WORLD EMPLOYMENT PROGRAMME RESEARCH

Working Paper

INTERNATIONAL EMPLOYMENT POLICIES

Working Paper No. 16

THE STATE AND INDUSTRIAL RESTRUCTURING:
A COMPARISON OF THE AEROSPACE INDUSTRY IN
INDONESIA AND SINGAPORE

by

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February 1988

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ISBN 92-2-106591-X

First published 1988

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Preface

This study on the aerospace industry in Indonesia and Singapore has been prepared for the research project on "Adjustment to structural change in manufacturing: A North-South perspective" undertaken under the umbrella of the ILO's International Division of Labour Programme. Its authors are Pang Eng Fong of the School of Management, National University of Singapore, and Hal Hill of the Research School of Pacific Studies, Australian National University, Canberra.

The structure of world production and trade changes continuously, opening up new job opportunities and threatening existing ones. This process of change causes considerable adjustment problems affecting the lives of millions of workers and their families in both industrialised and developing countries. In view of their potentially far-reaching consequences these changes need to be analysed in depth. Critical issues should be identified in time. The different options (and their consequences) open to policy-makers and other concerned parties must also be examined. These are the principal concerns of the research undertaken by the ILO's International Division of Labour Programme.

In this situation of constant change, where causes and effects are often hard to separate, it is not easy to guess what the future will bring. Certain trends may be discernible but many uncertainties remain. It is particularly important - but often very hard - to recognise which changes are cyclical and which structural. To what extent is unused capacity and unemployment in a particular industry related to low overall demand and to what extent are long-term structural factors at work?

The developing countries play an important role in the process of structural change. Their share of world manufactured production and trade has increased in the last few decades. So far, most of this greater share originates in few countries only (the newly industrialising countries - NICs). At first, developing country exports tended to be concentrated in industries using little capital and relatively simple technology. Gradually, however, the range of their exports expanded and came to include steel, ships, machine tools, colour TVs, videotape recorders, petrochemicals, arms and aircraft.

In more recent years, protectionism and the use of new technologies have tended to slow down the advance of developing countries exports in certain product areas. This has allowed industrialised countries to regain ground in some "traditional" industries. But it has also encouraged developing country exporters to accelerate their move into the production and export of more sophisticated products. A situation appears to be emerging in which most industrial goods using mature technologies can be produced in a large number of (industrialised and newly industrialising) countries. Sectors that use and generate the very latest technologies are exceptions.

Capital has become increasingly internationally mobile and this has contributed to an acceleration of structural change. It has also made labour adjustments more difficult. Capital can be moved by telex, but people move more slowly. Workers need to adjust to changing circumstances, to be trained and retrained. But this takes time. It is therefore essential that the social partners and workers in particular are aware at an early stage of the scope and the consequences of the structural changes taking place and

expected to take place. This will allow them to take timely action to reduce individual and social risk and the costs that these entail.

This research project takes as its point of departure the growing similarity among the issues related to industrial adjustment in industrialised countries, and those related to industrialisation in the more advanced developing countries. Two operational questions that the project tries to answer are: (1) to what extent has industry relocated from North to South; and (2) to what extent is this trend currently being arrested or reversed? It looks for the causes and consequences of this relocation process and attempts, through a comparison of four different sectors, to come up with general conclusions.

The project is organised at three levels:

1. Global studies on clothing, steel, automobiles and aircraft ask to which extent the industry has relocated, whether in more recent times this trend is being reversed, and what the underlying causes of the relocation process are. The four sectors chosen represent a wide range of industry characteristics: some are dominated by small and medium enterprises, others have predominantly multinational or public ownership; some use more labour intensive, others more capital or high-tech intensive methods of production; some are stagnating, others expanding. It is hoped that by taking industries which differ from each other in these respects (and so reflect the heterogeneous situation prevailing in many other industries) some more universally valid conclusions will emerge.

2. Selected case studies, focusing on the situation in one sector in one country, provide examples of how adjustment - successful or unsuccessful - has taken place in concrete cases. These studies compare different business strategies in the same sector; ask how workers have reacted to different strategies; and to what extent government policies have helped or hindered the adjustment process.

3. Conceptual studies

* * *

This paper compares the development of the aerospace industry in two South-East Asian Nation States. In both, the industry has grown very rapidly, employing, by 1985, 4,000 people in Singapore and over 12,000 in Indonesia. The strategies followed by each have been quite different, though. Singapore offered a series of advantages including a favourable location, an excellent infrastructure, generous tax incentives, and a growing pool of skilled manpower. It attracted a considerable number of enterprises, all of them private (with the exception of the SAI group). Many are subsidiaries of multinational enterprises producing for export. Such an approach is fully consistent with Singapore's overall development strategy: heavy reliance on multinational companies, outward looking and promoting high value-added industries using skilled manpower.

In Indonesia the industry consists basically of one firm, ITPN. This firm is entirely state owned and benefits from a great deal of financial independence. It has become the symbol of the country's push for technological modernisation. Consistent with Indonesia's overall development strategy ITPN produces mainly for the large, well-protected domestic market.

Apart from the difference in the enterprise structure and market orientations between the two countries, their industries also differ in one other essential element. Whereas Indonesia is committing huge resources to develop the capability to manufacture aircraft, Singapore has more modest objectives: it wants to become a regional repair and overhaul centre and a major aircraft component manufacturing base.

Indonesia and Singapore have adopted such different approaches to a similar objective that one is tempted to ask which strategy has the best long term potential. Such a question is not easy to answer. In the past, the study argues, both approaches to industrial policy have worked successfully in various settings. Moreover, the circumstances in each country differ greatly. Much will also depend on the potential for export, which in turn will depend on the intensity of foreign competition and developments on the world market in general.

Whatever the differences in approach, the study concludes, these two country studies show that there is substantial international relocation of the aerospace industry from industrialised to developing countries, whether in the forms of service and maintenance/activities and component manufacture, or in assembly and full manufacture.

As their name indicates, working papers are an intermediate form of presenting research findings. Any comments provoked by this paper are therefore most welcome.

Gijsbert van Liemt

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I. Introduction

In the past two decades, the world economy has expanded rapidly and undergone profound structural changes. Its centre of gravity has gradually shifted from the Atlantic to the Asia-Pacific region with the phenomenal export-driven rise of Japan as the world's second largest economy (after the United States) and the emergence of newly-industrialising countries (nics) such as South Korea and Singapore as major exporters of increasingly high value-added manufactures to North America and Europe. Japan's export success in areas that used to be dominated by North America and Europe is a source of continuing trade frictions with its major trading partners. The export-oriented development of the nics too has created problems. All of them are running short of low-wage labour and must move their economies away from labour-intensive export manufacturing, an activity in which near-nics like Thailand and Malaysia have a growing comparative advantage. But the upmarket strategies of the nics bring them increasingly into export competition with industrial countries. At the same time, several of them face external pressures to open up their markets and revalue their currencies.

If the Asian nics are restructuring in response to internal and external pressures, so too are the other Asian developing countries. In all countries, the state is playing a major role in encouraging the development of desired industries, either by providing incentives to private investors or by investing its own resources. This paper provides a case study of how two vastly different countries, namely Indonesia and Singapore, went about

promoting the development of an aerospace industry, an industry in which the western industrial countries retain a strong comparative advantage and in which Japan is not yet a dominant producer. We analyse the evolution and structure of the industry in the two ASEAN countries, with particular attention to the factors that influence its international competitiveness.

The aerospace industry provides an excellent basis for an examination of newly-emerging industries in the developing market economies of East Asia, and of the international relocation of industrial activity. Several governments in the region - most notably Indonesia's - attach considerable importance to the growth of the industry. This is so for a number of reasons.

First, both the assembly and manufacturing stages of the industry are high value added activities. This proposition is illustrated with reference to United States data, which are generally the best guide to relative factor intensities because of that country's mature industrial structure and relatively undistorted economy. All three sub-sectors of the industry display above average value added per worker (Table 1). More importantly, average employee remuneration is considerably higher than the all-manufacturing average. This suggests that the industry's high value added is due primarily to its skill intensity rather than to its physical capital intensity.

Secondly, the industry's production and ownership characteristics make it a leading candidate for third world governments wishing to encourage north-south technology

Table 1: Relative Factor Intensities in United States Manufacturing, 1983

	Value Added per Worker (\$'000) Index		Payroll per Worker (\$'000) Index	
All Manufacturing	47.1	100	21.1	100
Transport Equipment	61.7	131	27.6	131
Aircraft	55.8	119	30.1	143
Aircraft Engines & Engine Parts	63.3	134	29.1	138
Aircraft Equipment	54.3	115	28.2	134

Note: Index in both cases calculated as all manufacturing equals 100.

Source: US Department of Commerce, 1983 Annual Survey of Manufactures, Washington, 1985.

transfers. For one thing, the industry is R & D intensive, so governments see the industry as a means of acquiring access to rapidly changing technology frontiers. For another, like most transport manufacturing industries, the production process consists of a wide range of separate though interrelated component manufacturing processes, together with the final assembly stage. Such discontinuous production schedules lend themselves well to subcontracting arrangements and associated technology spin-offs, both nationally and internationally. Finally, the industry is dominated, at least in the OECD countries, by a small number of multinational corporations. This high seller concentration does not mean that there are few opportunities for developing countries to participate in the industry, though it does shape the market for international technology flows and conditions the bargaining power of governments wishing to establish an aerospace industry.

