17
Offsets and defense industrialization in Indonesia and Singapore

Richard A.Bitzinger

Introduction

Asia's newly industrialized economies (NICs)—Indonesia, Malaysia, Singapore, South Korea, Taiwan, and Thailand—constitute an important subset of the developing world's so-called second-tier of arms producing states.[1] They comprise some of the most economically advanced countries in the developing world, possessing growing wealth, sizable industrial capacity, and increasingly sophisticated technology bases, particularly in the area of electronics. They have pursued roughly similar paths of economic and industrial development, involving large-scale state investments, technology imports, applied research, and synergistic civil-military links (see US GAO, 1994). It is therefore no surprise that over the past 30 years most Asian NICs have embarked on some manner of local armaments production, both as a means of encouraging arms self-sufficiency and of driving general economic development.

Among the Asian NICs, South Korea and Taiwan have engaged in the most ambitious efforts at defense industrialization and have made the most progress toward achieving autarky in arms production. Both countries have reached a level where they are able, with varying degrees of success, to design and manufacture their own fighter aircraft, armored vehicles, surface combatants, and even missile systems (see, e.g., Cheng and Chinworth, 1996; Chinworth, 2004). At the other end of the scale, arms manufacturing in Malaysia and Thailand has been sporadic and decidedly low-tech: during the 1980s, for instance, Thailand assembled German-designed trainer jets from imported kits, and Malaysia licensed-produced Swiss turboprop trainers and South Korean-designed offshore patrol vessels. More recently, Malaysia has begun construction of six MEKO-100 corvettes under license from the German firm Blohm and Voss. For the past decade, however, Thai and Malaysian armament production has largely centered on supplying local armed forces and police with basic items like uniforms, small arms, ordnance, and radios, and for servicing and overhauling military equipment (Singh, 1989; Jane's, 2002).

Indonesia and Singapore took an interesting middle road when it came to the breadth and depth of defense industrialization. In both countries, armament production, while not as large-scale as in South Korea or Taiwan, was nonetheless wide-ranging. In some sectors—for example, Indonesia with respect to aerospace, or Singapore regarding systems integration capabilities—these countries pursued very ambitious indigenization agendas. In both cases, too, the central government played an instrumental role in assuming most of the risk of weapon development and production, both by directly

establishing and nurturing domestic arms industries, and by supplying a captive home market for their products.

Offsets were a noteworthy feature in both Indonesia's and Singapore's defense industrialization efforts. When it comes to developing countries, offsets and arms production have generally gone hand-in-hand—or, to put it another way, few developing countries have failed to pursue offsets as a means of promoting indigenous arms production. Indeed, offsets—licensed production, coproduction, technology transfer, etc.—as a condition for arms purchases have been perhaps the most important course of action taken by less-developed countries in order to abbreviate and quicken the process of defense industrialization and arms manufacturing.

Indonesia and Singapore employed offsets differently and to different ends. Jakarta embraced offsets in a traditional way, as a mechanism to ultimately reduce the country's dependency upon foreign suppliers and to drive economic development. Consequently, Indonesia is the only country in southeast Asia to attempt a large-scale indigenous aircraft development and manufacturing program. Singapore, in contrast, has used offsets sparingly and in accordance with strategic needs. As a result, it mostly pursued offsets that involved technology transfers that, in turn, met more immediate military requirements, such as the capacity to engage in weapon maintenance and overhaul, and system upgrades. By addressing their respective successes and failures in exploiting offsets to meet their national goals for defense industrialization, the experiences of Indonesia and Singapore offer interesting insights and caveats when examining the challenges and prospects facing aspiring developing-world arms producers.

Arms production decision making and offsets

A country's primary goals for indigenous armaments production and defense industrialization can have a considerable impact on how it pursues offsets. Countries can have several reasons for developing and producing their own weapons, but typically one or two objectives will emerge as the most crucial. Those key aspirations will, in turn, generally affect how a country approaches the whole process of defense industrialization and how offsets fit into this process.

Obviously, one of the strongest rationales for indigenizing armament production is *strategic* (see Evans, 1986, pp. 100–101; Nolan, 1986, pp. 12–14; Sanders, 1990, pp. 11–17; Brzoska and Ohlson, 1987, pp. 279–280; Brauer, 2002, pp. 106–107). In a basically anarchic international security system, so the argument goes, states are naturally impelled to seek an independent defense capability. In order to defend its territory satisfactorily, a state requires a reliable source of armaments, and the most dependable source is generally a domestic one. Self-sufficiency in arms procurement is therefore a crucial strategic goal. Additionally, relying too heavily on arms imports means exposing a country to cutoffs or to technology hold-backs, thus increasing the risk that it will be unable to acquire the weapons it deems essential to its defense. Embargoes, sanctions, and other types of supplier restraints, real or potential, have tended only to reinforce the perception on the part of many countries that they must establish a secure, *indigenous* source of armaments. South Africa initiated indigenous armaments production in direct response to the 1963 and 1977 UN-imposed arms embargoes. As a result, by the late 1980s, Pretoria could

claim to be "95 percent self-reliant" in military procurement, including fighter aircraft, armored vehicles, artillery, and surface combatants (Landgren, 1989, pp. 63–123).

