Raising Indonesia's Industrial Competitiveness

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Abstrak

Berbagai kajian oleh lembaga-lembaga konsultasi internasional dan peneliti Indonesia maupun asing telah mengungkapkan bahwa kemampuan teknologi industri kebanyakan perusahaan manufaktur Indonesia, termasuk BUMN, kurang memadai. Oleh karena ini daya saing internasional kebanyakan perusahaan manufaktur Indonesia juga kurang memadai untuk bertarung di pasaran internasional.

Untuk memahami mengapa kemampuan teknologi kebanyakan perusahaan manufaktur Indonesia kurang memadai, perlu dikaji kemampuan teknologi nasional (KTN) Indonesia, karena KTN ini menentukan lingkungan ekonomi eksternal maupun pasokan sumber daya produktif yang secara positif atau negatif mempengaruhi keputusan pimpinan perusahaan apakah mengadakan investasi dalam pengembangan kemampuan teknologi perusahaan tersebut menguntungkan atau tidak.

KTN sesuatu negara terdiri atas tiga faktor utama, yaitu sistem insentif, kemampuan, dan lembaga-lembaga. Interaksi antara ketiga faktor utama ini akan menentukan hasrat dan kemampuan perusahaan manufaktur untuk mengembangkan kemampuan teknologi mereka dalam rangka peningkatan daya saing. Penilaian KTN Indonesia mengungkapkan, bahwa sistem insentif yang dihadapi perusahaan-perusahaan Indonesia pada umumnya belum cukup kondusif untuk mendorong pengembangkan kemampuan teknologi mereka. Meskipun kebijakan ekonomi makro selama era Soeharto pada umumnya cukup baik, namun kebijaksanaan niaga dan terutama kebijaksanaan persaingan domestik kurang baik.

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Dengan reformasi dalam kebijaksanaan niaga serta kebijaksanaan persaingan domestik yang telah dilakukan pemerintah dalam rangka persetujuan dengan IMF, diharapkan bahwa sistem insentif yang dihadapi perusahaan-perusahaan manufaktur Indonesia lebih kondusif untuk mendorong peningkatan efisiensi dan daya saing mereka melalui upaya pengembangan kemampuan teknologi.

Tinjauan tentang KTN mengungkapkan, bahwa investasi dalam modal fisik maupun modal insani cukup mengesankan, meskipun upaya teknologi, seperti tercermin pada pembiayaan dan pelaksanaan kegiatan Litbang, masih kurang memadai dibanding dengan negara-negara tetangga Indonesia. Demikian pula peranan lembaga-lembaga, khususnya lembaga- lembaga Iptek di Indonesia dalam memberikan jasa-jasa pelayanan teknologi kepada perusahaan-perusahaan manufaktur masih jauh dari memadai.

Dengan demikian, maka suatu kebijaksanaan untuk meningkatkan daya saing internasional perusahaan-perusahaan manufaktur Indonesia harus mengusahakan agar ketiga unsur dari KTN perlu diperbaiki dahulu, sebelum KTN ini dapat mendorong dan memungkinkan perusahaan-perusahaan manufaktur Indonesia untuk meningkatkan daya saing internasional mereka melalui pengembangan kemampuan teknologi.

I. WHY INDONESIA NEEDS TO RAISE ITS INDUSTRIAL TECHNOLOGICAL CAPABILITIES

Since Indonesia was hit by the severe financial and economic crisis in 1997/98, Indonesia's economic policy-makers have been mainly concerned with restoring macroeconomic stability, restructuring the blighted banking system and the huge corporate debt, and protecting the poor from the adverse impact of the crisis.

While full economic recovery is still at least a few years off, macroeconomic stability has, with help from the IMF, been largely restored. To further improve the economy, Indonesia's policy-makers will have to tackle various problems which during the height of the crisis were temporarily shelved, including the need to raising the international competitiveness of Indonesia's manufacturing sector. This, in turn, will be essential in order to raise and sustain the growth of Indonesia's manufactured exports which had been temporarily halted as a result of the crisis.

Sustaining this growth is important as since the mid 1980s Indonesia's manufacturing sector had gradually emerged as the major engine of growth and the major source of export earnings, at least until Indonesia was hit by the severe economic crisis of 1997/98.

To a large extent the rapid growth of the manufacturing sector since the late 1980s was due to the rapid growth of manufactured exports, particularly labour- and resource-intensive exports. However, the surge in manufactured exports of the late 1980s and early 1990s, however, proved to be shortlived, as these exports began to grow at a more sluggish rate since 1993. While manufactured exports during the period 1986-1992 grew at an average annual rate of 20-30 per cent, it grew only at an average rate of 11.3 per cent during the period 1994-1996. (Biro Pusat Statistik 1997).

In view of these developments, since the early 1990s Indonesia's policy-makers became concerned that the country was losing its comparative advantage in labour- and resource- intensive manufactured exports in view of the disappointing performance of its largest labour-intensive manufactured exports, namely textiles, garments, and footwear, and its largest resource-intensive manufactured exports, namely wood and wood products. It was therefore argued that to sustain the growth of

its manufactured exports, Indonesia could no longer continue to rely only on its traditional sources of comparative advantage, namely its large supplies of relative cheap but mostly low-skill labour and natural resources. Instead, Indonesia would need to develop a more sustainable source of competitive advantage in order to raise the international competitiveness of its manufacturing industries.

To achieve this, Indonesia's manufacturing firms, including the small- and medium-scale enterprises (SMEs), would, just like Japan and the first tier East Asian newly-industrialising economies (NIEs) a few decades earlier, have to make a much greater effort than they had done so far to develop and raise their technological and organisational capabilities. In fact, the experience of Japan and these East Asian NIEs, particularly South Korea and Taiwan, had indicated that their remarkable export performance had become increasingly influenced by greater technological capabilities. Hence, to enable Indonesia to develop more technology- and skill-intensive, higher value added industries the development of better technological capabilities (TCs) would be required. Better TCs would also be required to strengthen the international competitiveness of the traditional labour-intensive, export-oriented industries.