Thirdly, the industry is of interest to governments for several other reasons. One is the possible military know-how spin-offs from the industry, especially for countries wishing to develop an independent defence capacity. Another is the poor state of surface transport infrastructure (both by land and sea) in archipelago states (and Southeast Asian has two of the largest such states - Indonesia and the Philippines), especially in the development of enclave mining activity. Both these factors require a more highly developed air transport network - although not necessarily a manufacturing capacity - than would otherwise be the case. Finally, and not infrequently, there are "prestige"

and "national pride" factors in countries developing manufacturing competence in high-tech industries. The latter in particular has been of major significance in Indonesia's case.

II. Development Strategies in Indonesia and Singapore

Both Indonesia and Singapore grew rapidly in the decade and a half through to the early 1980s, Indonesia because of high commodity prices and Singapore because of its successful labour-intensive, export-oriented development strategy.¹ Until the recent price declines, Indonesia relied on oil and gas exports to an extraordinary degree. Over the period 1973-1983, for example, they accounted for approximately 75 per cent of merchandise exports and two-thirds of government revenue. The effects on the manufacturing sector were broadly two-fold. On the one hand, manufacturing grew rapidly, owing to the recycling of petroleum revenues domestically, to large government investments in industry, and to very high protection against import competition. On the other hand, however, manufactured exports barely increased, both because of the "Dutch disease" effects (via the currency's real effective exchange rate appreciation) and lack of official interest. Manufactured exports have really only begun to grow since 1980, following the collapse of commodity prices, and they remain small compared to developing East Asian economies. Consequently, Indonesia's growth rate has fallen sharply since 1982, to below 3% annually, or less than half that recorded in the 1970s.²

Unlike Indonesia, Singapore continued to register high growth rates in the early 1980s, thanks to the rapid expansion of traded services and domestic construction. In 1985, however, its

economy contracted, a result caused by internal policy mistakes and aggravated by unfavourable external factors. In 1979, Singapore had begun to pursue an upmarket strategy aimed at attracting high-tech industries and phasing out labour-intensive industries. Additional incentives for priority industries (of which aerospace was one) were introduced, infrastructure and manpower development programmes expanded, and wage costs sharply raised. By the mid-1980s, wages had grown out of line with productivity, leading to high increases in unit labour costs that severely blunted the competitiveness of Singapore industries. As a result, exports of most industries hardly grew and the inflow of foreign investments--the driving force behind the rapid transformation of Singapore manufacturing--slowed greatly. To counter the recession, the government cut various operating costs and introduced a policy of wage restraint.³ By late 1986, the economy was on the mend. A growth rate of 8% is expected for 1987, up from 2% in 1986, and much better than that projected for Indonesia.

In both Indonesia and Singapore, the state is heavily involved in the economy, both directly through state-owned enterprises and indirectly through various controls and incentives. In Indonesia, regulations are extensive and often market-inhibiting because of the country's protective industrial policy which encourages inefficiency and rent-seeking. In Singapore, regulations are probably equally extensive, but they have on the whole been friendly to private enterprises, facilitating rather than frustrating their activities.

Because Indonesia's industrial strategy is still basically inward-looking while that of Singapore is oriented towards world markets, the approaches the two countries are using to develop their aerospace industries are strikingly dissimilar. For strategic and self-sufficiency reasons, Indonesia is committing huge state resources to develop a capability to manufacture aircrafts, even though its industrial support base is weak. It is no exaggeration to state that its rapidly developing aircraft industry has become the symbol of its push for technological modernisation. Singapore, in contrast, has not invested state capital in trying to develop a commercial aircraft manufacturing capability, even though its industrial sector is much more highly developed than that of Indonesia. But it does have a state-owned firm which assembles military jet trainers and also refurbishes helicopters. Its approach is to encourage, with generous incentives, private firms to expand their capability to manufacture aircraft components or service and repair aircrafts in Singapore, while ensuring that its state-owned firm and subsidiaries are able to meet the strategic needs of its air force and at the same time service on a commercial basis foreign aircrafts. While Indonesia's strategy involves a quantum leap in technology from a narrow industrial base, Singapore's represents a gradualist approach with no clearly-defined long-term objective such as the manufacture of entire commercial aircrafts.

As the aerospace industry in Indonesia is so different from that in Singapore, and the data are not comparable, we will analyse first the development of the industry in Indonesia, then its counterpart in Singapore, before highlighting their main

differences and speculating on likely changes in the next five years.

III. The Aerospace Industry in Indonesia

(a) Introduction

The aerospace industry is a new-comer to Indonesia. There were attempts to manufacture aircraft before 1966, and the armed forces had developed limited service capabilities for military purposes. But, as a result of the economic stagnation in the country's first two decades of independence, Indonesia barely possessed any capital goods industries, let alone aerospace. There was a dramatic reversal in Indonesia's economic fortunes after 1966. The pragmatic orientation of the so-called "New Order" regime of President Soeharto, and the sharp increase in commodity prices, ushered in an era of unparalleled growth and prosperity.

While the government pursued orthodox macroeconomic policies, there was also widespread support for the development of spectacular investment projects involving quantum leaps in technology. Following the oil price increases of 1973, the head of Pertamina, the state-owned oil company, initiated an extraordinary range of ambitious projects, with presidential backing. However, financial mismanagement within Pertamina quickly became apparent, and by 1976 the company had accumulated debts of \$10 billion, then equivalent to one-third of the country's GDP.⁴

In the ensuing rescue package many of the Pertamina schemes were abandoned or modified. However, there was still influential

support for the notion that Indonesia required a massive infusion of new technologies, and that ambitious investment projects were the most effective means of acquiring them. It is for this reason that the country's aerospace industry developed, and it is in this light that subsequent developments must be evaluated.

The industry consists of one state-owned factory situated on the outskirts of Bandung, the capital of the province of West Java. It is propelled by the powerful Minister for Research and Technology, Dr B.J.Habibie, who returned in 1974 from a senior position in West Germany (Vice President of the Messerschmitt corporation), reportedly at the direct invitation of the President. Two years later, P.T.Nurtanio Aircraft Industry was established. In 1986 its name was changed to IPTN.⁵ We first provide an overview of the industry's development, before taking a more detailed look at IPTN.

It is important to emphasise, by way of background, three dominant features of the industrial policy environment and the role of the state in Indonesia. First, the state is a major investor in industry. Manufacturing activities which are often the preserve of multinationals in other countries - such as aerospace, not to mention petroleum refining, steel and petrochemicals - are in the main exclusively state-owned in Indonesia. Secondly, manufacturing protection is high, and highly dispersed, with large variations in effective rates of protection among similar industrial groupings. Consequently, much of Indonesian industry is inefficient, and the policy-making environment highly politicised. Thirdly, the government is highly

interventionist in virtually every aspect of domestic economic activity. The Investment Coordinating Board (BKPM) vigorously screens all incoming investments, while all government departments retain a large array of regulatory requirements. Each of these factors is important to an understanding of IPTN's development.

(b) An Overview of Recent Developments

Despite important gaps, secondary data indicate the industry's spectacular growth. In its first year of production, industry output comprised just two airplanes (Table 2).⁶ Thereafter, production rose sharply, to 13 helicopters and three

airplanes in 1976/77, and to 43 and 21 units respectively in the most recent year for which data are available (1985/86). Of course, these figures are somewhat misleading since they refer only to assembled units and take no account of trends in local content. Nevertheless the increase in the space of just one decade is impressive.

For a more detailed picture it is necessary to refer to the annual series, Statistik Industri. Unfortunately, these data are not provided at a sufficiently disaggregated level for the aerospace industry to be identified. However, for the latest published year (1984) there were only three firms in the industry, and unpublished figures reveal that almost three-quarters of the industry's output was produced by IPTN. The firm was included in the annual survey only in 1982 (Table 3).

Table 2: Production of Airplanes and Helicopters, Indonesia.

Year	Helicopters	Airplanes
1985/86	43	21
1984/85	30	10
1983/84	29	7
1982/83	21	21
1981/82	12	17
1980/81	12	12
1979/80	16	16
1978/79	16	16
1977/78	6	7
1976/77	13	3
1975/76	0	2

Source: Nota Keuangan [Financial Note], Jakarta, various issues.

Table 3: Principal Statistics for "Other Transport Equipment" Industry

	1982	1983	1984
1. Number of Firms	4	4	3
2. Employment	6,488	6,177	5,861
3. % Production Workers	-	-	64
(4. % Production Workers - all industries	-	-	81)
5. Value added per Worker	-	-	3,631
(6. Value added per Worker - all industries	-	-	3,736)
7. Employment Costs per Worker	-	-	1,602
(8. Employment Costs per Worker - all industries	-	-	896)
9. Value added as % of Gross Output	-	-	36
(10. Value added as % of Gross Output - all industries	-	-	30)
11. Total Inputs	34,106	34,506	38,189
12. Raw Materials Inputs	30,866	30,173	33,419
of which: airplane components	27,256	27,556	31,913
13. Gross Output	30,874	30,255	40,869
of which: aircraft	28,027	26,946	36,897

Note: Totals (items 11-13) refer to Rp m; ratios (items 5-8) refer to Rp'000.

