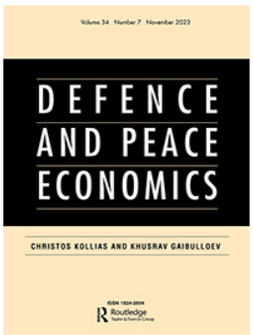

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The Role of Offset in the Enduring Gestation of Indonesia's Strategic Industries

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ABSTRACT

The purpose of this paper is to examine the performance of Indonesia's informal offset policy over the period 1976-2014. The paper offers four original academic perspectives: firstly, it is framed by reference to what Indonesia's former Minister of Technology, Dr Habibie, described as the Progressive Manufacturing Plan, a novel approach in which offset was intended to play a critical supportive role in the systematic development of strategic civil-military industries; secondly, the analysis is structured into three distinctive 'development-survival-revival' industrialisation stages that impacted on the performance of both offset and the broader defence economy; thirdly, the study is uniquely different in the sense that the offset case studies all occurred in an era absent of a formal offset policy regime; and lastly, the study provides a wealth of rich data in a subject field well-known for its sensitivity, if not secrecy, and thus is characterised by a paucity of empirical evaluation.

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Indonesia; defence offset; defence industry; strategic industries

Introduction

Since 1961, Indonesia's foreign policy has been based on non-alignment, placing a premium on self-reliance. The urgency of this goal was reinforced by the trauma of two arms embargoes, firstly by the Soviets (1966) and then by the US and EU (1999). In pursuit of self-reliance, Jakarta initiated policies in the 1970s to establish a state-owned defence industry.[1] The government recognised indigenous defence industrialisation could not be immediate.[2] Thus, to accelerate the process, and in parallel with other development strategies, such as import-substitution and capital goods-led industrialisation, defence offset (the demand for reciprocal investment linked to procurement)[3] was viewed as an important mechanism for leveraging military technology acquisition. Although Indonesia was one of the first countries to engage in countertrade, surprisingly defence offset was not requested until the early 1980s.[4] Moreover, its offset regime was unlike no other, save perhaps for that of India, whose informal offset regime characterised arms procurement from the 1960s to the launch of its official policy in 2005 (Pardesi and Matthews 2007). The conventional international approach towards offset is for governments to mandate it against clear and published guidelines to ensure transparency and consistency in policy interpretation and implementation. By contrast, Indonesia's approach to offset, until the launch of its first formal offset policy in 2015, was to treat offset as *ad hoc*, and devoid of policy prescription. The principal benefit of informal offset arrangements is case-by-case flexibility, enabling business solutions to be tailored to the unique contextual circumstances surrounding each offset deal. Japan and Singapore are examples of countries that have pursued successful non-

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standardised, flexible offset frameworks (Chinworth 1992; Matthews and Koh 2019). Neither state has published formal offset guidelines, but instead has sought to agree mutually feasible sets of obligations. Arguably, this open approach works because both states enjoy high levels of technology absorptive capacity, affording a wider spectrum of competitive offset opportunities. However, similar negotiating flexibility may not be available to poorer states, such as Indonesia, where directed and prescriptive policy will likely be the only recourse for ensuring investment packages are made available in such primitive high-risk defence industrial environments.[5]

The rationale behind flexible non-prescriptive policies is that while offset is a disarmingly simple concept, effective implementation is remarkably complex, often involving nuanced and contorted policy interpretations. At the heart of the problem, undermining the prevalent notion that offset is a 'win-win' partnership, is the ever-present danger of goal divergence between the recipient offset authority and the offshore vendor. In other words, while the purpose of an authority's mandated demand is for reciprocal investment to facilitate local development, this nearly always conflicts with the offshore defence vendor's corporate objective of profit maximisation. Under such circumstances, offset endures because of firstly the prevailing international buyers' market, characterised by excess arms supply over demand, and, secondly, relatively high procurement scale, which acts to entice vendors to agree recipient country offset demands. Foreign defence contractors refusing to accede to offset demands, face the risk of losing the sale to competitors prepared to comply with such requirements.

Offset policy effectiveness from the recipient country's perspective is dependent on the creation of sustainable productive capacity. Ambitious offset policies are normally framed to strengthen national security (Kannianen and Lehtonen 2019; Amara and Pargac 2009) through fostering capabilities such as production expertise , high technology skill sets, innovative local supply chains, R&D and export opportunities via access to foreign OEM (Original Equipment Manufacturer) global manufacturing networks. Much is expected from offset, but reality often diverges from rhetoric. There is criticism, for instance, that offset is anti-competitive, welfare reducing and market-distorting (Brauer and Dunne 2004). At a practical level, offset carries a cost premium (Markowski and Hall 2014), and often fails to deliver on pre-determined policy objectives, offering only short-term business solutions rather than long-term industrial and technological sustainability (Lazar 2019; Martin 1996). Yet, notwithstanding these revealed fault-lines, there is evidence that offset policy can be 'fit-for-purpose', delivering on policy objectives (Matthews 2014). Success, however, is qualified by the essentiality of recipient nations possessing the necessary technological absorptive capacity (Martin 1996), and, therefore, advanced states are likely to benefit the most from offset practices. For the majority of developing states, opportunities exist to access technology, but benefits will be more sporadic and localised, creating isolated 'pools' of technological development as opposed to dynamic defence-industrial transformation. Hence, offset policy does not conform to a 'one-size-fits-all' paradigmatic framework and should be analysed via country case studies (Balakrishnan and Matthews 2009).[6]

The purpose of this paper, then, is to offer an empirical examination of Indonesian informal offset practices across the extended period 1976-2014.[7] Indonesia not only provides a fascinating case study of a country that has a comparatively long history of offset, but one that has explicitly embroidered its use into a novel 'strategic' industrial planning framework. The government's aim was to access foreign technology in tandem with building local technological absorptive capacity. These two policy thrusts are not mutually exclusive, as offsetting investment can be directed towards fostering weapons production capacity alongside creating the supportive industrial and technological infrastructure. Success in meeting these two policy aims is examined via a historical profile of Indonesia's informal offset experience over the almost four decades since 1976, when only an informal offset policy was in place.[8] A formal offset policy was not introduced until 2012, but policy vagueness prevented its implementation until clarifying legislation was published in 2015.[9] Thereafter, a dramatic expansion of offset programmes occurred. Given that most of these programmes are still 'live', it is too early to pronounce on the performance of Indonesia's formal offset policy, this remaining a subject for future study.

Strategic Industries as Vehicles of Technological Transformation

Indonesia's former President Soeharto initiated the process of technological transformation during a period in Indonesia's post-independence era that became known as the New Order (1966-1998). Its underlying thematic was an economic policy, characterised by a technocratic focus anchored to strong government intervention and an Import Substitution Industrialisation (ISI) strategy (Ariff and Hill 1985). Indigenous technological development was held to be the responsibility of government because it was the principal sponsor of R&D spending, which amounted to just 0.19-0.56 percent of GDP throughout 1975-1992 (Hill 1995). Further, the private sector proved unable to fill the R&D gap, owing to its lack of a research culture, a preference for trading, minimal incentives for foreign investors and limited cooperation between private and public R&D institutions (Hill 1995). The absence of local R&D investment meant that external sources of technology, such as Foreign Direct Investment (FDI) and defence offset, became important.

However, the State Minister for Science and Technology, Dr Habibie (1978-98), recognised that external technological transmission was a 'static' development process, not leading to industrial deepening. The Minister, who had gained his engineering credentials in Germany, sought to address the problem by pursuing what he termed 'transformative industrialisation' via the launch of a Progressive Manufacturing Plan (PMP). It would foster organic technological development through an ISI regime that would protect the domestic market until such a time as high levels of competitiveness could be achieved. Habibie's search for levels of competitiveness comparable to advanced countries would be secured through the PMP. The plan sought to promote a comprehensive defence industrial base, driven, firstly, by the creation of key value-adding industrial nodes within the economy, such as aerospace, maritime and vehicles, and secondly, by cultivation of organic layers of indigenous subcontracting commercial industries, generating high levels of skilled employment. Habibie described this process as a form of 'reverse' technology development: beginning at the end (development of high technology prime contractors) and ending at the beginning (vertical disintegration of the primes, creating small, specialised, subcontractors) (Habibie 1995).

The PMP was expected to induce a value adding momentum, generating both industrial deepening and a minimum critical mass of domestic and international demand. This would create optimal economies of scale, high quality production and a robust after-sales service, representing the building blocks for constructing strategic industries (Habibie 1995). Habibie argued that the strategic industries would provide the motive force to power technological and industrial transformation (*wahana transformasi teknologi dan industri*). He further conceptualised that the PMP would embrace four transformative stages, as shown in Figure 1. The first would focus on building capability to master advanced design, technology and production. There would be no local R&D at this stage, through fear it would simply 'reinvent-the-wheel'. Instead, defence offset, especially licensed production, was held to guarantee linkage between technology transfer and the appropriate production scale. The second stage would centre on technology integration into the new product. This would require acquisition of design and blueprint capability as well as optimisation and integration of components. The third stage would focus on technology development, enabling newly industrialising countries to pursue acceptable levels of competitiveness through innovative development of technologies and systems. This would lead logically to the fourth stage of conducting basic research.

