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UnChartered Territory

DR GOH KENG SWEE AND THE ST ENGINEERING STORY

A TRIBUTE

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Released in conjunction with the 40th anniversary of ST Engineering, this book pays tribute to Dr Goh Keng Swee, rightly called the father of Singapore's defence industry. Dr Goh's myriad achievements in public service have greatly contributed to the building of modern Singapore, with indelible marks on its economy, politics, defence and society.

This book singles out one of his many accomplishments, defence industrial policy, which culminated in the establishment of Chartered Industries of Singapore (CIS), forerunner of the multi-sector, multinational conglomerate that is ST Engineering. The book examines the central role that Dr Goh played in the company's origins, the considerable challenges that he faced in developing an indigenous defence industrial base, and the extraordinary vigour, courage and imagination that he brought to bear on those challenges. Indeed, this book also argues that the CIS project best showcases the intellect, determination and creativity that is Dr Goh Keng Swee.

UNCHARTERED TERRITORY

“... given the private nature of the man, studying what, why and how Dr Goh thought and did is arguably the most honest way to approach the man. Needless to say, his work on establishing Chartered Industries of Singapore and navigating its transformation into ST Engineering represents merely one aspect of Dr Goh’s achievements in public office. Nevertheless, the ST Engineering story best exemplifies Dr Goh’s intellect, determination and indefatigable imagination.”

– Adrian Kuah Wee Jin



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DR GOH KENG SWEE AND THE ST ENGINEERING STORY

Adrian Kuah Wee Jin

Published under the auspices of



**S. RAJARATNAM SCHOOL
OF INTERNATIONAL STUDIES**
A Graduate School of Nanyang Technological University

 **ST Engineering**

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“Defence technology is vital to the security of Singapore. On the battlefield, defence technology plays a critical role as a force multiplier, giving us the crucial qualitative edge over potential adversaries. On the home front, it contributes to our ability to protect Singaporeans from unconventional threats.

“Over the years, MINDEF has been building up our defence technology capability in partnership with our local Science and Technology institutions, namely the Universities, Research Institutes and Defence Industry. Such partnerships enable MINDEF to tap the wider national talent pool, and ride upon their successes in academic or commercial research.

“Furthermore, we recognise that each of our local institutions has its unique core competency. For example, the Defence Industry’s core competency is in the development and production of systems, the Universities specialise in upstream R&D, and DSO focuses on secret-edge R&D projects. Our Defence Science and Technology Agency manages the total R&D effort and makes the strategic tradeoffs in the manner we invest into various defence technologies.”

Dr Tony Tan Keng Yam,

Deputy Prime Minister and Minister for Defence,
in a Keynote Address at the Defence Technology Prize Presentation
Ceremony on 6 November 2001 at Nanyang Auditorium,
Nanyang Technological University



Minister for the Interior and Defence Dr Goh Keng Swee visits the Vigilante Corps trainees in Mandal Forest Reserve, 11 December 1966.



Foreword

THE MAGIC WAND
AND LASTING LEGACY OF
DR GOH KENG SWEE

On 9 August 1965, Singapore separated from Malaysia and became the young Republic of Singapore. For our self-defence, the Singapore Armed Forces (SAF) were set up by our first Minister for Defence, Dr Goh Keng Swee.

In 1967, Dr Goh planted the seed of **Chartered Industries of Singapore** (CIS) and gave it the charter for licensed manufacturing of the American M16 rifle and its 5.56mm ammunition, for use by the SAF. Concurrently, CIS minted circulation coins for the Board of Commissioners of Currency of Singapore (BCCS). The Singapore Mint within CIS shared the tool and die workshop with the 5.56 ammo production line. Thus CIS began by serving both military and civilian markets.

In June 1970, as a freshly qualified Industrial/Systems Engineer, I was lucky to be posted to the Ministry of Defence (MINDEF) to set up a Systems and Research Branch in the Logistics Division.

Dr Goh returned from the Ministry of Finance to be Minister for Defence in October 1970. As the Minister for Defence, Dr Goh nurtured and monitored the young CIS. He personally chaired the monthly meetings of the CIS Board of Directors and its management.

MINDEF's Logistics Division was the buyer for the SAF. To be able to answer Dr Goh's constant queries about which and what parts of the M16 were manufactured locally, I interacted closely with CIS management.

Waving his "magic wand", Dr Goh created a whole slew of focused defence companies:

Singapore Shipbuilding & Engineering (SSE 1968, now called **Singapore Technologies Marine**), to build six missile gunboats for the Republic of Singapore Navy (RSN);

Singapore Electronic & Engineering Ltd (SEEL 1969, renamed **Singapore Technologies Electronics**), to repair weapons and electronic equipment for the RSN;

Singapore Automotive Engineering (SAE 1971, renamed **Singapore Technologies Kinetics**), to repair military trucks and the AMX-13 tanks for the SAF;

Ordnance Development & Engineering Company of Singapore (ODE 1973), to produce rifle bayonets and also mortars for the Artillery units;

Allied Ordnance of Singapore (AOS 1973), to assemble and repair Bofors naval guns;

Singapore Food Industries (SFI 1973), to buy and supply food to the SAF; and

Singapore Aerospace Maintenance Company (SAMCO 1975, renamed **Singapore Technologies Aerospace Engineering**), to refurbish second-hand US Navy Skyhawk aircraft for the Republic of Singapore Air Force.

In early 1974, as MINDEF's Director of Finance and together with the Director of Logistics, we registered a company known as **Sheng-Li Holding Company Private Limited**, to be the "umbrella" of the nascent defence companies. Dr Goh personally chose the name **Sheng-Li**, which is Chinese for "**Victory**".

After four-plus hectic years in MINDEF, I needed a break. I applied for and won a two-year US Fulbright scholarship to Harvard Business School in August 1974. Dr Goh was not at all enamoured by my long study leave! He asked then Permanent Secretary of Defence, Mr Pang Tee Pow, to persuade me to "drop out and come home"! I still have the 1976 letter from Mr Pang informing me that Dr Goh had instructed him to tell me not to take any vacation after the MBA graduation ceremony, but to return home immediately. My planned European vacation for the summer of 1976 evaporated into thin air!

I returned in June 1976 to be Director of Logistics Division. I distinctly remember meeting up with Dr Goh in his office that day. He went to his cupboard and took out a stack of files and handed them to me, saying: *Kept these files for you for the past two years!*

I was concurrently appointed Chairman of SAE and of AOS and Executive Committee Director of CIS and ODE. Dr Goh told me that we needed to set up a defence export company for the Sheng-Li group. He chose the name **Unicorn International** (UI) and I was appointed Chairman, UI.

Dr Goh, concurrently Deputy Prime Minister, left for the Ministry of Education in early 1979 to revamp the education system. He told the new Minister for Defence, Mr Howe Yoon Chong, that I was to report to Dr Goh himself for defence technology matters. So Mr Howe regularly asked me: "How is your boss today?"

Dr Goh attends the People's Defence Force artillery exercise at Pasir Laba, 24 November 1966.





In June 1979, Mr Howe appointed me Executive Chairman of CIS and, in September 1979, Permanent Secretary for Defence Industries, Logistics and Technology. In January 1984, I assumed the appointment of Chairman, SSE and took out S\$40 million from CIS's surplus to inject into SSE's debt-ridden coffers so that it could build the six Corvettes for the RSN. CIS was the father of many companies which included Singapore Computer Systems, Chartered Semiconductors Manufacturing and Chartered Materials and Services (which later became SembCorp Logistics).

In January 1986, I left MINDEF for the Economic Development Board to help lift the Singapore economy out of its first recession. I did not totally leave the Sheng-Li group as I was still Chairman of CIS, AOS and SSE. In June 1987, I was appointed Exco Chairman of Sheng-Li.

In 1989, we adopted the **Singapore Technologies** brand name and logo as the common corporate identity for the Sheng-Li group. In 1990, we listed SSE (**ST Marine** today), followed by Singapore Aerospace (**ST Aerospace** today) and five other ST companies.

I finally left the Singapore Technologies group in 1994 to head Sembawang Shipyard. In 1996, I merged ST Industrial Corporation with Sembawang Corporation to create **SembCorp Industries**, which I led till September 1999.

In my years of involvement with the Singapore Technologies group, I was lucky to have Dr Goh's constant guidance and tutoring.

This year, 2007, the Singapore Technologies group, now called the ST Engineering Group, happily celebrates its 40th anniversary and fondly remembers its founding father, Dr Goh Keng Swee, and his lasting legacy.

Philip Yeo

September 2007

“... Singapore survives and prospers because it has been able to adjust to quickly changing situations. For this, we need people with keen minds, able to see beyond the routine and the ordinary to perceive the big opportunities ahead and to think out bold, imaginative yet practical plans and to carry these out successfully.

“If history has one lesson to teach us, it is that we can hope to live in peace if we maintain strong defences. Small countries generally have no other desire than to be left in peace to develop their potential. But until a new international order is created whereby small nation states can have an assurance that their territory and independence will always be respected, there is no other choice than the example of Switzerland and Sweden (national service).”

Dr Goh Keng Swee,

Minister for Defence, in a speech at a ceremony at Sembawang Base on 27 February 1972

Zero Hour



Part One

We all know how the story begins. With the twin trauma and euphoria of independence, Singapore's first generation leaders found themselves confronted with a Pandora's box of problems – an economy in shambles, rampant unemployment, an acute housing shortage, and social unrest.

But for the newly independent Singapore, as with all newly independent states, one pressing need took precedence over all the others – the defence of the land and its people. This was especially the case when Singapore's separation from Malaysia was framed in a tense geopolitical environment defined by the Vietnam War, *Konfrontasi* with Indonesia and the impending withdrawal of British troops from the region.