Source: Biro Pusat Statistik, Statistik Industri [Industrial Statistics], Jakarta, various issues.

The industrial data reveal a mixed picture. Gross output has increased steadily (Indonesia's inflation rate over the period was low), but employment actually declined somewhat, partly because the number of firms in the industry fell by one. Contrary to the United States data, the industry's value added per employee is below that for Indonesian manufacturing as a whole. However, this result is to be expected, since the industry is still in a development phase, and so the ratio is a poor indicator of the industry's factor intensity. Nevertheless, the data do indicate the industry's high skill intensity: employment costs per employee are almost double the all industry average, while the proportion of production workers in the total workforce is substantially below the average.

In most years the total value of inputs approximated the value of gross output, indicating that most of the companies' value added was derived from "services rendered" - presumably subcontracting and components manufacture. By far the most important input has been airplane components, all of which were imported.

Indonesia's aerospace exports have been very small, and consisted to date entirely of aircraft parts (Table 4).⁷ These exports have fluctuated considerably, depending on job orders. They have declined considerably in recent years, as the company geared up for its ambitious assembly operations. Imports have also fluctuated considerably, mainly because aircraft imports have varied enormously, from a high of \$131 million (1984) to as

Table 4: Indonesia's Trade in Aircraft and Parts, 1975-1985
(\$'000)

	Aircraft	Imports Parts	Total	Exports (all parts)
1985	6,301	71,355	77,656	669
1984	130,615	46,216	176,831	442
1983	213,031	76,434	289,465	1,055
1982	179,753	78,204	257,957	43,276
1981	45,468	53,947	99,415	54,216
1980	23,152	22,031	45,183	548
1979	1,831	14,952	16,783	6,796
1978	92	11,616	11,708	3,365
1977	n.a.	n.a.	n.a.	3,115
1976	508	472	980	875
1975	44	19,842	20,866	3,037

Source: Biro Pusat Statistik, Ekspor and Impor, Jakarta, various issues.

little as \$44,000 (1975). Imports of aircraft parts have, however, risen steadily, reflecting the company's expanded operations.

As Table A.1 illustrates, the major import item has been aircraft exceeding 15,000 kg, which would be jet aircraft for the country's national carrier, Garuda. The data in Table A.1 also indicate Indonesia's principal trading partners for aerospace products. The United States, France, and Spain have been the major sources for helicopter and aircraft parts, reflecting the commercial licensing arrangements IPTN has with firms from these countries. The export values, though very much smaller, also indicate the same three major licensor countries.

(c) A Case Study of IPTN

Let us now look more closely at the development of the state-owned company, IPTN. It is literally no exaggeration to state that the project is the brainchild of Dr Habibie, with the active blessing of the Indonesian President. A lengthy newspaper report captures some of the flavour of the birth of the company:

"Seeds of the current plan were sown at an extraordinary meeting between President Suharto and Mr Habibie one evening in January 1974 ... Mr Habibie recalls that the president spoke of his long-range vision for Indonesia's economy, focusing on his goal of achieving a "take-off" into industry by the mid 1990s. Mr Suharto said he needed someone to advise him on getting and applying modern technology. "I've decided you are the man to do that." When Mr Habibie suggested he start by using his expertise to build planes, Mr Suharto gave him his blessing ... According to the younger man, Mr Suharto said, "You know how to do it. You just do it."⁸

The Habibie plan did not favour the gradualist approach. Rather than developing technology capacity over a long period of time, through components manufacture and a service-maintenance

experience - as Singapore has done - Indonesia opted immediately for full assembly. It is worth emphasising that the country had virtually no machine and capital goods base in the mid 1970s - manufacturing accounted for less than 10 per cent of GDP, and the share of capital goods within manufacturing (that is, ISIC 38), was also below 10 per cent. Moreover, the scientific infrastructure was extraordinarily weak, following the two decades of economic mismanagement which resulted in high inflation and poor growth rates before 1966.

Dr Habibie faced immense obstacles to realising his ambitions. But he also had two very important assets. One was (and is) access to virtually unlimited government support, in the form of finance, government facilities, and financial guarantees. Even in Indonesia's current economic downturn, the Minister is able to operate independently of the Department of Finance. The second asset is that he has a stranglehold on Indonesian aerospace imports. Apart from Garuda's jet purchases, he must approve all other imports. In an era of extraordinarily rapid growth in the 1970s, including huge expansion of major users such as the mining and petroleum industries (in which state enterprises predominate), this was a not unattractive incentive for potential foreign licensors.

By 1976, just two years after planning commenced, the then Nurtanio (now IPTN) plant was opened, on the edge of Bandung's airport. The company secured permission to assemble aircraft from two European manufacturers: from CASA (Construccion Aeronautica SA) of Spain the 212-Aviocar, a 19-seater twin-turboprop; and from Messerschmitt (Habibie's former employer in Germany) the

NBO-105 helicopter. In the following year, 1977, Nurtanio obtained a license to assemble the French SA 330J Puma helicopters from the Aerospatiale company. In the early years, not surprisingly, the Nurtanio operations consisted basically of assembling imported components kits for local market sales. But it is indicative both of Indonesia's bargaining power and of the fact that the international market for aircraft technology is perhaps more open and competitive than is commonly supposed that these three licensing agreements were secured so quickly.

In 1979, just three years after the plant's opening, Nurtanio announced a bold new plan to become Southeast Asia's first aircraft manufacturer. With CASA it established a joint venture known as Airtech (Aircraft Technologies Corporation) to design and build a new 30-40 seater plane, the CN-235. Under the agreement Nurtanio was to be responsible for production of the outer wing, rear fuselage and stabilisers, while CASA was to handle the centre wing-box, fuselage mid-section and cockpit. Each company was to be the sole-source supplier of its designated components and to under-take sub-assembly. The units were then to be cross-shipped for final assembly in each countries' plant. Nurtanio claimed it was producing 65 per cent of the value of the aircraft, a figure inflated by its higher share of import-intensive components.

Progress has been solid but not spectacular. The initial plan was to obtain airworthiness approval from the US Federal Aviation Administration (FAA) - a necessary imprimatur for international sales - by 1983, and to have the first unit

delivered to customers by 1984. While the first unit rolled over the Bandung assembly line in September 1983, to a blaze of publicity and outpourings of national pride, the CN-235 has experienced difficulty obtaining the FAA airworthiness certificate, although relevant certification from the Indonesian and Spanish authorities was quickly secured. The target date for FAA approval has been revised on several occasions; without it, there is little prospect of international sales.

Meanwhile, the company has pressed on with other plans. In 1983 it announced its intention to build a \$50 million engine overhaul and repair centre for turboprop and turboshaft work, with the technical assistance of General Electric. In August 1986 the Universal Maintenance Centre, as it became known, together with a major expansion of the now IPTN, were opened by the President. The IPTN complex now covers an area in excess of 40 ha., and comprises assembly hangars, surface treatment and composite shops, central storage and management buildings, and technology, training and computer centres. The total workshop area is 365,000 sq. metres.

The company has diversified its range of activities considerably in its first decade of operations. It still assembles the French and German helicopters, and in 1985 commenced assembly of the Bell 412 helicopter from the American company. It continues to assemble the NC-212 plane from CASA, in addition to the CN-235. In 1982 it signed a technical assistance agreement with the Boeing Corporation. In 1986 this culminated in an announcement at the much-publicised Jakarta Air Show - coincidentally the tenth anniversary of the establishment of

Nurtanio - from the American company that IPTN was certified to bid for components manufacture, and that the two companies were working on the design and "possible manufacture" of a 90-seat airplane. Later, in August 1986, the Indonesian Department of Defence signed an agreement to purchase 12 General Dynamics F-16 fighter planes for \$337 million. The agreement includes an offset manufacturing provision under which IPTN will make F-16 parts worth 35 per cent of the "flyaway" cost of the aircraft, and receive access to technical knowhow in specified areas.

It is likely that such offset agreements could provide much of the company's future growth. In addition to Defence purchases, Dr Habibie clearly has his eyes set on Garuda's jet purchases. Speculating on such a possibility, he declared:

"I'm not going to build 747s, but I'll ask the Boeing people to offset, say, 30 per cent of the price of airplanes. If the deal is \$1 billion, I will produce \$300 million. If they don't want to sell, well, I do it with somebody else."

Defence purchases, and access to the local market in related production activities, include assembly of the FAR rocket and the SOT torpedo, under licence from Belgium and West German companies respectively, and the state-owned PT Pal ship manufacturer in Surabaya, East Java.

What is one to make of the seemingly impressive progress in Indonesia's aerospace industry? Does the industry provide the basis for Indonesia's drive to technological modernisation? Or are these very large investments an example of wasteful extravagance in the state sector, with few technological - let alone financial - spin-offs? The truth probably lies somewhere

between the two, but it needs to be emphasised that insufficient information is publicly available for a thorough assessment of the costs and benefits.

