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Opportunities and Challenges facing Philippine Defense Industrial Development

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Introduction

For decades, successive Philippine administrations have attempted to spur the growth of Philippine defense industries to achieve self-reliance in defense equipment, only to be stifled by various issues affecting the entire defense enterprise. The lack of political will, limited financial resources, technological deficiencies and tedious bureaucracy were identified in the available literature as the underlying reasons why previous attempts to develop the Philippine defense industries have not advanced.¹ There is also a dearth of studies examining such a topic from a political-economy and macro-economic lens. This paper seeks to fill in such a research gap. It hopes to provide answers to the following questions:

- What were the past attempts to implement a Self-Reliant Defense Posture in the Philippines, what happened, and why did it not materialize?
- Is there space in the global or regional defense markets for the Philippine defense industry? If so, which niches?
- What subsectors/industries can be feasibly supported using private-sector investment or private-public partnerships, if at all?
- What are the prospects for a Philippine defense market to generate demand sufficient to support the defense industry, especially in an immediate environment post-COVID-19?

This paper is divided into four sections. The first section provides an overview of the global

defense industrial market, its structure, and recent developments. The second section will elucidate the previous and current Philippine efforts to create a defense industry. The third section will tackle the issues and challenges hounding the Philippine defense industrial development, namely, a stagnant domestic demand, gaps in Philippine understanding of defense economics regarding complex weapons, and an overreliance on real estate-based and private sector-driven solutions. The last section will consider the prospects for growth and identify some policy recommendations toward crafting a more coherent defense industrial policy and strategy.

There is no coherent definition of “defense industry” in Philippine official documents. The 2018 National Security Strategy’s Annex B identified several “strategic industries” considered vital for national security and economic development, but such a term included industries which have no direct link to defense, such as agriculture, banking, tourism and services.² For purposes of this paper, “defense industry” refers to the economic sector responsible for development, production and maintenance of weapons systems and components of these systems. Related to this, the defense industrial base sector is the “industrial complex that enables research and development, as well as design, production, delivery, and maintenance of military weapons systems, subsystems, and

components or parts” to meet the military’s requirements.³

There are two key interrelated reasons why countries develop a defense industry—strategic and economic.⁴ Strategic reasons include ensuring security of supply to compensate for perceived strategic isolation, to prevent overdependence, or address vulnerability to sanctions; and for national prestige or “technonationalism”.⁵ Economic reasons include the promotion of backward linkages with other sectors such as steel and machine tools; development of “technology locomotives”; import-substitution which help preserve foreign currency reserves and create jobs; and lastly, hopes for export earnings.

I. The Global Defense Industrial Sector – Status and Prospects

Global defense spending has been generally on the rise since the 2000s, partly due to the onset of the War on Terror and the invasions of Iraq and Afghanistan.⁶ However, the defense industrial landscape has undergone various shifts and changes through the years. The defense industries which met the needs of the War on Terror were not the same as those during the Cold War. Many pioneering defense firms had either been bought out, restructured, or abandoned altogether, resulting in, particularly with the case of the US, the emergence of virtual monopolies or duopolies in certain product lines.⁷ Similar contractions were seen in European producers, as well as in Russia after the fall of the USSR. Then-emerging defense industries like in Brazil were also heavily impacted by the general decline in defense spending worldwide, and the massive surplus of new Western and Eastern weapons available in the market following the end of the Cold War. This “predatory dumping” destroyed the prospects for some emerging defense industries which relied heavily on exports to remain afloat, given the low

domestic demand of those sectors’ home countries.⁸

The past decade also saw the expansion of new defense industries from the East and Southeast Asia into the global market space. The most significant new player is the People’s Republic of China (PRC). From mostly importing

“To maintain a defense industry, large numbers of systems and a sustained, multiyear, multi-administration, procurement program is required; all of which are costly.”

both Western and Russian weapons systems, the Chinese defense industry has grown to become one of the largest in the world.⁹ China is now able to design and produce almost the entire product range of cutting-edge defense systems, from low-observable stealth fighter aircraft, to drones and large aircraft carriers. Several Southeast Asian countries such as Myanmar, Laos and Thailand have procured major weapons systems such as submarines and fighter aircraft from Chinese manufacturers, and Chinese defense products have seen some success in Africa and Latin America in the past decade.