Dr Goh Keng Swee had once observed, "The first thing an independent state must have is a defence force," even remarking to then Prime Minister Lee Kuan Yew, "You are a Prime Minister but you don't have any army." What he did not say, though it was something that he most certainly would have thought of, is that while it was one thing to set up armed forces, it was an altogether different task to arm and equip the soldiers. Clearly, there was a crucial difference between the provision of defence by the armed forces and the provision of defence materiel that would enable the armed forces to do its job. It is the latter that occupies the field of defence economics, and which defence industrial policy is supposed to address.



Dr Goh inspects contingents at the passing out parade of the first basic training course for volunteer leaders of Singapore Vigilante Corps at the Police Training School, 3 July 1966.



Dr Goh (back to camera) at the passing out parade of the first basic training course for volunteer leaders of Singapore Vigilante Corps at the Police Training School, 3 July 1966.

The critical task of planning Singapore's defence and security was put into the capable hands of Dr Goh Keng Swee upon independence on 9 August 1965, when he assumed the portfolio of Minister for the Interior and Defence. This would be the first of many recurring episodes that defined Dr Goh's career in public service – in the event of crisis, whenever there was a pressing problem, the ultimate (and frequently even the first) recourse would be to deploy the resident troubleshooter extraordinaire. Throughout Singapore's short history, Dr Goh's sure and steady hand would be clearly evident in steering its early course in every aspect of the nation's society and economy.

For all of his myriad achievements, Dr Goh is usually seen as the primary architect of Singapore's economic miracle, the driving force behind Singapore's emergence as a developed country and its ascendancy to the ranks of global cities such as Tokyo, New York and London. Such a view of Dr Goh's achievements obscures the fact that he was

responsible for many of the hallmarks that define modern Singapore. Diverse institutions such as the Economic Development Board, Port of Singapore Authority, Jurong Town Corporation, Housing and Development Board and Central Provident Fund – all had their genesis in Dr Goh’s mind. Such institutions were no mere abstract policy instruments; rather, they have directly and materially improved the welfare and lives of all Singaporeans, and continue to do so.

Add the likes of the Jurong Bird Park, the Zoological Gardens, the Singapore Symphony Orchestra and Sentosa, and it is apparent that his is no ordinary mind.

Dig a little deeper still, and it becomes obvious that Dr Goh was not merely a “big picture” intellectual and planner, but also very much a meticulous implementer and an imaginative improviser. In a sense, Dr Goh combined in the same person the “artist” and the “craftsman” – just as the cathedrals of medieval Europe were designed by artists, but ultimately built by craftsmen, Dr Goh was clearly one to see a project through from conceptualisation to realisation, from the drawing board to the production line.

Not content to simply occupy the rarefied political echelons and to provide guidance to his subordinates, Dr Goh with his predilection for hard work and his intense curiosity was never one to shy from rolling up his sleeves and personally plunging into the thick of things. It is that potent combination of curiosity and determination that manifests itself in his penchant for asking “why?” and “why not?”

The one project that best captures all of such qualities is the creation of Chartered Industries of Singapore (CIS), the precursor of the present-day ST Engineering. This book is about how Dr Goh conceived, started and developed CIS, of how he flew in the face of conventional wisdom by taking an improbable project and making it work. One might even say that the story of Singapore’s development is the story of ST Engineering writ large, with the major common theme running through both being the critical role that Dr Goh played.

What this book is not, however, is an attempt at a biographical sketch of Dr Goh the man; rather, it is an examination of one strand of the many things he accomplished in public life, namely defence industrial policy. Yet, as is often the case, one gets to know a person through the things that he does. So it is in this case, where to know what Dr Goh did (and how he did it) is to really know the man himself.

Samuel Johnson, the great 18th century English essayist, remarked that the wonder of a dog walking on its hind legs was not that it was done well, but that it was done at all. The same applies here to Dr Goh’s attempt to develop a domestic defence industrial base in Singapore. That ST Engineering has succeeded beyond all initial expectations is a testimony to the groundwork that Dr Goh laid.

Ignition ●

Part Two

SPEECH BY DR GOH KENG SWEE,
MINISTER FOR FINANCE,
AT THE OPENING OF CHARTERED
INDUSTRIES OF SINGAPORE LTD
ON SATURDAY, 27 APRIL 1968,
AT 5:00 PM

“Today we see the first-stage development of Chartered Industries of Singapore. The products consist of small arms ammunition and coins. The combination of these two products is unusual though I am told that there is one private company in Birmingham which jointly produces coins and small arms ammunition. There are many practical advantages in this combination, for both share common facilities, for instance, in security arrangements, in metrology and in the tool and die workshop.

“Many people were sceptical at the beginning, whether good ammunition can be produced in the tropics. Apart from difficult problems posed by temperature and humidity, experts believed that the high standard of precision engineering required in this industry could not be achieved in Singapore. Sir Laurence Hartnett, whom we consulted, spent much time in assessing the skills of workmen and engineers in Singapore. It is gratifying that his confidence in Singapore’s capabilities was fully justified.

“I remember one of Sir Laurence Hartnett’s injunctions when we discussed this project last year. That was to concentrate on quality. He predicted that when other armament manufacturers visit the plant and see for themselves how standards are maintained, this would lead to expansion in other fields. This forecast has happily come to fruition. Chartered Industries will soon move on to the production of hand grenades and demolition material. The company has also entered into partnership with a Hong Kong enterprise for the production of webbing equipment, steel helmets, military engineering tools, jerry cans and other military equipment.

“Chartered Industries has also entered into a licensing agreement with Etablissement Salgad of Finland for the production of mortar bombs. This is a considerable undertaking involving a total investment of \$15 million on plant and equipment. First-stage production will commence at the end of this year and the full production line is expected to be completed by the middle of 1970. There are also other proposals now under consideration with European armaments manufacturers. All things considered, this promises to be one of the growth industries of Jurong. Further, because it is the first large-scale venture into precision engineering in Singapore, local industries will benefit by the expertise that will grow in the tool and die workshop.

“It only remains for me to congratulate all those concerned in this project – the Board of Directors, management and engineering personnel and all members of staff. They have regarded this project as a challenge and have given of their best. Finally, I want to thank Sir Laurence Hartnett and Mr R.H. Osbourne of the Royal Australian Mint for their invaluable assistance.”

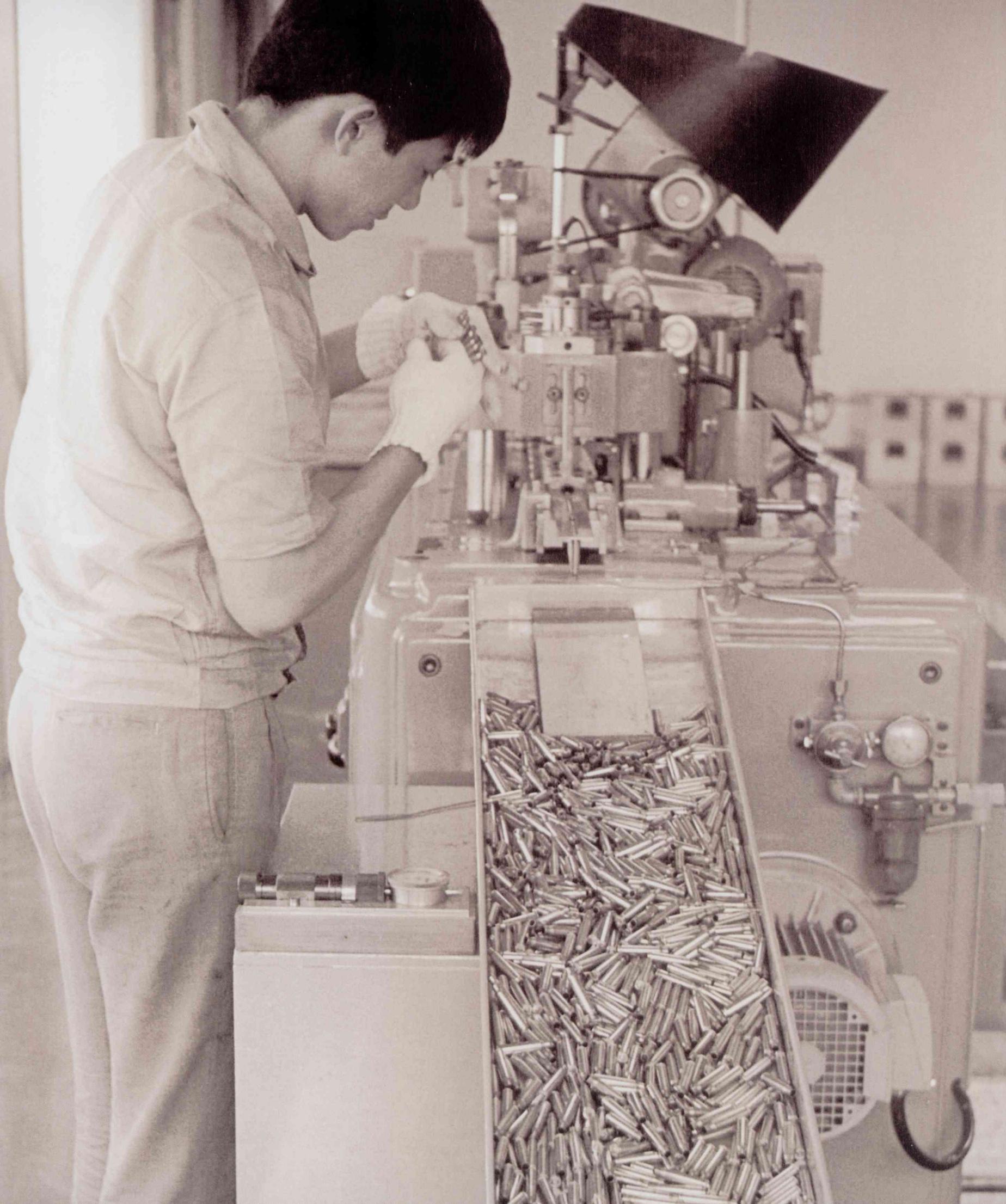
Dr Goh Keng Swee’s speech at the opening of Chartered Industries of Singapore on the evening of 27 April 1968 was characteristically brief and succinct. He began conventionally enough: “Today we see the first-stage development of Chartered Industries of Singapore.” So far, so good. *First-stage* even conveyed a sense of optimism about the future of the fledgling enterprise, that there were to be subsequent stages. Then he continued: “The products consist of small arms ammunition and coins.” Yes, that’s right. Coins. The creative intellectual and pragmatic policy-maker that he was, Dr Goh recognised from the beginning that the infrastructure and facilities for manufacturing bullets could also be used for making coins.