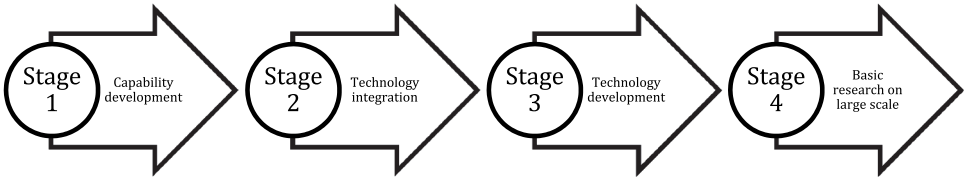

Figure 1. Habibie's Progressive Manufacturing Plan. Source: authors

Habibie determined that nine categories of industrial transformation were required, and these were prioritised as aerospace, maritime and shipbuilding, land transportation, telecommunications, energy, engineering, tools and agricultural machinery, defence industry, and finally related (supplier) industries (Habibie 1984). The government categorised all nine industrial vehicles as 'strategic'. This reflected the sense of Article 33(2) of the 1945 Constitution that … 'Branches of production deemed vital for the state' [must] be managed by the state" and would thus enjoy protection from competition. Table 1 lists the 10 State Owned Enterprises created through waves of Presidential Decrees across 1980, 1983, 1984, 1986, and 1989 that were intended to service the nine strategic industry categories. In the 1989 Presidential Decree No. 44, belatedly, and somewhat unhelpfully, a strategic industry was defined as an 'industry being granted status as strategic by this decree'.[10]

Table 1. Indonesia's 10 strategic industries, 1980-89.

No	Industry	Founded	Product
1	PERUM DAHANA	1966	Explosives
2	PT Boma Bisma Indra (BBI)	1971	Machine tools, construction equipment
3	PT Barata Indonesia	1971	Machinery and engineering service
4	PT Industri Telekomunikasi (INTI)	1974	Telecommunication
5	PT IPTN	1976	Aircraft, weapon systems
6	PT Krakatau Steel	1978	Integrated iron and steel product
7	PT PAL Indonesia	1980	Shipbuilding, general engineering
8	PT Industri Kereta Api (INKA)	1981	Rolling stock
9	PT PINDAD	1983	Small arms and heavy equipment
10	LEN Production Unit	1965	Electronics and communication

Source: Raillon (1990) *Indonesia 2000 the industrial and technological challenge*. CNPF-TEC & Cipta Kreatif

The strategic industries were not only expected to pursue development of lateral defence sectors and vertical supply chains, but also promote technological spill-overs, including spin-on and spin-off innovations. Jakarta's policymakers recognised the essentiality of civil-military integration as a means of reducing the high social cost of heavy military expenditure by seeking opportunities to spread investment benefits more broadly to other economic sectors. A formula was devised to reflect the appropriate ratios of production capacity in both peace and war. The planned peacetime ratio would be 80:20 in favour of commercial activity, which would be reversed during war (Shiraishi 1996). Yet, the pursuit of civil-military production initially only applied to PT Pindad, whose push for diversification led to the creation of capacities in forging, casting, industrial machinery and services. Due to the absence of a local commercial supply chain, such diversification was also a means of fostering vertical integration. Eventually, vertical integration was also directed towards the development of aerospace and maritime capabilities, with PT IPTN and PT PAL, respectively expected to engage in nurturing systems integration capabilities to supplement existing production capacity.

Habibie postulated that aerospace and shipbuilding would be the technology spearheads driving demand through technological spill-over effects. Figure 2 below, illustrates the hierarchy of Indonesia's strategic industries, and the way spill-over effects would stimulate the emergence of both defence and non-defence supporting industries (Tier 1 value chain industries – *industry pendukung*) and affected industries (Lower Tier value chain industries – *industry terimbas*). For instance, in the early 1980s, PT Barata commenced production of track shoe prototypes for PT-76 amphibious tanks at PT Pindad, PT Krakatau Steel supplied steel for shipbuilding at PT PAL and PT Dahana supplied explosives for military purposes.

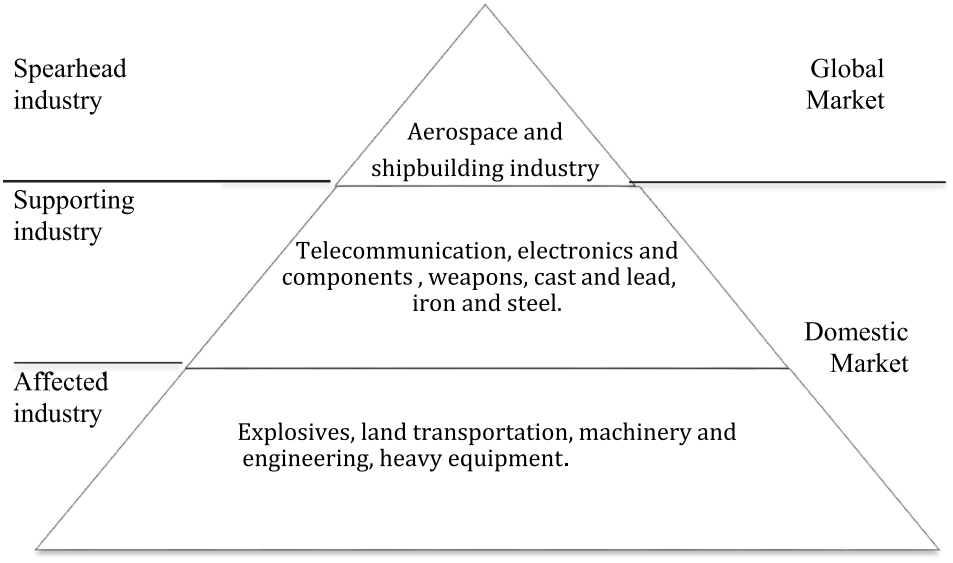

Figure 2. Strategic industry hierarchy embracing 'trickle-down' spill-over effects. Source: Badan Pengelola Industri Strategis (BPIS), internal document

Role of Offset in the Development of Strategic Industries

The four-stage PMP model illustrated in Figure 1 makes an important contribution to the broad body of knowledge on country technological development, generally, and to the process of Indonesia's strategic industrial transformation, specifically. However, the model was a child of its time. Conditionality, associated with Jakarta's US$43bn IMF loan during the late 1990's financial crisis, forced the removal of government subsidies supporting incipient strategic industrialisation. The loss of these subsidies destroyed further PMP implementation, but the concept of strategic industries nevertheless endured, as did the policy focus accorded to offset as a means of accelerating defence industrial development. Thus, in examining the long-term impact of informal offset on Indonesia's defence industrialisation push, an alternative model is employed, structured around three chronological politico-economic development phases:

- *'New Order' Development (1978-1998)*: reflecting the creation of strategic industries operating within Habibie's PMP. This first stage interpreted offset as essentially a 'best endeavours' activity, whereby direct offset via license production subjugated local industry to act as low value subcontractors to foreign suppliers. The transfer model was termed '*imbal produksi*' or 'counter-production', and during these two decades, offset 'policy' was fluid, with programmes negotiated without recourse to guidelines. Multipliers were never offered, with offset credits determined on a 'dollar-by-dollar' basis.
- *Survival, and early reform (1999-2009)*: this era was severely impacted by a US-imposed arms embargo (1999-2005) and the 1997 economic crisis that led to regime change and liberalisation – known as *reformasi* (reform). The combination of these events, plus reductions in state funding, led to cancellation and rescheduling of arms procurement programmes. During this challenging period, several countertrade deals were implemented. For instance, following the 2002 visit to Russia by the Indonesian Minister of Industry and Trade, President Megawati signed a contract for two each of the Su-27 and Su-30MKK fighters and also MI-35 helicopters,

worth in total around US$193mn (Muraviev and Brown 2008). Only 12.5 percent of the payment was in cash with the rest transacted through countertrade arrangements, including crude palm oil, rubber and its derivative products, across an eighteen-month period (Suhendra 2016).

- *Revival through Defence Modernisation (2010-14)*: this stage reflected the government's recommitment to Defence modernisation, whereby offset was viewed as a critical element in the success of a new long-term (2010-24) strategic posture termed Minimum Essential Force, spelling out the personnel and weapon system requirements for the next 15 years. The country's first formal offset policy was introduced in 2012 through the Law on Defence Industry, representing a concerted policy emphasis to promote indigenous defence industrialisation. High level direction was strengthened by the creation of a Committee for Defence Industry Policy (KKIP – *Komite Kebijakan Industri Pertahanan)*, whose principal aim was to synchronise industry production (supply side) with military requirements (demand side).