The Republic of Korea has also developed a formidable defense industry in the 2000s, largely through technology transfer and cooperation agreements with its traditional suppliers, such as the United States and Germany.¹⁰ It now produces an array of defense products, such as fighter aircraft, surface ships and submarines, artillery and missiles. Initially targeted for domestic consumption to support the Republic of Korea Armed Forces, the Korean defense industry has moved to the export business. It has scored several export successes particularly with the Philippines, which has procured F/A-50 Fighting Eagle supersonic fighter-trainers and its two *Jose Rizal*-class frigates from Korean suppliers.

Within Southeast Asia, the Philippines' ASEAN neighbors have resumed their development of defense industries. Indonesia has been investing heavily in its defense industry. Notably, it has collaborated with South Korea on a variety of military projects, such as the KF-X KF-24/F-33 jet fighter,¹¹ and the *Makassar*-class landing platform dock, among others. This partnership has already scored some notable

export successes, producing the two *Tarlac*-class landing platform dock ships (a variant of the *Makassar*) for the Philippine Navy. Singapore has also maintained a robust defense industry throughout the 2000s and 2010s.¹² While its primary export remains small arms and light weapons, its technological base has expanded to include armored fighting vehicles of high quality, even competing with the United States.

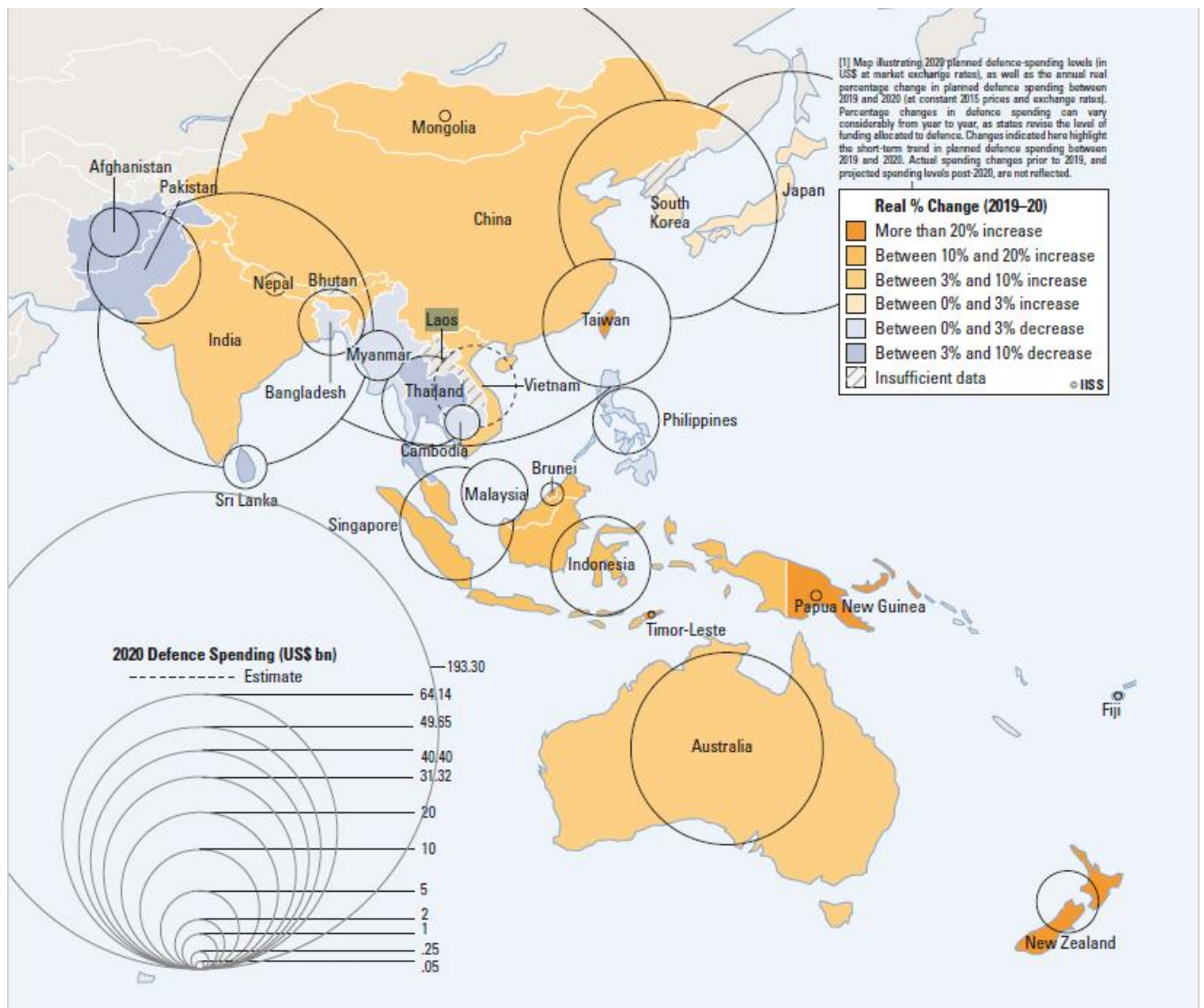


Figure 1.

Visual Map of Defense Spending in Indo-Pacific

Source: Institute for International and Strategic Studies 2021¹³

As seen in Figure 1, the Indo-Pacific is becoming a hotbed of defense spending activity. It should be noted that most countries in the region feature real percentage changes in defense spending despite the COVID-19 pandemic. The

region is expected to sustain a vibrant defense market in the immediate future, partly due to the intensifying power dynamics and changing threat perceptions.

II. Philippine Efforts towards a Defense Industry

Project *Santa Barbara* and SRDP

In 1972, the Philippine Navy, in cooperation with scientists from the then-National Science Development Board (now the Department of Science and Technology, DOST), launched Project *Santa Barbara*, a program meant to develop several types of rockets that could potentially be used by the Armed Forces of the Philippines.¹⁴ In 1973, the Philippine Aerospace Development Corporation (PADC) was founded through Presidential Decree No. 286.¹⁵ In 1974, Presidential Decree No. 415 formally established the objective of achieving “a self-reliant defense posture”.¹⁶ This can be considered as the formal beginning of the Self-Reliant Defense Program (SRDP). The SRDP was successively reinforced by various initiatives after the Marcos administration, such as the Republic Act (RA) 7898 AFP Modernization Law of 1995, and the RA 10349 Revised AFP Modernization Law of 2012.