There can be little doubt that the Indonesian company has expanded at an extraordinary pace. As noted earlier (Table 2), production of helicopters and airplanes rose from just two in 1975/76 to 63 in 1985/86. By January 1986 the company claimed to have delivered 194 aircraft (Table 5), 188 of which have been to domestic customers.¹⁰ The most important items have been the two

aircraft for which assembly licensing agreements were signed in 1976 - the NC-212 Aviocar and NBO-105 helicopter. At the Jakarta Air Show, in June 1986, the company also claimed to have firm orders and "negotiations" following expressions of interest for 135 CN-235s (Table 6). Most of the domestic purchasers have signed firm sales agreements, but, pending FAA certification, no foreign sales are guaranteed.

The data in Table 7 record the company's progress in a little more detail. Sales rose from Rp 2.6 billion (\$6.3 m at the then prevailing exchange rate) in the first year of operation, to Rp 67.3 billion (\$67 million) in 1985, the latest year for which information is available. Profit figures have also risen, somewhat erratically, although we will argue shortly that the data have little economic significance. The slump in profitability in 1985 is probably due to the allocation of resources to the CN-235 project, for which there was no immediate

Table 5: Delivery Status of IPTN Aircraft, January 1986

Type	Domestic	Foreign
NC-212 Aviocar (airplane)	Merpati Airlines 22 Armed Forces 18 Pelita Air 14 Others 18	Thai Agriculture 5 Air Guam 1
Total	72	6
NBO-105 (helicopter)	Pelita Air 36 Armed Forces 22 Dept. of Forestry 10 Others 22	
Total	90	
Puma, Super Puma (helicopters)	Pelita Air 8 Armed Forces 9	
Total	17	
Other Models	9	
Total, all models, domestic + foreign	194	

Source: Information kindly supplied by IPTN, Bandung.

Table 6: Sales Orders and "Negotiations", CN-235, June 1986

Domestic	Foreign (all armed forces)
Armed Forces 32	Thailand 20
Merpati Airlines 15	Philippines 16
Bouraq Air 10	Korea 10
Dirgantara Air Service 10	Japan 6
Others 10	Malaysia 6
Total 77	58

Source: As for Table 5.

Table 7: A Profile of IPTN, 1976-1985

Year	Sales (Rp m.)	Profit ^b (Rp m.)	Cumulative Investment (Rp b.)	Employment	Local Content, ^c NC-212
1985	67,260 ^a	230 ^a	352.7	12,596	80
1984	92,561	9,210	290.9	11,713	71
1983	39,964	5,637	208.1	10,774	57
1982	43,975	3,073	125.4	7,853	55
1981	38,338	758	66.6	4,742	37
1980	14,725	316	35.2	3,162	27
1979	9,535	2,306	21.2	2,362	25
1978	6,867	1,400	13.9	1,695	9
1977	2,683	(209)	11.6	1,279	6
1976	2,599	(255)	8.2	860	0
		22,466			

a Preliminary

b After tax gross operating surplus; bracketed data refer to losses. The last item in the column is cumulative gross surplus, 1976-1985, unadjusted for inflation.

c The local content data refer to phases, many of which overlap or are based on financial years. In these cases the figures are an average for the year.

Source: As for Table 5.

pay-off.

Cumulative investment also rose sharply, especially after work began on the CN-235, and in 1985 totalled Rp 353 billion (\$353 million at the current exchange rate, but rather less if averaged over the whole investment expenditure period). About two-thirds of the total has been on production machinery (Rp 78 billion), buildings and physical facilities (Rp 139 billion) and other equipment. The remaining one-third (Rp 117 billion) has been allocated to technical education and assistance, R & D, and licensing fees. Additional indicators of the company's expansion are its workforce, which grew from less than 1,000 in 1976 to almost 12,600 in 1985¹¹, and local content in the assembly of the CASA plane NC-212, which the company claims had risen to 80 per cent by 1985.

So much for the official picture; what of IPTN's contribution to Indonesia's technology development and its financial performance? Dr Habibie has always justified the project on the grounds that unless the country acquires first-hand competence in advanced technology it will forever be a technologically backward state, and that the most effective means of acquiring this competence is through projects such as IPTN. In his words, "I needed CN-235 as a vehicle where my people will be trained for complex technology."

There is little doubt that the company has introduced a wide range of new skills into Indonesia. It has provided jobs and created skills for a large number of workers who have no alternative employment opportunities. Over 2,000 of its workforce

- about one-sixth of the total - are university graduates, many of whom have subsequently been sent abroad. The company has imported much foreign technology, through technical licensing agreements and the large number of expatriate staff (frequently in excess of 100) working in the factory. By 1985, the company claimed, over 5,500 of its staff had graduated from IPTN training programs.

Nevertheless, its technology contribution needs to be kept in proper perspective. The assertion that local content on all assembled models (the data in Table 7 refer to just one) has risen to 90 per cent belies the fact that IPTN is - apart from the CN-235 - still essentially assembling components for final assembly. The company has progressed from assembling imported CKD kits, to assembling imported components for the final assembly, itself a not insignificant achievement. But the local content figure refers only to the aircraft frame, and so excludes much mechanical and electrical equipment.¹² Moreover, the company's technological contribution to smaller components manufacturers through subcontracting arrangements has been extremely limited; it is almost entirely an in-house operation. This is not necessarily a criticism of IPTN, but it is worth noting that in almost every other sub-sector of Indonesia's capital goods industries the government requires substantial subcontracting by the final assemblers.

The bottom line in an assessment of IPTN is a financial one. It is possible for any country to import technology. The real questions are whether the technology is used efficiently, and whether it makes economic sense to embark on such an ambitious

plan so rapidly. The reported cumulative profit figure of Rp 22.5 billion (about \$25 million using a weighted exchange rate over the period) provides little indication of the company's financial viability. The figure refers to gross operating surplus and excludes IPTN's very large investments. If, for example, the opportunity cost of the cumulative investment were 10 per cent, the capital cost exceeds the "profit" by more than 50 per cent.

Detailed financial data for IPTN are not available and, in any case, we would hardly expect such an ambitious project, starting from a very weak technological base, to be profitable within a decade. Nevertheless, there are three grounds on which the company's financial performance gives cause for some concern.

The first is that the company has a captive domestic market. Not only have most of its sales been domestic (see Table 5), the major customers have been government instrumentalities: apart from the armed forces and the Department of Forestry, Merpati (the nation's second domestic airline) is state-owned while Pelita Air is a subsidiary of the state-owned oil corporation, Pertamina. Financial transactions within the public sector are a very poor indicator of economic viability. Moreover, it is apparent that Dr Habibie has a stranglehold over all domestic sales. No aircraft may be imported without his approval; clearly his eventual target is Garuda's purchases, both in manufacturing their smaller aircraft and in achieving off-sets in their purchases of larger aircraft. Indeed, it is widely believed (and was reported in the aviation press) that Wiweko Supoeno - President Director of Garuda for 16 years - was removed from his

position in 1984 because he insisted on maintaining independence in the selection of aircraft for the Garuda and Merpati fleets.¹³

The second basis for concern is the project's lack of public accountability. Combined with Dr. Habibie's extraordinary political influence, the company operates an independent entity with access to very large state resources, in much the same manner as Pertamina did before 1976. The company has been generously bank-rolled by the government from the start. All its investment funds have been provided by the central government, in addition to numerous additional implicit subsidies (for example, the company is on state-owned land at Bandung airport; it has access to other government facilities, such as the Institut Teknologi Bandung and the new Science Park). Consequently, not only do the profit figures exclude capital costs, but total investments are an effective underestimate of the real outlays. It is, moreover, notable that IPTN's expansion has continued unabated during the last four years of financial austerity in Indonesia, when many other large projects have been deferred. IPTN has expanded rapidly because its prime supporter is one of the most powerful men in Indonesia.

Finally, notwithstanding the company's remarkable progress, it is not immediately obvious that the project is a sensible allocation of resources. There is a pressing need for an expansion of technical education in Indonesia, but is IPTN the appropriate vehicle? As noted, Indonesia's capital goods industries were extremely weak in the mid 1970s, and the country's technological base is very small compared to the Asian tigers and India. The region's emerging automobile exporters -

Malaysia is an unfortunate exception - first developed extensive metal-working and components manufacturing capacity, before advancing to full manufacture and assembly. From a much weaker base, Indonesia is attempting to circumvent such a gradualist approach, and in an industry characterised by even greater skill and technology intensity.

IV. The Aerospace Industry in Singapore

(a) Evolution and Government Policy

In Singapore, as in Indonesia, the aerospace industry is limited to aircraft manufacturing and servicing. Neither country has space-related industries such as the manufacture of satellites, rockets and so on. The aircraft parts manufacturing and servicing industry is a relatively young one in Singapore, having started only in the early 1970s with the rapid growth of the island as an air traffic centre and the rise in demand for support services to maintain and repair aircraft and aircraft components. An additional factor was the growth of regional oil exploration activities which increased the demand for helicopters and light aircraft and their maintenance.

In the early 1970s, the government identified aerospace as a priority industry deserving of special support and incentives. Its choice of aerospace (and other high-tech industries such as electronics, computers, medical equipment etc) was to be expected. Aerospace is a high value-added, skill-intensive industry that can capitalise on the island's location at the crossroads of international air traffic. The government's efforts at promoting the industry met with only limited success: only a

few aerospace companies located themselves in Singapore in the 1970s, the most notable one being Sundstrand, a U.S. firm that makes constant speed drive, a vital component in the electrical generation system of modern jet aircraft. Four factors explain this result. First, there was a lack of a regional market for aircraft component manufacturers. Second, there was difficulty in sourcing raw materials. And third, aircraft components made in Singapore and intended for the U.S. market had to be approved by the U.S. Federal Aviation Administration. Finally, manufacturers were uncertain about the availability of skilled manpower in Singapore because inadequate attention had been paid to the development of new skill training programs to supply the manpower required by the targeted industries. In 1979, despite the government's investment promotion efforts, there were only 10 aerospace firms in Singapore.