Reduced reliance on foreign sources of arms is also often viewed as a means for strengthening national political independence. Arms dependencies leave the buyer open to attempts by the supplier to withhold deliveries in order to coerce the former into making concessions on issues both national (such as human rights) or international (such as combating terrorism and drug trafficking or opposing a common regional threat). In the case of Japan, for example, proponents of *kokusanka* (autonomy in arms production) perceived this industrial strategy as providing Tokyo with greater freedom of action in international affairs. At the same time, *kokusanka* arguably helped to strengthen Tokyo's security relationship with the United States and permits Japan to play a larger role in the bilateral alliance (Green, 1995, pp. 22–26; but see Chinworth, 2004).

Another strategic rationale driving defense industrialization in many second-tier arms producing states, especially those aspiring to regional or even great-power status, are the more intangible aspirations of status and prestige (Green, 1995, pp. 11—13). Possessing an independent defense industrial capability feeds directly into some state's concepts of national power, not only by creating military power but also by demonstrating its industrial and technological prowess, thereby confirming its status as a great power in the broadest sense. This "rich nation/strong army" complex is not confined to aspiring great powers. Such "techno-nationalism" can be detected on the part of many smaller arms producers. Brazil's military rulers, for example, embarked on an ambitious defense industrialization program in the 1960s based in part on the belief that a powerful army was unsustainable in the absence of a strong domestic arms industry (Franko-Jones, 1992, p. 57; Perlo-Freeman, 2004).

If strategic concerns are one side of the coin driving autarky in arms production, *economics* is generally the other. In some countries it is increasingly the more important of the two. Arms production has often been perceived as providing many potential economic benefits to the nation as a whole. Defense industrialization promotes backward linkages spurring the expansion and modernization of other sectors of the national economy, such as steel, machine tools, and shipbuilding (see, e.g., Brauer, 2002, p. 108; Willett, 1997, p. 114; Huxley and Willett, 1999, p. 51). Industrialization and technological advancement feeds into the development of domestic arms-manufacturing capabilities, such as building up general skills and know-how, and provides lead-in support or equipment for arms production. The construction of warships, for example, stimulated the establishment of indigenous shipbuilding industries, while production of military vehicles required steel mills and automotive factories to provide critical parts and components, such as armor plating, chassis, and engines, and skilled labor to assemble these vehicles.

As a result, in many developing countries, armaments production has become a sizable component in the national economy. China's vast military-industrial complex, for example, provides jobs for more than 3 million workers, and engages engineers and technicians in over 1,000 enterprises, each constituting multiple factories, research institutes, trading companies, technical schools, and universities, along with housing units, schools, day care, hospitals, and recreational centers (Frankenstein, 1999, pp. 191–192). At its peak in the late 1980s, South Africa's arms industry employed nearly 132,000 workers, accounting for 9 percent of South Africa's manufacturing employment

and 1.5 percent of its gross national product. Armscor, South Africa's preeminent defense conglomerate, was one of the country's largest industrial groups (RSA DoD, 1998). During the 1980s, over 20 percent of Israel's industrial workforce was engaged in arms manufacturing, and for a time Israeli Aircraft Industries (IAI) was the country's single largest employer (Steinberg, 1987, p. 172; Sanders, 1990, p. 53).

Armament production can also serve as a "technology locomotive" spurring the growth of new industries and new technologies, particularly in the area of aerospace, electronics, and information technologies sectors (Elliot and Bonsignore, 1998, p. 31; Cheng and Chinworth, 1996, pp. 245–246). Military aerospace programs, for example, often constitute the basis for civilian aircraft production. Defense industrialization can also function as an important import substitution strategy, and instead of sending capital, and especially government monies, out of a country via arms imports, indigenous arms production can help to create jobs, ameliorate trade imbalances, and protect foreign currency reserves.

Finally, by *exporting* arms, defense firms can constitute an important source of foreign currency earaings. Brazil in particular pursued an aggressive export-led defense industrialization strategy, and by the late 1980s it had emerged as the world's largest exporter of wheeled armored vehicles as well as being a major supplier of lightweight trainer planes and multiple rocket launchers to a number of armed forces in Latin America, Africa, the Middle East, and even western Europe (Economist, 1991).

Defense industrialization in Indonesia and Singapore: differing motives, differing approaches to offsets

It is a simplification, but it is probably safe to argue that Singapore's approach to defense industrialization has been guided mainly by strategic and military rationales, while armament production in Indonesia has been driven mainly by their anticipated economic benefits.

