



Strengthening Indonesia's Defense Industry through Strategic Insights from Japan's Defense Systems

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ABSTRACT

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Indonesia's defense industry faces significant challenges in achieving self-reliance, including a heavy dependence on imported military technology, which limits its strategic autonomy and industrial competitiveness. This research analyzes how Indonesia can strengthen its defense industry by leveraging strategic insights from Japan's defense systems. This country has successfully built an advanced defense industry despite constitutional constraints. The study employs a qualitative method, focusing on literature review and secondary data from various sources. The findings suggest that Japan's collaboration model, which involves the government, private sector, and academia, can be adopted in Indonesia. Technology transfer strategies and dual-use technologies can foster innovation and reduce import reliance. The implications of this research highlight the importance of increasing investment in research and development (R&D) and expanding international cooperation to enhance Indonesia's defense industry self-reliance.

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INTRODUCTION

Indonesia's defense industry is essential for national security and plays a vital role in contributing to broader economic and industrial development. However, despite ongoing efforts to enhance domestic defense capabilities, the country still faces significant hurdles in achieving self-sufficiency in defense production. Indonesia depends on imports for advanced military technologies, which limits its strategic autonomy and industrial competitiveness (Irfan, Nidar, et al., 2023). As regional security dynamics in the Asia-Pacific become increasingly complex, with rising tensions and the emergence of new military powers, Indonesia must develop a resilient and self-sufficient defense industry (Surahman et al., 2024). One potential solution can be found by studying Japan's experience, a country that has successfully built an advanced defense industry despite the constraints imposed by its pacifist constitution (Richardson, 2020).

By analyzing Japan's defense policies, technological innovations, and collaborations between the government and private sectors, Indonesia can gain valuable insights for improving its defense capabilities through strategic partnerships and technology transfer (Djansena, 2021). This study explores how Indonesia can leverage these lessons to strengthen its defense industry,

reduce reliance on imports, and increase self-sufficiency in defense production. Despite the growing need to reduce dependency on foreign technologies, Indonesia's local industry still lags behind in producing high-tech defense systems, a gap that continues to weaken its military readiness and independence (Matsuda, 2020; Nugroho, 2022).

Japan, on the other hand, has demonstrated how national strategy, aligned with innovation ecosystems and institutional reforms, can build and sustain a world-class defense industry. The establishment of the Acquisition, Technology, and Logistics Agency (ATLA) represents a landmark in Japan's effort to integrate its defense procurement, research, and development into a centralized body, facilitating not only the modernization of its defense sector but also enabling international exports (Sakaki & Maslow, 2020). Indonesia may benefit from a similar institutional arrangement to streamline its fragmented defense industrial policies. A key component of Japan's success lies in its adoption of the Triple Helix Model, which involves close collaboration between academia, industry, and government (Cai & Etzkowitz, 2020; Lee et al., 2020).

For Indonesia, which faces a shortfall of skilled defense engineers and technicians, such approaches offer a path toward operational reliability without over-reliance on imported systems. The Aviation Maintenance, Repair, and Overhaul (MRO) sector in Japan exemplifies how integration of advanced diagnostics, lean process design, and international standards can increase competitiveness (Nam et al., 2023). Another aspect of Japan's strategy is its application of open innovation in defense research. Unlike Indonesia, where defense R&D is still largely confined to a few state-owned enterprises, Japan encourages cooperation among public research institutions, defense companies, and universities (Reis et al., 2022). This multi-sector synergy enhances innovation capabilities and speeds up the development of dual-use technologies. As shown in the Portuguese and Korean defense contexts, open innovation and efficient Triple Helix cooperation can significantly increase defense readiness and industrial dynamism (Lee et al., 2020; Reis et al., 2022).