In 1979, the Singapore government introduced new policies to accelerate industrial restructuring and get the island economy out of a low-wage trap. These policies included: a corrective wage policy to induce employers to use labour more efficiently and upgrade their operations; new and generous incentives for priority industries; and an expansion of educational and training institutions to produce the skilled manpower required to support the restructuring strategy. These policies help to change the perceptions of foreign investors about the kinds of industries Singapore was promoting and its commitment to manpower development. In consequence, there was a large influx of skill- and capital-intensive firms into Singapore from 1980 to 1984, when rising domestic costs blunted the country's competitive edge.

and deterred new foreign investments.

For the aerospace industry, the expansion took place only after 1981. Three developments account for its rapid growth after 1981. First, there was the first Asian Aerospace Exhibition which was held in Singapore in 1981 and which enhanced greatly Singapore's image as an attractive place for aircraft component manufacturing and servicing companies. Second, in 1981 Singapore's Changi International Airport opened. It expanded the capacity of Singapore-based firms to repair and service large commercial aircraft. Third, and most important, in 1981 Singapore signed with the United States a Bilateral Airworthiness Agreement. The Agreement meant that aircraft components made in Singapore satisfy international standards. It opened up new markets for Singapore-based firms and also cut costs as Singapore-made components need not undergo additional tests when exported back to the United States. By 1985, the number of firms engaged in aircraft manufacturing and servicing had almost doubled to 18, with the greatest increases occurring between 1982 and 1983¹⁴.

(b) Industry Structure and Capability

Aerospace firms in Singapore are engaged in one or more of the following activities:

- (a) Repair and maintenance of aircraft;
- (b) Overhaul of aircraft components and engines;
- (c) Manufacture of aircraft components;
- (d) Calibration, testing and specialist services;
- (e) Stockists and distributors of parts and aircraft.

The first three types of activities are included in statistics on industrial production. All require heavy investments and skilled manpower. The fourth is a diverse group comprising services ranging from the sophisticated laboratory testing of aircraft components to cargo and mail handling, and catering and cabin services. The analysis that follows deals mainly with the first three types of activities because of data availability.

In the 1970s, the industry's capability was limited to the maintenance of piston engined and first-generation jet engined aircraft. By the early 1980s, with the influx of U.S. firms, it had expanded to include the repair, overhaul and remanufacture of air frame structures, systems and equipment, and the manufacturing of aircraft parts including turbine blades, compressors, landing gears etc (see Appendix 3). Most firms are involved in maintenance/service and repair overhaul work. Few of them are manufacturing or assembling aircraft components.

(c) A Statistical Portrait

Foreign-owned and state-owned firms dominate the industry. Most foreign-owned firms are from the United States and the only state-owned firm, the Singapore Aircraft Industries (SAI) is a holding company with seven subsidiaries and associated companies. Supporting and subcontracting services in the industry are provided mainly by private local companies.

Cumulative investments, employment and output in the industry have grown at an extremely fast rate since 1977 (Table 8). Fixed cumulative investments, for example, multiplied more than ten times between 1977 and 1984 (the last year such data are available). In the same period, employment tripled and output

rose ten times.

Table 9 gives a more detailed picture of the industry's performance using data from one source. It reveals the rapid expansion of the industry's employment, output, value-added,

sales, employee remuneration and capital spending in the first half of the 1980s. It was in fact one of the few industries that was relatively unaffected by the contraction of the economy in 1985. Table 9 also shows that the industry's shares of employment, output, value-added, and direct exports of both the transport and manufacturing sector have increased significantly since 1980. Its share of the transport sector's output, for example, has risen sharply, from less than 10 per cent in 1980 to 35 per cent in 1985, partly because of its own rapid growth and partly because of the stagnation of shipbuilding and repairing.

The rapid annual double-digit expansion of the industry has been accompanied by strong productivity growth. As table 9 shows, value added per worker increased by 12.9 per cent a year in 1980-85. As remuneration per worker increased by only 9.3 per cent a year, unit labour cost in the industry has fallen, strengthening the industry's competitiveness.

The growth of the aerospace industry is especially remarkable when its performance is contrasted with that of the much older shipbuilding industry. The industry accounts for only 8.2 per cent of establishments in the transport sector in 1985, but it generates more value-added and direct exports than

Table 8 Singapore: Key Statistics of Aerospace/Aircraft-Related Industries, 1977-84^a

Year	Cumulative fixed invest- ment(gross) Sm	No of employees	Output Sm	% increase over previous year %
1977	28.8	1,400	47.0	na
1978	40.2	1,900	121.2	157.8
1979	78.0	2,340	168.0	38.6
1980	98.9	2,761	203.0	21.1
1981	144.0	3,124	233.2	14.6
1982	244.9	3,547	262.8	12.7
1983	253.3	3,945	382.0	45.4
1984	303.8	4,276	457.3	19.7

^a Not comparable with Table 2

Figures exclude SIA Engineering which is part of SIA which handles service, repair and overhaul work

Source: Singapore, Economic Development Board, The Aerospace Industry in Singapore, 1984

Table 9 Singapore Principal Statistics of the Aerospace Industry, 1980-85

	1980	1981	1982	1983	1984	1985 Ann ave growth rate (%) 1980- 1985
Establishments						
Aerospace (No)	10	10	11	17	17	11.8
As % of Transport Sector	4.0	3.8	3.7	5.8	6.7	-2.8
As % of Total Manufacturing	0.3	0.3	0.3	0.5	0.5	1.0
Employment (No)						
Aerospace (No)	2267	2535	3169	3494	3898	11.3
As % of Transport Sector	8.9	8.9	10.3	12.9	15.7	-4.6
As % of Total Manufacturing	0.8	0.9	1.2	1.3	1.4	-1.0
Output						
Aerospace (\$m)	191.6	223.4	297.0	399.6	461.2	23.8
As % of Transport Sector	9.4	10.0	14.3	213.9	23.6	-2.6
As % of Total Manufacturing	0.6	0.6	0.8	1.1	1.1	4.1
Value-added (\$'000)						
Aerospace (\$m)	147.6	176.6	231.1	304.4	363.4	24.3
As % of Transport Sector	13.9	14.9	23.0	32.8	36.0	-0.5
As % of Total Manufacturing	1.7	1.8	2.5	3.1	3.2	4.7
Direct Exports						
Aerospace (\$m)	122.4	121.6	189.5	290.6	338.8	26.7
As % of Transport Sector	12.6	12.2	17.0	27.4	35.6	2.4
As % of Total Manufacturing	0.6	0.5	0.9	1.3	1.3	4.8
Remuneration						
Aerospace (\$m)	34.3	40.6	58.3	67.7	86.7	20.7
As % of Transport Sector	9.4	9.4	12.0	14.5	18.2	4.0
As % of Total Manufacturing	1.4	1.4	1.8	1.9	2.1	13.5
Capital expenditure						
Aerospace (\$m)	20.4	29.9	25.9	27.1	42.6	6.5
As % of Transport Sector	13.6	24.9	11.0	13.5	31.3	-15.9
As % of Total Manufacturing	1.1	1.5	1.2	1.3	1.9	0.2
Ratios						
Output/Employment (\$'000)	84.51	88.14	93.73	114.38	118.33	12.5
VA/Employment (\$'000)	63.11	69.65	72.93	87.13	93.22	12.9
Remun/Employment (\$'000)	15.11	16.02	18.40	19.37	22.24	9.3
Cap Exp/Employment (\$'000)	8.99	11.78	8.18	7.76	10.92	-4.9
Remun/Output (\$)	0.18	0.18	0.20	0.17	0.19	-3.2

Source: Singapore, Department of Statistics, Census of Industrial Production, various years

shipbuilding which accounts for close to two-fifths of all establishments in the transport sector.

Total sales of the industry rose by an average of 25.7 per cent a year in 1980-85 (Table 10). Of the total sales of S\$640.8 million in 1985, about a quarter are to local firms, and the rest are exported, mostly to industrial countries. The U.S. market is the largest, reflecting the dominance of U.S. firms in the industry and the importance of intrafirm sales. Regional markets account for less than 10 per cent of direct exports in 1985. In the last few years, some market as well as product diversification has taken place, but the principal markets remain the industrial countries (Table 11).

Reflecting the still limited range of its servicing and manufacturing capabilities, Singapore is a net importer of aircraft and aircraft components (Table 12). In some years, 1981 and 1985 for example, imports have exceeded exports by as much as 50 per cent. These deficits are due to the purchase of new aircraft and equipment by Singapore Airlines, the national carrier. While domestic exports have increased, re-exports have fallen in both absolute and relative terms in 1980-86, mainly because of the growth of direct trading between exporters and Singapore's neighbours. Malaysia and Thailand absorb most of the re-exports. Indonesia which, as we have seen, has a policy of protecting its own fledgling aerospace industry is not a significant market.