Offset as a Catalyst for Defence Industrialisation

Over the extended period 1976-2014, and in the absence of a formal offset policy, Indonesia initiated 23 arms procurement and linked offset programmes (SIPRI Arms Transfer Database 1950-2019). Table 2 lists 21 of these programmes (representing 91 percent of the total), most of which were channelled through the two strategic 'technology spearhead' industries, aerospace and maritime, and a minority through the land systems industry.

The development impact of the selected offset programmes listed in Table 2 is evaluated by reference to the three 'development-survival-revival' industrialisation stages. A second level of analysis is also conducted to investigate the performance of Indonesia's informal offset policy against a six-variable spectrum of offset objectives. These objectives were identified via content analysis of an offset database (Countertrade and Offset Data Base 2021) and 20 published offset articles (spanning numerous case study countries, including Saudi Arabia, Canada, the Netherlands, Israel, Malaysia, UAE, Indonesia, Singapore, South Africa, and Czech) (Maharani 2016). Certain trends were observed from the data analysis. For instance, developed countries generally link offset to the development of domestic military industries (direct offset). Other country motives include regional ambitions (India, Brazil, Indonesia), maintenance, repair and overhaul (MRO) as well as upgrading capability (Singapore), industrial revival (Poland), and access to global supply chains (Australia, Canada). The so-called NICs (Newly Industrialised Countries) demonstrate a preference for both direct and indirect offsets, while impoverished states focus solely on indirect offset, prioritising broader economic development goals.

Hammond (1990) postulates that there are 13 economic objectives associated with offset, among which include enhanced market penetration, transfer of technology, increased diversification, and job creation. Indeed, employment generation according to Gandal, Hanson, and Slaughter (2000) is the principal offset objective for many countries, including Israel, Czech, Saudi Arabia, South Africa, and the United Arab Emirates. Markusen in Brauer (2004) suggests that countries choose to use their offset credits to construct new comparative advantages in sectors with greater income elasticity and growth potential. Yang and Wang (2006) argue that countries in the same region, characterised by similar factor endowments and at roughly the same stage of economic development, often have the same offset objectives. For example, Pacific Rim countries use offset for aerospace technology transfer while Middle Eastern states, reliant on oil production, pursue the same offset objective of economic diversification. Content analysis of comparative country offset policies identified numerous objectives that were common across states irrespective of development status, and these were distilled down to six, policy objectives, namely, employment, skill enhancement, technology transfer, supply chain creation, export, and R&D.

Table 2. Indonesian defence offset programmes, 1976-2014.

	Procurement	Technology Collaborator	Ordered	Procurement Value	Offset Value/ Against Procurement Value	Offset Category
PT IPTN/PT DI						
	Stage One					
1	(40) SUT AS/ASW Torpedo	AEG Telefunken Germany	1975-85	N/A	N/A	Direct
2	(20) SST Seal AS Torpedo	AEG Telefunken Germany	1978-82	N/A	N/A	Direct
3	(21) Rapier SAM System	BAe Dynamics, UK	1985-86	£100mn	N/A	N/A
4	(300) Rapier-1 SAM	BAe Dynamics, UK	1986-87	US$60 mn	N/A	Hybrid
5	12 F-16	General Dynamics, USA	1989-90	US$337mn	US$52mn	Direct
6	8 Hawk 100 trainer/combat aircraft	BAe Systems, UK	1996-97	(Part of) US $442mn	Offset 35%	N/A
7	24 Hawk 200 FGA aircraft	BAe Systems, UK	1997-98	(Part of) US $442 mn	Offset 35%	Indirect
	Stage Two					
8	(17) KT-1B	KAI, South Korea	2003-12	N/A	US$60mn	Direct and counter-purchase
	Stage Three					
9	9 C-295	Airbus Military, Spain	2014	US$256mn	N/A	Direct
10	12 F-16	Lockheed Martin, US	2014	Approx. US $750mn	N/A	Indirect
PT PAL						
	Stage One					
1	12 FPB 57	Friedrich Lurssen Werf, Germany	1988-95, 2000-04	N/A	N/A	Direct
2	FPB 28	Friedrich Lurssen Werf, Germany	N/A	N/A	N/A	Direct
	Stage Two					
3	4 LPD	DaeSun, South Korea	2004-07	US$150mn	Direct	Direct
	Stage Three					
4	4 Guided Missile Frigate Escorts (PKR)	Damen Schelde, Netherlands	2012	US$220mn	Approx. 5%	Direct
5	3 T-209 Chang Bogo Submarine	Daewoo South Korea	2011	US$1000mn	US$9mn	Direct
PT PINDAD						
	Stage One					
1	N/A FNC Assault Rifle	Belgium	N/A	N/A	N/A	Direct
2	35 Scorpion 90 light tanks	Alvis, UK	1995-99	N/A	N/A	Direct
	Stage Two					
3	11 Tarantula IFV	Doosan, South Korea	2009-2014	US$70mn	N/A	Direct
	Stage Three					
4	37 Caesar Howitzer	Nexter, France	2012	US$125mn	85%	Direct
5	(136) Mistral SAM	MBDA, France	2012	N/A	Approx. US$1mn	Direct
6	103 Leopard MBTs + 42 Marder IFV	Rheinmetall, Germany	2013-14	US$216mn	N/A	Direct

Source: Authors, with data compiled from SIPRI Arms Transfer Database 1976-2019; interviews with respondents from PT DI, PT Pal, and PT Pindad in 2021; and the Ministry of Defence Offset Database 2015-19.

Aerospace: PT IPTN/Dirgantara

Indonesia's aircraft industry was launched in 1976 upon creation of PT IPTN, representing a merger between Pertamina aircraft division and LIPNUR (*Lembaga Industri Penerbangan Nurtanio*). At the start of stage 1, PT IPTN was viewed as the principal technology spearhead industry within

Dr Habibie's PMP: the jewel in the crown of the strategic industries (Amir 2013). In addition to aircraft manufacture, the company undertook aircraft after-sales service, including MRO through licensing and international cooperation. Operations began with around 500 workers and just 17 engineers, though the workforce expanded to some 16,000 people by the early 1990s (Bitzinger 2005). Relatively small commercial offset projects commenced through license production of parts for the transport aircraft C-212 from Spain's CASA, and helicopters from several sources, namely Germany's MBB, France's Aerospatiale, and the US company, Bell. In PT IPTN's separate defence division, license production commenced of the SUT Torpedo from Germany's AEG Telefunken. There was also an important joint-venture with Spain's CASA in 1979, leading to the design and production of the CN-235 aircraft. This was followed by indigenous development of the N-250 in 1986, incorporating 'fly-by-wire', and later the N-2130 regional jet in 1995 (Amir 2013). The aerospace sector was the only strategic industry to navigate its way through all four of Habibie's PMP stages.

The first major offset programme was linked to the 1986 procurement of the General Dynamics F-16 fighter aircraft. Under the *Peace Bima Sena* programme, the Indonesian Air Force procured a squadron of 12 F-16s valued at US$337mn (SIPRI 2020). Habibie arbitrarily demanded 35 percent offset in the form of local production of airframe parts, anticipating this would promote exports through access to the US OEM's global supply chain (Habibie 1995). The offset delivery period was 10 years, covering the manufacture of 200 shipsets of flaperons, vertical stabiliser skins and doors.[11] A former PT IPTN Director, Indra Hasbi,[12] has provided a detailed account of the F-16 offset programme. It was delivered in several stages, commencing with General Dynamics providing training and technical assistance. Assembly was initially located at the US-based corporate facility, where Indonesian workers assembled the first 20 shipsets. Subsequently, the assembly process was conducted at the PT IPTN/DI's specialist subcontract and offset division in Bandung.

It is uncertain whether offset materially contributed to job recruitment or retention, because at the time, PT IPTN was already engaged in a massive recruitment campaign. However, in terms of skill enhancement, the offset work represented a significant 800,000 man-hours of military aircraft component manufacture, representing a completely new field of engineering endeavour for the company. In parallel, there was knowledge transfer, involving advanced structural composite manufacturing technologies. PT IPTN also acquired manufacturing capacity for six components and systems, including fuel and weapons pylons, vertical fin skins, wing flaperons and main landing gear doors.[13] The broad array of F-16 offset projects was impressive and created important manufacturing capacity for fighter aircraft components and systems. However, long-term, the work proved unsustainable. The absence of follow-on orders meant that jigs and tools used in the production process were abandoned.[14] In 1996, Jakarta did try to buy a further 11 F-16s via a low interest loan and a 30 percent offset deal. These aircraft were initially destined for Pakistan and only became available after the US embargoed their delivery following a major political disagreement over Islamabad's nuclear ambitions. Ironically, as Deen (1996) notes, Jakarta then suffered a similar fate linked to alleged human rights abuses by the armed forces in East Timor.