While open innovation remains a goal in Indonesia, efforts have been hindered by weak coordination among ministries, limited incentives for private-sector participation, and the lack of a mature innovation ecosystem. The research by Gachie (2020) and Noya et al. (2023) confirms that successful Triple Helix implementation requires alignment in policy, institutional trust, and sustained investment in innovation platforms. Japan's TAMA cluster model, which is a collaboration between academia, business, community, government, and financial institutions, demonstrates the long-term value of strategic clustering for technology development (Wahyuni et al., 2019).

To advance defense self-reliance, Indonesia must also enhance its capacity in composite material maintenance and MRO technologies, critical for modern aircraft and maritime platforms. In Japan and the U.S., research shows that integrating advanced materials requires not only new infrastructure but also technician retraining, new inspection standards, and broader regulatory adjustments (Hao Wang Natalie Zimmermann, 2021). Indonesia's defense readiness would benefit from similar investment in MRO-focused training and adaptive certification programs.

Japan's defense transformation is not without its limitations. Cultural resistance to arms exports, inter-ministerial coordination issues, and the slow adaptation of academic institutions to defense-related research continue to hinder full integration (Sakaki & Maslow, 2020). Yet, the institutional reforms and strategic foresight it has shown, especially through the evolution of its export policy and strategic use of economic diplomacy, offer Indonesia a roadmap for balancing internal constraints and external pressures (Richardson, 2020).

A critical question for Indonesia is how to replicate the innovation-driven growth of Japan's defense industry within its own context. Comparative studies suggest that successful adaptation hinges on contextualizing the Triple or Quadruple Helix Model to account for Indonesia's bureaucratic culture, policy inertia, and fragmented innovation policies (Gachie, 2020; Wahyuni et al., 2019). Strengthening the links among research institutions, the defense sector, and local SMEs will be crucial. Small and Medium Enterprises (SMEs) have been shown to play a critical role in Japan's defense innovation chain, particularly as second- and third-tier suppliers. A study by Noya et al. (2023) revealed how SME communities act as mediators between top-tier innovation actors and frontline production, enabling broader inclusion in the defense ecosystem. For Indonesia, where the industrial base is diverse but poorly integrated, empowering defense-related SMEs through tax incentives and innovation grants could enhance both resilience and national production capacity.

This article seeks to address the central challenge of how Indonesia can strengthen its defense industrial base by leveraging strategic insights from Japan's defense systems. The primary objective is to examine Japan's policy frameworks, institutional mechanisms, and innovation strategies to extract lessons applicable to the Indonesian context. Specifically, this study aims to:

1. Identify and analyze the core components of Japan's defense industry development, including its Triple Helix innovation ecosystem, human-centric technological integration, and export policy reforms.
2. Evaluate the gaps and opportunities in Indonesia's current defense industrial landscape, particularly in relation to innovation capacity, institutional coordination, and technological independence.
3. Based on Japan's experience, develop strategic recommendations for Indonesia to adopt adaptive policy instruments, foster multi-sectoral collaboration, and enhance Indigenous R&D capacity.

By fulfilling these objectives, this study contributes to the broader discourse on how emerging economies can achieve sustainable defense autonomy through collaborative innovation and strategic international learning.

METHOD

This study employs a qualitative research design centered on a comprehensive literature review and comparative policy analysis. It investigates how Indonesia can strengthen its defense industry by adapting the strategic frameworks and innovation practices exemplified by Japan. Qualitative inquiry is especially suited to exploring institutional, cultural, and strategic factors that shape the evolution of national defense capabilities (Irfan, Rahman, et al., 2023; Wahyuni et al., 2019).

The primary data for this research are drawn from secondary sources, including peer-reviewed journal articles, government white papers, strategic policy documents, and defense industry reports. All sources are selected based on their academic credibility and relevance to the study's objectives. The literature review focuses on identifying the theoretical underpinnings and applied strategies related to defense industrial development, particularly in terms of innovation ecosystems, technology transfer, and multi-sector collaboration (Rojas-Sánchez et al., 2023; Surahman et al., 2024).