True synergy – a term that has been overused, but absolutely appropriate in this case. This was typical of the man: the ability to look at a problem from different angles, the wherewithal to try harder, and the daring imagination to try differently.

But the road leading to the launch of CIS was far from easy, and not without complications and controversy. The decision to develop any industry from scratch is fraught with many challenges. Starting a defence industry in particular, with limited resources and within a tight time frame, magnifies such challenges, and was precisely what Dr Goh had to grapple with. When Dr Goh thanked Sir Laurence Hartnett for his advice on setting up CIS, it was not without irony, for CIS was set up against Sir Laurence’s initial misgivings. Indeed, one of the biggest obstacles was the difficulty in filling cartridges with explosives in Singapore’s humid climate, which Sir Laurence had duly pointed out. Dr Goh reportedly declared his readiness to change the weather if necessary to get the project off the ground. Brash, to be sure, but you get the picture. In the event, a cold room environment was set up to facilitate the cartridge-filling process. Try harder. Try differently.

Dr Goh Keng Swee
addressing the audience
at the official opening of
Chartered Industries of
Singapore on 27 April 1968.





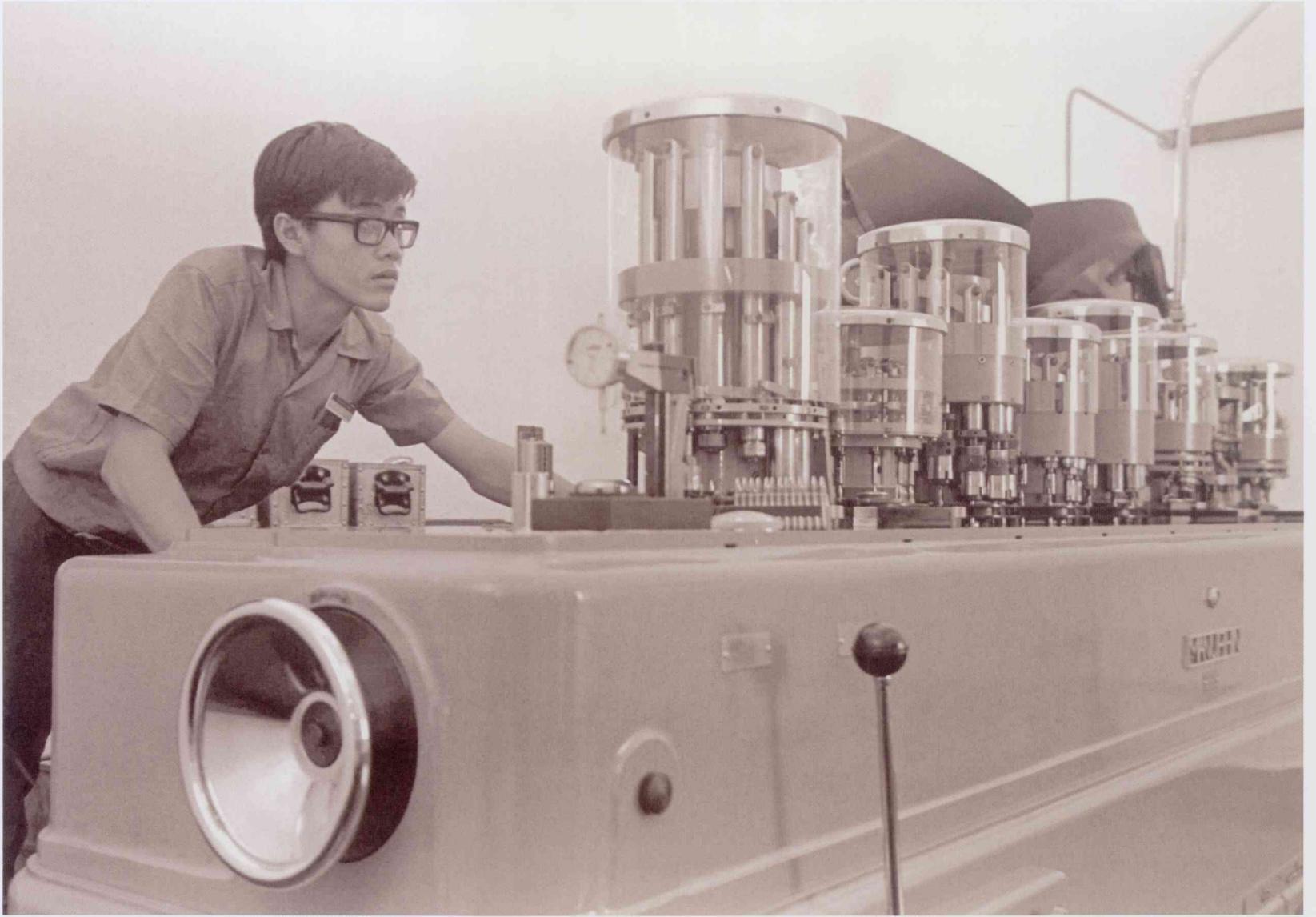
The Boon Lay Road premises of Chartered Industries of Singapore had two main products: ammunition and coins. (April 1968)

When he took on the responsibility for Singapore's defence, Dr Goh was painfully aware of his limitations. In a recent biography of the man (*Goh Keng Swee: A Portrait* by Tan Siok Sun, 2007), Dr Goh lamented that he was an economist, and not a military strategist. The truth of the matter, though, is that in planning Singapore's defence, and in developing CIS in particular, Dr Goh's skill in planning and improvising reflected the very best traits of a well-executed military campaign. Nevertheless, even Dr Goh could not be completely certain that the CIS project would succeed from the outset. In an interview with Dr Goh, in Singapore Technologies' 30th anniversary publication *Towards Tomorrow: The Singapore Technologies Story*, he admitted that while he had been confident that national service would be successful, by contrast he had not been all that sure about CIS.

Locating Dr Goh's Intellectual Framework

The colours that Dr Goh wore as an economist were largely those of a liberal, which in the main meant that he subscribed to the mechanism of the free market, albeit one that was prone to failure. When such market failures occurred, it was then the state's responsibility and role to intervene in a "market-friendly" fashion so that the market mechanism could resume its normal operation. Indeed, under Dr Goh's watch, Singapore's economy developed in a manner that incorporated both the invisible hand of the market and the long arm of state interventionism. This was best reflected in Singapore's post-Independence economic strategy, the Winsemius plan, which was essentially a programme of export-oriented industrialisation, based on manufacturing and driven by foreign direct investment. This strategy itself stood in stark contrast to the import-substitution industrialisation that was being practised in Latin America and which formed the orthodoxy in developmental economics at that time.

When he was tasked with the responsibility of planning for Singapore's defence and security, Dr Goh obviously realised that defence was just simply different. The issue of national defence fell outside of the liberals' laissez-faire framework, in that defence was deemed to be a public good, a good that if left to the devices of the market mechanism would not be provided by a profit-seeking private sector. In other words, market failure would invariably occur and it fell upon the state to raise and outfit the armed forces. Hence, while the liberal tradition held that the production and trade patterns of countries were determined by the concept of "comparative advantage", the creation and maintenance of state-subsidised and usually inefficient defence industries stood in opposition to and were exempted from the dictates of comparative advantage.



"All things considered, this promises to be one of the growth industries of Jurong ... because it is the first large-scale venture into precision engineering in Singapore," said Dr Goh, in his address at the opening of Chartered Industries of Singapore.

Thus, while theory called for the state to provide defence for its people *in abstracto*, Dr Goh defined this policy challenge as a two-fold problem: of starting armed forces, and then arming them. Simply put, the hardware such as weapons, ammunition, and even uniforms and boots had to come from somewhere, and had to be paid for. It was with the latter part of the national defence challenge in mind that Dr Goh first contemplated the notion of developing an indigenous defence industrial base in Singapore. The conceptualisation of CIS therefore addressed this second part of the policy challenge – that of providing the materiel by which the Singapore Armed Forces were able to undertake their task of defending the country.

As we shall see, though, the rationale for starting CIS went beyond merely arming and equipping the Singapore Armed Forces; indeed, foremost in Dr Goh's mind was the idea that CIS would be the primary means by which he would transform the industrial capabilities and economic landscape of Singapore.