Indonesia

The genesis for Indonesia's defense industry very much revolved around the concept of exploiting indigenous armaments production as an instrument for national development and industrialization (Huxley and Willett, 1999, p. 50). Defense industries were supposed to contribute directly and indirectly to the nation's technological and industrial modernization, both by the creation of new strategic industries, manufacturing military and commercial products, and by raising in general the country's level of technical expertise, manpower skills, and industrial infrastructure. Indonesia began armament production in earnest in the mid-1970s, with the establishment of several state-owned "strategic enterprises," the most important of which were PT *Industri Pewsawat Terban Nusantara*, or IPTN (aviation and aerospace), PT PAL (shipbuilding), PT Pindad (small arms and munitions), and, later, PT Centronix (defense electronics) (Singh, 1989, p. 251). Of these, IPTN was particularly revealing of Indonesia's greater goals harnessing armament production for industrial modernization and development. IPTN was the personal brainchild of its founder and first director, B.J.Habibie, who was also the

country's Minister for Research and Technology (and who briefly was to replace Suharto as Indonesia's President in 1998). Habibie (who later headed up PT PAL and PT Pindad) explicitly viewed the establishment of an aerospace industry as both an instrument and a model for advancing the country's overall technology and industrial base (Huxley and Willett, 1999, p. 50; Bailey, 1992, pp. 51–52). IPTN was to serve as an indicator of Indonesia's intentions to become a modern industrialized nation and "to prove that a Third World, Muslim-majority country could make a hi-tech leap into global aviation" (Cohen, 2000, p. 45).

The key to realizing these goals was an evolutionary industrial development strategy that explicitly used offsets to acquire the necessary research, design, and manufacturing expertise in order to give "optimal results in the efforts of mastering aviation technology in a relatively short period of time, [i.e.,] 20 years" (Indonesia, n/d). Subsequently, IPTN pursued a technology-transfer philosophy dubbed "Begin at the End and End at the Beginning." As laid out in IPTN's official history, this process is intended "to absorb advanced technology progressively and gradually in an integral process and based on Indonesia's objective needs" (Indonesia, n/d). Therefore, "in building aircraft, it does not necessarily start from components," but from directly learning "the end of a process," i.e., the final assembly of aircraft, and then working backwards to component manufacturing (Indonesia, n/d).

This technology development program was to run through four distinct, progressive phases. Phase one involved the "mastery of manufacturing capabilities" through subcontracting and licensed production of foreign aircraft designs, "providing the opportunity for both management and the workforce to gain knowledge, skills, and experience" (Bailey, 1992, p. 52). Phase two entailed the integration of technology and through expansion of workforce skills via joint projects with foreign partners. Phase three, technology development, entailed initial efforts to design, develop, and manufacture aircraft entirely on its own. Finally, during phase four, "basic research," IPTN was to entail the indigenous research and development of basic technologies, such as materials, propulsion, and electronics. Breakthroughs made at this stage would be fed into future aerospace programs.

This evolutionary and incremental process of defense industrialization is familiar to many as the "ladder of production" model as laid out by Krause and others (Krause, 1992, p. 171; Brzeska and Ohlson, 1989, pp. 15–27; Katz, 1984, pp. 8–9; Willett, 1997, pp. 116–118; Brauer, 2002, p. 105). According to this model (see figure 17.1), initial armament production tends to revolve around the assembly of foreign weapon systems from imported parts and components (knock-down kits). The next step usually consists of the licensed production of foreign weapon systems, with some—and in many cases, eventually nearly all—of the actual manufacturing of

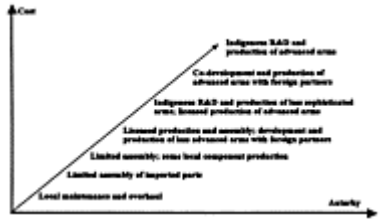

Figure 17.1: The arms production ladder

components and subsystems performed indigenously. Joint development programs with foreign partners which continue to rely heavily on imported know-how but which also nourish incremental improvements in the country's independent military R&D base usually follow this stage, and a country will often then attempt to indigenously produce more complex weapon systems. Lastly, a country may attempt to design and develop its own advanced weapon systems—such as fighter aircraft, missiles, submarines, large surface combatants, or military electronics—either across-the-board or by carving out certain niches or specialties.

The ladder of production model relies heavily on foreign technical assistance at the initial stages. These inputs often come in the form of offsets, particularly licensed assembly and production, and considerable foreign assistance in establishing turnkey factories. The underlying objective of this model, however, certainly the way it was intended to work in the case of Indonesia's arms industry, is to exploit foreign aid and inputs so as to gradually but surely wean oneself off such assistance, in other words, to use offsets as a means of boot-strapping the local defense industrial base to become not only self-sufficient but to eventually be globally competitive in certain industrial sectors.

In the case of IPTN, phase one, beginning in the mid-1970s, saw the company undertaking the licensed production of several kinds of foreign-designed aircraft, including the NC-212 light transport plane (from CASA of Spain), the NBo-105 utility-lift helicopter (from Germany's MBB), the NAS-332 Super Puma helicopter (from France's Aerospatiale), and the Bell 412 helicopter (from the United States). Initial production tended to entail the relatively simple assembly of imported kits, but subsequent aircraft in these production runs involved greater domestic content and work share, until most were built almost entirely indigenously (Bailey, 1992, p. 52). Also during this phase IPTN manufactured components for F-16 fighters and British Hawk trainers purchased by the Indonesian air force.