Project *Santa Barbara* was shelved after 1980, with none of its products adopted into service. Other attempts to develop domestic defense industrial capability, such as the PADC Defiant 300 and 500 aircraft, and Hummingbird utility helicopter project, languished and were canceled in the 1990s, due to lack of government support and legal issues with intellectual property, respectively. Much of PADC’s income was not even in design, construction, and maintenance of aircraft but on hangarage and building rental fees as of 2014.¹⁷

The Defense Ecozones

The National Security Policy (NSP) 2017-2022¹⁸ and National Security Strategy (NSS) 2018¹⁹ identified several strategic industries which were considered “vital for national security and economic development.” Several legislative efforts have also been pushed, one of which is the Philippine Defense Industry Development Act (PDIDA) of 2019. PDIDA’s salient provisions aim to provide investment and tax incentives for local enterprises and producers of defense articles, stipulate technology transfers as a condition for any purchase of foreign systems, authorize the DND and its bureaus to enter into multi-year contracts with local defense enterprises, and create a new undersecretary-level office within the DND focused on defense technology research, and defense development.²⁰ It has yet to pass final reading in either House as of June 2021.

The AFP, in partnership with the Philippine Economic Zone Authority (PEZA), has sought to open defense industrial zones.²¹ The AFP-PEZA partnership aims to construct a *defense industrial complex*, which is defined as:

“a tract of land with defined boundaries located physically and/or administratively outside the customs territory and predominantly oriented to export production. This will produce world-class defense products to meet both domestic and world market requirements, thus, maximizing the utilization of economic zones to generate maximum revenues for the government and support to the modernization program as well (as) create employment opportunities in the Philippines, particularly in and around the complex.”²²

Several defense firms have expressed interests in setting up shop in the Philippine defense industrial ecozones. These include the Russian Kalashnikov,²³ well-known for its small arms and recently venturing into unmanned aerial

vehicles, and the Swedish Saab Aerospace, which has been competing for the Philippine Air Force's Multirole Fighter (MRF) project.

