic industrial technological capabilities (ITCs), namely the production, investment and adaptive capabilities.

Imports of capital goods and the transfer of skills by technical experts of foreign supplier firms

Imports of capital goods provide another way of acquiring the means of production without the transactional costs involved in FDI or TLAs (Dahlman, Ross-Larson & 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).

These imported capital goods can be a cheap way of developing local ITCs if they can be used as models for reverse engineering to produce the machines locally (Dahlman, Ross-Larson & Westphal 1987: 768). However, Indonesian firms have in general not engaged

in 'reverse engineering' on a large scale to develop their ITCs. However, 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 kind of technology and skill transfer by technical experts from foreign firms to Indonesian employees has been quite significant for most foreign machinery suppliers. This training is crucial as the mere imports of capital goods do not automatically lead to an enhancement of local ITCs, if local employees do not know how to operate, maintain or repair the imported machinery. However, if the imports of capital goods is accompanied by the effective training of local workers on how to operate, maintain and repair the imported machinery, these imports will lead to the development of the basic production (operational) capabilities of the firms and over time also to the development of adaptive capabilities, specifically to carry out minor process adaptations (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 (SMEs), has been provided by their participation in world trade, specifically through exporting their products. This informal channel was utilised effectively by local firms, particularly electronics firms, in the four East Asian NIEs, including the Republic of Korea, Taipei, China, Hong Kong, China and Singapore which, based on low wage rates, were able to build up basic operational (production) capabilities through simple assembly of mature products for exports, often developed through technical assistance provided by foreign buyers (Hobday, 1994: 335; World Bank 1996: 4). These local NIE firms successfully coupled export and technological development, allowing export market needs (the needs and design and product specifications of their overseas buyers) to focus their investment in technological upgrading and to provide a channel for them to acquire foreign technologies from their overseas buyers. 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 vital information transfer and technical and managerial assistance (for instance in plant lay-out, 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. This assistance was provided on a for-profit basis, as it was specifically tied to tangible product output results (Cole 1998: 275; Thee & Hamid 1997). 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).

In fact, a similar type of vital information transfer and technical, managerial and marketing assistance by foreign buyers who also acted as technical consultants, is also found in the development of the export-oriented furniture industry in the town of Jepara, Central Java. These foreign buyers played a major role in introducing new, higher value added designs, teaching quality control methods, standardising output required for the rapid expansion of order-driven production tailored to the quickly changing preferences of foreign buyers, and opening up new export markets for modern Jepara furniture. As a result, the quality of Jepara furniture has been steadily upgraded (Sandee, Andadari & Sulandjari, 2000: 5-7), as has been the case with Bali's export products.

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 would be facilitated if the capacity of the banking system to appraise such investments could be strengthened. In Indonesia the government during the late Soeharto era 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, if at all available. The Indonesian government never considered establishing a financing firm for technology development, similar to the Republic of Korea's Korea Technology Development Corporation (KTDC) (World Bank, 1996: 29). A state-owned venture capital firm, the PT Bahana Pembinaan Usaha Indonesia (Bahana PUI) was mainly entrusted to guide and development small-and medium enterprises (SMEs) (FIAS: 1996: 54). However, the performance of this venture capital firm has not been satisfactory, as it was generally not very successful in guiding the development of SMEs to become viable.

After 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. At present banks and non-financial institutions have provided large amounts of loans for housing loans and credit card lending. In fact, bank consumer credit has been growing rapidly since 2000, and in 2004 grew at an average year-on-year rate of over 30 per cent (Soesastro & 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 Asian economic crisis when many borrowers defaulted on their loans. As a result of the Asian economic crisis, the amount of funds available for R & D in Indonesia is miniscule, not only compared with Japan and the East Asian NIEs, but also compared to Malaysia (Table 7).

Table 7 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
The 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: Processed from OECD data on main science and technology indicators by PAPPITEK-LIPI (Research Centre for Science and Technology Development, Indonesian Institute of Sciences) and the Kenterian Research dan Teknologi (Office of the Minister of State for Research and Technology), and published in: Buku Saku Indikator IPTEK Indonesia (Pocketbook on Science and Technology Indicators, Indonesia, Jakarta, 2004, table A.1, p. 3.