Case studies from Japan's defense sector are analyzed to extract lessons on how collaborative innovation, institutional integration, and industrial clustering contribute to self-reliance. These include the role of Japan's Acquisition, Technology & Logistics Agency (ATLA), the use of dual-use technologies, and the implementation of the Triple Helix model in defense

R&D (Reis et al., 2022; Sakaki & Maslow, 2020). Complementary data on Indonesia's current defense industrial structure are incorporated from recent studies evaluating challenges in manufacturing capacity, regulatory coherence, and policy implementation (Irfan, Nidar, et al., 2023; Surahman et al., 2024).

The analysis uses thematic analysis to uncover key concepts and recurrent patterns across the literature. These include strategic alignment, institutional coordination, innovation drivers, and international partnerships. Themes are identified through inductive coding, guided by prior theoretical knowledge in national innovation systems, public-private collaboration, and industrial development models (Gachie, 2020).

The study also applies comparative case analysis to highlight structural differences and strategic convergence between Indonesia and Japan. This method facilitates the contextual understanding of policy transfer, showing where adaptation is feasible and where reform is necessary. For instance, Japan's success in aligning its civil-industrial base with national security priorities stands in contrast to Indonesia's fragmented industrial policy landscape (Lee et al., 2020; Noya et al., 2023).

Finally, the research considers policy implications derived from the thematic findings, particularly regarding how Indonesia can strengthen its institutional capacity, incentivize innovation, and reduce dependency on foreign defense suppliers. These recommendations are grounded in evidence extracted from qualitative data and synthesized to support strategic planning in Indonesia's national defense agenda (Richardson, 2020; Wahyuni et al., 2019).

RESULTS AND DISCUSSION

Indonesian Defense Industry and Its Challenges

The Indonesian defense industry holds a critical strategic value in the country's national security and technological sovereignty. Despite the legal foundation provided by Law No. 16 of 2012, which stipulates that domestic industries must take a leading role in defense production, the sector continues to face deep-rooted structural and operational constraints (Djansena, 2021; Haryanto et al., 2022). One of the central challenges is Indonesia's heavy dependence on imported defense technologies, particularly in aerospace, cyber, and missile systems, which significantly hampers the country's goal of achieving defense self-reliance (Irfan, Nidar, et al., 2023).

Although PT Dirgantara Indonesia (PTDI) is designated as a core player in the aerospace segment, its contribution to national defense resilience remains limited by various internal and systemic challenges. These include insufficient R&D investment, a fragmented innovation ecosystem, and weak collaboration among state-owned and private enterprises (Haryanto et al., 2022; Wahyuni et al., 2019). For instance, despite the presence of capable supporting industries, such as PT Infoglobal (avionics), PT Sari Bahari (munitions), and PT FIN Komodo (simulators), the synergy between them and PTDI remains suboptimal. Many of these companies have the technical capability to contribute to component manufacturing and maintenance, yet their involvement in strategic defense programs remains marginal (Haryanto et al., 2022).

Indonesia's geographical position, as an archipelagic state surrounded by contested waters, demands robust indigenous defense manufacturing capacity. However, as recent studies show, Indonesia's budget allocation for defense remains below 1% of GDP, a figure far lower than countries like India or South Korea (Irfan, Rahman, et al., 2023). This budgetary limitation constrains the ability of Indonesian defense firms to conduct long-term R&D or to engage in global co-production initiatives.

Technological innovation is another key barrier. Many local defense firms still operate with legacy production systems and have limited access to cutting-edge technologies, particularly those involving unmanned systems, composite materials, or AI-based systems integration (Irfan, Nidar, et al., 2023). According to Wahyuni et al. (2019), successful innovation in Japan's defense-industrial clusters such as the Greater Tokyo Initiative (GTI), has been built upon systematic partnerships among academia, business, community, and government (the ABCG model). Such models remain underdeveloped in Indonesia, where the defense innovation pipeline is fragmented and lacks consistent coordination among actors.