The defense ecozone initiative is set to be further bolstered by the Special Purpose Defense Eco Zone Authority Act (SpeDEZA). Unlike PDIDA, this act aims to provide the Government Arsenal lands in Camp General Antonio Luna, Lamao, Limay, Bataan to be the first SpeDEZ; establish the SpeDEZ Authority to manage it; the provision of visas for investors with minimum investment of 200,000 USD; and an authorized capital stock of PhP 3 billion from the government.²⁴ The Philippine Congress approved the bill on 04 February 2021, however it must now pass the Senate before it will be signed by the President.

There are also efforts to revive the SRDP by the AFP's major services. Specifically, the Philippine Navy has actively encouraged local shipbuilders and producers to help contribute defense goods.²⁵

III. Analysis of the defense market and PH efforts

The general trend since before the end of the Cold War is for weapon systems to become increasingly complex and expensive, which has reduced the number of different types of weapon systems and the volume of production runs.²⁶ This has major implications for the sustainment of a defense industry; specifically, 1) fewer new systems are brought in to replace larger numbers of older systems, resulting in overall force shrinkages, and 2) production must be stretched out across a longer timeframe to preserve the industrial base for longer, or risk losing the industrial base altogether if production is not sustained or the assembly line is not working on new products. To maintain a defense industry, large numbers of systems and a sustained, multiyear, multi-administration, procurement program is required; all of which are costly. It is therefore no accident that only a few nations, such as the United States and China, can maintain defense industries that produce most if not all defense product lines, as only they have the economic power and willingness to spend large sums in defense.

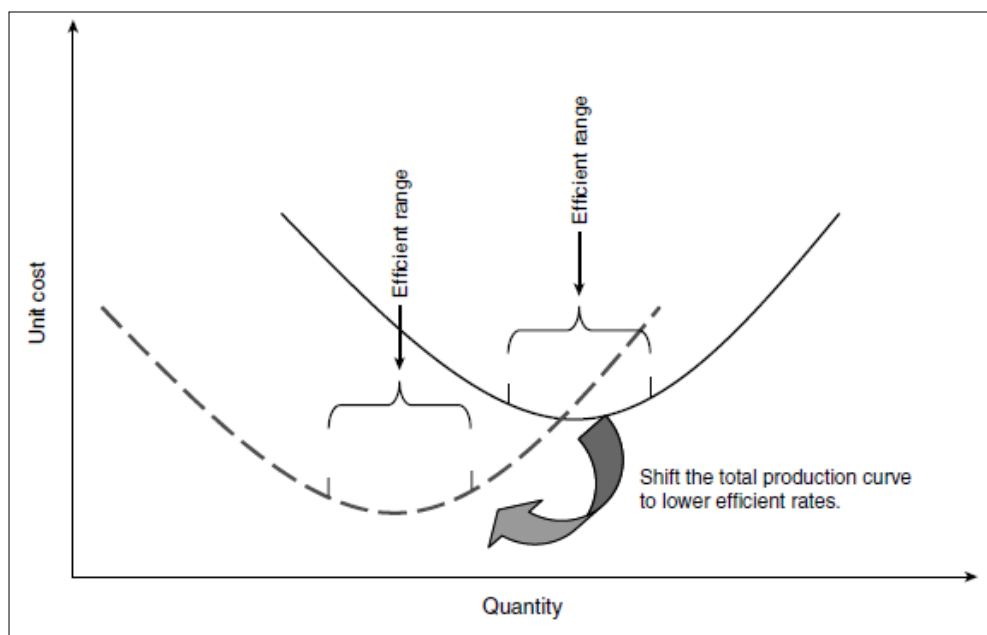


Figure 2.
Production Curve adjustment for smaller quantities ordered.

The smaller the quantity, the more the production curve shifts. Past a certain point, it will become too inefficient to start production for very small volumes.