Prior to the embargo, Jakarta had reduced its dependence on US weapons systems by procuring 32 BAe Hawk Trainer/fighters at a cost of over US$400mn (SIPRI 2020). Another former PT IPTN Director,[15] advises that while the Hawk procurement was a defence acquisition, the associated offset programme was 'indirect', consisting of C-235 certification and several overseas post-graduate aeronautical and business scholarships for PT IPTN professional staff. Investment in human capital is arguably a 'smart' offset, providing the basis for long-term indigenous technology development, and yet Indonesia failed to widen and deepen its human capital during the 2000s. This had nothing to do with offset but was rather the impact of a serious business downturn forcing the company to lay off many of its employees, who then took jobs overseas in competitor companies, such as Boeing and Airbus.[16]

Indonesia's transition from the high tempo of its early development phase to one characterised by industrial survival was due to the devastating effects of the 1997/98 economic crisis. The situation was not helped by the government's ideological switch to right-wing liberalist policies, whereby

competitive pressure became the major policy thrust for developing Indonesia's aerospace sector. The policy emphasis on 'competition' was in line with not only IMF policy, but also the general economic thinking of the late 1990s, and beyond. This might not have been a problem if the government through its aircraft purchases had worked to sustain PT IPTN aerospace capacity, but its procurement approach, based on 'open-competition', ensured that aircraft orders went to overseas suppliers, with no requirement for offset work to be channelled into the PT IPTN Bandung complex. The IMF's conditionality lending terms led directly to the cancellation of ambitious programmes, such as the indigenous N-250 and N-2130 aircraft, the dismissal of thousands of PT IPTN workers and a swathe of directors (Bisnis Indonesia 2003). The ensuing years saw the company battling against strikes that slashed its productivity and culminated in a 2004 restructuring programme, further reducing employment from 9,670 to 3,720 (Bappenas 2012).

Thereafter, the company suffered long-term capacity contraction. The business focus was on MRO work, and diversification into maritime patrol aircraft and simulators. The paradox is that while PT IPTN struggled to maintain its manufacturing profile with the Indonesian government, it nevertheless proved successful in developing an international reputation as a quality aviation parts supplier to Western OEMs. An example of this expertise is provided by a former PT IPTN Vice-President (VP)[17] who stated that the company had produced level II components for Airbus A320, A340 and A380 aircraft, including for the latter a contract to produce 18 components per leading edge, amounting to 300 sets during the early 2000s. The VP added that these contracts were won on a competitive basis, not through offset deals. Importantly, however, the acquired capability and approval to enter the bidding process resulted from offset.

According to a former PT IPTN manager,[18] success in competitive tendering was also exemplified through contracts for systems design, adaption, and flight dynamics on the Airbus (Military) A400M programme. Although PT IPTN demonstrated high levels of competence in its subcontract activities with foreign OEMs, it faced many challenges in developing indigenous aerospace production capabilities. It was designated a strategic industry, yet according to the manager, this had no meaning as there was neither protection nor government support. The company was saddled with big debts owed to the government on a failed local project, the N250 aircraft, and notwithstanding winning overseas orders, PT IPTN inevitably faced the long-run challenge of creating an international 'brand'. Moreover, the manager cautions that while PT IPTN used over 500 local (civil) suppliers, a high value-added network of SMEs did not emerge, requiring, for instance, all composite materials (Kevlar, fibre glass and carbon fibre) to be imported.

In 2000, these pressures led to the company reinventing itself under the new name, PT Dirgantara Indonesia (PT DI). In parallel, Indonesia's defence budget began to recover, and modest procurement funds became available. The Korean KT-1B Wong Bee was the first major procurement in the aftermath of the economic crisis. By 2008, Indonesia had procured 20 KT-1B Wong Bee trainers in three batches. The first was for seven aircraft with spares, valued at US$60mn, and the second and third batches were for five and eight aircraft, respectively (SIPRI 2020). PT DI obtained offset in the form of final assembly of nine aircraft, modification of two previously assembled in Korea and collaboration on one aircraft. According to another former PT DI Business Manager,[19] the programme generated work valued at US$2.1mn, or less than five percent of procurement contract value. The offset deal was anecdotally described as a 'take-for-granted' project, meaning that although PT DI was excluded from the negotiations, it was debarred from declining agreed offset work.

This same manager offers further insights into the Wong Bee offset programme, noting especially that associated job creation was insignificant. Less than 10 workers were hired to service the offset manufacturing process, representing a tiny proportion of PT DI's total employment at the time. The offset programme fell short of any meaningful contribution to skill enhancement. While PT DI workers did acquire the basics of trainer final assembly, including the ejector seat and canopy, such skills added minimal value because the technology was perceived as inferior to existing PT DI capability. Only limited technical assistance was provided though the assignment of a South Korean

supervisor to oversee the assembly process. Most of the tools were basic, save for special tools required to fit the Hartzell four-blade aluminium propeller, provided by the Korean Aircraft Industry (KAI), but immediately taken back once the programme concluded. Nor were local supply chains created, as KAI supplied all systems, components, and materials. PT DI initially planned to assemble one aircraft per month but delays in the supply of KAI parts meant that the programme's completion stretched beyond seven years. Moreover, as with the F-16 offset programme, local capacity proved unsustainable. Once the KT-1B order was completed, manufacturing operations ceased. This was despite KAI's success in exporting around 40 KT-1B aircraft worth US$400mn to Turkey in 2007 (SIPRI 2020).

Entering the revival stage (2010-14), the challenges continued. For example, although the 2011 procurement of 16 Korean KAI T-15 Golden Eagle trainer aircraft came with offset packages that included detailed drawings of aircraft parts, such as engine brackets, for local manufacture, the work package was rejected, because its value failed to cover even domestic manufacturing investment requirements. By 2011, PT DI's employment had risen to 4,196 people, and only 67 percent were full time staff, possessing expertise in production, engineering, and management (Bappenas 2012). The company was also suffering problems with infrastructure, much of which had been around for three decades. Ageing facilities were causing 50 to 80 percent lower efficiency levels, and consequently PT DI's manufacturing capacity was constrained to 12 fixed-wing aircraft per year (Bappenas 2012). Fortunes were reversed in 2012, however, when PT DI and Airbus Military contractually agreed to replace the ageing Fokker-27 with the CN-295 aircraft, a stretched version of the CN-235. There already existed a solid relationship with Airbus, stemming from 2002 when PT DI, as earlier mentioned, was awarded, under open competition, a contract to supply components for the Airbus A380 landing edge wing assembly.

Igan Satyawati,[20] PT DI's present Head of Business Development, details the challenges the company has faced from the CN-295 offset programme, which was valued at 30 percent of the contract cost and consisted of five packages: airframe fabrication; rear fuselage manufacture; construction of a delivery centre; skill enhancement; and development of a service centre, including MRO facilities. Commencing mid-2012, Airbus Military supplied PT DI with experts, tooling, and machinery, as well as IT systems, on a programme that was expected to last for 20 years. The first offset project focused on local manufacture of aircraft empennages, and to support production, PT DI received intangible technology transfer in the form of production expertise and technical assistance. The second offset project was rear fuselage production, necessitating component manufacture, but according to Satyawati, PT DI discontinued its interest in producing the 'skin', believing that the required chemical milling was uneconomical

By mid-2014, PT DI had delivered the first five of the nine C-295 aircraft ordered. The work included assembly, functional checking, painting, interior fitting and final flight-line checking. Satyawati states the total offset was valued at US$7.4mn, with Airbus Military providing the ground equipment for the flight-line. Over 2012-15, the CN-295 programme was viewed as PT DI's principal production operation, contributing significant workload and skill enhancement. The same commentator explains that aircraft assembly generated 120,000 man-hours per unit, with each hour valued at around US$25, but identifying offset-related job creation was difficult, because at the time PT DI was embarking on a massive replacement of its ageing workforce. On the other hand, as Satyawati observes, skill enhancement has continued to materialise through the provision by Airbus Military of US$8mn worth of computer-based training to support aircraft operations, as well as licenses for local production of equipment. Technology transfer was intended to support PT DI achieve international quality standards and become the CN-295 heavy maintenance centre for at least five years following production.

Table 3. Offset Impact: PT IPTN/DI.