Unlike the advanced countries, developing countries which are still in the early stages of industrialization, such as Indonesia, are generally unable to undertake frontier innovation, that is finding and introducing completely new products or processes. (Lall 1993a: 720). Instead, in developing countries technological development mainly takes the form of *borrowing* or, more accurately, *importing* new technologies developed in the advanced countries and adjusting these technologies, both process and product technologies, to local conditions. In fact, the experience of Japan and the East Asian NIEs has indicated that their rapid and sustained industrial growth could to a large extent be attributed to their ability in 'borrowing' new technologies from the advanced countries and adjusting these technologies to local conditions. (Dollar 1993: 434).

During the early stages of their industrial development the relevant technological capabilities (TCs) for developing countries would be the knowledge and skills - technical, managerial, and institutional - that allow manufacturing firms in these countries to utilize capital equipment and technical information efficiently. (Lall 1993a: 720; Lall 1993c: 72-73).

This is often not the case in developing countries, including Indonesia, where many manufacturing firms are characterized by technical inefficiency, which is reflected in low productivity and poor performance. The reason for this technical inefficiency lies in their inability to make efficient use of the technologies they imported. In turn, this inability is caused by their failure to make the necessary investments in generating the information and capabilities to handle and improve the technologies they imported. (Lall 1993c: 73).

The need for Indonesia's manufacturing sector to develop and raise its TCs becomes even more pressing since its technological base is shallow and backward in comparison to its East Asian neighbours, particularly the large East Asian NIEs, South Korea and Taiwan. In comparison with these two East Asian NIEs, Indonesia's TCs to absorb and improve upon complex imported technologies are narrow and weak; its capital goods subsector, a crucial element of industrial deepening, is relatively underdeveloped; and its relatively modest technological effort is distorted and concentrated. (Lall 1998: 136). In fact, until the economic crisis of 1997/98 hit Indonesia, most of its technological effort was focused on the 10 state-owned strategic industries, particularly the state-owned aircraft industry.

Although information on the TCs of Indonesia's manufacturing industries is relatively scarce, the available (quantitative and qualitative) information provided by the findings of several studies conducted by foreign consulting firms at the request of the Indonesian government and of several studies conducted by individual Indonesian and foreign researchers has indicated that in general the technological capabilities (TCs) of Indonesia's manufacturing enterprises, including its small- and medium-scale enterprises (SMEs), are inadequate. (e.g. Thee 1990; Hill 1991; SRI International 1992; FIAS 1995; Ray 1997; Thee & Pangestu 1998).

In fact, the major research findings of the above recent studies on the firm-level technological capabilities (FTCs) in Indonesia's manufacturing industries has indicated that the FTCs in most of these industries are still relatively low. To the extent that these manufacturing firms had been able to develop their technological capabilities, these capabilities were mainly confined to those capabilities required during the early phases of industrialisation, namely the basic operational or production capabilities required to run a plant efficiently and, to a lesser extent, the acquisitive

(investment) capabilities (i.e. the knowledge and skills required to search, assess, negotiate, and procure the relevant technologies as well as install and start up the newly set-up production facilities) and adaptive (minor change) capabilities (i.e. the knowledge and skills required to understand and digest the technologies purchased or imported and to carry out minor modifications in the product or process technologies). (Sripaipan 1990: 7). In general, however, the large majority of Indonesia's manufacturing firms were not yet concerned with developing those technological capabilities required in the more advanced stages of industrialisation, namely the innovative capabilities, that is those capabilities to carry out significant research and development (R & D) activities and to make radical (major) process or product modifications. (Sripaipan 1990: 7).

In the following pages an attempt will be made to identify the major factors which may account for the fact why the TCs of many manufacturing firms in Indonesia are limited.

2. INDONESIA'S NATIONAL TECHNOLOGICAL CAPABILITIES: AN ASSESSMENT

The extent to which a manufacturing firm feels compelled to undertake the necessary investments in developing its technological capabilities (TCs) depends on its response to internal and external stimuli, and its interaction with other economic agents, including private and public, and domestic and foreign agents. Hence, the above factors include those that are firm-specific (e.g. the entrepreneurial characteristics of the firm's owner; the firm's corporate philosophy) and those that are common to given countries (depending on their policy regimes, skill endowments, and institutional structures). (Lall 1992: 169).

Following the work of Sanjaya Lall of Oxford University, these common factors are referred to as a country's national technological capabilities (NTCs). These NTCs include three sets of factors which can be referred to as the incentive system facing individual firms, the capabilities available to these firms, particularly the available human skills, and the institutions, particularly the country's science and technology (S & T) institutions. (Lall 1992: 169-172; Lall 1993a: 729-743). The incentive system is a major factor which affects the demand for

technology development by the manufacturing firms, while the two other sets of factors, namely the capabilities and institutions, are the major factors affecting the supply-side capabilities of these firms. The extent to which a firm will make the necessary investments in developing its technological capabilities will depend on the interplay of the above three sets of factors and how this will impact on this firm. (Lall 1992: 180-81).

In the following pages an attempt will be made to assess Indonesia's NTCs, specifically the incentive system facing firms, the country's capabilities, particularly its skill endowments, and the country's institutions, specifically the country's S & T institutions.

1. The Incentive System

A country's economic incentive system is determined by various factors, particularly policy variables. Among these policy variables, the most important are the government's:

i. Macro-economic policies;
ii. Trade regime;
iii. Domestic competition policies.

i. Macroeconomic policies

Sound macro-economic policies to maintain macro-economic stability are clearly conducive to long-term capital investment, including investment in developing and upgrading a firm's technological capabilities.