Source: Gansler (2011)²⁷

Figure 2 shows just how difficult it is to get the right production curve for any specific weapons system. This has significant implications for AFP procurements. For the AFP to get the optimum cost of any specific weapons systems, it needs to either: 1) buy alongside other countries' orders to achieve scale economies, 2) be prepared to invest more to improve the production efficiency, or, more likely, 3) it will not receive any tenders. This can explain the inability of certain AFPMP projects to take off, such as the Maritime Patrol Aircraft project which has a very small order volume to be worth the effort of producers.

To develop a defense industry, one must understand the market for all defense items. The defense industry is not like the typical consumer industries or service businesses, with generally homogeneous product ranges and exceptionally large customer bases. Except for small arms and light weapons, which tend to have some overlap with the civilian firearms market, the defense industries' main product lines (armored fighting vehicles, combat aircraft, warships and submarines, military space assets, missiles, custom command and control systems, etc.) have only one customer: states. Neither can industries casually sell to just any prospective buyer; it is very unwise after all to sell advanced weapons to states who might be prospective enemies. These considerations are what set defense industries apart from consumer industries. It would therefore be a grave mistake to view the enterprise

from a purely economic lens. Scale and strategic considerations are equally important factors.²⁸

The Philippine defense market has grown robustly since 2012, with defense spending around ~1% of GDP.²⁹ As illustrated in Figure 1, this remains relatively small compared to its peers in the Southeast Asian region. The trend has also remained consistent despite calls by Defense Secretary Delfin Lorenzana to increase defense spending to 2% of GDP or greater. The introduction of the Revised AFP Modernization Program in 2012 should have led to greater demand for defense equipment as evidenced by the AFPMP PhP 300 billion Horizon 2 program.³⁰ However, the actual effective demand is still only determined by the annual appropriations allotted to the DND.

The country's defense capabilities have not been given priority in the national budget, as evidenced by defense spending as a percentage of GDP progressively declining from 2.294% in 1995 to 1.129% in 2018.³¹ This is unlikely to change due to the current health emergency. Moreover, the existing defense spending percentages are not accurate indicators of defense modernization, as a large portion of the budget goes to personnel expenses.³² Table 1 below lists the Maintenance and Other Operating Expense (MOOE) and Capital Outlays (CO), which are more reliable indicators of the allocated budget in relation to arms, parts and munitions acquisition and consumption.³³

Table 1
DND Defense Budget MOOE and CO, 2015-2021 (in millions of pesos)

	2013	2014	2015	2016	2017	2018	2019	2020
MOOE	22,594.3	21,121.1	22,729.7	26,871.2	41,023.5	40,913.6	43,619.7	41,340.9
CO	9,332.2	11,091.7	14,027.5	20,559.2	44,259.0	24,286.2	31,370.8	30,686.4

Source: Congressional Policy and Budget Research Department 2020³⁴

This inability to generate strong local demand is at the heart of the current deficiencies and failures of the Philippine efforts for a strong defense industry. Without large and sustained defense demand, companies shrivel up and die, and prospective entrepreneurs are unlikely to take the risk of starting up a defense firm, given the high capital and startup costs of modern weapon systems.

There is a notion that one needs to start small before going big in defense industries. This stems from an outdated understanding of the processes and dynamics of arms production—which assumes a certain level of homogeneity in the industry (e.g., expertise to produce “small items” can be easily and quickly translated to bigger and more complex items). This neglects the reality that each weapons category is effectively an industry unto itself with niche specializations that do not cross over across categories, even with

otherwise closely related civilian counterparts.³⁵

There are also specializations that must be nurtured to keep the industry alive while delivering quality products.³⁶ Even a few years’ time gap between orders can be damaging to firms’ long-term efficiency,

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performance, and survival.

Intellectual property is also a critical issue in the development of the defense industry. The failures of the PADC’s Hummingbird helicopter project can be attributed to its unlicensed attempt to copy an existing German helicopter design, which predictably led to threats of litigation from the parent company Eurocopter (now part of the

Airbus Group).³⁷ To preserve competitiveness and market shares, all activities of the defense industry should meet regulations on intellectual property, and exports control of intangible technologies.