Industry Stages	Employment Creation	Skill Enhancement	Technology Transfer	Supply Chain Creation	Exports	R&D
Stage 1	No	Yes (training, technical assistance, manufacturing)	Yes (process technologies)	No	Yes	No
Stage 2	No	Yes (training, assembly)	Yes (know-how, discipline)	No	No	No
Stage 3	Yes (job creation and retention)	Yes (training, technical assistance, assembly)	Yes (management, production, know-how, hardware, software, license)	No	Possibly	No

Source: Authors

PT IPTN/DI Summary Performance, 1976-2014

Ten aerospace offset programmes were evaluated across stages 1-3 of the study period, and the results summarised in Table 3. The offshore defence vendors included major UK, US, European and Korean contractors. Offset policy ambitions were limited, resulting in only negligible impacts on jobs, supply chains, exports and R&D. Yet, globally, offset rarely generates big job numbers (Matthews 1996, 2014; Matthews and Koh 2021; Balakrishnan and Matthews 2009), and supply chains, exports and R&D only emerge through the passage of time and eventual transition to defence industrial maturity. Indonesia's lack of technological absorptive capacity in the aerospace domain is a factor explaining the superficiality of offset impact. Yet, technology transfer through offset is also a mechanism that can be used to construct the foundations of such capacity, and the findings from examination of Indonesia's aerospace offset experience suggest this did indeed happen. There is also evidence to suggest that technology transfer, especially in the form of process technologies and know-how, led to upgraded worker skills through training and broader technical assistance.

Maritime: PT PAL

In the final year (1939) of Dutch colonial rule, PT PAL commenced operations as a ship maintenance and repair facility at the Surabaya dockyards. PT PAL was designated a strategic industry in 1980, comprising six engineering divisions (warships, commercial ships, general engineering, maintenance and repair, electronics, and weapons), and by the 1990s the workforce had reached around 6,000 (Raillon 1990). The first major offset was the license production of Fast Patrol Boats (FPB)-57. The Indonesian government selected Germany's Friedrich Lurssen Werf-Bremen (FLW) as the foreign supplier, and PT PAL was awarded the license to locally produce 12 FPB-57s across 1988-95 (Bappenas 2012). The license fee to build these boats was equal to 2.5 percent of production value rather than contractual procurement value (Bappenas 2012). A high-level advisor[21] to PT PAL's CEO states that over 100 of PT PAL's design, production and management staff were sent to Germany for training. Technology transfer was undertaken in phases, with PT PAL assembling the first ship, co-producing the second and locally building the third and subsequent ships in Surabaya. However, the offset programme suffered delays. Only eight FPBs were delivered during the planned 1988-95 period, and the remaining four units were not delivered until 2004, due to delayed government orders caused by the 1997 economic crisis (SIPRI 2020). Although the partnership with FLW was a success, the collaboration abruptly ended. The advisor recalls the partnership termination was rumoured to be linked to Jakarta's resentment of German involvement in the US-led military embargo.[22]

At the start of the survival stage, PT PAL went from a healthy company in 1999 to one of Indonesia's financially weakest state-owned companies a decade later (Akbar 2019). Non-offset considerations, such as defence budget reductions and zero government orders after the 1997 economic crisis, forced the closure of warship production and raised reliance on commercial

shipbuilding, general engineering, and MRO, simply to survive. Civil shipping contracts included the joint design, with Mitsui Japan, of two tankers, one of 3,000 and the other of 3,500 DWT. Dubbed '*Caraka Jaya*' (Glorious Way), they were locally manufactured by PT PAL and five other Indonesian shipbuilders working closely with their Japanese counterparts (Subekti 1993). Then, in 2004, Jakarta procured four South Korean Landing Platform Dock (LPD) ships. These *Makassar* Class LPDs were designed and manufactured by the South Korean Daesun Shipbuilding and Engineering Company. The same anonymous advisor believes that PT PAL's bargaining position to push for offset to facilitate indigenous capability was undermined because the LPD procurement was financed through export credits. The first two *Makassar*-class LPDs, the *'KRI Makassar'* and *'KRI Surabaya'*, were built in South Korea and delivered in 2008 (Farley 2019). The third and fourth ships were built at the PT PAL Surabaya shipyard during 2008-11, costing respectively US$19.9mn and US$30mn (Global Security 2020).

A senior PT PAL manager[23] states that the LPD offset programme faced several challenges. The first was weak communication processes. Daesun did not provide language training, supplying blueprints and manuals in the Korean language which no one at PT PAL could understand. The second challenge arose from the Indonesian navy requiring modifications to Daesun's standard LPD design. PT PAL was obliged to develop its own drawings to modify one of the LPDs to act as the flag ship, and more generally to incorporate command and control systems and stealth attributes into the design of all LPD ships. The third challenge was the lack of appropriate industrial infrastructure in the Surabaya shipbuilding facility. The manager explains that the warship division had no crane for lifting the immense LPD weight, with PT PAL obliged to divide production of the ship into over 100 smaller component blocks and then integrate them to assemble the entire LPD. Irrespective of the delays these problems caused, PT PAL succeeded in supplying the four LPDs fully compliant with user requirements. Technical improvements were achieved, including greater payload, capacity for five helicopters instead of three, acquisition of stealth-based design displaying a smaller radar silhouette and greater speed compared to earlier LPD versions (PT PAL Indonesia 2020).

The LPD offset programme employed around 800 workers, but did not significantly contribute to PT PAL employment, as the majority of workers were sourced from domestic contractors.[24] Nevertheless, it is likely that skill enhancement and technology transfer would have generated considerable learning benefits through, for instance, welding methods and the integration of systems enabling LPDs to half-submerge when launching landing craft, vehicles and personnel from a small well-deck for transit to the shore.[25] The same manager also mentions that know-how was transferred via the fitting of combined diesel and diesel (CODAD) propulsion systems and the integration of two MAN B&W 8L28/32A diesel engines, with each engine possessing a twin shaft propulsion unit. High level skills would in any case have been generated in the configuration of these engines, as the work posed far greater engineering challenges than those found in commercial ship production.[26]

Yet, the LPD offset programme made only a minimal contribution to the development of local value chains. Daesun supplied high value elements, such as power packs and electronic and hydraulic systems, while local production amounted to little more than low value items, such as beds and doors. However, the PT PAL manager argues that an unanticipated spin-off, not directly linked to the offset arrangements, was the evolution of 'stealth' design skills.[27] This capability led to PT PAL securing its first overseas order from the Philippines for stealthy LPDs, worth US$90mn (Parameswaran 2016). PT PAL won the contract through an open procurement tender against South Korean and other competitors to supply two advanced Strategic Sealift Vessels capable of carrying more crew and equipped with a mobile hospital and expanded capacity for tanks, trucks, and helicopters. Yet, PT PAL's limited local maritime supply chains meant that around 40 percent of components and systems had to be imported.

Entering 2010, and the start of the revival stage, around 43 percent of PT PAL's orders originated from overseas, and close to 60 percent from the domestic shipbuilding market (Antara News 2010). PT PAL urgently needed to refresh its ageing workforce, upgrade engineering skills, and improve industrial facilities. Hardware and software capabilities were obsolete, with only 80 percent of docking facilities operational and 90 percent of computers more than eight years old (Bappenas 2012). In a bid to make PT PAL lean, and as a precondition for restructuring its debt, the company laid off almost 1,000 workers in 2012 (Bappenas 2012). Future product development was at risk due to insignificant corporate and government-sponsored R&D spending, though domestic R&D collaboration and offset programmes offered some respite by leveraging innovational opportunities. For instance, PT PAL partnered with MoD R&D institutions, such as *Institut Teknologi* Surabaya, on the development of a mini-submarine, and the MoD's hydro-lab for 40m Missile Fast Boat test modelling (Bappenas 2012). PT PAL had registered several patents on new welding tool designs and new products were introduced, such as a 50,000 DWT Bulk Carrier and a 24,000 DWT chemical tanker (Bappenas 2012).

In 2010, partially as a response to PT PAL's industrial weaknesses, the government announced a naval modernisation plan linked to Indonesia's Minimum Essential Force, spanning 2010-24. The Minister of state-owned enterprises ordered the company to focus on warship production, and contracts were placed to manufacture a 60m Fast Patrol Boat, tugboat, and landing craft. A national Frigate programme was also launched. The programme's genesis was the indigenous production of a 16-20 ship fleet of guided missile frigates (designated locally as PKR – *Perusak Kawal Rudal*). To facilitate procurement, Jakarta secured a contract with the Netherlands' shipbuilder, Damen Schelde, to supply four Sigma Frigates. The first two ships would be built at Damen Schelde's dockyard, while production of the remaining two would be shared between the dockyards of Damen Schelde and PT PAL. Approximately 75 Surabaya engineers received training in the Netherlands to support PT PAL's ambition of acquiring indigenous frigate design capability (Indonesian MoD 2017)

A PT PAL project engineer[28] offers a detailed account of the work arrangements, explaining that Surabaya frigate production involved around 500 people, both organic staff and subcontractors, working under the supervision of eight Damen Schelde supervisory engineers. Production of the final two of the four PKR frigates was scheduled to take 40 months, for delivery in October 2017. The Dutch company provided advanced production methods, including jigs and tools, required for warship construction. It also supplied a 3D precision measurement device required for the joint-ring section, representing a flat panel floor to ensure distribution of heat during welding, so minimising deformity risk. The latter facility was new to PT PAL, carrying spin-off potential through its application to production of thin plate ships, such as fast boats and warships. However, the offset business model used in the Frigate programme ensured PT PAL was at a negotiating disadvantage. It positioned the Indonesian shipbuilder as a subcontractor to Damen Schelde, not the lead integrator as in the case of FPB-57. Hence, PT PAL had little bargaining power, securing offset value equal to only five percent of total procurement value.