Since the Soeharto government assumed power in Indonesia in 1966, it had from the outset attached great importance to maintening macro-economic stability. Undoubtedly, the key to the Soeharto government's success in maintaining macro-economic stability, at least until the financial crisis of 1997, had been the financial discipline maintained by the economic technocrats in the government, specifically by keeping the public budget deficit at a level that could be financed through official development assistance (ODA) offered on concessionary terms and an open capital account supported by a realistic exchange rate management. (Nasution 1995: 4).

Since the early 1990s, however, these sound macro-economic policies came under pressure, as internal and external imbalances tended to widen. These imbalances have at the macro-level been mainly

attributed to what an Indonesian economist has called the 'erosion of financial discipline' and the rise in debt servicing. (Nasution 1995: 3). The erosion of financial discipline was reflected by the increase in off-budget transactions which were not subject to the fiscal discipline emphasised by the economic technocrats.

Not surprisingly, after the Indonesian government turned to the International Monetary Fund (IMF) for financial assistance after the financial crisis of late 1997, the IMF insisted on the necessity of restoring fiscal discipline by incorporating the off-budget accounts in the central government budget at the beginning of the fiscal year 1998/99. At present, the most important task of macroeconomic policy is to strengthen the rupiah and to dampen the inflationary pressures which, if left uncontrolled, can lead to hyperinflation. (IMF 1998: 1-3).

ii. The trade regime

In response to the end of the oil boom in the early 1980s, the Indonesian government since the mid 1980s began to introduce more outward-looking policies with a view to increase non-oil exports, particularly manufactured exports. To this end, the government introduced several deregulation policies, including trade deregulation measures to reduce the 'anti-export bias' of the trade regime. These measures included the steady reduction in tariff protection, the gradual but steady reduction in non-tariff barriers (NTBs), specifically quantitative import restrictions, and its conversion into tariff protection, and the introduction of a duty exemption and drawback scheme for export- oriented companies (i.e. companies exporting at least 65 per cent of their output) in May 1986.

These trade reforms have led to increased import competition which, in turn, has forced several manufacturing firms to develop and raise their TCs in order to improve their efficiency, product quality, and product design. (World Bank 1996b: 7). This enhanced competitiveness has been a major factor which has accounted for the rapid rise in manufactured exports since the late 1980s.

In spite of these trade reforms, however, Indonesia's trade regime continues to have a significant 'anti-export bias', as the scheduled tariff reductions slowed down in 1996, and some non- tariff barriers (NTBs) continued to persist. However, under the IMF package of January 1998

and subsequent Letters of Intent (LoI), the Indonesian government has committed itself to adhere to its scheduled tariff reductions and eliminate its remaining quantitative restrictions. (IMF 1998: 8). These measures will undoubtedly contribute to creating a more competitive business environment for Indonesia's manufacturing firms.

iii. Domestic competition policies

While sound macro-economic policies have on the whole been firmly established in Indonesia since the Soeharto era, sound micro-economic policies, particularly domestic competition policies, were relatively neglected, at least until the Indonesian government under its agreement on structural reforms with the IMF on 15 January 1998 committed itself to further deregulating domestic activities and increasing domestic competition. Under this agreement the structural reforms to improve domestic competition included the Indonesian government's measures to eliminate BULOG's (State Logistics Agency) import monopoly over wheat and wheat flour, soybeans, and garlic, the elimination of the administrative retail price for cement, and the dissolution of all the existing formal and informal restrictive marketing arrangements, including those for cement, paper, and plywood, which had severely hampered domestic competition. (IMF 1998: 8-9).

Since its involvement with Indonesia's recovery in October 1997 until today, the IMF has been criticised for having made some mistakes in its advice to the Indonesian government, for overloading the reform agenda, and for unwanted intervention in Indonesia's internal economic affairs. However, the inclusion of several structural reforms in its January 1998 agreement with the Indonesian government, specifically those directed at eliminating the extensive regulations and restraints on domestic competition which had significantly increased the cost of doing business in Indonesia, reduced efficiency and limited economic opportunities (World Bank 1997: 118) should be welcomed. Without doubt these structural reforms are likely to contribute to creating a more competitive business environment for Indonesia's manufacturing firms by improving healthy domestic competition. Despite the shortcomings of Indonesia's new Competition Law, enacted in March 1999, as well as the other deregulation measures should hopefully be able to create a more competitive business environment.

2. Capabilities

At the country level, the capabilities which determine a country's national technological capabilities (NTCs) comprise three factors, namely:

i. Investment in physical capital;
ii. Investment in human capital;
iii. Technological effort.

These three factors are closely interlinked in ways that make it difficult to identify their separate contributions to a country's industrial performance, but they do not always go together. For instance, if physical capital is built up without the skills or technology required to operate it efficiently, a country's NTCs will not develop adequately. On the other hand, if formal skills are created but technological effort lags, then efficiency will also not improve rapidly. On the other hand, if skills and technological effort are increased without the requisite physical investment, then the human resources cannot be properly utilized in production. (Lall 1992: 170).

i. Investment in physical capital

This physical investment can be considered a basic capability required for industrial development, as plant and capital equipment are essential to manufacturing industries. However, while the magnitude of physical capital investment is an important determinant of industrial development, the efficiency with which capital is utilized is of even greater importance, as it reflects the ability to mobilize the necessary financial resources to purchase in the capital equipment purchased as well as the technology embodied in this capital investment. (Lall 1992: 170).

The efficiency with which capital is utilized is indicated by the incremental capital output ratio (ICOR). Unfortunately, no data on the sectoral ICOR of the manufacturing sector are available in the absence of reliable data on sectoral investment rates. However, on an overall basis the available data show that gross domestic investment as a share of Indonesia's gross domestic product (GDP) rose from 16 per cent in 1971 to 25 per cent in the early 1980s. (Hill 1994b: 65 - 66).

Although the development budget underwent a considerable reduction during the 1980s following the end of the oil boom in 1982, the investment rates remained high as private investment, including foreign private investment, rose rapidly as a result of the improvement in the investment climate following the successive deregulation packages.