Providing foreign firms land for operations and facilitating ease of business, while helpful, will be insufficient for developing an effective defense industrial base. Proper demand signaling and generation are critical. Thus, while the Department of Trade and Industry (DTI) launched its Inclusive Innovation Industrial Strategy (i3S) in 2017, and sees itself, together with the Bureau of Investment, as a facilitator of and coordinator for addressing the binding constraints of the industries;³⁸ this does not mean that they oversee generating demand for said industries, especially defense industries.

The ecozone experience here in the Philippines is also instructive. Other industries that took advantage of ecozones, such as car manufacturing, have struggled to compete due to the absence of economies of scale and a weak parts supply base.³⁹ This is further exacerbated by the disruptions caused by the pandemic. The problems of weak supply chains also have hindered existing state efforts at local arms production. The Government Arsenal is currently unable to provide greater than 10-20% of the AFP’s annual ammunition needs, due to a chronic lack of raw materials and difficulties with the AFP’s procurement processes.⁴⁰ Similar issues will be faced by any defense firm that sets up shop under the auspices of SpeDEZA.

IV. Prospects for growth and competition

Defense spending has largely been sustained in 2020, and in the case of the US and China has even increased despite the COVID-19 pandemic.⁴¹ This rate of expenditure might not be sustained in the short-term as pressures for social spending may lead to stagnation or even defense

budget cuts in 2022-2023. In 2021, Chile, South Korea, Russia and Brazil instituted cuts to their defense budget or reallocated funds to pandemic responses. Even the Philippines had to realign defense funds as part of pandemic relief efforts.⁴²

However, the heightened threat perceptions in both Europe and Asia, as well as intensifying great power competition do mean that there will be strong long-term demand for defense systems. This bears out in Southeast Asia and in the wider Indo-Pacific. While much of the world is preoccupied with the pandemic, China continues to launch aggressive activities against

India, Taiwan, Japan, Philippines, Malaysia and Indonesia in the land and maritime spheres. The procurement demand will also be increasingly skewed on higher technology and higher capability weapons systems. Such trends can be seen in the conduct of modernization programs across the Indo-Pacific, and

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recent conflicts most particularly the 2020 Nagorno-Karabakh war.⁴³

A major factor in Philippine defense demand is political priorities. It is clear that for the near term and possibly even mid-term, defense is unlikely to receive more funds. The pandemic has effectively derailed AFP Modernization Horizon 2, as acknowledged by no less than Secretary Lorenzana himself.⁴⁴ Defense legislation such as PDIDA, SpeDEZA and a National Defense Act have yet to be signed into law despite the evolving security situation of the country.

Recommendations

Defense legislation and current efforts towards improving local industrial participation in defense modernization are welcome, but they can be further enhanced and strengthened. To this end, this research proposes the following policy recommendations:

Review existing policies regarding defense industrial development: This includes reviewing the list of strategic industries identified as important to national security in the NSP and NSS. Several of such industries listed do not have any direct relevance to national defense and security, nor do they contribute to deterrence or total combat power. As important as agriculture, banking, tourism and services may be to inclusive development, their operation and development are entirely outside the scope of defense planning. As we move towards developing a more coherent policy as regards defense industrial development, there is a need to clarify which industries will directly impact the performance of the DND and AFP’s mandate of protecting the people and securing the state from external and internal threats, and which should be relegated to a different operational strategy.

There is also a need to review the mandates and performances of specific government entities involved in defense equipment and support, such as the Government Arsenal and Philippine Aerospace Defense Corporation. It should be noted that their failures to meet existing Philippine defense needs may not necessarily be addressed by simply giving them more money; the problems that they face are structural (supply chains) or procedural/institutional (intellectual property enforcement and procurement). Efforts to recapitalize, privatize or dismantle said entities should be carefully considered.

Craft a Defense Industrial Strategy. The DND and AFP need to get more involved in industrial

planning and proactively work with DTI. While i3S is a good guide and reference document, it is not a substitute for a dedicated defense industrial strategy, due to the unique peculiarities of defense product categories, as well as the defense priorities of the DND and AFP. By the nature of their respective mandates and technical expertise, the AFP and DND would be in a better position to determine the needs of warfighting and securing the country, but DTI is the architect of the i3S overall national industrial strategy and specific industry roadmaps.⁴⁵ There is a need for both departments to bridge knowledge-gaps regarding defense product categories and the defense market. A defense industrial strategy will provide more direction to defense legislation such as PDIDA and SpeDEZA, as it will serve as a roadmap on envisioned structure and conduct of defense industries, including on research and development, target production capacity, and options for financing.