Phase two, which began in the early 1980s, centered on the co-development of the CN-235 transport aircraft in a 50:50 joint venture with CASA of Spain. Design work began in 1980 and the aircraft first flew in 1983. The CN-235 was adapted both for military purposes (as a cargo and maritime patrol aircraft) and for civilian use as a commuter plane; it was also the first airplane that IPTN produced for export. Altogether, IPTN built around 75 CN-235s between 1983 and 2002, including 31 aircraft sold to the United Arab Emirates, Brunei, Malaysia, Pakistan, South Korea, and Thailand (Jane's, 2003).

Phase three began in the late 1980s and continued through to the 1990s. The centerpiece of this phase was the N-250, a 50-seat turboprop commuter aircraft designed and manufactured entirely in Indonesia, but still using a large number of foreign components, such as the engine, avionics, and landing gear. The N-250 flew in 1995, and two prototypes were built and tested. Another phase-three program was the N-2130, an 80 to 130-seat passenger jet that could cap Indonesia's emergence as a world-class aerospace producer; the N-2130 was unveiled in 1997. By 1997, IPTN had grown to a workforce of almost 16,000, including 1,500 engineers, and the company was intending

to become "'the Toyota of aerospace,' with an aircraft to meet every niche in the 20 to 130-seat range" (Bailey, 1992, p. 52; Cohen, 2000, p. 46).

Shipbuilding and small arms followed paths only slightly different from that of IPTN. PT PAL has constructed two types of German-designed patrol boats, while PT Pindad has produced, under license, assault rifles from Belgium, submachine guns from Italy, mortars from Finland and Israel, and grenade launchers from Singapore (Singh, 1989, p. 251).

Singapore

For its part, Singapore has pursued quite different defense industrialization objectives than has Indonesia, and these goals have led it to approach the idea of offsets differently. Singapore, in contrast to Indonesia's modernization strategy, developed an arms industry primarily for strategic reasons. As a small nation with limited natural resources, a declining birthrate, a shortage of skilled manpower, no strategic depth, and sandwiched between two large and potentially threatening neighbors, local armament production has been focused first and foremost on meeting the immediate needs of the Singapore Armed Forces (SAF). In addition, since high technology is seen as a critical force multiplier, arms procurement decisions have been generally measured against what Singapore can afford to do by itself and what is more sensibly bought from foreign sources (Huxley and Willett, 1999, p. 50; Yam, 1999).

When it comes to indigenous arms production and defense industrialization, Singapore, as opposed to Indonesia, therefore regards potential economic benefits as secondary to the task of bolstering the country's defense capabilities. As one observer stated more than a decade ago:

> "…the Singapore defense industries are not viewed as part of the country's economic development strategy, as they are in Indonesia, but rather are viewed as an integral part of the country's concept of Total Defense" (Singh, 1989, p. 259).

Consequently, Singapore has tended to take a more pragmatic and selective approach toward defense industrialization. It has never sought nor even harbored the goal of autarky in armament production, and the country has remained entirely dependent upon foreign sources for such critical weapon systems as fighter aircraft, helicopters, submarines, tanks, and all kinds of tactical missile systems (air-to-air, surface-to-air, antitank, etc.). Instead, the local defense industrial base is geared primarily toward guaranteeing the supply and maintenance of critical systems, and toward developing the capability to upgrade and modify imported weapon systems (Matthews, 1999, p. 20).

Local arms production is centered on the state-owned Singapore Technologies Engineering (STE). STE has its roots in Chartered Industries, established in the mid-1960s to produce small-arms ammunition for the SAF. After going through several expansions and reorganizations, STE now comprises four main subsidiaries: ST Aerospace (aircraft manufacturing and maintenance), ST Electronics (sensors, communications, software, and combat systems), ST Kinetics (land systems and ordnance), and ST Marine (shipbuilding). By 2002, STE employed over 11,000 workers

and boasted revenues in excess of US$1 billion (Huxley, 2000, pp. 11–12; Karniol, 2003). STE has developed considerable expertise in logistics and depot management, in the maintenance and overhaul of aircraft and aircraft engines, and in ship repair (Karniol, 2003). In addition, it has built up its systems design, engineering, and integrations skills necessary to undertake modernization and upgrade programs on behalf of the Singaporean armed forces, including (Huxley, 2000, pp. 13–14):

> refurbishing and refitting Republic of Singapore Air Force (RSAF) A-4S fighter aircraft with a new engine and new avionics;
>
> upgrading RSAF F-5 flghters with a new cockpit avionics suite and radar; modernizing the army's M-113 armored personnel carriers; and
>
> retrofitting the Navy's patrol boats with Harpoon anti-ship cruise missiles and Barak air-defense missiles.