Since the Indonesian government launched several large-scale capital-intensive projects since the mid 1970s through the early 1980s following the sharp increase in oil earnings, the country's ICOR rose from 1 - 2 during the rehabilitation period of the late 1960s to 2.5 - 3 in the mid 1970s and then to over 6 in the early 1980s as the government moved into the second stage of import- substituting industrialisation and began to build upstream, large-scale, capital-intensive, basic industries. (Hill 1994b: 66). However, after the introduction of various deregulation measures since the mid 1980s to promote a more efficient manufacturing sector, rapid economic growth resumed along a more efficient, labour-intensive path. As a result, the ICOR dropped to slightly less than 4. (Hill 1994b: 66).

Compared to other developing countries at similar stages of development, however, Indonesia's relatively high ICOR reflects a still relatively inefficient use of its physical capital. This technical inefficiency may be caused by the inadequate TCs of many Indonesian firms, which may be reflected in their inability to find, choose, and negotiate for the best imported technologies (embodied in the capital equipment) or to master properly the embodied technologies they purchased. This latter implies that the embodied technologies (i.e. capital equipment) may be used below best practice levels of efficiency. (Lall 1992: 73).

However, a word of caution is in order when using overall ICORs as a measure of the investment efficiency of a country. As the ICOR implicitly attributes growth of output to new physical investment, it overlooks the contribution of a more effective use of the total existing stock of physical stock or of new investment in human capital. Moreover, the overall ICOR may also change because of changes in the productivity of individual sectors or industries due to technical progress or organizational improvements, or because of structural changes in favour of or against high-ICOR sectors or industries. (Arndt 1993: 243-45).

ii. Investment in human capital

A broadly skilled labour force, an effective technical training system, good science and engineering departments and management training and development programs in the various state and private universities and institutes are crucial to an industrializing country's efforts to develop and raise its TCs and its ability to respond flexibly to rapid economic and technological change. (World Bank 1996b: ii).

The Indonesian government has since the early years of independence put a high priority on the expansion of education, initially the expansion of primary education. Consequently, since the late 1970s universal primary education had been largely achieved.

Although education at all levels has experienced a rapid expansion, this expansion has not yet been able to produce an adequate number of skilled workers at all levels required to support the rapid industrial growth and transformation of the country. The data in **Table 1** show that in 1990 74 per cent of the working age population only had had primary education or less, that is had had either no schooling or only incomplete primary schooling, while another 25 per cent had completed secondary education, and only 1.6 per cent had enjoyed tertiary education. (Hull & Jones 1994: 167-169).

Table 1
Population Aged Fifteen Years and Over, by Educational Attainment, 1971, 1990

Sex	Year	No schooling	Incomplete primary schooling	Completed Primary schooling	Completed lower of upper secondary schooling	Academy or university education	Total
Males	1971	32.4	29.4	27.1	10.4	0.7	100
	1990	12.2	24.3	32.2	29.2	2.1	100
Females	1971	57.0	21.2	16.5	5.1	0.2	100
	1990	25.4	24.9	28.1	20.6	1.0	100
Both sexs	1971	45.2	25.1	21.6	7.7	0.4	100
	1990	18.9	24.6	30.1	24.8	1.6	100

Source: Terence H. Hull and Gavin W. Jones: Demographic Perspectives, in: Hill, 1994, Table 3.14, P. 168.

The data in Table 1 suggest that as the large majority of Indonesia's labour force has only had primary education or less, Indonesia's comparative advantage still lies mainly in low skill labour-intensive industries (in addition to resource-intensive industries).

Moreover, despite the rapid expansion of education and training, there is increasing concern that this expansion has not been accompanied by a commensurate rise in the quality of education, including primary education as well as technical and vocational training. The poor quality of technical training is largely caused by deficiencies in equipment and teaching materials, uneven teacher training, weak links with industry, and the lack of flexibility in a highly centralized system. (World Bank 1996b: 17).

Hence, besides investing more in the expansion of secondary and tertiary education, Indonesia needs to put a high priority on raising the quality of primary and secondary education in order to provide a stronger basis for subsequent training. Moreover, at this relatively early stage of Indonesia's industrial development, a greater priority needs to be given on providing a good training of technicians and craftsmen rather than scientists and engineers. (World Bank 1996b: ii).

Nevertheless, Indonesia's need to gradually develop more skill- and technology-intensive industries requires that over time greater attention should also be paid to expanding as well as improving the quality of higher education in the engineering and natural sciences.

This argument is supported by looking at the academic orientation of tertiary students which shows that out of the 338,304 students enrolled in 1992/93 at state universities providing training in the natural sciences and engineering, only 135,501 students (or 40 per cent of the total) were studying natural sciences and engineering (NSE), including the medical and agricultural sciences (Republic of Indonesia 1995: 142).

In 1992/93 220,640 NSE students had graduated from the public universities. While this supply of new NSE graduates appears to be adequate for the replenishment and general employment growth of the economy, the expected major increase in demand for NSE graduates required for Indonesia's industrial and technological upgrading cannot be met in the short run, unless new ways are devised to increase the number of NSE graduates. (Republic of Indonesia 1995: 33). However,

meeting the demand for NSE graduates for industrial and technological upgrading is not only a matter of increasing the output of NSE graduates as well as of improving the quality of their education, but also of enticing more of them to look for employment in national industry rather than mostly in employment with the public sector, as is the case right now. (Table 2).

Table 2
Natural Scientists and Engineers by Sector of Employment and Field of Education, 1991

Field	Sector			
	Government	Industry	Higher Education	Total
- Engaged in R & D:	5,435	3,700	7,775	16.910
- Production engineering	-	10,750	-	10,750
- Other	83,085	3,825	10,650	97,560
Total(incl.holders of Bachelor's, Master's, & Ph.D. degrees)	88,520 (70.7%)	18,275 (14.6%)	18,425 (14.7%)	125,220 (100.0%)

Source: Republic of Indonesia: *Science and Technology Indicators of Indonesia, 1994*, 2nd Edition, Jakarta, March 1995, Badan Pengkajian dan Penerapan Teknologi (BPPT) - Kantor Menteri Negara Riset dan Teknologi (KMNRT) - Pusat Analisa dan Perkembangan Ilmu Pengetahuan dan Teknologi (PAPIPTEK-LIPI), Annex tables 2.4 & 2.6, pp. 113 and 115.