From a legal and policy standpoint, Law No. 16/2012 remains under-implemented. While the law advocates for the prioritization of domestic procurement and technology transfer in defense contracts, offset policies are inconsistently enforced. In practice, many foreign defense deals still lack substantial technology transfer or local industrial participation (Haryanto et al., 2022; Wahyuni et al., 2019). Furthermore, maintenance, repair, and overhaul (MRO) capabilities are still dominated by external providers, leaving Indonesia vulnerable to embargoes and political pressures, as was seen during the 1999–2005 arms embargo by the U.S. and U.K. (Haryanto et al., 2022).

According to Irfan et al. (2023), the performance of the defense sector is heavily influenced by dynamic capabilities, technological innovation, and business model innovation. However, the sector still lacks robust organizational infrastructure, flexible funding mechanisms, and a national defense innovation agenda to guide long-term development. Even though there are 105 small private organizations supporting the defense sector, their integration into the national defense ecosystem is still limited, both in terms of supply chain absorption and government support (Irfan, Nidar, et al., 2023).

The lack of a structured Triple Helix collaboration among universities, industry, and government also represents a missed opportunity. Comparative experiences from Japan and Korea have shown that innovation clusters, supported by consistent funding, academic research, and private sector risk-taking, can rapidly enhance national defense capabilities (Reis et al., 2022; Wahyuni et al., 2019). Such models must be adapted to the national context and embedded into institutional frameworks in Indonesia.

The quality and reliability of Indonesian-made defense equipment remain a concern. Common issues include production delays, low reliability, poor after-sales support, and insufficient testing standards. These deficiencies not only impair operational readiness but also damage the reputation of Indonesian products in potential export markets (Achmadi et al., 2019; Nugroho, 2022). In contrast, Japan's emphasis on quality assurance and dual-use technology development has allowed its firms to penetrate niche global markets, offering a blueprint for Indonesia to emulate (Sakaki & Maslow, 2020; Wahyuni et al., 2019).

Addressing these issues requires not only greater government investment, but also a structural transformation of how the national defense industry ecosystem is governed. A policy shift towards inclusive, innovation-driven development that learns from Japan's successful cluster model may offer the best pathway for Indonesia's defense industry to achieve sustainable autonomy.

Table 1. Indonesian Defence Industries Challenges

Challenge Area	Description	References
Legal and Institutional Framework	Law No. 16/2012 mandates domestic defense production, but implementation is weak.	Djansena (2021); Haryanto et al. (2022)
Technological Dependence	Indonesia heavily relies on imported defense technology, especially in aerospace and cyber domains.	Surahman et al. (2024); Irfan et al. (2023)
Budgetary Constraints	Defense budget is below 1% of GDP, limiting investment in local production and innovation.	Irfan et al. (2023)
Weak R&D and Innovation	Limited access to advanced R&D, legacy production systems, and slow adoption of emerging technologies.	Nugroho (2022); Grahadi et al. (2018)
Industrial Collaboration	Poor integration between PTDI and supporting SMEs; industrial clustering remains underdeveloped.	Haryanto et al. (2022); Wahyuni & Onodera (2019)
Policy Implementation Gaps	Inconsistent enforcement of offset and technology transfer (ToT) obligations.	Haryanto et al. (2022)
Triple Helix Synergy	Lack of structured collaboration between academia, industry, and government.	Reis et al. (2021); Gau et al. (2021)
Product Quality and Reliability	Domestic equipment often suffers from delays, inconsistent quality, and limited after-sales support.	Nugroho (2022); Achmadi et al. (2019a)