In accordance with its minimalist economic goals for defense industrialization, offsets have played a much more modest role in Singapore's arms industry than in Indonesia's. In fact, Singapore has no formal offsets policy *per se*, but instead engages in Industrial Cooperation Programs with foreign suppliers that require technology transfer and training as part of licensed production arrangements or off-the-shelf buys (Huxley, 2000, p. 10). These cooperative agreements, in turn, have mostly been used to expand the local defense industry's maintenance, repair, and upgrade capabilities. STE, for example, has a collaborative arrangement with Pratt and Whitney to overhaul turbine engine blades, which supports it capacities to overhaul RSAF F-16 fighter aircraft and submarines (Karniol, 2003).

Production offsets have been even more limited. Licensed production has generally been employed in those defense sectors where Singapore believes it can

best contribute to eventual self-sufficiency in design, development, and production, and where it believes that indigenous production can meet national defense requirements and still be cost-effective and technologically world-class. For example:

> during the 1970s and 1980s, Singapore constructed both 45-meter and 62-meter missile patrol boats under license from Germany's Lürssen, as well as *Landsort*-class mine hunters under license from Sweden's Kockums; building upon these experiences, Singapore during the 1990s built its own indigenously designed *Fearless*-class of offshore patrol vessels and *Endurance*-class of 8,500-ton landing ships;
>
> Singapore reportedly turned to a foreign company, Belgian-based SRC International, to help develop its indigenous FH-88 155mm howitzer (Huxley, 2000, p. 14);
>
> Singapore licensed-produced the M-16 rifle during the 1970s, as well as manufacturing foreign-designed small arms (the Ultimax 100 and the SAR 80), before graduating to producing an entirely indigenous assault rifle, the SAR 21 (Huxley, 2000, p. 14).

Even in some of these cases, however, offsets have not led to greater self-sufficiency in armament design and manufacturing. The country's next generation of warships, for

example, will be a licensed-produced version of the French *Lafayette*-class frigate. Singapore is arguably truly self-sufficient only in the area of small arms and ammunition, artillery, and light armored vehicles.[2]

In conclusion, Singapore appears to have adopted a *core competencies* or *niche production* approach to its defense industries. It deliberately decided to concentrate arms manufacturing in those areas where it believes it has particular key strengths—and also greater potential to either export its products or find foreign partners—and either abandoned or declined to enter those areas where it believed that arms production would not be economically viable or technologically competitive. In so doing, Singapore is a rarity among developing-world arms producers in that it does not appear to follow the ladder of production model of defense industrialization. More to the point, it appears to be content with remaining at the lower rungs of the ladder.

Recent developments in the Indonesian and Singaporean defense industries

Indonesia

By the mid-1990s, Indonesia's defense industry, and certainly its aerospace business, appeared to be riding high. IPTN in particular enjoyed preferential treatment as a strategic enterprise, backed up by strong central government support (Jakarta invested billions of dollars in the company, while Habibie was part of Suharto's inner circle) and a captive market (Indonesia's military and domestic commuter airlines were compelled to buy IPTN products, even when they did not match their needs; for example, two Indonesian domestic airlines were forced to buy CN-235 transports as commuter planes, even though they performed poorly in this role [see Jane's, 2003]). The company had grown from an initial 500 workers to more than 15,000 by 1997, and its main factory at Bandung featured a state-of-the-art manufacturing facility, including several dozens of advanced computerized numerically controlled tools (Jeziorski, 2000, p. 77). It had one major indigenous program, the N-250 commuter plane, already flying and another, the N-2130 regional jet, on the drawing board. Indonesia appeared to be making considerable strides toward meeting its goals of self-sufficiency and toward creating a world-class defense and commercial aerospace sector.

Much of this apparent success was illusory, however. In reality, IPTN was a bloated, state-owned white elephant, employing many more workers than it needed and was awash in excess production capacity. Moreover, Indonesia was finding it increasingly difficult to break into civil aviation manufacturing at the level of a systems integrator or even as a major partner in collaborative aircraft programs. The Indonesian government poured nearly US$1 billion into the N-250 program, but despite this huge investment, the aircraft continued to experience considerable teething problems (Cohen, 2000, p. 45). In particular, the plane failed to receive certification from the US Federal Aviation Authority, which made it almost impossible to market the aircraft overseas. At the same time, orders had already begun to dry up for its other products, particularly the NC-212 light transport aircraft and helicopters (Jeziorski, 2000, p. 77; Cohen, 2000, p. 46).

The 1997–98 Asian financial crisis was the defining event that forced Jakarta to reexamine and ultimately dramatically scale back its ambitious plans for its aerospace industry and instead to greatly downsize its arms industry. As a condition of the bailout by the International Monetary Fund, the central government was forced to cut off all support to IPTN, and by 2000, the company had run up a debt of US$570 million. In response, the company underwent major restructuring. This included a name change (to Indonesian Aerospace, or IAe), the divestiture of unneeded production capabilities (particularly in the area of engineering), and—most significant of all—the elimination of around one-third of its workforce, or 5,000 employees (although IAe anticipates that it may have to cut an additional 3,500 jobs in the near future; see Cohen, 2000, p. 46). The company has put both the N-250 and N-2130 civilian airliner projects on hold, pending the possible infusion of foreign capital, which so far has not been forthcoming, and has largely fallen back on marketing its workhorse product, the CN-235. New sales of the CN-235 have been slow, however, just eight to South Korea and four to Pakistan. Overall, the future of Indonesia's defense industry is not bright.