Table 10 Singapore: Details of Sales of Aerospace Industry, 1980-86
(\$m)

	1980	1981	1982	1983	1984	1985	Ann ave growth rate (%)
Total sales	177.2	186.4	273.5	409.3	478.1	640.8	25.7
Sales in S'pore							
Total	54.8	64.8	84.0	118.6	139.3	174.7	23.2
Wholesalers	0.0	0.0	0.0	2.5	1.9	2.7	na
Retailers	0.0	0.0	0.0	0.0	0.0	0.0	na
Dir consumption	41.2	0.0	26.4	14.7	22.2	41.2	-0.3
Others	12.9	63.5	57.6	101.4	115.2	130.8	46.3
Direct exports							
Total	122.4	121.6	189.5	290.6	338.8	466.1	26.7
Malaysia	2.4	2.4	7.4	5.9	6.0	6.3	19.6
Other ASEAN countries	20.2	20.0	36.0	16.7	17.1	24.7	3.9
Other overseas countries	99.8	99.2	146.1	268.1	315.7	435.1	29.5

Source: As in Table 9

Region/Country	1980	1981	1982	1983	1984	1985	1986	Percent
North America								
US	65.8	65.9	49.3	45.3	36.1	31.5	33.5	
Canada	65.6	41.8	19.0	44.8	35.8	30.9	31.9	
	0.2	24.1	30.3	0.5	0.3	0.6	1.6	
Other								
OECD countries	10.2	6.0	3.1	1.2	21.4	43.4	14.1	
Australia	0.9	1.6	0.5	0.5	0.5	0.8	5.3	
Belgium	0.4	0.6	0.1	0.2	0.2	6.0	2.5	
France	0.1	2.4	0.9	0.2	0.1	17.5	2.2	
Greece	0.0	0.0	0.0	0.0	20.0	17.8	1.1	
UK	8.8	1.4	1.6	0.3	0.6	1.3	3.0	
ASEAN								
Brunei	17.3	16.4	19.6	7.1	5.7	3.5	14.8	
Philippines	4.9	1.2	0.5	0.5	0.4	0.9	3.1	
Pen Malaysia	1.3	0.0	5.4	0.9	0.4	0.3	0.3	
Sarawak	3.3	2.5	5.9	3.1	4.2	1.6	6.6	
Thailand	0.3	9.3	0.2	0.0	0.0	0.0	0.2	
	7.5	3.4	7.6	2.6	0.7	0.7	4.6	
Others	6.7	11.7	28.0	46.4	36.8	21.6	37.6	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Source: Singapore, Department of Statistics, Import. & Export: Statistics, various years

Table 12 Singapore: Trade Statistics of the Aerospace Industry 1980-86
(SITC 7928200 & 7929000)

Year	Imports	Total Exports	Domestic Exports	Re-Export Exports	Net Exports
1980	114.0	33.9	4.1	29.8	-80.1
1981	59.1	32.7	4.4	28.3	-26.4
1982	60.8	23.6	1.6	22.0	-37.2
1983	134.0	57.1	10.7	46.4	-76.9
1984	160.9	39.5	2.8	36.7	-121.4
1985	176.6	94.4	2.1	92.3	-82.2
1986	98.8	32.8	4.9	27.9	-66.0

Source: As in Table 11

(d) The Experiences of Two Companies

The eighteen firms that were engaged in aircraft part manufacturing and servicing activities in 1985 form a diverse group. Of these, the largest number are wholly-owned subsidiaries of U.S. firms including several which established themselves in Singapore in the early 1970s. There are also a number of European, mainly British and French, firms engaged in aircraft servicing activities. No Japanese firm has yet located itself in Singapore. This is due in large part to the fact that the Japanese have not developed a strong global competitive presence in the aerospace industry. There are also a few local firms in the industry, the largest of which is state-owned.

The market orientation of aircraft manufacturing and servicing firms differs. Those engaged mainly in making aircraft parts export their output to their parent companies, while those concentrating on the repair and servicing of aircrafts see the entire Asia-Pacific region as their market. Some have expanded in Singapore through increased sales, while others have grown in part through increased output and in part through acquisitions. Sundstrand, a company that makes constant speed drives, is an example of the former type of company while Dowty Aviation, a subsidiary of the British aerospace giant Dowty Group PLC, is an example of the latter. In 1987, Dowty Aviation acquired for \$15 million Heli Orient, a sales and maintenance operation mainly for Bell helicopters, and its subsidiary FAS-Orient, a company specialising in repairing components for helicopters and other aircraft. It also spent \$5 million on tooling and equipment to

upgrade its operations, making itself as a result one of the largest aircraft repair and overhaul companies in the Asia-Pacific region. The expansion allows Dowty to provide total capability to the commercial fleet of the Civil Aviation Administration of China (CAAC), with whom it has a three-year contract.

While Dowty has the capability to service and overhaul many types of aircrafts, other firms are much more specialised. An example is Samaero, a subsidiary of French aircraft maker Aerospatiale. Samaero serves the needs of companies operating helicopters built by Aerospatiale. It recently completed building a comprehensive hangar/workshop/storage facility which will enable it to service a wider range of Aerospatiale helicopters and Socata aircraft in the Asia-Pacific region. Thus while Dowty and a few other general aircraft servicing firms are geared to capturing a larger share of the market for aircraft repair and overhaul, Samaero is essentially a company established in Singapore to service Asia-Pacific owners of Aerospatiale-built aircrafts. But for all of them, Singapore offers a unique combination of advantages including location, excellent infrastructure, tax incentives, a growing pool of skilled manpower, and low unit labour costs compared with those in industrial countries.

Of the eighteen aircraft part manufacturing and servicing companies, the two largest in terms of employment are Sundstrand, a U.S. affiliate, and Singapore Aircraft Industries (SAI), a state-owned firm with six operating subsidiaries. The strategies and experiences of these two firms are very different and worth

highlighting. Sundstrand, a wholly-owned affiliate, established itself in Singapore to take advantage of lower operating costs and tax incentives. Its parent company is involved in a diverse range of activities of which aerospace is only one. Its Singapore facility is its second in Asia, the other being in Japan. The Singapore plant manufactures shafts and gears which are used to make constant speed drives, a high value-added product that forms a vital part of the electrical generation system of a jet aircraft. About 80-90 per cent of the drive are made in Singapore, but the final assembly work is carried out in the U.S. Most of the inputs for the shafts and gears are obtained from the parent company, and almost all its output is sold to the parent company. Its workforce of 600 workers includes relatively few graduate engineers but many skilled technicians who have been trained on the job. While the company has introduced some new skills to Singapore, its contribution to the development of support industries has been minimal. It has established few forward or backward linkages and transferred little technology to local firms compared to electronics firms such as Philips. While the company's early establishment has helped to boost Singapore's image as a producer of sophisticated aircraft parts, and so contributed to the willingness of the U.S. government to sign the Airworthiness Agreement of 1981, the company (which has been very profitable and enjoys rising productivity) has little independence of action. Its parent company decides its product lines and its long-term future hinges on its ability to produce at lower cost the products decided by its parent company. Should

it fail, either because of internal inefficiency or because of rising domestic costs (wages, statutory charges, and so on) over which it has little control, then its parent company may decide to relocate the production of constant speed drives elsewhere. For the present, however, such a prospect is most unlikely. The Singapore plant, with its internally trained and skilled workers, is doing well. There are no plans to diversify its product lines.

In sharp contrast to the U.S. subsidiary, Singapore Aircraft Industries is a diversified group. Two of its six subsidiaries were directly under a holding company of the Ministry of Defence before they were spun off as part of the government's strategy to promote the aerospace industry. The six subsidiaries are Singapore Aerospace Maintenance (SAMCO), Singapore Aerospace Manufacturing (SAM), Singapore Aero-Components Overhaul (SAC), Singapore Electronic and Engineering (SEEL), Singapore Aerospace Warehousing and Suppliers (SAWS), and Singapore Aero-Engine Overhaul (SAEO).

The SAI group is thus a conglomerate engaged in the full range of aircraft part manufacturing, assembly and repairing activities. It employs about 2,000 workers, 160 of whom have engineering degrees. It used to rely on a large number of foreign engineers but this dependence has declined as a result of the growing output of locally-trained engineers. But it continues to rely on suppliers for access to new technologies and processes. Unlike the private aircraft servicing or manufacturing firms, SAI's main client is the Republic of Singapore Air Force (RSAF). It services military aircrafts and has also assembled jet trainers for RSAF. Because its sales are mainly to RSAF, the SAI

group is less affected by market demand changes. By the same token, it is also difficult to evaluate its market efficiency as there is clearly a strategic component in its relationship with RSAF. In contrast to the U.S. affiliates, the technology and skill contribution of the SAI group to Singapore's economy are considerable, partly through various linkages to local firms but also through worker mobility. While the group has developed some experience in making aircraft parts and assembling jet trainers, its particular expertise remains essentially in the area of maintenance and overhaul.