Relatedly, the AFP must have a clear appraisal of what kinds of systems it needs. This entails the conduct of well-researched analyses that combine economic and technical feasibility with strategic priority and relevance to the AFP's military strategies, and the expected future of warfare in the coming years.⁴⁶ Instead of "self-reliance", perhaps "selective sufficiency" in certain system categories⁴⁷ should be aspired for in the mid-term. Ideally, such selective sufficiency should be in systems or equipment categories that both meet critical AFP needs and have long-term potential backward and forward linkages with other industries, allowing them to further industrial and technological base expansion.⁴⁸ This must also be clearly communicated to the wider defense industrial ecosystem so the proper demand signals can be conveyed.

Encourage and capitalize Defense Innovation. Apart from DTI, the AFP and DND should also work more extensively with science and technology organizations in the Philippines. The Philippine Navy Naval Research and Technology Development Center has already been working with bodies such as the Philippine Space Agency (PhilSA) and the Cebu Technological University on several interesting projects. These should not only be encouraged but be further provided with research capital, as well as the proper mechanisms to transition their innovations towards production status. Decisions on which projects to prioritize should be aligned with the National Military Strategy, the Major Services' Operational Strategies and Concepts, and the prospective defense industrial strategy.

Developing a defense industry needs more than money or even "political will." It requires coherent long-term strategic rationales and well-informed analyses that combine both economic, logistical, and strategic aspects.

Improve defense ecozone and incentives policy to ensure long-term sustainability. The incentives offered under SpeDEZA and PDIDA can stand to be further recalibrated since defense product categories have very structural barriers to entry and high risks for prospective defense firms. In the Philippines, rather than taxes, the

more critical constraints to higher-value production are power costs and reliability, as well as supply and value chain issues such as raw materials and intermediate parts availability.⁴⁹ Such issues will need attention, as modern, complex systems and even frontier systems such as drones, and unmanned vehicles will require foreign parts.

Related to this, if the defense ecozones are expected to provide export opportunities for defense producers, the Philippines should consider acceding to international arms export standards and regulations, such as the Missile Technology Control Regime (MTCR) and the Wassenaar Arrangement on Export Controls for

Conventional Arms and Dual-Use Goods and Technologies. Accession to these multilateral export control regimes enable the Philippines access to critical technologies and build its credentials as a legitimate player in the defense market.

Conclusion

There are few real substitutes for increased state spending to build an industry, especially one as complex and expansive as the defense industry. But, at the same time, it is understood that the Philippine state's resources are limited, especially now as the country continues to grapple with the effects of the COVID-19 pandemic. Developing even a modest defense industry will take expertise, effort, resources and time that the powers that be may not be willing to give.

The failures of Project *Santa Barbara* and the early SRDPs, as well as the current problems with the AFPMP, show that developing a defense industry needs more than money or even “political will.” It, like the entire defense sector, requires coherent long-term strategic rationales and well-informed analyses that combine both economic, logistical, and strategic aspects, to justify the significant investments that must then be made to achieve the desired objectives.

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³² Rene Acosta, “Personnel, veterans to receive chunk of DND’s P258-B budget”, *Business Mirror*, 02 September 2019, Accessed 03 February 2020 at <https://businessmirror.com.ph/2019/09/02/personnel-veterans-to-receive-chunk-of-dnds-p258-b-budget/>

³³ MOOE and CO is not and cannot be made wholly available for purchasing items. MOOE includes operating and representation expenses apart from consumption of items, and CO includes infrastructure upgrades, which are outside the scope of what is normally considered as part of defense industries.

³⁴ Congressional Policy and Budget Research Department, *Agency Budget Notes – Department of National Defense*, House of Representatives, 2015, 2016, 2017, 2018, 2019, 2020, accessed at <https://cpbrd.congress.gov.ph/2012-06-30-13-06-51/2012-06-30-13-36-48>

³⁵ A good example of this is the difference between commercial/civilian shipbuilding and military shipbuilding; generally speaking, commercial/civilian ships built to civil standards have lower service lives, lower shock and damage tolerances than warships. Electronics and weapons are custom-made for warships and thus have no commercial equivalent, which is another source of specialization and cost.