Summary Performance: PT PAL, 1976-2014

Over the reference period, five maritime offset programmes were examined, with the results shown in Table 4. These deals involved several defence contractors, comprising German (Fast Patrol Boats), Dutch (Frigates) and South Korean (Landing Patrol Docks and submarines - the latter being ordered but on final delivery Indonesia considered it an 'unfinished' programme). There is evidence to suggest that job creation and retention did occur, and across all three industry stages, offset-related investment was directed towards development of subcontractor enterprise. Moreover, in similarity with the aerospace offset performance findings, there is evidence of substantial transfers of 'soft' technology in the form of training, design skills, production/management know-how, technical assistance – especially in assembly and integration of weapons systems, know-why and the amorphous cultural characteristics of industrial discipline.

Table 4. Offset Impact: PT PAL.

Industry Stages	Employment Creation	Skill Enhancement	Technology Transfer	Supply Chain Creation	Exports	R&D
Stage 1	Yes	Yes (training, technical assistance, assembly, design, production)	Yes (design, management, production, know-how, license)	Yes (low value)	No	No
Stage 2	No	Yes (technical assistance, design, assembly, integration of weapon systems)	Yes (design, know-how, license)	Yes (low value)	Yes	No
Stage 3	Yes (job retention)	Yes (technical assistance, training, design manufacture, assembly, integration of weapon systems)	Yes (design, management, know-how, production methods, know-why, license, discipline)	Yes (medium value)	Not available	No

Source: Authors

Land Systems and Ammunition: PT Pindad

Another of Dr Habibie's transformative vehicle is Land Systems, and the principal company is PT Pindad. It started life in 1808 as the Dutch company, Artillerie Constructie Winkel, and evolved to produce mines and large calibre munitions. In the 1950s, PT Pindad repaired artillery and produced small calibre ammunition, and in 1983, the government designated it a strategic industry under the management of BPIS (*Badan Pembina Industri Strategis* – Agency for Strategic Industry Management). PT Pindad's offset programmes commenced in 1984 through two license production deals, namely, the SS1 assault rifle (with Belgium's FN Herstal) and light and heavy ammunition (with Germany's Fritz-Werner). In the same year, PT Pindad began manufacturing commercial goods, specifically machine tools under license from Taiwan's YAM. Other offset deals were arranged with several German companies, including Siemens for generators and high precision industrial components, MANN for gas turbines, and Thyssen RH, for forging and casting products (RSIS Indonesia Programme 2013). By 1997, PT Pindad was a key supplier to the locomotive industry, manufacturing gear cases and brakes.

In the 1990s, Indonesia procured 35 Scorpion light tanks from Alvis UK, and offset was agreed in the form of assembly (SIPRI 2020). The procurement proved controversial, however, because the President's daughter, Siti Hardiyanti Rukmana, was allegedly involved in illegal mark-ups (Leigh, Pallister, Evans and Aglionby 2004). The former Director of MoD Defence Industry and Technology Division, Brigadier Suyarso,[29] confirms that the MoD and the Army negotiated the offset, and PT Pindad was the principal industrial beneficiary. Ramelan[30] criticises the deal by arguing that the offset work was low value, focused on platform assembly rather than higher precision commercial engineering. Just one month's supervised training by Alvis engineers was given to around 20 staff from various divisions, but which, nevertheless, with the provision of appropriate facilities and special tools, proved sufficient for local assembly of the light tanks.

During the difficult 'survival' 2000's decade, Land Systems, proved a qualified exception to the norm by prospering. The Alvis offset programme contributed to the development of Indonesia's military vehicle production capability, but not in the way intended. The UK's embargo on Indonesia's 36 Scorpion light tanks during the 2004 Aceh conflict led to the vehicles' immediate operational withdrawal (Aglionby 2004), and, instead, an experimental PT Pindad light armoured personnel carrier (APC) was rushed into deployment. A former member of PT Pindad's management team explained that workers assigned to the Scorpion offset programme suddenly became the designers and engineers of this indigenous six-wheeled APC, later called *Anoa*.[31] Following its accelerated development, Army

certification was received in 2006, the first order for 150 vehicles in 2007, and deployment in 2008-09 by Indonesia's *Garuda* peacekeeping battalion in Lebanon (Karim 2014). By the close of that decade, the *Anoa* production line employed 187 people, and more than 300 vehicles had been produced, including command and control, logistics, ambulance, reconnaissance, and amphibious variants (Bappenas 2012).

There were also potential regional exports to Brunei and Timor Leste (Fikri 2018). The *Anoa* project promoted local R&D investment, and, through reverse engineering, an APC called the APR-IV 4 × 4 was constructed on a commercial truck chassis (Bappenas 2012). Indigenisation had progressed, yet there was concern that Indonesia's armoured vehicle sector remained highly dependent on foreign supply, with more than 90 percent of units imported (Laksmana, Gindarsah, and Maharani 2020). Moreover, after the success of *Anoa*, PT Pindad's attempts to develop cannon panzer floundered due to the army's preference for foreign technology. In 2009, for instance, the government procured 22 locally named Tarantula 6x6 Armoured Fire Support Vehicles (AFSV) from South Korea. The associated offset package of semi-knocked down kits for local assembly of 11 of these AFSVs was intended to sponsor industrial 'deepening' of light tank capability. However, PT Pindad was invited to the negotiating table only after the procurement deal was signed, and leverage was thus lost.

South Korea''s Doosan DST designed and built the Tarantula 6x6 AFSVs, which were claimed to be competitive against Turkish and Russian armoured vehicles in terms of both performance and price (Viggen 2013). The offset programme employed around 30 of PT Pindad's Special Vehicle Division engineers, who were dispatched to South Korea for two months of training. Highly skilled training was not required as the assembly process required only standard tools already available at PT Pindad. Under the supervision of South Korean engineers, assembly of the 11 AFSVs took less than three months. The offset programme created minimal value, save for an enlightened understanding of South Korea's work ethos and enhanced English language skills.

A year later, in 2012, the army procured a Mistral Anti-Air Defence system from MBDA. In a separate deal, the Indonesian Army paid US$141mn for 37 Caesar Howitzer 155mm field guns and shells from the French company Nexter, formerly known as Giat (Tomkins 2017). These Mistral and Howitzer procurements led to defence offset programmes aimed at modernising the indigenous Komodo – a PT Pindad designed tactical vehicle. The offset arrangements proved successful, due to two factors: firstly, both Nexter and MBDA had ensured compliance with Indonesia's recently launched defence offset policy, proactively engaging with PT Pindad; and, secondly, Nexter, had previously supplied the *Anoa* power pack, smoothing the way for PT Pindad to license produce the Caesar Howitzer platform, and facilitating its integration into the Komodo. The same former member of PT Pindad's management team indicated that Nexter supported integration into the Komodo of command-and-control technology through specialised software tools, including electrostatic systems for sensor technology. No training was provided, but Nexter's provision of software tools and technical assistance enabled local production of 51 Komodo platforms across six variants, including battalion command vehicles, battery command vehicles and relay vehicles (Saragih 2019).

While both offset programmes were successful in terms of modernising local capability, MBDA and PT Pindad suffered problems integrating the Mistral Anti-Air Missile System into the Komodo mobile anti-aircraft SAM 4 × 4 platform. A member of the MoD official offset team[32] explains that a serious problem arose from MBDA's agreement to allow PT Pindad to use its own chassis in the vehicle design and build as it subsequently failed stringent French certification tests, forcing the use of a replacement Renault chassis that considerably delayed programme completion. Use of a foreign chassis for the anti-aircraft SAM Komodo again reflected the high dependence on foreign technology, including high value components and sub systems, such as the engine and transmission. The local supply chain failed to meet the exacting quality standards required by the licensor and was obliged to supply lower value/skill inputs, such as the Komodo's monocoque body and interior, including bulletproof glass and brackets.[33] Also, the Mistral Komodo offset programme failed to generate significant employment opportunities, with just 60 staff, most of whom were existing

Table 5. Offset Impact: PT Pindad.