The data in Table 2 show that the large majority of NSE graduates at all levels (B.A. through Ph.D. levels) are indeed employed with the government rather than in national industry, while even a slightly higher number is employed in higher education than in national industry.

iii. Technological effort

Technological effort refers to the conscious exertion to use technological information and to accumulate technological knowledge to choose, assimilate, adapt, or create technology. (Bell, Ross-Larson, and Westphal 1984: 107-108). However, unlike developed countries, developing

countries, including Indonesia, generally are not yet able to create new technology. Hence, for their technological development developing countries have to rely largely on technology transferred to them in the form of importing the required technologies from the advanced countries, and then focus their technological effort on assimilating and adapting these imported technologies to the local conditions. (Dollar 1993: 434).

Like the governments of other East Asian countries, the Indonesian government has also made several efforts to encourage local technological effort by promoting R & D (Research and Development) activities in its various public S & T (science and technology) institutes. However, in terms of the proportion of Gross Domestic Product (GDP) allocated to R & D expenditures Indonesia's technological effort in 1994 was still quite low compared to the industrially more advanced countries, including Japan and the two large East Asian NIEs. (**Table 3**).

Table 3
Ratio of R & D Expenditures to Gross Domestic Product in Selected Asian Countries

Country	Ratio of R & D Expenditures to Gross Domestic Product
Japan (1992)	2.8
South Korea (1992)	2.2
Taiwan (1991)	1.7
Singapore (1992)	1.3
China (1992)	0.7
Indonesia (1994)	0.16

Source: Centre for the Analysis of Scientific and Technologica Development, Indonesian Institute of Sciences (PAPIPTEK-LIPI), August 1996.

The data in **Table 4** show the relative importance of the major sources of R & D funding in various Asian countries as well as the relative importance of the various performers of R & D activities in terms of the relative amounts of R & D expenditures spent by the respective performers.

Table 4
Sources of Funds and Location of R & D Activities in Selected Asian Countries, 1992 (Percentage)

Source of R & D Funds :

Country	Sector		
	Government	Industry	Other
Japan	17.4	76.0	6.4
South Korea	17.2	82.4	-
Singapore	39.2	60.8	-
Taiwan (1991)	52.1	45.5	-
India	74.0	26.0	-
Indonesia (1991)	80.0	19.0	1.0

Location of R & D Activities :

Country	Sector		
	Government	Industry	Other
Japan	8.9	73.5	16
South Korea	3.7	72.7	22
Singapore	22.7	60.8	21
Taiwan (1991)	9.1	53.6	31
India	74.0	26.0	-
Indonesia (1991)	62.0	33.0	5.0

Source: Republic of Indonesia: *Science and Technology Indicators of Indonesia, 1994*, 2nd edition, BPPT- Office of the Minister for Research and Technology (KMNRT)-PAPIPTEK-LIPI, Jakarta, March 1995, Appendix Table 1:4, p. 107.

The data in Table 4 show that in Indonesia and India the major source of R & D funding is the government, whereas in Japan and South Korea it is private industry. Similarly, in Indonesia as well as in India the major performer of R & D activities is the government, specifically the public S & T institutes, whereas in Japan and South Korea it is again private industry.

That Indonesia's government plays the major role both as a source of R & D funding as well as a performer of R & D activities is not surprising, as in developing countries in the early stages of industrial development, such as Indonesia, the government has a major role to play in funding and initiating R & D activities. (Hill 1995: 99).

3. INSTITUTIONS

Besides capabilities and the incentive system, institutions can play an important role in supporting industrial development and the development of NTCs. The domestic institutions which an industrialising country needs most are the science and technology (S & T) institutes which can assist manufacturing firms in using technologies effectively. The useful services which these S & T institutions can perform for manufacturing firms include technical consultancy services for realising the full potential of the equipment and processes which were purchased; testing services to qualify products to meet national and international industrial standards; calibration services for measuring instruments; and information services to source technical supplies, products, and services (Sripaipan 1990: 8); and the screening and scanning of new technology developments of potential use to these firms.

In the following pages a brief account will be given of Indonesia's government S & T institutes which are to provide technology support services to national industry. These comprise the R & D Centres under the Agency for Industrial Research and Development (*BPPI*), Department of Industry and Trade, and the R & D Centres of the Non- Departmental Government Institutes (*LPND*) which are under the technical coordination of the Minister of State for Research and Technology (*Menristek*).

i. The R & D Centres of the Agency for Industrial Research and Development, Department of Industry and Trade

In Indonesia the Department of Industry and Trade (DoIT) through its Agency for Industrial Research and Development (*Balai Penelitian dan Pengembangan Industri, BPPI*), nine sectoral R & D institutes to serve various manufacturing industries, five industrial R & D and testing centres, and 10 regional testing laboratories, has the largest number of technology support institutions to serve national industry. These R & D centres are entrusted with conducting R & D activities and providing technical extension and information services for national industry, including the small- and medium-scale industries (SMIs). In addition, the BPPI also provides quality standards testing services for several industrial products. (Scherer 1993: 84).

BPPI's R & D centres face various problems, notably poor funding and staffing, low staff morale and an inability to recruit good quality engineering and technical staff because of the relatively low salaries in BPPI's R & D centres, and inadequate and obsolete facilities and equipment which have prevented these centres from keeping up with rapid technological developments in their respective fields. In turn, this has prevented these R & D centres from establishing effective and mutually profitable linkages with their potential clients, namely the various manufacturing firms, including private as well as state-owned enterprises (SOEs), which are in need of technology support services. (Lall 1993b: 40-41).