Costs and Benefits of a National Defence Industrial Base

As a highly competent economist, Dr Goh would have been well aware of the costs and benefits of starting and maintaining a national defence industrial base. Except in this case, the costs were very real and anything but theoretical, while the potential benefits were simply that – potential – and not at all guaranteed. In other words, like any other risky enterprise, there was the very real risk that the initial costs would not see a return on the investment. This was the pay-off matrix that initially confronted Dr Goh in conceptualising the CIS project.

The literature on defence economics, then as now, is clear on the theoretical costs and benefits of a national defence industrial base. As the theory goes, the primary benefit of having indigenous defence industries is that a country could then enjoy a certain level of security in the supply of defence equipment, especially during emergencies and war. This is the self-sufficiency or autarky argument, where having a home-grown defence industrial base would free a nation from dependence on potentially unreliable foreign suppliers of essential defence material.

The other major benefit of having defence industrial capabilities is that it then makes the country a more informed and savvy consumer of defence hardware. This means that, one, a country can improve its bargaining power when dealing with foreign vendors in negotiating more advantageous contracts, especially in terms of prices paid, and being more knowledgeable in the testing, evaluation and acceptance of equipment specifications. Two, the industrial know-how would give the country the ability to better adapt and customise imported defence equipment to the specific needs of their militaries.

And finally, and especially important in the case of developing countries, having a national defence industrial base is a way by which valuable and often scarce foreign currency can be saved. Hence, instead of buying from overseas suppliers, there would be import substitution by domestically produced equipment. This argument typically takes the form of “why buy when we can make it ourselves”.

Arrayed on the other side are equally compelling arguments against indigenous defence industrialisation, chief of which are the high start-up costs of setting up defence industries. Such high initial development costs, not only in setting up production facilities but also building up research and development capabilities to the requisite level, essentially negates the anticipated savings on foreign exchange. Furthermore, the small size of the Singapore Armed Forces, which translates into the small size of the Singapore defence goods market, means small production runs and hence no opportunities to enjoy economies of scale. In other words, it might still be cheaper to buy from abroad.

It is also difficult to justify the high costs involved in the defence industrialisation process, especially if such a programme is simply geared towards making the government a more informed defence customer, improving its bargaining power vis-à-vis foreign vendors and developing its capabilities in customising equipment to its military’s specific needs. The conventional wisdom suggests that a small core of either state or privately owned research and development agencies would provide sufficient knowledge to enable the state to be an informed buyer.

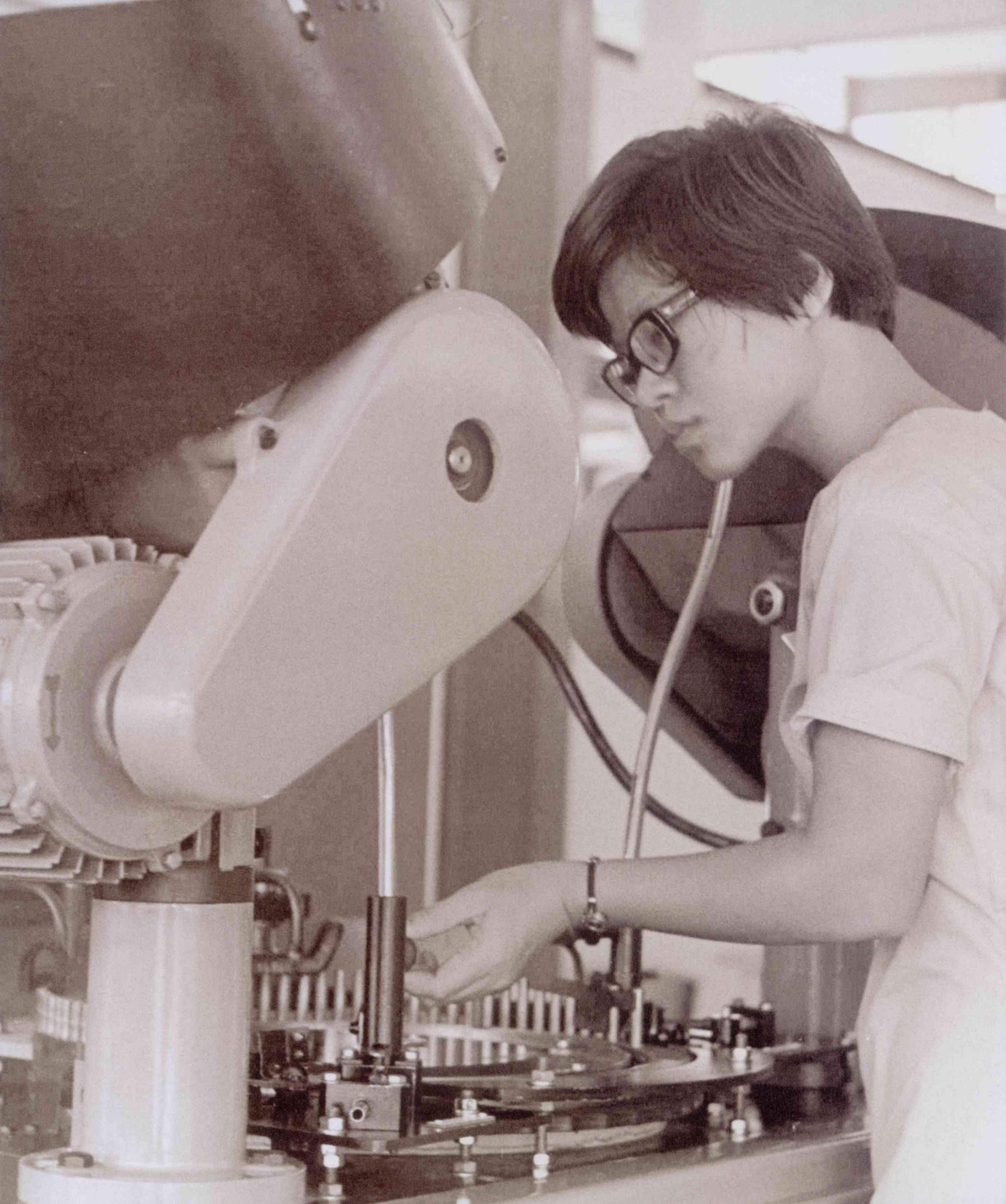
Finally, attempts at self-sufficiency through the development of indigenous defence industries rarely succeed, the main obstacle being the ineffectiveness and unviability of the domestic industries themselves. All nations can point to instances where their national defence manufacturers have failed to deliver products that meet the operational quality requirement, that are delivered on time, and within budget, project cancellations notwithstanding. Indeed, the very notion of national self-sufficiency in defence equipment has been shown to be a myth, both then and especially now in this age of globalisation and escalating equipment and systems costs.

The arguments for and against developing from scratch an indigenous defence industry capability were hotly debated in the post-Second World War world, not only by academics working in the field of defence and industrial economics, but also by defence and economic policy-makers grappling with real world issues of economic development and defence planning. Such arguments would almost certainly have crossed Dr Goh’s mind. And yet, as the ST Engineering story shows, Dr Goh’s rationale for defence industrialisation was clearly located at the much broader level of Singapore’s socio-economic and industrial development, rather than the narrow confines of defence economics as the then prevailing wisdom dictated.

“Some of our citizens have mixed feelings about our growing military strength. Three factors may reassure them. First, it is the sovereign right of independent states to protect and secure their independence by such measures as the people and their elected governments consider necessary. Second, ... since the main strength lies in the reserves, our military potential cannot be used lightheartedly because of the crippling dislocation the civilian economy will suffer on the activation of the reserves. Finally, there is a consideration that what we have been building over the last seven years is not to meet any immediate direct threat to our survival as an independent nation. Rather, we are building a defence system as something enduring and serving future generations of Singaporeans.”

Dr Goh Keng Swee,

Minister for Defence, in a speech at the Commissioning Ceremony of SAF Officers at the Istana on 3 October 1972



The Myth of Self-sufficiency

Before analysing the main reasons for setting up CIS, it is also important to examine what was *not* the reason for embarking on the project. In the case of Singapore, autarky, or self-sufficiency in defence production, was not a motivating factor for starting CIS. In the defence economics literature, as discussed earlier, it is the pre-eminent reason for developing indigenous defence production capabilities. Indeed, it typically forms the main thrust of the political rhetoric employed to justify developing a national defence industrial base, where defence industrial policy is conflated with notions of self-sufficiency in defence production, independence and sovereignty. The fact of the matter is that self-sufficiency in defence production is a fiction, albeit a convenient fiction used by political and business interests, especially for small countries with limited defence markets.

Autarky in military affairs is neither a practical nor desirable goal, especially with the risks and escalating costs of defence research, development and production. Indeed, defence economists and policy-makers alike agree that some level of dependence on foreign suppliers has to be accepted, even for the superpowers. Self-sufficiency, to varying degrees, incurs such high costs as to render the strategy unviable, raising questions such as “What is the desired level of self-sufficiency?”, “What size should the defence industrial base be in order to obtain that level of self-sufficiency?”, “Are production capabilities by themselves enough, or should there also be research and development capabilities?”, and “Should such capabilities be maintained over a wide range of defence items, or be confined to some selected ones?” All of these questions that invariably confront policy-makers serve to illustrate the complexity of trying to negotiate self-sufficiency in defence production, and highlight the different costs that various policy choices entail.