Singapore

Singapore's defense industry appears to be thriving, largely because of its core competencies/niche production business strategy. In particular, in recent years efforts to commercialize and globalize its business activities have become more critical to Singapore's arms industry than offsets have ever been. The past decade or so has seen STE engage in a concerted effort to reduce its dependency upon contracting to the country's armed forces. ST Aerospace (STAe) greatly increased its commercial subcontracting business over the past decade, manufacturing components for western

Table 17.1: Singapore Technology Engineering's (STE) international business activities

Division	*Foreign firm/country*	*Type of activity*	*Products*
Aerospace	BAE Systems (UK)	joint venture	aircraft parts
Aerospace	BAE Systems (UK)	joint venture	military/civil training facility
Aerospace	Dee Howard (USA)	acquisition	aircraft maintenance
Aerospace	EADS (France)	co-development	EC-120 helicopter
Aerospace	Elta (Israel)	joint venture	aircraft upgrades
Aerospace	Messier Bugatti (France)	joint venture	landing gear, hydraulic components, transmissions
Kinetics	Kenetics Systems (China)	subsidiary	electric/hybrid-drive systems
Kinetics	Nesscap (South Korea)	acquisition (10%)	capacitors
Aerospace	Pratt & Whitney	joint venture	turbine engine blades

	(USA)		
Kinetics	Thales (France)	joint venture	electronics
Kinetics	Timoney (Ireland)	acquisition (25%)	armored vehicle components
Kinetics	Vickers (UK)	joint venture	armored vehicles, artillery
Marine	Halter Marine (USA)	acquisition	ships

companies such as Eurocopter and Boeing. It has also become a global maintenance and overhaul center for commercial aircraft. Consequently, roughly half of STAe's revenue comes from non-military work (Huxley, 2000, pp. 16–17; Karniol, 2003).

Just as important have been the Singapore defense industry's efforts to increase its international footprint through co-development alliances, joint ventures, and transnational mergers and acquisitions (see table 17.1). STAe, for example, is a member of the US-led international consortium currently engaged in the development of the F-35 Joint Strike Fighter. It is collaborating with Eurocopter France in manufacturing and marketing the EC-120 light utility helicopter, and with Israel's Elta to upgrade F-5 fighter aircraft for the Turkish and Brazilian air forces (Huxley, 2000, p. 19). ST Kinetics teamed with up with a US firm, Teledyne Brown Engineering, in an (ultimately unsuccessful) attempt to sell its Bionix IFV to the US Army to meet the latter's Interim Armored Brigade concept. Singapore has signed defense technology collaboration agreements with several other arms producing countries, including Australia, France, Norway, South Africa, and the United Kingdom. In the case of Sweden, it has created a bilateral technology development fund to jointly finance cooperative R&D projects; Swedish-Singaporean cooperation has been particularly close in the areas of undersea warfare and biochemical defenses (Huxley, 2000, p. 10). Finally, Singapore's defense industry has expanded its overseas operations, with STE taking a 25 percent stake in the Irish company Timoney, which produces suspension systems for armored vehicles, and also acquiring the US shipbuilder Halter Marine as a wholly owned subsidiary. Altogether, STE has more than 2,500 workers, nearly a quarter of its labor force, employed outside Singapore (Karniol, 2003).

This globalization strategy has had a significant impact on further diminishing the nation's already low attachment to offsets as an industrial policy. With specific regard to participation in the Joint Strike Fighter, for instance, Singapore "has rejected the concept of industrial offset outright, preferring instead to leverage its military purchases to gain the expertise it needs to become a major partner in international aircraft development and upgrade programs" (Doyle, 2001, p. 38). In this regard, the JSF program fits neatly into Singapore's strategy, as this program explicitly rejects the idea of guaranteed work shares and other kinds of offsets. In addition, whoever successfully sells next-generation fighter aircraft to the country is expected "to make a long-term commitment to their relationship with Singapore" (Doyle, 2001, p. 38).

Conclusions

Indonesia and Singapore offer both a cautionary tale and an interesting role model for other aspiring arms producers in the developing world. Indonesia's experiences show that offsets offer no great shortcuts, either economic or technological, when it comes to achieving viable, self-sustaining defense industries. Arms production is a "capital and technology-intensive industry" requiring significant investments in equipment and personnel (Baek and Moon, 1989, p. 157), and offsets alone are insufficient to provide for these requirements, especially as a country attempts to move up the ladder of production. Indigenous, and often quite substantial, sources of financial, industrial, and human capital must also exist independently in order for a nation to make progress toward the independent development and production of advanced weapon systems (Brauer, 1991, p. 166). Offsets cannot substitute for a strong science and technology base.