The above data clearly show how far behind Indonesia is in R & D activities compared to the other East Asian countries because of the great shortage of funds, particularly after the Asian economic crisis. Even before the Asian crisis, R&D spending in Indonesia as a percentage of GDP was barely 1.0 per cent.

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 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-labelling. 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 technology support services, particularly the MSTQ services, was rated as inadequate by many firms. To some extent this was caused by the fact that many firms did not realise that their products needed to conform to strict standards (e.g. technical and sanitary standards) and performance requirements (e.g. ISO 9000), both national and international, particularly if they wanted to enter export markets (Thee, 1998: 127).

The available technology support service providers, including the important MSTQ services, are public institutes. The quality of these services was generally rated by many firms as inadequate before the Asian economic crisis. However, after the crisis the range and quality of these public institutes have likely 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 privatised, but it appears unlikely that at present the private sector would be willing to take charge themselves of these services, as firms may not be sufficiently aware of the importance of these services.

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. The Indonesian government will therefore have to focus its industrial and technology policies on attempting to meet the above conditions for industrial technological development, if it is serious in raising Indonesia's industrial competitiveness.

Other Possible Measures to Promote Industrial Technology Development

Tax credits for R & D expenditures

To encourage R & D activities, the Department of Industry offers 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 make R & D not feasible. 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 8.

Table 8 Sources of funds for R & D, 2000

Source of funds	Amount (billions of rupiah)	Percentage
Government	659	68.6
Universities	54	5.6
Private industry	247	25.7
Total	96 0	100.0

Source: PAPPITTEK-LIPI & Kementerian Research dan Teknologi, Buku Saku Indikator IPTEK Indonesia, Jakarta, 2004, table B.1, p. 11.

The above table shows that unlike Japan and the East Asian NIEs, specifically the Republic of Korea and Taipei, China, where the bulk of R & D spending is funded and conducted by the private firms themselves, the bulk of R & D spending is financed by the government, which allocates these funds to the state universities, the R & D outfits of the various government departments and 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).

While the research centres at the state universities are expected to conduct basic research, the research centres of the non-departmental government institutes are expected to conduct more applied research, particularly on the various development problems facing the country. The R & D units of the various government departments are expected to conduct applied research and development on issues of direct importance to their respective departments.

An important part of these government funds, however, are not spent on research, but are used for routine purposes, notably to supplement the relatively meager incomes of the public servants working in the various research centres of the state universities, non-departmental government institutes and the R & D units of the various departments. In view of the relatively low pay of government employees, including the 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 centres.

The research centres 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 centres themselves, instead of *demand-driven*, that is determined by the actual needs of private industry (Thee, 1998; Thee & Pangestu, 1998). In fact, there is little awareness on the part of the research centres 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 centres have to offer or, worse, have little confidence in the ability of these research centres to assist them in their research needs.

Coordination of enterprises in clusters

A major feature of many small-scale manufacturing enterprises (SEs) operating in Indonesia, particularly on Java, is that they have historically been operating in clusters, specifically in rural areas, in which they grouped together geographically and by economic subsector (food, garments, non-metallic minerals, metal goods or handicraft industries). This clustering offers agglomeration economies that allow manufacturing SEs to participate profitably and competitively in wide trade networks, and this accounts for the resilience of these small-scale industries. Research conducted on these SIs 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 spread of risk associated with demand fluctuations (Berry, Rodriguez & Sandee, 1999).

The importance of these SI 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.

Encouragement of joint research initiatives

Indonesian research institutes and their foreign counterparts, particularly from the advanced countries, have for a long time been quite active in carrying out joint research. Most, if not all, of this research, however, has been of an academic nature. Thus far no joint research has been undertaken on the technological upgrading of Indonesia's manufacturing firms.

The Indonesian government, specifically the Indonesian Research Council (DRN) and the Indonesian Institute of Sciences (LIPI), have during the past decade attempted to encourage joint research by Indonesian research institutes, which would be funded by private industry and which therefore be geared to the technical needs of private industry. In fact, however, these attempts have thus far generally been unsuccessful, as it has turned out that most of the proposed research projects were formulated by the academic researchers themselves, who expected funding to come from private industry. In other words, the proposed research projects were *supply-driven* rather than *demand-driven* (Thee, 1998). For this reason private industry has shown little inclination to fund these proposed research projects.