Hence, to improve their performance, the government, specifically DoIT, will have to make a real effort to address these problems, amongst others by providing these R & D centres and testing stations with more financial resources to train their staff with a view to upgrade their qualifications and to purchase modern, up-to-date equipment, and by providing more managerial autonomy to the management of these R & D centres. However, in view of the tight financial constraints faced by the Indonesian government at present, the above problems faced by BPPI's R & D centres can obviously not be tackled for the time being. Moreover, in view of the serious financial problems faced by private industry, private sector funding to tackle the above problems also seems remote at present.

ii. The R & D centres of the Non-Departmental Government Institutes

Among the R & D Centres of the Non-Departmental Government Institutes (*LPNDs*), those of the Indonesian Institute of Sciences (*LIPI*) and of the Agency for the Assessment and Application of Technology (*BPPT*) are potentially the most suitable ones to provide technology support services to national industry.

LIPI was established in 1967 and has at present 19 R & D centres, a number which are potentially able to provide technology services to manufacturing industry, such as the R & D Centre for Calibration, Instrumentation, and Metrology (*KIM- LIPI*). (Kartowisastro 1991: 12). The services *KIM-LIPI* can provide to industry include calibration, instrumentation, and metrology services to support industry in producing internationally competitive products.

LIPI's Centre for Standardisation disseminates information on standardisation, and also serves as the centre for the management of the national information network on standardisation. *LIPI* also serves as the Secretariat of the National Standardisation Council (*Dewan Standardisasi Nasional, DSN*) which coordinates and promotes cooperation between institutes concerned with standardization activities in Indonesia. The National Standardisation Council is not merely concerned with standardisation activities, but also with product quality assurance. Hence, with this in mind, in 1989 a National Network of Testing Laboratories was introduced which can be utilized by departmental as well as private laboratories. (Kartowisastro 1991: 5 - 6).

In view of the great importance of the metrology, standards, testing, and quality assurance (MSTQ) services to the diffusion of best-practice technologies to national industry in general, the delivery of these services by the above government laboratories needs to be expanded and improved. This improvement is essential to enable national industry to meet the exacting standards required to penetrate export markets. At present these MSTQ services are still very weak and therefore quite inadequate to meet the needs of national industry (World Bank 1996b: 45).

Another important non-departmental government S & T institute relevant to industrial development and the development of ITCs is the Agency for the Assessment and Application of Technology (*BPPT*) which was established in 1978, and since its establishment until March 1998 was headed by Professor Habibie, the then Minister of State for Research and Technology (*Menristek*). Since November 1999 BPPT is headed by Dr. A.S. Hikam, the current Minister of State for Research and Technology.

Although BPPT has overall responsibility for the techology policies and technological development in Indonesia, it has thus far been mainly concerned with promoting the 10 strategic industries under the aegis of the Management Board of Strategic Industries (*Badan Pengelola Industri Strategis, BPIS*). More specifically, BPPT is entrusted with assisting these strategic industries to achieve their technological mission to stimulate Indonesia's industrial technological development by their entry into high-technology activities and by building a range of design and production capabilities. (Scherer 1993: 84).

However, as almost all of these 10 strategic industries (SOEs) are performing poorly, it remains to be seen whether whether any of them will be able to survive the restructuring of the SOEs, to be undertaken by the Indnesian government undrer the terms of the IMF Agreement of January 1998. Based on clear profit and performance criteria applied to these 10 strategic industries, the Indonesian government will have to decide whether these 10 SOEs will continue to operate as SOEs, be privatised, or be closed altogether. (IMF 1998: 10).

In a report, prepared in 1994 by the Science and Technology Policy Institute of the Korea Science and Technology Institute (STEPI/KIST) for BPPT's STAID (Science and Technology for Industrial Development) Program and the Indonesian Institute of Sciences (*LIPI*), it was found that while BPPT and LIPI each had a solid institutional foundation and good track record in some areas, these two government institutes generally were rated as not efficient in research management and not sensitive to the technology needs of national industry in view of the fact that their operations were skewed towards the bureaucratic requirements of the government budget. (*LIPI* 1994: 13). As their systems are constrained by the controls and regulations associated with the government budget's funding mechanisms, the current management system governing the operations of *BPPT* and *LIPI* does not allow for managerial autonomy nor accountability for results. (*LIPI* 1994: 16). As a result, both BPPT and *LIPI* have, just like *BPPI*'s R & D centres, not been successful with establishing effective linkages with both private firms and SOEs.

Hence, to make Indonesia's domestic S & T infrastructure more attuned to the needs of national industry, the above technology support institutes should be these institutes should be given much greater managerial autonomy. Coupled with this, the government can set a tight schedule for requiring these S & T institutes to become more self-financing. (World Bank 1996b: v). By forcing these institutes to become made more commercially oriented, their activities will automatically become more demand-driven, that is oriented to the real technology needs of private firms as well as SOEs.

4. CONCLUDING REMARKS

Although the four East Asian NIEs offer different models of technology development, their policies to stimulate technology development contain

a core of common elements. For instance, in South Korea and Taiwan the deepening of local TCs involved a highly selective policy on foreign direct investment (FDI), interventions in foreign trade, and various supporting measures. These measures included a controlled exposure to international competition combined with selective infant industry protection, the creation of a strong human capital base, a vigorous promotion of the capital goods subsector, the establishment of a strong domestic science and technology (S & T) infrastructure to provide technology support services to manufacturing firms, including SMEs, the development of an appropriate policy and institutional framework for financing technology development, and the underwriting of highly risky investments. (Lall 1998: 163).

Unlike the interventionist policies of South Korea and Taiwan, Hong Kong's government pursued a liberal trade and industrial policy, and as a result a light industrial structure developed in Hong Kong which consisted mostly of industries involved in the assembly and manufacture of consumer goods. However, the Hong Kong government did provide extensive support and subsidies to its numerous SMEs to raise their productivity and to facilitate their adoption of new technologies. (Lall 1998: 163).