An observation made with regard to the efficacy of offsets in defense industrialization in South Korea and Taiwan is equally appropriate in the case of Indonesia:

> "Offsets…have had limited impact in fulfilling larger plans for becoming self-sufficient producers across a range of systems (much less becoming global players in high tech industries). This apparent failure could be attributable to overly ambitious plans by central governments, as well as a measure of naiveté in understanding the dimension of domestic resources needed to fully exploit such transfers. There is no doubt that domestic capabilities have grown…as a result of technology licensing, production buybacks and other forms of offsets …However, offsets have not resulted in anything approaching the creation of global competitors in a vast range of systems…nor are they likely to in the immediate future" (Cheng and Chinworth, 1996, pp. 275–276).

On the other hand, Singapore can be viewed as a model of how a smaller arms producing state can leverage its strengths in certain niche areas to become a vital player in the international arms business and also create a globally competitive, profitable defense industrial base. Singapore has joined other second-tier arms producers, such as Sweden and South Africa, who are increasingly using a core competencies strategy to emphasize the unique contributions it can make in partnership with collaborative weapon programs such as the JSF (Bitzinger, 2003). In part because of this approach, STE has been consistently profitable for several years, and employment and revenue per employee have both increased (Singapore, 2003).

For second-tier arms producers like Singapore, repositioning oneself to play a subordinate role in a more globalized division of labor may make considerable economic and technological sense. It is certainly one of the most cost-effective ways to preserve and maintain national defense industries, and it permits smaller arms industries to make maximum use of their few competitive advantages in the global arms market, particularly with regard to lower labor costs and market access. Moreover, it keeps these arms industries open to cross-fertilization from foreign technologies; indeed, one of the

greatest drawbacks to autarky is the risk of inadvertently isolating one's defense industrial base from innovative foreign technologies, foreign capital, and global markets. Of course, such subordination means abandoning any goal of autarky in armament productions and concede a formal, pervasive, and maybe even irreversible dependency on foreign defense industries. In addition, globalization entails a fundamental shift away from insulating one's arms industries toward opening up and exposing these industries to the oft-times harsh economic realities of the international arms marketplace. Yet however little these countries may like to admit it, they appear to have few alternatives.

Notes

The assessments and arguments expressed in this chapter are strictly those of the author and should not be interpreted as representing those of the Asia-Pacific Center for Security Studies or the US Department of Defense.

1. I use the term second-tier arms producers to define a rather diverse group of countries comprising those industrialized countries possessing small but often quite sophisticated defense industries—for example, Australia, Canada, the Czech Republic, Norway, Japan, and Sweden—as well as those developing or newly industrialized countries engaged in ambitious, relatively recent (i.e., since the end of world war II, or, more accurately in most cases, since the 1960s or 1970s) defense industrialization efforts—e.g., Argentina, Brazil, China, India, Indonesia, Iran, Israel, Singapore, South Africa, South Korea, Taiwan, and Turkey. The first-tier of arms producing states comprises United States, the United Kingdom, France, Germany, and Italy; these five countries possess the world's largest and most technologically advanced defense industries, and together they account for more than three-quarters of the world's total armaments production. Moreover, they dominate—either singularly or collectively (particularly in the case of the major West European arms producers, who are increasingly regionalizing their arms production activities)—the global defense research and development (R&D) process. Third-tier arms producing states are defined as those possessing very limited and generally low-tech arms production capabilities; countries in this group would include Egypt, Mexico, and Nigeria. For a longer discussion of the problems and prospects facing the world's second-tier arms producers, see Bitzinger (2003).
2. ST Kinetics produces three types of indigenously designed light armored vehicles, the Bionix tracked infantry fighting vehicle, the Terrex wheeled armored personnel carrier, and the All-Terrain Tracked Carrier, reportedly a reverse-engineered version of the Swedish Bv-206 all-terrain personnel carrier (see Huxley, 2000, p. 15).

References

Baek, K.I and C.I.Moon (1989) "Technological Dependence, Supplier Control and Strategies for Recipient Autonomy: The Case of South Korea," in K.I.Baek, R.D.McLaurin, and C.I.Moon (eds.) *The Dilemma of Third World Defense Industries.* Boulder, CO: Westview Press.

Bailey, J. (1992) "Habibie's Grand Design." *Flight International* (19 February 1992).

Bitzinger, R.A. (2003) *Towards a Brave New Arms Industry?* London: Oxford University Press.

Brauer, J. (2002) "The Arms Industry in Developing Nations: History and Post-Cold War Assessment," pp. 101–127 in J.Brauer and J.P.Dunne (eds.) *Arming the South: The Economics*