In the case of Singapore, the myth of self-sufficiency was never indulged in, and certainly not by Dr Goh. In fact, as the company’s history shows, Dr Goh’s principal watchword was viability, rather than self-sufficiency for its own sake. Thus, Dr Goh managed to sidestep the various trade-offs that were described above. Indeed, the strategic aim of Singapore’s defence industry has never been complete self-sufficiency. As then Brigadier-General (NS) Lee Hsien Loong, Second Minister for Defence (Services), explained in 1988, “...because the SAF is so small, it is out of the question for us to develop all our armaments.” Rather, the guiding principle was viability, with viability being defined in two important ways. One, viable in the sense that the products that CIS manufactured were of such a quality that they would contribute to the SAF being an effective organisation and therefore contribute to the security of Singapore; and two, viable in the sense that the underlying business rationale for CIS was a sound one: in other words, CIS had to be a profitable going concern with strong growth prospects.

Such concerns were clearly reflected in the manner in which CIS was established, which was as a commercial operation rather than as an ordnance department within the Ministry of Defence. And as a commercial operation, it was required to turn a profit.

Manufacturing bullets, a seemingly simple product, was fraught with challenges in Singapore’s humid equatorial climate.

In fact, the “Chartered” in “Chartered Industries of Singapore” underlined the fact that the company was specially commissioned, or chartered, to supply to the Singapore Armed Forces. In this respect, CIS was treated no differently from other state-owned enterprises in Singapore, which thrived or failed on the basis of how profitable they were. Professor Lui Pao Chuen, presently the Chief Defence Scientist and one of the pioneers of Singapore’s defence science and technology establishment, recalled that at the very first Board meeting of Sheng-Li, the holding company which was to evolve into Singapore Technologies Holdings, the discussion centred on the profitability of the different companies and operations. This insistence on profitability, first promulgated by Dr Goh, continues to be the watchword today.

Dr Goh’s Rationale for Starting CIS

Any analysis of Dr Goh’s rationale for starting CIS is necessarily speculative, due mainly to the lack of publicly available primary documents on Dr Goh’s thinking on the matter. Aside from speaking in very broad brushstrokes in the rare occasional interview, Dr Goh did not discuss in detail his rationale for developing CIS. Indeed, in the three-volume collection of his speeches, which touch on topics as diverse as economic development, social transformations, education policy and so forth, Dr Goh never did articulate and discuss an explicit defence industrial policy.

This itself is highly instructive for two reasons: one, it shows that as far as the CIS project was concerned, Dr Goh was more for doing than talking; and two, it suggests that his strategy for CIS was *emergent*, in the sense that there was a great deal of improvisation along the way, rather than a strategy that *emerged* fully formed. This reading would be fully consistent with the uncertainties that shrouded the project in the early days, and is borne out by those who have worked with Dr Goh on this from the beginning.

Nevertheless, an excerpt from his opening speech gives a big clue to his rationale for CIS: “... because it [CIS] is the first large-scale venture into precision engineering in Singapore, local industries will benefit by the expertise that will grow in the tool and die workshop.” From this statement can be inferred Dr Goh’s justification for the CIS project.

Over and above the shorter-term concerns of supplying equipment to the SAF and attempting some low degree of self-sufficiency to mitigate against reliance on foreign suppliers, the key reason for CIS was to facilitate technology transfer. The argument is that the defence industrial base is seen as the means of acquiring and assimilating new technology and acting as a focal point for the broader economic development agenda. This argument is based on the assumption that the defence sector is at the forefront of technological innovation and developments. On this view, the defence sector is said to be a promoter of industrial development and of broader economic growth in general. Furthermore, because defence technology is often seen to be operating at the cutting edge of innovation, the national defence industrial base is seen as a promoter of high

Building up a base of
technologically skilled
human resources at
Chartered Industries over
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civilian economy.



technology work, which in turn provides valuable technological spin-offs to the civilian sector of the economy. Finally, it creates employment opportunities for scientists and engineers, professions which are critical to the defence industry, thereby building up a base of technologically skilled human resources that over time spills over into the civilian economy.

It was clear that Dr Goh from the outset believed that technology would be a key driver of Singapore's economic transformation, especially in developing a technologically skilled human capital base. In an interview published in 1997, Dr Goh said, "CIS, when it started, formed the core of the government's industrial effort... But what really promoted industrial development in Singapore was the increase in the number of technical personnel. The nurturing of the country's pool of technical personnel was something that occupied us for the best part of the last 30 years." Furthermore, while stating that CIS was not intended to be a springboard for Singapore's industrialisation programme, he conceded that it was nevertheless "a centrepiece of Singapore's effort in industrialisation".

Dr Goh's emphasis on technology as a substitute for scarce capital and labour in the early days could also be seen in another important defence technology project that began in 1971, the creation of Defence Science Organisation (DSO).

While DSO clearly had a distinct and separate rationale from CIS, when juxtaposed against each other, what begins to emerge is a coherent vision on the part of Dr Goh to transform Singapore's long-term future, while addressing the pressing needs and problems of the day. DSO accomplished for Singapore's research and development capabilities and culture what CIS achieved in enhancing Singapore's production and manufacturing prowess, through spin-offs from the defence to the civilian sector. All of these policies are consistent with the wider strategy of state-led export-oriented economic development, in which the government essentially played the role of "investor of last resort", thereby crowding in rather than crowding out investments. Taking the analysis further, one can see that the Economic Development Board (EDB), another Goh Keng Swee brainchild, would go on to effectively do for the private sector what CIS and DSO would do for the defence sector, acting as a catalyst to jumpstart investments and develop indigenous capabilities. All of which was made possible by Dr Goh taking a risk, and deciding, yes, *let's give it a shot.*

Making It All Work

Clearly, Dr Goh's approach to defence industrial policy differed from the conventional policy prescriptions of defence economics in that he framed the CIS project within the broader milieu of Singapore's industrial development, and not simply on its own narrow merits as a defence equipment manufacturer. In other words, the strategic criterion of self-sufficiency

Dr Goh visits the camp of
the 1st and 2nd Singapore
Infantry Regiments on
14 September 1965.





Dr Goh visits the camp of the 1st and 2nd Singapore Infantry Regiments on 14 September 1965.

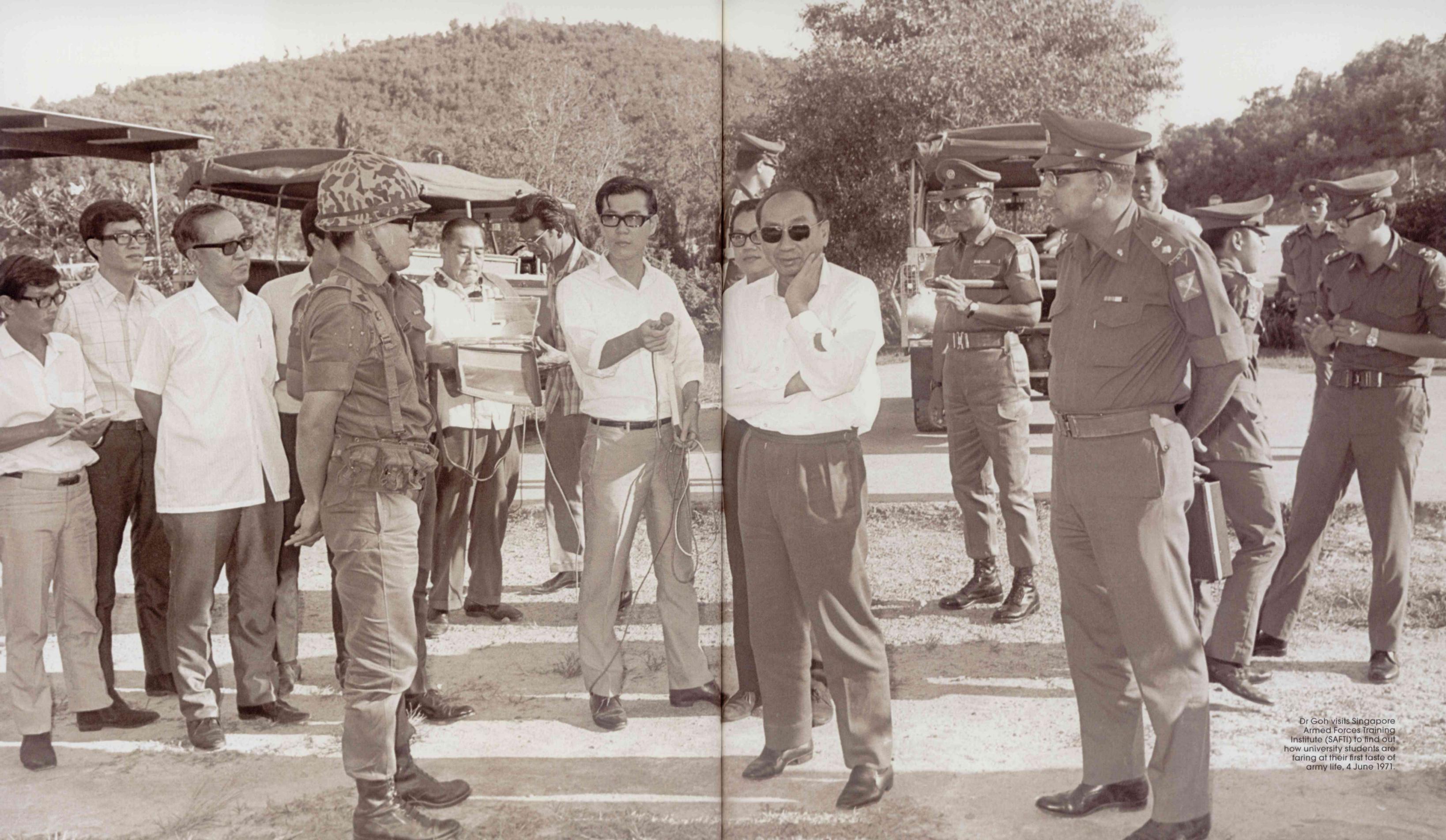
mattered less than the potential synergies that CIS could generate in broader industrial infrastructural development and the technological spin-offs to the other civilian industrial sectors.