Singapore, on the other hand, combined a liberal trade policy with a deliberate strategy to attract and guide foreign direct investment into more skill- and technology-intensive activities. To this end, the Singapore government provided incentives, backed up by institutional, human capital, and infrastructural measures to make the industrial and technological upgrading attractive to the transnational corporations (TNCs). As a result, Singapore was able to develop a much 'heavier' industrial structure than Hong Kong. (Lall 1998: 163).

The question arises to what extent Indonesia's industrial and technology policies resemble some of the industrial and technology policies pursued by any of these East Asian NIEs? Like South Korea, Indonesia pursued a highly interventionist industrial strategy, for instance by providing high protection to its industries and intervening extensively in credit provision to favoured enterprises, particularly well-connected conglomerates. (Hill 1995: 17-29). However, while South Korea generally used the same policy tools as Indonesia to foster large conglomerates, the outcomes of these policies differed between these two

countries. In South Korea the provision of various incentives and preferential treatment to the large corporations (*chaebol*) were explicitly linked to the attainment of export targets set by the Korean government. By forcing these firms from the outset to submit themselves to the rigours and discipline of the export markets, these Korean corporations from the outset had to put a high priority on achieving international competitiveness which over time was achieved by the gradual accumulation of technological capabilities (TCs). This linkage between the provision of preferential treatment and export was never stipulated by the Indonesian government, and as a result Indonesia's large conglomerates generally were not able to achieve international competitiveness, as reflected by their relatively poor export performance and inadequate TCs.

That many of Indonesia's manufacturing firms have inadequate TCs is also borne out by several research findings on the firm-level technological capabilities (FTCs) in various manufacturing industries in Indonesia, which has limited their abilities to raise their international competitiveness.

To understand why the FTCs in many manufacturing industries in Indonesia are rather weak, one needs to make an assesment of the overall economic environment in which the various manufacturing firms operate. The various factors comprising the overall economic environment which would favourably or adversely affect a firm's decision to raise its FTCs can be referred to as a country's national technological capabilities (NTCs). These NTCs consist of three major sets of factors, namely the incentives, capabilities, and institutions. The complex interaction of incentives, capabilities, and institutions, determines the willingness and ability of manufacturing firms to develop their FTCs. Emphasizing only or two sets of factors to the detriment of the other set or sets will therefore not lead to a rapid development of a country's NTCs. (Lall 1993a: 730).

The above assessment of Indonesia's NTCs has indicated that while during the Soeharto era some real improvement in the various elements comprising Indonesia's NTCs has been achieved, namely the incentives, abilities, and institutions, in general Indonesia's NTCs were and are not yet adequate to encourage the various manufacturing firms to raise their FTCs on a sustained basis to improve their international competitiveness.

As for the incentive system, macro-economic policies have over the past three decades been generally sound. However, since the onset of the financial crisis in mid 1997 the incentive system has experienced a severe deterioration as macroeconomic stability has been severely disrupted as the rupiah has depreciated very sharply and inflation has increased steeply. Hence, the restoration of macroeconomic stability is essential to the improvement of the incentive system. On the other hand, the trade regime and domestic competition policy is likely to improve considerably as the Indonesian government has under the terms of the IMF Agreement of January 1998 committed itself to proceed with further trade deregulation to eliminate the remaining 'anti-export bias' of the trade regime and to improve domestic competion by removing the remaining regulations and restrictions on domestic competition and by enacting a Competition Law.

In regard to the capabilities, rapid physical investment over the past three decades has led to the modernisation of the country's capital stock. Similarly, human capital investment over the past three decades have been quite impressive, particularly in regard to the rapid expansion of education at all levels, particularly at the primary and to a lesser extent at the secondary level. However, as the quality of education at all levels still leaves much to be desired, at present raising the quality of primary and secondary education needs to be given high priority as this will provide a good basis for further training. Moreover, at the present level of Indonesia's industrial development, a higher priority should be given to the training of technicians and craftsmen rather than scientists and engineers only. As regards technological effort, in terms of R & D expenditures as a percentage of GDP, Indonesia's technological effort is still relatively small compared to its East Asian neighbours, particularly South Korea and Taiwan.

In regard to the institutions, Indonesia's domestic S & T infrastructure, specifically the government S & T institutes, have thus far not been able to provide adequate technology support services to national industry in general, including SMIs. To a large extent this failure can be attributed to the fact that the management systems governing the operations of the major government S & T institutes are constrained by the regulations and controls associated with the government's budget funding mechanisms. To remedy this situation, the government R & D

institutes need to be given much greater managerial autonomy than is the case thus far, while they should also have greater accountability for the results of their R & D activities. By forcing these institutes to become more self-financing, these institutes will become more demand-driven and commercially oriented in their activities. In this way these institutes will be encouraged to establish more effective and mutually profitable linkages with private manufacturing firms and SOEs.

To a large extent Indonesia's relatively weak and uneven record in developing its NTCs during the Soeharto era may be attributed to the fact that in the past Indonesia's technocrats, all of whom were economists, had by virtue of their academic training and often also by necessity been paying much more attention to the demand side of a country's NTCs, namely establishing the right incentive system, specifically by emphasising sound macroeconomic policies and by improving the trade regime to reduce its 'anti-trade bias'. This goal was not always easily attainable, particularly when external shocks, such as the steep drop in the price of petroleum in the early and mid 1980s threatened macroeconomic stability. In addition, dismantling the overly protectionist trade regime and the various restrictions governing domestic competition was often hampered by the resistance of vested, politically well-connected interests with a stake in preserving the status quo.