of Military Expenditure, Arms Production, and Arms Trade in Developing Countries. New York: Palgrave.
Brauer, J. (1991) "Arms Production in Developing Nations: The Relation to Industrial Structure, Industrial Diversification, and Human Capital Formation." *Defense Economics* Vol. 2, No. 2 (April), pp. 165–175.
Brzoska, M. and T.Ohlson (1987) "Conclusions," in M.Brzoska and T.Ohlson (eds.) *Arms Production in the Third World 1971–1985.* Oxford: Oxford University Press.
Cheng, D. and M.W.Chinworth (1996) "The Teeth of the Little Tigers: Offsets, Defense Production and Economic Development in South Korea and Taiwan," pp. 245–298 in S.Martin (ed.) *The Economics of Offsets: Defense Procurement and Countertrade.* Amsterdam: Harwood.
Chinworth, M.W. (2004) "Offset Policies and Trends in Japan, South Korea, and Taiwan," chapter 16 in J.Brauer and J.P.Dunne (eds.) *Arms Trade and Economic Development.* London: Routledge.
Cohen, M. (2000) "New Flight Plan." *Far Eastern Economic Review* (2 March 2000), p. 45.
Doyle, A. (2001) "Asian Industry: Market Forces." *Flight International* (13 August 2001).
[Economist] (1991) "Third World Arms Industries: Swords Not Ploughshares." *The Economist* (23 March 1991).
Elliot, J. and E.Bonsignore (1998) "Asia's 'New' Aerospace Industry: At the Turning Point?" *Military Technology* (February), pp. 24–32.
Evans, C. (1986) "Reappraising Third-World Arms Production." *Survival* (March/April), Vol. 28, No. 2, pp. 99–118.
Frankenstein, J. (1999) "China's Defense Industries: A New Course?" in J.C. Mulvenon and R.H.Yang (eds.) *The People's Liberation Army in the Information Age.* Santa Monica, CA: RAND.
Franko-Jones, P. (1992) *The Brazilian Defense Industry.* Boulder, CO: Westview Press.
Green, M.J. (1995) *Arming Japan: Defense Production, Alliance Politics, and the Postwar Search for Security.* New York: Columbia University Press.
Huxley, T. (2000) "Singapore's Defense Procurement, Research & Development, and Industry." Paper presented to the conference on "Transformation in Global Defense Markets and Industries," London, United Kingdom, 4–5 November 2000.
Huxley, T. and S.Willett (1999) *Arming East Asia.* Oxford: Oxford University Press.
[Indonesia] (n/d) *Evolution and History of the Indonesia Aviation Industry.* Not dated. From Indonesian Aerospace's web site www.indonesian-aerospace.com/history/history.htm.
[Jane's] (2003) *Jane's All the World's Aircraft (Intenet version).* "Airtech CN-235" [posted 10 January 2003].
[Jane's] (2002) *Jane's Naval Construction* (Internet version). "Penang Shipbuilding & Construction" [posted 11 September 2002].
Jeziorski, A. (2000) "Toughing It Out." *Flight International* (25 July 2000).
Karniol, R. (2003) "Singapore's Defense Industry: Eyes on Expansion." *Jane's Defense Weekly* (30 April 2003) (Internet version).
Katz, J.E. (1984) "Understanding Arms Production in Developing Countries," in J.E. Katz (ed.) *Arms Production in Developing Countries: An Analysis of Decision Making.* Lexington, MA: Lexington Books.
Krause, K. (1992) *Arms and the State: Patterns of Military Production and Trade.* Cambridge: Cambridge University Press.
Landgren, S. (1989) *Embargo Disimplemented: South Africa's Military Industry.* Oxford: Oxford University Press.
Matthews, R. (1999) "Singapore Buys Longbows and Grows its Defense Industry." *Asia-Pacific Defense Reporter* Vol. 25, No. 7 (December), pp. 20–21.
Nolan, J.E. (1986) *Military Industry in Taiwan and South Korea.* New York: St. Martin's Press.

Perlo-Freeman, S. (2004) “Offsets and the Development of the Brazilian Arms Industry,” chapter 13 in J.Brauer and J.P.Dunne (eds.) *Arms Trade and Economic Development.* London: Routledge.

[RSA DoD] (1998) Department of Defense (Republic of South Africa). *White Paper on the South African Defense-Related Industries*, Chapter II (March). www.gov.za/whitepaper/1998/defence/defence.html.

Sanders, R. (1990) *Arms Industries: New Suppliers and Regional Security.* Washington, DC: National Defense University Press.

[Singapore] (2003) Singapore Technologies Engineering. http://www.stengg.com/AR2002/%20finhighlights.htm [accessed 8 September 2003].

Singh, B. (1989) “ASEAN’s Arms Industries: Potential and Limits.” *Comparative Strategy* Vol. 8, pp. 252–253.

Steinberg, G.M. (1987) “Israel: High-Technology Roulette,” in M.Brzoska and T. Ohlson (eds.) *Arms Production in the Third World 1971–1985.* Oxford: Oxford University Press.

[US GAO] US General Accounting Office (1994) *Asian Aeronautics: Technology Acquisition Drives Industry Development.* May 1994 GAO/NSIAD-94–140. Washington, DC: GAO.

Willett, S. (1997) “East Asia’s Changing Defense Industry.” *Survival* (Autumn), Vol. 39, No. 3, pp. 107–134.

Yam, T.P. (1999) “Harnessing Defense Technology: Singapore’s Perspective.” *DISAM Journal of International Security Assistance Management* Vol. 23, No. 1 (Spring), pp. 9–13. http://www.disam.dsca.mil/pubs/INDEXES/journals/%20Journal_Index/v.21_3/Yam.pdf [accessed 12 September 2003].