In recent years, both the U.S. firm and the SAI group have enjoyed rapid growth, the U.S. firm because of the growing demand for aircrafts and thus the need for more constant speed drives, the SAI group because of the rapid built-up of Singapore's air force for strategic reasons. Both firms occupy special niches in their market segment. The U.S. firm has a unique product for which there are few substitutes. Demand for the firm's product is thus in the short term fairly inelastic. The SAI group also enjoys a special position because of its relationship with the RSAF. The long term demand of RSAF for its services is likely to grow slowly once the RSAF has completed its expansion. The SAI group therefore needs to look to other sources of demand for its expertise and services. It has begun to explore possible markets for its services in China and neighbouring countries. The diversification of its client base will take time and will not be easy. It will also increasingly bring it into competition with private firms, including the many foreign ones that have

established themselves in Singapore to service the Asia-Pacific region.

Singapore's rapid industrialisation in the past two decades was led by foreign multinationals and state-owned firms, with local private firms playing only a supporting role. This pattern of development - the dominant role of foreign multinationals and state-owned companies - appears likely to be repeated also for the aerospace industry. In the past, the private sector in Singapore has complained of unfair state competition. It would be surprising if such complaints are not registered in the future as the SAI group moves more aggressively to develop a wider client base for its activities.

V. Role of the State and the Industry's Prospects

(a) Singapore

The Singapore government's long-term aim is to develop the island into the aviation support centre of Asia. Specifically, it wants to (a) develop Singapore into the most comprehensive repair and overhaul centre in the Asia-Pacific region; (b) transform Singapore into a major aircraft component manufacturing base producing for world markets; and (c) to encourage international headquarters for the regional market. Its objectives are realistic, given the island's role as the business hub of the Southeast Asian region, its strategic location, excellent infrastructure, and developed skills. It does not have the heavy industrial infrastructure for large-scale aircraft manufacture, but its skills and infrastructure make it competitive in a number of activities related to the aerospace industry such as

electronics, avionics, parts manufacture and even light aircraft assembly. Unit labour costs are still one third those of the U.S. and Europe, despite rapid increases in 1980-84 which eroded to some extent the industry's competitiveness. In 1985-86 the Singapore government, as part of its program to restore the island's competitive edge, reduced statutory board changes and introduced a policy of wage restraint. As a result, operating costs of firms fell, helping to quicken Singapore's recovery from its worst recession in two decades.

To attract foreign aerospace firms, the government offers a growing number of incentives including tax holidays, investment allowances, training grants, and investment guarantees. It has expanded greatly the output of vocational, technical and engineering graduates to provide a ready pool of skilled manpower. In addition, it has designated the Loyang Industrial Estate as a base for aerospace and aircraft-related companies. The Estate, located near the Changi International Airport has ready-built premises to help reduce start-up time of new firms.

Besides favourable internal factors--competitive wage levels, attractive incentives, excellent infrastructure, a growing pool of skilled manpower - there are a number of external factors that are likely to quicken the growth and development of the aerospace industry in Singapore. First, despite current difficulties, long-term growth prospects in the Asia-Pacific region are good. Business and holiday travel will expand rapidly with rising incomes. This will generate a demand for new aircraft which will lead in turn to greater demand for aircraft-related services. The modernisation of China, in particular, will create

numerous opportunities for Singapore-based aerospace firms, who will be able to provide at competitive prices parts and services to Chinese-owned aircrafts. Second, with the trend towards deregulation in the U.S., competition among airlines will intensify. Airlines will be under growing pressures to cut operating and maintenance costs. As Singapore is a reliable and lower-cost repair centre, many of them will be attracted to transfer their labour-intensive maintenance operations to Singapore. Third, fierce competition for market shares has prompted aircraft manufacturers to set up overseas product support centres to provide quick and efficient "on-the-spot" after-sales services like maintenance, repair, overhaul, replacement and refurbishment services. Such centres also serve as regional distributors and stockists of spare parts. With its location and other competitive advantages, Singapore is well placed to serve as a product support centre for aircraft manufacturers.

But there are several threats to Singapore's ambition to be an aviation support centre. First, Singapore faces growing competition from other countries. India, Indonesia and Malaysia have plans to expand their aerospace capabilities. Over time, they are likely to become less dependent on the technical services Singapore has to offer. The second and greater threat to Singapore's aim to expand into aircraft component manufacturing comes from Japan. With its technology, large internal market and considerable experience in developing export markets, Japan is in a position to develop in the medium-term a

competitive edge in manufacturing not only aircraft components but also light aircrafts.

At present, aerospace firms in Singapore have a comparative advantage in the servicing, repair and overhaul of the following areas: aircraft components, nonstructural hardware, airframe structures, and engine accessories. In addition, it is an established aircraft parts stocking and distribution centre as well as a calibration and testing centre. These competitive strengths that Singapore firms have developed will likely be maintained in the next five to ten years.

Singapore does not have a capability to manufacture entire aircrafts. Though it has some experience in assembling military aircrafts, the range of skills and supporting industries it now has is too narrow to support an aircraft manufacturing industry, even if one is desirable. Indeed, the government's strategy so far is to concentrate on aircraft servicing and component manufacturing in the belief that such activities are less sensitive to protectionism in developed countries. Moreover, the market for new aircrafts, even small ones, is extremely small and competitive, and the returns likely to be low, as the experiences of many manufacturers suggest. The resources--manpower and financial--needed to develop a comparative advantage in aircraft manufacturing could be more profitably invested elsewhere.

In short, the medium-term outlook for Singapore's aerospace industry is promising. The strong growth witnessed in the industry in the past decade will continue. Singapore's share of the world market for the servicing and overhaul of aircrafts will rise, but from a small base. With the influx of more aircraft

component manufacturing firms from the U.S. and possibly Europe, its output and world market share of aircraft components will also increase. But the shift of production of aircraft components from the industrial countries to Singapore (and other developing countries) is likely to be gradual, not swift as in the case of consumer electronics. It will likely not provoke strong protectionist responses from the industrial countries, at least not in the foreseeable future.

(b) Indonesia

Indonesia's government has been equally interventionist in the development of its aerospace industry, but as with other aspects of industrial policy, the nature of this intervention could hardly be more different. Singapore's government has provided a conducive and financially attractive environment but, with the exception of one state enterprise, it has avoided direct intervention by means of licensing and regulatory controls. It has also favoured a gradualist approach, building on its service and components manufacturing capacity. The thrust of government intervention in Indonesia has been entirely different. The domestic market for aircraft has been closed; there is only one firm in the industry; it is state-owned and operating in a highly politicised environment; and the company opted for full manufacture of aircraft barely three years after its establishment.

The interplay of policy and economic factors, domestically and abroad, will determine the industry's future in Indonesia as in Singapore. Nevertheless, many of the basic parameters will

differ in Indonesia's case. Let us look at the industry's prospects with reference to the domestic and foreign factors.

Domestic demand for IPTN's products will depend on two factors: Indonesian economic growth and the scope for import replacement. Unless commodity prices recover quickly, Indonesia is unlikely to experience the very high growth rates of the 1970s. In an era of subdued expansion and government fiscal austerity, demand for civil aviation services might be expected to grow slowly. However, even if this economic forecast is correct, the picture is not quite so simple. The experience of the last few years suggests that a great deal depends on the continuing political influence of Dr Habibie. Despite recent government cutbacks, IPTN has continued to develop rapidly. The government sector - the Departments and state enterprises - is still large enough to support increased sales of IPTN aircraft, given the right combination of subsidised pricing (which results from such practices as credit guarantees, the granting of domestic monopoly, and the compulsory purchase of aircraft by government agencies) and political persuasion. Moreover, as we have seen, the purchases of both the armed forces and Garuda and its affiliates provide ample scope for sales, both through off-set arrangements and direct sales.

International sales are more problematic. Three variables are important in a consideration of likely future trends. The first is international market access. In the industrialised OECD countries, this is unlikely to present difficulties for very small potential exporters such as Indonesia, unless trade friction between major countries such as the United States and

Japan spills over, adversely, on to third parties (such as has occurred, for example, in the case of Korean steel exports). But IPTN has set its sights more on the regional Asian market and, as for Singapore's export drive, several of these countries are developing plans to manufacture aircraft themselves.

The second variable is the scope for leverage in obtaining access to other countries' markets. Such a possibility is probably not available for Singapore. But for Indonesia - strategically important, the world's largest moslem country, and now also a substantial debtor - a strategy of negotiating market access and exports in the case of aircraft cannot be ruled out. In the 21 years of the New Order the government has not sought to actively combine commercial and strategic interests. But it is possible, if the economy continues to perform poorly, and given such high-level political involvement in IPTN.

Finally, exports will depend on the company's international competitiveness. This in turn will depend on the capacity of the state to financially underwrite the whole project (and not to become embroiled in allegations over subsidised exports), and on how quickly IPTN can increase technical and economic efficiency. On both grounds there seem reasonable prospects for modest sales, assuming appropriate airworthiness certification is obtained. The initial target is likely to be price-sensitive regional markets, in which selling price and financial packages are likely to be more important than international brand names. Given continuing access to state resources, and increased efficiency from "moving up the learning curve" and from scale economies, IPTN might

expect to expand its exports to perhaps 20 or 30 per year.

VI Conclusion

Indonesia and Singapore have adopted such vastly different approaches to a common objective that one is tempted to ask which strategy is right. The answer is that both approaches to industrial policy have in the past worked successfully in various settings, and that in any case circumstances in Indonesia and Singapore differ greatly. As a small island state, Singapore had little choice but to look outward, a strategy which was also conditioned by centuries of entrepot trade. As with most of its industrial policy, the government has opted for "efficiency enhancing" intervention together with quite extensive (but declining) state ownership in the aerospace industry.