On the other hand, Indonesia's so called *technologists*, most of whom were engineers, were mainly concerned with strengthening the *supply-side capabilities* of the country's NTCs, through their emphasis on human resource development (HRD) and on the institutions, specifically the development and upgrading of the government S & T institutes to support the industrial and technological development of national industry. However, being mainly concerned with promoting the 10 'strategic industries', all of which consist of state-owned enterprises (SOEs) mostly enjoying monopolistic positions and, until the financial crisis, receiving large amounts of government subsidies, the technologists have tended to neglect the demand side of a country's NTCs, particularly the importance of trade policies and domestic competition policies in fostering a conducive competitive environment for the manufacturing firms to spur their technological efforts.

A realisation on the part of both schools of thought that a healthy development of a country's NTCs would require a favourable interaction

of *all* the three sets of factors, namely the incentives, capabilities, and institutions, would obviously be a prerequisite before a more comprehensive and consistent set of policies can be designed for raising the international competitiveness of Indonesia's manufacturing industries.

5. REFERENCES

Arndt, H.W. 1993. *50 Years of Development Studies*. Canberra: National Centre for Development Studies, The Australian National University.

Bell, Martin, Ross-Larson, Bruce, and Westphal, Larry. 1984. "Assessing the Performance of Infant Industries," *Journal of Development Economics*. 16(1-2): 101-128.

Dollar, David. 1993. "Technological Differences as a Source of Competitive Advantage," *The American Economic Review - Papers and Proceedings*, May: 431 - 435.

Ernst, Dieter, Ganiatsos, Tom, and Mytelka, Lyn. (Editors). 1998. *Technological Capabilities and Export Success in Asia*, Routledge, London.

FIAS. 1995. *Indonesia - Backward Linkages: Opportunities and Impediments*, Washington, D.C.: Foreign Investment Advisory Service.

Hill, Hal. 1991. *Indonesia's Industrial Technology Capability:Past Experience and Policy Options*. Report prepared for BAPPENAS, Jakarta, September.

———, 1994a. *Indonesia's New Order - The Dynamics of Socio - Economic Transformation*. Sydney: Allen & Unwin.

———, 1994b. The Economy, Hill, 1994a: 54-122.

———, 1995. *Indonesia's Industrial Policy and Performance: 'Orthodoxy' vindicated*. Economics Division Working Papers no. 95/1. Canberra: Research School of Pacific and Asian Studies, The Australian National University.

Hill, Hal and Thee, Kian Wie (editors). 1998. *Indonesia's Technological Challenge*. Research School of Pacific and Asian Studies, Australian National University, Canberra and Institute of Southeast Asian Studies, Singapore.

Hull, Terence H. and Jones, Gavin W. 1994. *Demographic Perspectives*, in: Hill, 1994a: 123 - 178.

IMF, 1998. Indonesia - Memorandum of Economic and Social Policies. Jakarta, 15 January.

Kartowisastro, Herudi. 1993. *Technological Supporting Capability for the Industrial Development of Indonesia*, Paper presented at the Seminar on Developing Physical and Supporting Infrastructure for Industrial Restructuring, Kuala Lumpur, 4-9 March, 16 pages with graphs.

Lall, Sanjaya. 1992. "Technological Capabilities and Industrialization," *World Development*. 20(2): 165 - 186.

---------, 1993a. "Understanding Technology Development," *Development and Change*. 24(4): 719 - 753.

---------, 1993b. *Indonesia-Sustaining Industrial Growth - Technology and Skills*, Revised Draft, January (mimeo).

---------, 1993c. "Policies for Building Technological Capabilities: Lessons from Asian Experience," *Asian Development Review*. 11(2): 72-103.

———, 1998. *Technology Policies in Indoesia*, in: Hill & Thee (editors). 1998: 136-168.

LIPI. 1994. *Overview of the Final Report - Staid Project Element No. 10 -13, R & D Management System*, Vol. I, Science and Technology for Industrial Development (STAID) and the Indonesian Institute of Sciences (LIPI), Jakarta.

Nasution, Anwar. 1995. "Survey of Recent Developments," *Bulletin of Indonesian Economic Studies*. 31(2): 3-40.

Ray, David. 1997. *Innovation and Growth in the Indonesian Economy*. Ph.D. thesis submitted to the Centre for Strategic Economic Studies, Victoria University of Technology, Melbourne, November.

Republik Indonesia. 1995. *Indikator Ilmu Pengetahuan dan Teknologi 1994* (Science and Technology Indicators 1994), Edisi ke-2. Jakarta: BPPT-Kantor Menteri Negara Riset dan Teknologi (KMNRT)-PAPIPTEK-LIPI.

Scherer, Peter R. 1992. "Technology and Skills Development," Proceedings of the Seminar on Strategy in Indonesia - A Contribution to the Second Stage of the Long-Term Development. November, 77 - 93. Berlin: Forum Diskusi Indonesia.

Soesastro, Hadi and Pangestu, Mari. 1990. *Technological Challenge in the Asia-Pacific Economy*. Sydney: Allen & Unwin.

SRI International. 1992. *Technology Development Plan for Indonesia's Engineering Goods Industries*. Draft report prepared for the Department of Industry, Government of Indonesia.

Sripaipan, Chatri. 1990. "Constraints to Technology Development in a Rapidly-Growing Economy: The Case of Thailand," *TDRI Quarterly Review*. 5(3): 6 - 11.

Thee, Kian Wie. 1990. *Indonesia: technology transfer in the manufacturing industry*, in: Soesastro & Pangestu, 1990, 200- 232.

Thee, Kian Wie and Pangestu, Mari. 1998. *Technological Capabilities and Indonesia's Manufactured Exports*, in: Dieter Ernst, Tom Ganiatsos, and Lynn Mytelka, 1998, pp. 211-65.

World Bank. 1996a. *Indonesia-Sustaining High Growth with Equity*. Report no. 16433-IND. Washington, D.C.: Country Department III, East Asia and Pacific Region, 30 May.

----------, 1996b. *Industrial Technology Development for a Competitive Edge*. Report no. 15451-IND. Washington D.C.: East Asia Pacific Regional Office, Country Department III, Industry and Energy Operations Division, May 29. ■