Industry Stages	Employment Creation	Skill Enhancement	Technology Transfer	Supply Chain Creation	Exports	R&D
Stage 1	Yes	Yes (training, technical assistance, assembly, design)	Yes (know how)	No	No	No
Stage 2	No	Yes (training, assembly)	Yes (know-how, discipline, language)	No	No	No
Stage 3	Yes (job creation and retention)	Yes (manufacture, integration of electronics and weapon systems)	Yes (management, testing, hardware, software)	Yes (low value)	Possibly	No

Source: Authors

employees, allocated to the production programme. PT Pindad acknowledges that the offset experience obliged it to recognise the critical role that quality control plays in enhancing capability and facilitating effective technology transfer.[34]

The final offset programme during this revival stage occurred in 2013-14 and was linked to Indonesia's procurement of over 100 German Leopard Main Battle Tanks and 42 Marder IFVs. These platforms were 2nd-hand, costing only around US$200mn, and linked to a similarly modest offset package, comprising local production of light spare parts and a small training provision for PT Pindad engineers (Novia 2014).

Summary Performance: PT Pindad, 1976-2014

Between 1976 and 2014, six Land Systems offset programmes were examined. These were conducted through overseas procurement partnerships with Belgium (assault rifles), the UK (light tanks), South Korea (IFVs), France (howitzers and missiles) and Germany (MBTs and IFVs). The empirical findings are shown in Table 5 and indicate that offset delivered only modest job creation and retention opportunities, but there was an expansion of rudimentary subcontractor capacity and the possibility of future export opportunities. Again, as occurred in the aerospace and maritime sectors, offset had the greatest impact on building foundational industrial skills and technical expertise, especially in design, production, assembly, testing and the challenging technological fields of electronics and weapons systems integration.

Postscript: 2015-19

Indonesia's first formal offset policy was issued by President Yudhoyono in 2012, under Law No. 16 Defence Industry. Since then, defence industries have twice received injections of state capital in 2012 and 2015, aimed at revitalising production facilities and replacing aging workers. This investment enabled the industries to boost their contribution to military procurement from 28 percent in 2014 to 49 percent in 2019 (Indonesian MoD 2019). Article 43 of the Law notes that in reference to procurement … 'there must be no future arms embargoes, political conditionality or any other impediment to the deployment of the weapons technology' (Indonesian MoD 2012). The same article states that if … 'foreign procurement is inevitable, mandatory countertrade, local content and offset must prevail'. Implementation of the offset policy commenced in 2014 and was codified as Government Regulation No. 76/2014 (Indonesian MoD 2014): Mechanism of Countertrade, Local Content and Offset (CTLCO). However, the new offset legislation lacked clarity, especially regarding contractual requirements, monitoring mechanisms and penalties. Offshore vendors were confused, and (save for the notable exceptions of MBDA and Nexter), offset negotiations stalled. It was not until the 2015 issuance of Defence Ministerial Regulation 30 (Indonesian MoD 2015), under President

Widodo, that offset implementation finally commenced. The MoD established an *ad hoc* offset team, consisting of three appointed experts, to formulate Offset Policy Guidelines for five imminent procurement programmes, namely, military bridging equipment, degaussing systems, a fighter simulator, a radar system and large calibre munitions.

Core elements of Indonesia's offset policy can be summarised as follows: there is no minimum procurement threshold value, with the policy applicable to all weapon systems; local content value and/or offset must be at least 35 percent of procurement contract value, which, when combined with countertrade, the minimum value must be at least 85 percent of procurement contract value, subject to a 10 percent increment every five years; multiplier values are available across a range of one to three, with the highest multiplier accorded to proposed activities possessing clear linkages to the Seven National [indigenous weapons-related] Programmes (jet fighters, submarines, medium tanks, missiles, rockets, radar, and propellants); and, finally, penalties of up to five percent of offset contract value can be imposed. The policy is prescriptive in nature, and initially offshore vendors were reluctant to comply. However, by 2017, as an MoD expert official, Sudharmono, observes, there was a grudging acceptance that the policy had become a permanent feature of the Indonesian procurement landscape.[35]

Data provided by the Directorate General for Defence Potential, Indonesian Ministry of Defence (2019)[36] offer valuable insights into the performance of Indonesia's new offset policy. Between 2015 and 2019, the policy had created 31 investment programmes: two relatively minor ones had been completed relating to military tactical bridges and G-129 Grob training aircraft; 25 were in the process of implementation, including a degaussing project and a Sukhoi simulator investment; and four had been agreed but not yet commenced. Additionally, there were four other programmes still to be agreed and subject to CTLCO approval and one further programme slated for re-tender. One of the more important offset programmes was linked to the 2018 US$1.1bn procurement of 11 Russian Su-35 fighters (SIPRI 2020). The deal was the first to include supplementary 'countertrade' provisions, stipulating that around 50 percent of the value (US$570mn) would be paid in commodities and 35.3 percent would attract offset.[37]

During this period, offset projects generated US$3.1bn, equivalent to 75 percent of procurement value; and while offset values as a percentage of procurement contracts, varied, all, save one, successfully met the 35 percent threshold, with 22 exceeding the 85 percent threshold; the lowest offset value was 19 percent and the highest, 115 percent. Russia was the biggest offset supplier over this period, capturing five procurement programmes, with offset deals worth more than half a billion US dollars.[38]

The MoD data highlight that the total number of offset programmes had been sourced from 22 separate offshore defence contractors belonging to 16 countries. The five principal obligor nations were Russia (US$541.4mn), Brazil (US$341.4mn), Canada (US$323.2mn), Germany (US$249.8mn) and France (US$202.4mn). The remaining 11 countries accounted for around US$1.4bn of offset value. Approximately 55 percent of the offset programmes involved Indonesian state-owned strategic industries serving as either the prime integrator or Tier 1 subcontractor industries. A further 29 percent of offset value was channelled to private sector enterprise, 10 percent to the armed forces, five percent to R&D institutes and two percent to universities/polytechnics. Of course, offset values do not equate to offset success, and the latter can only be evaluated by conducting full impact analysis via post-implementation audits.

Conclusion

This paper has explored the performance of Indonesia's informal offset programmes from 1976 to 2014, with the aim of establishing whether *ad hoc*, case-by-case, flexibility proved effective in promoting viable defence-industrial capacity. The approach adopted has been to analyse performance across the three industrial stages by reference to six metrics that reflect the generally accepted principal offset objectives. The results are consistent whether applied to the aerospace,

maritime and land systems industries. Job creation proved minimal, and this finding is in line with the offset experience of other countries, irrespective of whether informal or formal policies were in place. Indonesia's offset programmes also made little impact on the higher industrial capabilities associated with supply chain, export and R&D capacities that invariably calibrate with the mature technological and competitive defence industrial stature of advanced economies. Where offset did make a positive contribution, however, was in the enhancement of manufacturing and technical skills via technology transfer. Throughout the three conceptualised politico-economic development stages, the research findings suggest that offset did have a positive impact on training, technical assistance, know-how and importantly know-why, reflecting 'deeper' industrial learning, design and testing processes, including even acquisition of technologically more challenging systems integration skills.

The overarching conclusion, then, is that while collectively the various offset programmes have failed to fuel the intended dramatic technological transformation process within Habibie's novel Grand Defence Industrial Strategy, they did act to put in place the building blocks contributing to future defence industrial development. The sole strategic industry to reach PMP stage 4 was PT IPTN, with PT PAL and PT Pindad both failing to progress beyond transformation stage 2. Offset made only a meagre contribution to creating and sustaining capital goods capacity. Yet, in the absence of relevant supplementary technological support policies within a strategic technology road map, it is inevitable that a sole focus on offset-driven technology transfer will result in just 'pockets' of capability rather than broader-based industrial transformation. Within such pockets, however, it is indisputable that technology transfer deepened learning and expanded skill sets during the early aircraft development programmes. The F-16 offset experience, for example, led to enhanced indigenous design, development, assembly and production of diversified aircraft components and systems. Higher quality production was the *sine qua non* for this development process, culminating in the vitally important certification enabling successful bids for Airbus and Boeing work. Similar learning benefits occurred in the maritime sector, such as PT PAL's LPD venture and in the Land Systems field, notably PT Pindad's Scorpion tank and *Anoa* APC programmes.

Notwithstanding these positives, the economic, industrial, and technological downsides of Indonesia's offset experience are formidable. Arguably, the principal offset priority is job creation, but this was minimal in nearly all Indonesia's offset programmes. Nor did offset contribute to the development of local supply chains. On the contrary, the findings suggest that high value work packages continued to be imported from overseas suppliers, with low value assembly work consistently characterising offset deals from the early KT-1B procurement to the much later Airbus programme. Similar outcomes occurred in both maritime offset activities, particularly the high technology SIGMA warship programme, and in PT Pindad land systems. Implementation inefficiencies acted to exacerbate the weak offset performance. On occasions, offset was only considered 'after' the procurement contract had been signed, undermining the offset authority's bargaining position. Similarly, low scale procurement and vendor export credits reduced Indonesia's ability to leverage attractive offset deals.