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 (SOEs), including the aircraft assembling enterprise IPTN (Industri Pesawat Terbang Nusantara), now named PT Dirgantara; the shipbuilding plant PT PAL, a steel plant, PT Krakatau Steel; a consumer electronics enterprise, PT LEN, which was expected to develop electronic components; two machine tool enterprises dating back to the Dutch colonial period; an enterprise assembling train wagons; an enterprise making phone sets; and two enterprises making light armaments respectively ammunitions for the army. These 10 'strategic' SOEs were managed by a state holding company, the Managing Board of Strategic Industries (Badan Pengelola Industri Strategis, BPIS), which was chaired by Dr. Habibie, who got the full support of President Soeharto. All these 10 SOEs received lavish implicit and explicit government subsidies and strong protection with the blessing of President Soeharto.

Although this BPIS was never disbanded after the fall of Soeharto, the concept of 'strategic industries' has disappeared from current government policy. Because of the tight fiscal situation, the four successive post-Soeharto governments, including the current government of President Susilo Bambang Yudhoyono (SBY), could not and cannot afford to lavish these 10 SOEs 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', was recently considering to lay off thousands of its workers, which have vociferously resisted these lay-offs and have taken their predicament to the government and the parliament. At present there is now a 'stand-off' between the government and the workers.

In response to strong public pressure, including from the parliament and columnists, to the Department of Industry to come up with a clear industrial policy, this Department early this year came up with a list of 32 strategic industries, which need to be promoted. The criteria on which these industries have been identified, however, are not very clear. The fact, however, that such a wide range of strategic industries have been selected, apparently without regard to national priority, has raised concern that the selection was not strongly 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

The above discussion has indicated that past industrial policies in Indonesia have not been successful in nurturing a strong, economically viable and internationally competitive manufacturing sector. Industrial policy during the oil boom of the 1970s was inward-looking and focused on a costly second-stage import substitution to establish upstream, large-scale basic industries, after the easy phase or first phase of import-substitution was

completed around the mid-1970s. Industrial policy only shifted to export-promotion after the mid-1980s 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 government tax 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 by the neglect of paying attention to the basic and enabling conditions necessary to promote the development of ITCs to underpin the development of highly competitive industries, except for generally sound macroeconomic management and gradual trade reforms to reduce the 'anti-export bias' of the trade regime. Instead, it relied more on Indonesia's traditional sources of comparative advantage in low skill labour-intensive and resource-based industries as well as on efforts to keep the real effective exchange rate at a competitive level. For this reason since Indonesia's manufactured exports started growing rapidly in 1987 up to the Asian economic crisis, the export-oriented industries kept on producing resource-based products (wood products) and low skill, labour-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 for Indonesia for the required industrial and technological upgrading of the manufacturing sector would be to attempt to attract more FDI, as was also evident from the recent study on Indonesia's industrial competitiveness conducted for the World Bank (Aswicahyono; Atje & Thee, 2005). However, the great challenge facing the Indonesian government at present would be to make a serious and determined effort to improve the investment climate, which is currently rated as one of the worst, if not the worst, among the countries in the East Asia-Pacific region. This will be an uphill struggle, as even modest efforts to improve the investment climate is running into strong resistance by vested interests (e.g. the customs and tax offices) or by the shortage of funds to rehabilitate and improve the dilapidated physical infrastructure. However, for the SBY government the most important policy priority is now to improve the investment climate if it wants to increase investment, including FDI, to raise economic growth and reduce absolute poverty.

However, 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 ITCs. This can be achieved by improving the *incentive system* for firms to encourage them to invest in upgrading their ITCs. This involves the determined removal of all restrictions on domestic competition and trade, which have adversely affected the business environment for firms. The government should also take steps to enable firms to improve their *supply-side capabilities* by steadily raise 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 labour force will also improve their absorptive capacity for new and more advanced technologies imported by FDI and 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 the 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 of the East Asian NIEs, particularly 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, the possibility of privatising these services should be seriously explored. This will not only lessen the fiscal burden of the government, but more important, it will enable these important services to really cater their services to the concrete needs of private industry.

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