By contrast, successive Indonesian governments have adopted inward-looking, protectionist and highly interventionist industrial policies. The aerospace industry shares many of these features, although Dr Habibie is much more efficiency-oriented and outward-looking than many other key industrial policy-makers in Indonesia. While, as argued in earlier sections, the industry has recorded tremendous technological progress and it has moderately good sales prospects, its future depends much more heavily on political considerations than does its Singapore counterpart. This is because IPTN essentially operates without external checks and balances, either in the form of bureaucratic constraints (the Department of Finance) or market forces.

Despite their different approaches, these two country studies of the aerospace industry point to a common feature. There is substantial international relocation of the industry

from industrialised to developing countries, whether in the form of service and maintenance facilities and components manufacture (as in Singapore) or in assembly and full manufacture (as in Indonesia). As the civil aviation industry of East and Southeast Asia continues to expand, and the countries expand their technological capacity, this trend is likely to accelerate.

Footnotes

*The authors are grateful to Gijbert van Liemt for helpful comments on an earlier draft. We also acknowledge with thanks the assistance of Linda Low and Heng Kian in Singapore, and officials of IPTN in Bandung, Indonesia.

¹For an analysis of the development strategies of Indonesia and Singapore, see Mohamed Ariff and Hal Hill, Export-Oriented Industrialisation: The ASEAN Experience, Sydney: Allen and Unwin, 1985, pp.13-34.

²The only exception was 1984, when a good rice harvest and expanded petroleum refining capacity resulted in a rate of 6.5%. The economy is monitored in each "Survey of Recent Developments" of the Bulletin of Indonesian Economic Studies, published every four months.

³For details on Singapore's new economic strategy, see Singapore, Ministry of Trade and Industry, Report of the Economic Committee, Singapore's Economy: New Directions, February 1986, pp.15-28.

⁴For an account of the Pertamina debacle, see Peter McCawley, "Some Consequences of the Pertamina Crisis in Indonesia", Journal of Southeast Asian Studies, 9(1), 1-27.

⁵The initials refer to Industri Pesawat Terbang Nusantara, or literally Archipelago Aircraft Industry.

⁶Data in Table 2 refer to the Indonesian financial year, 1 April to 31 March. Later data all refer to the calendar year.

⁷We will see shortly that the company information and official statistics are not entirely in agreement on the composition of exports.

⁸Raphael Pura, "Indonesia Pursues Costly Aircraft Plan", Asian Wall Street Journal, 2 September 1985.

⁹Ibid.

¹⁰As noted in footnote 7, there is a discrepancy between export statistics which record only aircraft parts (see Table 4), and the company data which suggest aircraft exports of six up to January 1986. There is no obvious explanation for the discrepancy.

¹¹The difference between this figure and the employment data shown in Table 3 is that the latter refers only to manufacturing employment.

¹²A very rough indication of the company's local "value added" content is that the industrial statistics suggest that the

company's value added in 1984 was about Rp16 billion, or 17 per cent of sales for the same year.

¹³ See "Wiweko ousted as No.1 in shakeup at Garuda", Asian Aviation, November 1984. According to the report, Wiweko opposed the introduction of the CN-235 into the Merpati fleet, and had commenced negotiations with Fokker. Mr Wiweko's successor, Reyne Lumenta, announced the companies will adopt a "less independent and more cooperative approach" to Dr Habibie.

¹⁴ According to the Economic Development Board, there are thirty-one firms in the aerospace industry (their names are in Appendix II). The Board's list is comprehensive and includes firms not engaged in manufacturing and repairing activities. The Census of Industrial Production collects statistics only on firms primarily involved in manufacturing and repairing activities and so excludes transportation firms such as Singapore Airlines which has a subsidiary that does aircraft maintenance and servicing work.

Appendix 1

Indonesia's Aerospace Trade by Product and Major Trading Partner, 1981-1985
(\$ '000; major trading partner and its percentage of total in parentheses)

(1) Imports	Helicopters	Helicopter Parts	Aircraft Parts	Other Parts	Aircraft	
					(a) < 2,000 kg	(b) 2,000-15,000 kg (c) > 15,000 kg
1985	5,952 (US, 75%)	27,534 (US, 45%)	43,565 (US, 30%)	256 (US, 88%)	349 (France, 72%)	0
1984	1,926 (WG, 100%)	20,711 (France, 50%)	24,811 (US, 32%)	694 (UK, 73%)	878 (Switz, 97%)	23,952 (US, 90%) 103,859 (Holland, 78%)
1983	21,767 (US, 100%)	45,106 (France, 57%)	30,877 (Spain, 48%)	451 (US, 56%)	824 (US, 90%)	73,280 (UK, 90%) 117,160 (Holland, 73%)
1982	7,099 (UK, 60%)	33,375 (France, 61%)	44,276 (Spain, 44%)	553 (UK, 29%)	173 (US, 100%)	16,028 (UK, 100%) 156,453 (WG, 48%)
1981	20,864 (France, 96%)	26,052 (France, 47%)	25,205 (Spain, 53%)	2,690 (UK, 95%)	3,202 (Switz, 99%)	12,014 (France, 78%) 9,388 (France, 100%)
(2) Exports						
1985	331 (France, 100%)	336 (Spain, 42%)	2 (Holland, 100%)	neg.	0	0
1984	13 (US, 54%)	429 (US, 57%)	neg.	0	0	0
1983	282 (France, 55%)	773 (Spain, 88%)	0	33	0	0
1982	1,678 (France, 46%)	41,565 (WG, 60%)	33	1,339 (France, 49%)	0	0
1981	41,273 (Sing'pre, 91%)	11,604 (France, 44%)	1,339 (France, 49%)	0	0	0

Source: As for Table 4.

Appendix 2 List of Aerospace Companies in Singapore, 1986

- 1 AAR Pacific Pte Ltd
- 2 Aerosystems Pte Ltd
- 3 Airfast Services (S) Pte Ltd
- 4 Aviation Engineering Services Pte Ltd
- 5 Bell Helicopter Asia (Pte) Ltd
- 6 C & A Aviation (Pte) Ltd
- 7 Cana Aircraft Co
- 8 Composite Technology International Pte Ltd
- 9 Dunlop Aviation South East Asia Pte Ltd
- 10 Diethlem Industries Pte Ltd
- 11 Dowty Aviation Services Pte Ltd
- 12 Field Aviation (S'pore) Pte Ltd
- 13 Flite Industries Investment Pte Ltd
- 14 Garrett S'pore (Pte) Ltd
- 15 General Electric (USA) Aviation Service Operation Pte Ltd
- 16 GKL Keen Lee Equipment Pte Ltd
- 17 Hawker Pacific Pte Ltd
- 18 Hypercoat Enterprise Pte Ltd
- 19 Inchcape Aviation Holding
- 20 Interturbine Singapore Pte Ltd
- 21 NGL (Singapore) Pte Ltd
- 22 Pratt & Whitney Canada Services (SEA) Pte Ltd
- 23 Sadler Engine Design Manufacturing
- 24 Samaero Co Pte Ltd
- 25 SFENA Asia
- 26 Singapore Aircraft Industries Pte Ltd
- 27 Singapore Airlines Ltd
- 28 Sperry Aerospace & Marine Pte Ltd
- 29 Sundstrand Pacific (Pte) Ltd
- 30 TRW Turbine Overhaul Services Pte Ltd
- 31 Vias Aviation & Engineering Pte Ltd

* Its 6 subsidiary companies are:

- 1 Singapore Aerospace Maintenance Co Pte Ltd (Samco)
- 2 Singapore Aerospace Manufacturing Pte Ltd (SAM)
- 3 Singapore-Aero Components Overhaul Pte Ltd (SACO)
- 4 Singapore Electronics & Engineering Pte Ltd (SEEL)
- 5 Singapore Aerospace Warehousing Suppliers Pte Ltd (SAWS)
- 6 Singapore Aero-Engine Overhaul Pte Ltd (SAEOL)

Source: Singapore, Economic Development Board, The Aerospace Industry in Singapore, 1984.

Appendix 3

Total Capability of the Singapore Aerospace Industry, 1985

Hot Rpr Rfg Mfg Ass

HOT SECTION

Combustors
Turbine Blades
Nozzle

COLD SECTION

Fan
Compressors
Propellers
Rotor Blades

ENGINE

Fuel Pump
Generator
Gear Box
Starter Motor
Constant Speed Drive
Hydraulic Pump

AIR FRAME STRUCTURE

NONSTRUCT HARDWARE

Cargo Container
Galley Equipment

SYSTEMS & EQUIPMENT

Aux Power Units
Fuel Systems
Hydraulic Systems
Air Conditioning
Flight Controls
Avionics
Instruments
Audio Equipment
Communication
Electrical Power
Landing Gear
Wheels & Brakes

Hot = Maintenance/Service

Rpr = Repair, Overhaul & Remanufacture

Rfg = Structural Modification/Refurbishment

Mfg = Manufacturing

Ass = Assembly

INTERNATIONAL DIVISION OF LABOUR

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