The disappointing performance of Indonesia's informal offset policy begs the question as to whether implementation of the country's first official offset policy will lead to broader and deeper technology infusion in the spearhead strategic industries. Only two relatively minor offset programmes from the total of 31 have to date been completed, but positive signs are emerging. The relatively high 85 percent offset quota target value has been agreed for most of the programmes under implementation. Yet, agreement is not the same as compliance, and elusive offset-induced success remains a long-term ambition. Offset is a controversial subject, and while the performance of Indonesia's formal policy awaits definitive assessment through future research, offset will likely increasingly be used as the vehicle to progress local defence-industrial development, rather than indigenous R&D or foreign collaborative acquisition programmes.

Notes

1. Indonesia in the 1970s marked the return of economic nationalism and economic take-off ambitions under President Suharto. For that purpose, he directed Dr Habibie, as the Minister of Technology, to develop the country's technological base via a series of Presidential decrees through 1980-1989. The process would herald the creation of strategic industries that would serve as 'transformation vehicles'. The principal (strategic) defence industries were held to be the 'spearhead' aerospace, shipbuilding, and ammunition sectors.
2. Defence industrialisation could not be immediate because the preconditions for arms production, such as high-level output and the availability of skilled manufacturing workers did not exist. Manufacturing during that early period accounted for only 12.7 percent of national income, far behind agriculture and mining. While other preconditions, such as defence spending and procurement could be boosted quickly based on changed threat perceptions, as happened in the 1960s when Indonesia waged a military campaign against the Dutch in Papua, increased local defence industrial capability requires a longer passage of time.
3. Offset may be more comprehensively defined as encompassing 'a range of industrial and commercial benefits provided to foreign governments as an inducement or condition to purchase military goods or services, including benefits such as co-production, licensed production, subcontracting, technology transfer, purchasing, and credit assistance'. Offsets in Defense Trade, (2021). US Department of Commerce, Bureau of Industry and Security, Twenty-Fifth Study, p.1. https://www.bis.doc.gov/index.php/documents/pdfs/2788-twenty-fifth-report-to-congress-7-21/file
4. The 1980's offset turning point was premised on two factors: firstly, during 1980-1982 Indonesia's economy suffered a severe slowdown due to the world recession, and offset was viewed as a means of stimulating inward investment; and, secondly, the government sought to strengthen industrial structures as per Dr Habibie's Progressive Manufacturing Plan and offset, among other policies, was used to promote technology development.
5. High value, skill-intensive offset investments are difficult for any offset authority to secure, but the potential for success is far higher in advanced countries possessing mature defence economies, as well as competitive and diversified supply chains. By contrast, there is little incentive for offshore defence vendors to offer high value offset packages to developing states characterised by limited numbers of inefficient and labour-intensive manufacturing entities.
6. There are several states in East Asia which are exceptions to this generalised position. See, Samuels (1994) who argues that Japan from the 19th Century until the present time benefitted hugely from defence offset. Since the 1970s, Bitzinger (2020) makes a similar case for the Republic of Korea. Finally, while China has never announced the existence of an offset policy, it has been successfully engaging in offset deals, since the 1990s, with Boeing and Airbus on commercial aerospace programmes and Russia on military licensed production ventures.
7. The fieldwork comprises three components: firstly, the initial interviews that formed part of personal academic endeavour; secondly, site visits and interviews comprising the empirical contribution of Dr Maharani's doctoral programme at Cranfield University; and, finally, field interviews as part of an Indonesian MoD-sponsored defence-industrial mapping project. Approval to conduct the interviews was granted by Cranfield University Research Ethics Committee.
8. Indonesia's Ministry of Trade issued a countertrade regulation in 1982, which included an offset obligation linked to government procurement exceeding 500 million Rupiah. However, none of the interviewees were aware of this regulation.
9. From 1976 until the end of the 1990s, offset policy and its implementation was solely directed by Dr Habibie, who was also in charge of the three 'spearhead' defence industries (PT IPTN, PT Pal, and PT Pindad). Habibie became President in 1998, a position he held for less than two years. Around a decade later two events coincided to raise the profile of offset in the country: the defence industries were near bankrupt at the same time as the military planned to embark on a major modernisation under the Minimum Essential Force policy (2010-2024). President Yudhoyono (2004-2014) decided to revitalise the defence industries, and for that purpose he issued Law No. 16 Year 2012 to regulate mandatory offset. Offset was finally acknowledged to have the strategic role of securing a critical mass of defence industrial capacity (ultimately for self-reliance) notwithstanding substantial ongoing overseas arms procurement.
10. The term 'strategic industries' is no longer applied to these 10 industries. However, the three defence companies, PT Dirgantara, PT Pal, and PT Pindad still benefit from four types of preferential treatment: firstly, through designation as lead integrators in the production of warships, aircraft, and combat vehicles/ammunition/other land systems; secondly, from the provision of government-sourced capital to revitalise productive capacity and upskill workers following the negative impact of the 1997 crisis; thirdly, via priority consideration over foreign contractors in the evaluation of arms procurement bids; and fourthly, and importantly, by the imposition of a legal requirement for offset investment linked to military procurement. Further, over the last four years, the government has been developing the concept of a defence industrial holding company, with the objective of uniting all state-owned companies engaged in the defence sector.
11. Former Director, PT DI (interview, November 2011)

12. Former Director of Manufacturing and Head Subcontractor and Offset Division, PT IPTN, Bandung (interview, June 2014; telephone follow-up, April 2021)
13. Former Director of Manufacturing and Head Subcontractor and Offset Division, PT IPTN, Bandung (interview, June 2014; telephone follow-up, April 2021)
14. Former Director of Manufacturing and Head Subcontractor and Offset Division, PT IPTN, Bandung (interview, June 2014; telephone follow-up, April 2021)
15. Jakarta (interview, July 2014)
16. Sezsy Yuniorrita, Flight Engineer, PT DI, Bandung (interview, June 2020; follow-up e-mail correspondence, April 2021)
17. Bandung (interview, October 2008)
18. Former Manager Technology, PT DI, Bandung, Indonesia (interview, October 2008)
19. Former Manager, Directorate of Aircraft, PT DI, Bandung (interview, August 2015)
20. Bandung (interview, June 2014; follow-up e-mail correspondence, April 2021)
21. Surabaya (interview, April 2013; follow-up e-mail correspondence, April 2021)
22. Anonymous, Adviser to CEO, PT Pal, Surabaya (interview, April 2013; follow-up e-mail correspondence, January 2021)
23. Anonymous, Project Manager, PT Pal, Surabaya (interview, August 2015; follow-up e-mail correspondence, April 2021)
24. Anonymous, Project Manager, PT Pal, Surabaya (interview, August 2015; follow-up e-mail correspondence, April 2021)
25. Anonymous, Project Manager, PT Pal, Surabaya (interview, August 2015; follow-up e-mail correspondence, April 2021)
26. Anonymous, Project Manager, PT Pal, Surabaya (interview, August 2015; follow-up e-mail correspondence, April 2021)
27. Anonymous, Project Manager, PT Pal, Surabaya (interview, August 2015; follow-up e-mail correspondence, April 2021)
28. Anonymous, Surabaya (interview, January 2015; follow-up e-mail correspondence, April 2021)
29. MoD, Jakarta (interview, April 2015; follow-up e-mail correspondence, April 2021)
30. Former Minister for National Development Planning and Director, BPPT, Jakarta (interview, June 2014)
31. Anonymous, PT Pindad, Bandung (interview, June 2014; follow-up e-mail correspondence, April 2021)
32. Anonymous, Indonesian Ministry of Defence (interview, December 2015)
33. PT Pindad's former Executive Director, Adik Sudarsono, states that the local supply chain for critical components is presently focused on commercial production contracts (telephone discussion, April 2021).
34. Anonymous, former senior staff member, PT Pindad, Bandung (interview, June 2014; follow-up e-mail correspondence, April 2021)
35. F.X. Sudharmono, Member of the expert team for director general of defence potential, Indonesian Ministry of Defence (interview, July 2017; follow-up e-mail correspondence, April 2021)
36. Direktorat Jenderal Potensi Pertahanan Kementerian Pertahanan, 2019. Internal dataset covering the period 2015-2019.
37. The policy of Law No. 16, 2012, stipulates the requirement for countertrade, local content and offset (CTLCO). Offset represents just one of the reciprocal benefits that are negotiated with foreign vendors supplying military equipment. In the case of Russia's Su-35 programme, countertrade was used for the first time. The goal here was not aimed at ToT/industrial development but rather the imperative of reducing the debt burden incurred from Moscow's export credit, which is the normal means of payment for procurement of Russian weapons.
38. By mid-2020 there had been no movement on several Russian contracts, namely, for the SU-35, BT-3 F armoured personnel carriers, BMP-3 F amphibious tanks and Mi-17 transport helicopters. These procurements along with the associated offset programmes, were all frozen due to threatened imposition of the US Countering American Adversary Through Sanction Act (CAATSA). This targets states cooperating with countries deemed as US adversaries, namely Russia, China and North Korea, but also impacts third countries, notably India, Vietnam and Indonesia, which have close procurement and strategic ties with Russia.

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