In a way, this was inevitable given that even while Dr Goh was the Defence Minister, he was more importantly the chief economic policy-maker. Because of where he sat, and because he employed different lenses that allowed him to switch back and forth between the big picture and the ground level, Dr Goh was able to balance the micro-level needs of defence production with the arguably more critical macro-level concerns of Singapore's economic development. Ultimately, in the grand scheme of things, CIS's importance consisted in its being a key strand of Singapore's overall industrial economic policy as much as it was the pre-eminent defence contractor.

Still, having a sound rationale for starting CIS was still no guarantee of its success, both as an arms producer and as a catalyst for the broader economic plan. Indeed, the empirical data and the experiences of other countries attempting defence industrialisation proved to be no guide, and were in fact worrying. In looking at studies of defence industrialisation in the post-Second World War period, with particular focus on the question of technological spin-offs, the results were ambiguous for both industrialised and industrialising countries. This essentially meant that for every case where defence industrialisation led to successful technology transfer from the defence sector to the civilian sector, there would also be a failed case where the promise of spin-offs failed to materialise. Cases of failed defence industrialisation, where defence companies were run inefficiently and at a loss and where the quality of the products failed to meet the required standards, could be seen in the experiences of post-Second World War Latin American and African countries.

The negative experiences in particular of the developing countries opened the way to criticisms of defence industrial policy. The first criticism was that because of the esoteric nature of defence technology, its spin-offs to the civilian sector were few and of little significance. In fact, spin-ins from the civilian sector to the defence sector were theorised to be more common. The second criticism was that the national defence industrial base, simply by virtue of its close links to the government, was essentially shielded from competition, which in turn gave rise to inefficient industrial structures. Because of government protection (as is still often the case globally), defence companies had no incentives to become more efficient and profitable. Finally, critics argued that the defence industrial base had a "crowding out" effect, diverting capital and human resources away from civilian activities that are of equal or even higher priority, such as health, education and housing. Dr Goh was clearly aware of such pitfalls and was determined that CIS would avoid such a fate.

In his policies and in the evolution of CIS, one can see how Dr Goh took all of these criticisms in his stride. First, the argument that there would instead be technological spin-ins from the civilian sector to the defence sector was moot in Singapore's case



Dr Goh visits Singapore Armed Forces Training Institute (SAFTI) to find out how university students are faring at their first taste of army life, 4 June 1971.

simply because the state of technology in the civilian sector in the early days of independence was extremely low – to borrow the word that Dr Goh used to describe the early economic conditions, it was “wretched”. Furthermore, the success of any technology transfer programme depended not only on the effectiveness of the “transferring sector” (in this case, the defence sector), but also how prepared the “recipient sector” was in absorbing and assimilating the technologies and knowledge. That CIS was part of a bigger industrialisation strategy can be seen in how it worked in tandem with the likes of other organisations such as the EDB and the Development Bank of Singapore (DBS), agencies which worked in the private sector, to develop the necessary physical and financial infrastructure so that the technological spin-offs from CIS could be absorbed into and adapted to the needs of the civilian industrial base.

With regard to the second argument that defence industries were inevitably inefficient and reliant on government protection, Dr Goh sidestepped these concerns in how CIS was set up in the first place: as a defence contractor rather than a sub-unit of the defence ministry, with the key characteristic that contracts from the armed forces were not guaranteed. In other words, CIS from the start had to prove its worth through the quality and efficiency of its products and production processes. Once again, the operative word then, as now, was profitability. Indeed, the setting-up and running of CIS best illustrates Dr Goh’s approach to economic management, the unique blend of state intervention and market forces: state intervention to the extent that CIS was a creature of public policy, and yet upon creation CIS was immediately subjected to the ultimate market principle of profitability.

Similarly, the criticism that the development of the defence industrial base would crowd out the private sector, meaning that valuable resources would be diverted away from other worthy projects in both the public and private sector, did not hold in Singapore’s case. Again, such an argument holds only in circumstances where the economy is operating at less than full employment. Clearly, this was not the case for 1960s Singapore. CIS was instead the means by which Dr Goh sought to jumpstart the manufacturing sector, with the CIS project intended to crowd in other investments, especially foreign investments.

Ngiam Tong Dow, one of the pioneering civil servants and a highly trusted lieutenant of Dr Goh’s, has said on many occasions how he was Dr Goh’s “gong beater” at the many foundation stone laying ceremonies that Dr Goh officiated, where the name of the game was to generate publicity and to instil confidence in investors. In terms of gongs, then, CIS was as big as they came: as it grew from strength to strength, as the quality of its products improved and its reputation became widespread, CIS delivered the ultimate confidence boost that Singapore’s manufacturing sector needed.

Structurally, defence industrial policy in and of itself is predisposed to neither success nor failure. That Singapore has succeeded with CIS, and continues to ride the continuing achievements of ST Engineering, is proof of that. Hence, the factors that determine success

"...(W)e had to be smart buyers of weapon systems, and smart users of weapon systems. MINDEF needed a highly competent engineering and scientific staff. We sought people who would know how to evaluate and buy the right equipment and weapons, and then modify, develop and upgrade them to suit the SAF's special requirements and tactics. Such people add value to our purchases, and make every defence dollar spent on hardware count. This is what defence technology is about ... This investment in people enables DSO to continue to do top-line research and development. The result of this investment has been an invisible but significant contribution to the SAF's operational capabilities."

BG (NS) Lee Hsien Loong,

Minister for Trade and Industry and Second Minister for Defence (Services), in a speech at the Opening Ceremony of DSO Building on 27 October 1989

or failure are located at the level of agency. Essentially, that is academic-speak for saying that it is the people, their choices and their actions that make the difference. In Dr Goh and the team that he had in place, one must surely argue that the field was heavily tilted towards success.

It is tempting to try and analyse Dr Goh's rationale and choices within the usual framework with which one examines business strategies: "What was his analysis?", "How did he formulate his strategy?" and "How did he implement it?" The fact is, aside from his initial vision of what CIS should be, many of the essential details had to be improvised on the spot simply because this was uncharted territory and therefore the endeavour was inherently risky despite all due diligence. To paraphrase from the motto of Britain's elite Special Air Service, Dr Goh dared, and won. And the correct strategy is not the one that works; rather, the strategy is correct because it works.

**THE MINISTER,
THE ENGINEER AND
THE M16 RIFLE**

This is a story that has grown in the retelling, so much so that it has become an integral part of the Singapore Technologies mythos. The story goes like this. Out of the blue, the Minister for Defence calls up a CIS junior engineer: "Come and see me. And bring an M16." Bewildered and more than a little worried, the junior staffer draws out the weapon to show the Minister. That junior engineer was Lai Chun Loong, a pioneer of CIS who subsequently rose through the ranks to the very top of the company. Thus Mr Lai began his long association with Dr Goh Keng Swee, starting as a trusted subordinate, and becoming a valued colleague and a loyal friend.

A Colombo Plan Scholar, Mr Lai returned after his studies and in 1968 opted to serve out his bond as a mechanical engineer in CIS. One of the early pioneers of the then fledgling defence industry, Mr Lai stayed on at CIS beyond his scholarship bond and rose through the ranks, becoming its General Manager from 1980 to 1982, Managing Director from 1983 to 1989, and eventually assuming the post of President from 1989 to 1993.

With his experience as Quality Control Manager, Mr Lai was responsible for realising Dr Goh's vision of CIS as a manufacturer of world-class quality and reliability. He was also a tireless promoter of CIS products worldwide. More than that, Mr Lai was credited by Dr Goh in a 1997 interview as being the solution to a string of ineffective management problems in the early days. Mr Lai is currently a consultant to Temasek Holdings, as well as the Executive Director of his own consulting company (Prominent Consulting Pte Ltd) with a representative office in Vietnam.

In this interview, Mr Lai recounts in his own words fond memories of working with Dr Goh from the early days of CIS to its subsequent transformation into the multi-industry, multinational company that is ST Engineering.

On why Dr Goh decided to set up Chartered Industries of Singapore

Dr Goh is a great economist, and he always had the big picture in mind. When he looked at the industrialisation of Singapore, in a very broad sense, he knew that defence industries were at the forefront of technology and precision engineering, and that they would be a good way to absorb technology into Singapore, which could then be spun off into other industries. I think that's one of the important reasons why he started CIS.

In starting CIS, and in the various things we did in the company in the early years, there were no such things as cost-benefit studies. He knew we had a small army, and he knew that it was difficult to economically sustain such an industry with small armed forces. Yet he went ahead with it. Perhaps foremost in his mind, Dr Goh had the bigger goal of industrialising Singapore, by using the technology and the experience we gained through absorbing technology from foreign partners to be spun off to other industries. He wanted Singapore to scale the technology ladder, and CIS was the way to do it.

He said to me once, “What happens if we fail? Well, if we failed, we would just simply consider it the cost of one battleship sunk.” He was very bold in making the decision to go ahead with CIS as our climatic environment is not suitable for the manufacturing of ammunitions.

Dr Goh’s personality and the company’s corporate culture in the early days

He was a great visionary and very bold in his actions. He was very careful in nurturing the company in the early years. He had regular meetings with the Board and the management to check on the company’s progress. He was very involved in the appointment of the CEOs of the company. It was Dr Goh who selected the first few CEOs including myself.