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- ³⁶ John H Schank et al, *Learning from Experience: Lessons from the United Kingdom's Astute Submarine Program*, RAND Corporation, 2011, Accessed at https://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1128.3.pdf
- ³⁷ Paul Filmer, "Military Aviation in Manila." Global Aviation Resource. 20 December 2011. Accessed at <http://www.globalaviationresource.com/reports/2011/military-aviation-worldwide-philippine-military-aviation-in-manila/>
- ³⁸ Department of Trade and Industry, *Philippine Inclusive Innovation Industrial Strategy: Propelling Jobs, Investments and Shared Prosperity for All*, DTI Policy Brief 2017-05, p. 16, accessed at <http://industry.gov.ph/wp-content/uploads/2017/11/DTI-Policy-Brief-2017-05-Philippine-Inclusive-Innovation-Industrial-Strategy.pdf>
- ³⁹ Department of Trade and Industry, *Philippine Inclusive Innovation Industrial Strategy: Propelling Jobs, Investments and Shared Prosperity for All*, DTI Policy Brief 2017-05, p. 14.
- ⁴⁰ Jesus Jeffrey Grapa, "Ensuring Ammunition Adequacy in the Armed Forces of the Philippines," presented at the National Security Studies Program Colloquium on 24 March 2021
- ⁴¹ Stockholm International Peace Research Institute, "World Military Spending Rises to almost \$2 trillion US in 2020," *SIPRI Press Release*, 26 April 2021, accessed at <https://www.sipri.org/media/press-release/2021/world-military-spending-rises-almost-2-trillion-2020>
- ⁴² Congressional Policy and Budget Research Department, *Agency Budget Notes for FY2021 – Department of National Defense*, House of Representatives, 2020
- ⁴³ Shaan Shaikh and Wes Rumbaugh, "The Air and Missile War in Nagorno-Karabakh: Lessons for the Future of Strike and Defense", *Critical Questions*, Center for Strategic and International Studies, 08 December 2020, accessed at <https://www.csis.org/analysis/air-and-missile-war-nagorno-karabakh-lessons-future-strike-and-defense>
- ⁴⁴ Frances Mangosing, "Lorenzana says 2nd stage of PH military upgrade won't be completed on time", *Philippine Daily Inquirer*, 12 October 2020, accessed at <https://newsinfo.inquirer.net/1346864/lorenzana-says-2nd-stage-of-ph-military-upgrade-wont-be-completed-on-time>
- ⁴⁵ Ramonette B Sarafica and Jose Ramon G Albert, *Comments on House Bill No. 206, "An Act Providing for a National Defense Industry Through the Strengthening and Revitalizing of the Self-Reliant Defense Posture Program, Incentivizing In-Country Defense Enterprises, Creating the Office of the Undersecretary for Defense Technology Research and Industry Development Under the Department of National Defense and Providing Funds Therefore"*, Philippine Institute for Development Studies, 22 January 2020.
- ⁴⁶ Dianne Faye C Despi, Erick Nielson C Javier, Rowena S Tatad and Joshua Bernard B Espena, "Short, Sharp and Multidimensional: Future Wars and Considerations for Philippine Defense and Deterrence." *Future of Philippine Warfare* Volume I, pp.78-88, January 2021. National Defense College of the Philippines.
- ⁴⁷ Benjamin Leander, "The Role of Defense Materiel Development in the Philippines' Credible Defense Posture: From Self-Reliance to Selective Sufficiency," presented at the National Security Studies Program Colloquium on 24 March 2021
- ⁴⁸ This refers to systems that would impact and integrate multiple industries. A good example: an unmanned air vehicle (UAV) of even modest complexity would not just touch aircraft design and manufacture, but also flight computers and software systems, aircraft engines, materials and engineering, radar and sensors, support systems, etc.
- ⁴⁹ Department of Trade and Industry, *Philippine Inclusive Innovation Industrial Strategy: Propelling Jobs, Investments and Shared Prosperity for All*, DTI Policy Brief 2017-05, p. 12.