Dr Goh is a person who does not believe in organisational hierarchy. He would call you up himself, no matter how junior you were or what position you held in the organisation. He would either call you himself, or have his PA call you, and he would ask you to see him, or just ask about what was going on. In fact, this sometimes caused misunderstanding with the immediate superiors when they were cut out of the communications with Dr Goh.

Once, Dr Goh called me directly, bypassing my then General Manager, the late C.V. Olsen. I said to Mr Olsen, “Dr Goh called me up on this matter,” and I could see that Mr Olsen was definitely unhappy, upset even, about this. He started to ask me a lot of questions about what was going on, even telling me that I should not be bypassing him. So finally I got fed up and I told him, “Look, I didn’t call him, you know. He called me. I’m too junior to call him. What could I do? Why don’t you tell Dr Goh not to call me directly?” That put an end to the matter.

That, I think, sums up the working environment and culture under Dr Goh, where you go straight to the person who is responsible and you deal with him directly. That was Dr Goh’s style of doing things. It wasn’t that CIS was a flat organisation; it was just that Dr Goh chose to cut through the various layers. He didn’t care who happened to be the boss in this or that department, or whose turf it was. It was more efficient to him to get the information first-hand from the ground level, and not through a third party.

On the “Come and see me. And bring an M16” incident

How did I feel when I got the call? (Laughing) I was worried, of course! I remember thinking, “Why should the Minister call me? I’m just a junior engineer.” At the same time, I was excited about the whole idea of meeting up with this great man. And nobody knew what he wanted to do with the rifle, which was even more worrying!

I told my Chairman, the late Ong Kah Kok, “Dr Goh just asked me to see him, and to bring a rifle along. What should I do?”

Mr Ong, who was very familiar with Dr Goh's working style, was nonplussed and said, "Oh, just go ahead, and find out what he wants."

With the rifle that I drew out, I went to Tanglin to see the Minister.

At the old MINDEF building at Tanglin, I showed Dr Goh the rifle. He told me to take the rifle apart and to segregate the parts into those made in Singapore and those made overseas. And to further segregate the high-value items from the low-value ones. And he proceeded to ask me, "Why aren't we making this? Why aren't we making that? Why?" His constantly asking us "why" was a way of challenging us. "Why aren't we doing this? Why aren't we doing that?" That really got our minds cranking.

He probably looked at it from an economist's point of view, thinking in terms of import substitution, "Why are we importing if we could make it ourselves?" So you had to reason with him, and explain to him why it could not be done with such small economies of scale. And if your argument was sound, he would accept it.

On Dr Goh as a boss

He was a very demanding and impatient boss. When he chaired a meeting, he wanted the minutes on his desk within 24 hours, no more. And if it was an important meeting, he would chase you every hour for the minutes.

His working style was very hands-on. And he knew his stuff for he read a lot, so we learnt never to try to bluff him. If you didn't know the answer, it was better to just say, "Sorry, sir, I'm not sure, but I'll check it out for you."

His approach to problem-solving was a combination of being hands-on and putting people with the knowledge and expertise in charge of the problem. The key was to build a certain level of trust and confidence between you and the man, so that he would be more receptive to your reasoning.

Let me tell you how much attention he paid to management issues and how meticulous he was. I used to submit a monthly management report on the quality of the ammunition we produced. It was a very boring type of report, full of statistics – how many lots were made, how many lots inspected, how many failed the test and so on. One day, my Chairman came back to me and said, "Dr Goh says your report is very boring and wants you to do something about it." I was so surprised to find out that he read the reports! He really paid a lot of attention to detail.

When he knew you better, you found him approachable and a warm person with the people's welfare at heart.

On how Dr Goh made decisions

He was a deep thinker, a very careful man, and he was very aware that we could not foul up in the early days.

Let me tell you about how careful and involved Dr Goh was when we were trying to get our first export sales off the ground. My late Chairman Ong Kah Kok had just negotiated a contract to supply anti-aircraft ammunition to Switzerland in the mid-1970s. It was our first major overseas order. Mr Ong went to Switzerland with me. Mr Ong happily prepared a report after securing the deal, sealed it, and asked me to bring it back to Dr Goh, while he stayed on in Zurich to await further instructions.

I took the next flight home, delivered the letter to Dr Goh's office, and nothing happened! One, two, three days, and nothing happened.

And Mr Ong called me, "Did you send the letter? What's going on?"

I said, "I sent the letter the moment I reached Singapore."

It was very unlike Dr Goh's style to sit on a decision.

So Mr Ong said, "I'm going to fly back to find out what's going on, I cannot sit here indefinitely."

We finally went to see Dr Goh, and he wanted a briefing on the whole project involving this particular export order before he gave the approval. I was the one who gave a briefing on the production side of things. Dr Goh was quite patient, and he listened very intently even though we knew he did not like long briefings as a rule.

He asked very deep, probing questions such as "Which is the critical component in the production process?" and "What type of contingency plans do you have in case of breakdowns?" I told him that the critical component was the big 35mm cartridge case, and that it was made using the 1000 Ton May Press and that there was only one such May Press in Singapore. If that were to break down, we would have problems.

He wanted to know what type of contingency plans I had if the machine broke down. So I told him my various contingency plans, how I would build up stocks to after the May Press stage by working double shifts, that I would store up critical spare parts for the May Press, and finally that I had made arrangements with the Swiss so that if the May Press were to break down, they would ship the semi-finished components to us for us to finish the process.

You know what Dr Goh said? He said, "Just go and buy another May Press even if it costs more than \$1 million!"

I was shocked, because the May Press was not cheap. When the decision was taken, my General Manager kept chasing me, "Have you purchased the May Press?" The fact was that I didn't want to buy the second May Press for the simple reason that we might not have gotten a follow-on order, and we would end up with a white elephant for the company. Plus, I felt that I had taken enough precautions. So my General Manager said that I should go to explain to Dr Goh why the second May Press was unnecessary. After my explanation,

Dr Goh agreed not to go ahead to buy this second May Press and gave his approval to proceed with the export order.

I was surprised that he was willing to invest in another May Press, because he was very careful about spending money. Years later, I found out the reason for that decision. He told me in one casual meeting, "The reason I was so careful with the first overseas order you guys obtained is because we cannot afford to fail. If we had failed in this first export order, we might as well close shop."

That was why he sat on the decision for so long before accepting the order, and why he wanted a full presentation on our production capabilities and the order specifications. He had to be fully convinced that we would succeed in this deal! He was willing to spend on a second May Press just so that the company would not fail in its first overseas order. The reputation of the company was just much bigger than the cost of one May Press. If we had fouled up the first order, we were finished! It seemed like a rash decision to buy a second May Press, but looking at it from the big picture, it was a careful and considered move with the company's reputation at stake. Again, there was no cost-benefit study; it was a case of "just do it".

That, incidentally, was the first time I "disagreed" with Dr Goh. That episode also helped me gain his trust, because I reasoned with him on the issue of the May Press and did not give in. In retrospect, I was proven correct.

On Dr Goh's relationship with the company

He had a great affection for the company. Whenever there was a new product, he wanted to be kept informed, he wanted to see it. We frequently invited him over to see the new products, and every year the senior management would have a dinner with him to showcase our new products. We would hold this in a restaurant, and we would have to bring the "new toys" along to show him. Security would have to clear the place not only for him but for the things we brought to display.

Dr Goh nurtured us well in the early years, and there were many instances where without his personal involvement, things would not have moved. In the early days, in terms of export sales, we were not allowed to be aggressive. He was very careful, because we didn't yet have the expertise, or the track record, and also because of the ramifications of a small country exporting armaments and defence materiel to other countries. From the mid-'70s, we started to put the "Chartered" brand name on the international map. That was when I started travelling almost 60 per cent of the time, promoting our products.

Dr Goh on a personal level

I had the opportunity to travel with him in May 1985. It was our first official trip to China, when he was about to be appointed the economic advisor to then Chairman Deng Xiaoping on China's open-door policy. It was easy travelling with him, or maybe because I was quite familiar with him by then.

Once he gets to know you well, Dr Goh becomes really interested in your welfare. I remember I went on a marketing trip in the early 1990s to the Middle East during a period of instability. Before I left, I got a call from Dr Goh telling me not to go, that it was too dangerous. I was so surprised and touched. I told him all the meetings had already been set up, and that it was important for the company for I was going there to attend a tender negotiation.

He was silent for a while, then he said, "Okay, but I want to know what's going on. Make sure you keep me informed."

He is really a warm and caring person, but he is such a private man that not many people see that side of him.

On Dr Goh's legacy in ST Engineering

I would say Dr Goh will be remembered not only for starting CIS, but also for laying the foundation for transforming the company into ST Engineering. He definitely had a hand in turning a strictly ammunitions manufacturer into a highly diversified business.

Dr Goh mooted the idea of diversification into non-defence business. The Singapore Mint was started by him. Let me give you more examples

When he knew that the production line for anti-aircraft ammunition was running low, Dr Goh called me up and said, "Why don't you use the machinery to make spark plugs? Spark plugs, volume-wise, might be quite saleable." I had to do a study, and found out that the manufacturing process was completely different. So I told him, "Dr Goh, if I make spark plugs using these machines, the spark plugs would cost about ten times what it would normally cost to make." So he just laughed and said, "Okay, forget it then." On another occasion, he also asked us to make doorknobs and window latches for the HDB!

Later on, when he was Minister for Education, he knew that there were many schools that had to be renovated, so he asked us to consider going into the construction business. That was how we started CDC (Chartered Development and Construction), which later on became Singapore Technologies Construction. He was very energetic in pushing the company towards diversification into non-defence businesses. So while the actual diversification process was driven by Philip Yeo, it was Dr Goh who planted the seed for the process.

Dr Goh started to be less hands-on in the mid-1980s. He felt that the company had grown and matured, and that a strong management team was in place. We had started the diversification process into non-defence business under Philip Yeo's chairmanship and he put a lot of trust in Philip getting things done. But he still kept his finger on the pulse, giving guidance instead of instruction.

He was truly the founding father of Singapore Technologies. It was his vision that made it happen.

A personal tribute to Dr Goh

I am very fortunate to have worked under Dr Goh. He was a tough and demanding boss, but you learnt a lot from him. As long you could perform and deliver, and earn his trust, things worked out fine. It was a great honour to have worked for him. The things he taught you, how to think and reason – well, as they say, they don't teach you that at Harvard. Some of the things he taught were just common sense, but it's always the simple stuff that is most difficult. For Dr Goh, it was all about how to translate simple but powerful ideas into action.

When I finally took over the top job at the company, I knew that I had to do things differently from my predecessors. By that time, I had a great team in place, probably among the best management teams that Singapore had in those days. Credit for the success of CIS has to be attributed to this team. One thing that I learnt is that I want to be challenged, and I don't particularly like yes-men. I want a full and frank discussion of different options, but in the end, I have to be the one who makes the decision and sees it through. That is how Dr Goh worked, and that is what I have tried to do as well. Although Dr Goh always had the big picture in mind, he wanted to listen to different opinions from different levels.

I have "reasoned" with Dr Goh on a few occasions. The first encounter was over the May Press, and I wasn't even in charge yet. That was probably the first time he took notice of me. And then there were "disagreements" over spark plugs, doorknobs and window latches. He tended to look at things from the "economies of scale" perspective, but not being an engineer, he was not aware that the manufacturing processes could be very different.

For me personally, he was a great mentor and a good tutor. I think that without him, Singapore would have been different.

Lift-Off



Part Three

THE CHANGING LANDSCAPE AND THE EVOLUTION OF ST ENGINEERING

ST Engineering's vision statement today reads "To be a global defence and engineering group", with its mission statement affirming the following: "We are an integrated engineering group, we bring value to our customers and partners through our delivery of total, integrated quality solutions and support."

Much has changed as Chartered Industries of Singapore transformed into ST Engineering, evolving from being primarily an armaments manufacturer highly dependent on contracts from Singapore's defence establishment, to a multifaceted, multinational manufacturing and technological powerhouse with a global reach in both the public and private sectors, in defence and non-defence businesses. And yet if one looks hard enough, much has stayed the same: certainly the defence business is still an important part, but more importantly the commitment to quality and the aspiration to straddle the global market that were hardwired into the company's DNA at conception continues to be a constant operating principle.

The transition from CIS to ST Engineering can be said to have occurred on 19 April 1989 when then Minister for Trade and Industry and Second Minister for Defence (Services) Brigadier-General (NS) Lee Hsien Loong launched the "Singapore Technologies" corporate identity. In his speech, he highlighted that peculiar characteristic of the companies within the Sheng-Li companies, that they had been conceived as "privately run companies, rather than departments of MINDEF, so that they could be run efficiently, and without incurring hidden costs". He also said then, that "[f]or some time now, Sheng-Li has recognised that for it to grow further, it should not rely on the military markets alone but must diversify into industrial products and services."

Privately run. Efficiently. Diversify. If these words seem familiar, it is because they were the very operating watchwords that Dr Goh had himself used in setting up CIS in 1968, where viability and profitability were paramount, where being subjected to the market was the ultimate test, and where the name of the game was to diversify. These initial principles ensured that the evolution from CIS to ST Engineering was a logical inevitability.

In a sense, the transformations that led to the emergence of ST Engineering could be said to have preempted the dramatic changes in the global strategic and business landscape in the late 1980s and early 1990s. The end of the Cold War combined with the gathering momentum of the so-called “revolution in military affairs” or RMA led to the consolidation and rationalisation of the defence industry in the United States. This resulted in a small group of mega-firms dominating the US defence industrial base. Given the higher technology demands associated with the RMA, the escalating costs of technology, and the emergence of dual-use technologies, governments embarked on a strategy of becoming more reliant on global suppliers to fulfil the needs of their armed forces. By the mid-1990s, the age of defence globalisation was in full swing.

Yet the changes that were occurring within the company predated such global developments. From the early 1980s, under Philip Yeo’s leadership, the company had embarked on a strategy of civilianisation, or diversification into commercial activities to complement its defence business. This was made possible by largely leveraging on dual-use technologies for both civilian and defence production. Indeed, it is the emergence of dual-use technologies that has done the most to blur the lines between a defence company and a non-defence company. For example, the computer software that is used in a guided missile system could be applied in myriad other civilian applications, and could originate from any part of what is now a global supply chain. The day of the traditional defence contractor was clearly done.

In a way, Dr Goh foresaw all of this, and preempted many of the problems that would plague traditional defence companies by his continually emphasising the importance of letting market forces work where they could, and courageously intervening with various policy instruments when they failed. The roots of the diversity of ST Engineering’s activities could, without exaggeration, be said to lie in one man’s refusal to accept the status quo, and his determination and curiosity to explore how seemingly disparate parts could work together.

Dr Goh’s Legacy in the ST Engineering Story

The totality of Dr Goh Keng Swee’s work can be aptly summarised as a combination of brilliance, determination, imagination and courage. That this work was in the service of his fellow Singaporeans makes it all the more admirable. At one level, his role in establishing a national defence industrial base and then embedding within the company values and principles that would enable it to evolve into a diversified, technologically advanced global

"It was Dr Goh Keng Swee, as Minister for Defence, who made the bold decision to commit some of our ablest engineers and scientists to defence science and technology, and to build up expertise in this area systematically year after year. Looking back, it was one of the wisest decisions MINDEF has made."

BG (NS) Lee Hsien Loong,

Deputy Prime Minister, in a speech at the 25th Anniversary Dinner and Dance, DSO National Laboratories, on 3 October 1997 at the Suntec City Ballroom

company is an extraordinary achievement. This is all the more so given the pitfalls of establishing defence industries. At a higher level, that this successful project of defence industrialisation was itself one key strand of Dr Goh's broader strategy for Singapore's economic development makes it all the more remarkable.

In paying tribute to Dr Goh at the company's 25th anniversary dinner in 1992, Brigadier-General (NS) Lee Hsien Loong, Second Minister for Defence (Services), said of Dr Goh: "As Defence Minister, Dr Goh saw the importance of developing a local armaments industry, and was instrumental in turning the idea into a reality." More importantly, he continued: "Outside the defence field, CIS has contributed significantly to the Singapore economy. CIS has put strong emphasis on manpower development. It has attracted, groomed and retained a strong team of engineers and researchers ... CIS's success has benefited not just the defence industries. Other manufacturing firms have also indirectly benefited as from time to time experienced staff leave the defence industries to join them."

There can be no stronger acknowledgement that Dr Goh's rationale for CIS as a trigger for technological and manpower development, beyond its role as a munitions maker, has been a great success.

ST Engineering, from its early days as CIS, occupies a unique place in the continuing Singapore story: it is still the pre-eminent defence firm, and yet it is so much more than that, being the prime mover in various technological innovations and commercial projects. In that regard, ST Engineering's role in the Singapore milieu is multidimensional. Likewise, it is too simplistic to think of Dr Goh's legacy in terms of being the "father of CIS". Far from being simply the force behind its creation, Dr Goh's legacy in the ST Engineering story must also be seen in two additional, complex dimensions: one, as an active legacy in that the principles that he encoded into the company's cellular structure continues to serve it well; and two, that as successful as CIS was, and ST Engineering is, this highly effective exercise in defence industrial policy was a critical component of a bigger, even more courageous plan to transform and modernise Singapore.

This tribute to Dr Goh has essentially taken the form of a discourse on defence industrial policy as practised in Singapore. But given the private nature of the man, studying what, why and how Dr Goh thought and did is arguably the most honest way to approach the man. Needless to say, his work on establishing Chartered Industries of Singapore and navigating its transformation into ST Engineering represents merely one aspect of Dr Goh's achievements in public office. Nevertheless, the ST Engineering story best exemplifies Dr Goh's intellect, determination and indefatigable imagination.

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Published for ST Engineering

51 Cuppage Road
#09-08 StarHub Centre
Singapore 229469
<http://www.stengg.com>

by SNP International Publishing

A subsidiary of SNP Corporation Ltd
1 Kim Seng Promenade
#18-01 Great World City, East Tower
Singapore 237994
<http://www.snpcorp.com>

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Photographs courtesy of National Archives of Singapore (pages 5, 12-13, 17, 18, 24-25, 26, 32, 34, 38, 41, 43, 44) and Singapore Press Holdings (pages 46-47)

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Printed in Singapore

National Library Board Singapore Cataloguing in Publication Data

Kuah, Adrian.

UnChartered territory : Dr Goh Keng Swee and the
ST Engineering story / Adrian Kuah Wee Jin. – Singapore :
Published for ST Engineering by SNP International, 2007.
p. cm.

"Published under the auspices of S. Rajaratnam School
of International Studies, a graduate school of Nanyang
Technological University."

ISBN-13 : 978-981-248-169-6

ISBN-10 : 981-248-169-9

1. Goh, Keng Swee, 1918– 2. Chartered Industries of
Singapore Private Limited. 3. Military engineering – Singapore
– History. 4. Defense industries – Singapore – History.
I. ST Engineering. II. Title.

UG113

338.7623095957 — dc22

OCN176920914

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