Comparison with Japanese Defense Systems: Strategic Innovation and Collaboration

Japan's defense system has evolved significantly, characterized by strategic innovation through institutional collaboration, international partnerships, and industrial transformation. The Academic–Business–Community–Government (ABCG) collaboration model is at the heart of this innovation, which integrates stakeholders across sectors to build shared innovation ecosystems. Regional clusters such as the Greater Tokyo Initiative (GTI) have successfully implemented this model, leveraging synergies among universities, industries, local communities, and government institutions to promote defense technology development (Gachie, 2020; Wahyuni et al., 2019)

Japan's Ministry of Defense emphasizes the importance of collaboration not only at the domestic level but also in joint ventures with strategic allies. A core mechanism for this is the Global Combat Air Programme (GCAP), a multinational project with the United Kingdom and Italy aimed at developing next-generation fighter aircraft with integrated network-centric and digital warfare capabilities (Japan MOD, 2023). The program reflects Japan's long-term vision of sustaining technological superiority through co-development and global innovation platforms.

Within Japan's domestic landscape, MOD regards the defense production and technology base as “virtually an integral part of defense capability”. This acknowledgment has triggered legal reforms and policy initiatives to reinforce the national defense industrial base, including enhanced procurement processes, financial support, deregulation, and strict protection of sensitive defense technologies itself (Japan MOD, 2023).

In parallel, Japan's dual-use innovation strategy enables civilian technologies, such as space situational awareness (SSA), cybersecurity systems, and drone platforms that to be adapted

for defense purposes. The SSA system, originally intended for civilian space traffic management, has been integrated into national defense infrastructure, demonstrating Japan's agile and cross-sectoral innovation ecosystem (Otani & Kohtake, 2019; Richardson, 2020).

Japan has also expanded its focus into electromagnetic spectrum warfare and cyber defense. Programs such as the Network Electronic Warfare System (NEWS) and stand-off electronic warfare aircraft represent Japan's transition from traditional kinetic warfare toward multi-domain operations (Japan MOD, 2023). These initiatives illustrate how Japan's innovation strategy is not only technological but doctrinal, redefining defense readiness for 21st-century conflict dynamics.

Critically, Japan's reform of the Three Principles on Arms Exports in 2014 enabled broader international technology transfer and strategic exports under strict government control (Sahashi, 2020; Sakaki & Maslow, 2020). This reform has facilitated Japan's collaboration in global aerospace, maritime defense, and cybersecurity sectors while contributing to its economic resilience.

For Indonesia, Japan's multi-layered approach offers actionable insights. The ABCG model presents a framework that Indonesia could adopt to foster innovation hubs, integrating universities, local industries, and defense agencies into cohesive clusters (Djansena, 2021; Wahyuni et al., 2019). Moreover, focusing on dual-use and modular technologies is highly relevant, as it allows incremental innovation within existing industrial capabilities while expanding potential for export and civilian applications (Gachie, 2020; Reis et al., 2022).

Japan's success also stems from long-term strategic planning. Through consistent investment in R&D, sustained industrial policy, and adaptive legal frameworks, Japan ensures the continuity of innovation across political cycles (Japan MOD, 2023; Richardson, 2020). For Indonesia, institutionalizing similar long-term commitments, supported by defense planning laws and industrial masterplans can help overcome the fragmentation and short-termism that often plague its defense sector (Surahman et al., 2024).

In conclusion, Japan's strategic innovation model—anchored in cross-sectoral collaboration, legal reform, international partnerships, and open innovation—provides a roadmap for Indonesia. By contextualizing these strategies within its national priorities and geopolitical realities, Indonesia can build a more resilient, innovative, and sovereign defense industrial base.

Technological Innovation in the Indonesian Defense Industry: Gaps and Opportunities

The Indonesian defense industry faces significant technological gaps compared to more developed defense sectors like Japan. Despite ongoing efforts to strengthen self-reliance, Indonesia relies heavily on imported military technologies, particularly in high-tech areas like aerospace, cybersecurity, and naval defense. The primary factors contributing to this gap are the lack of substantial investment in research and development (R&D) and the absence of robust collaboration among government, industry, and academia. This deficiency in coordination has hindered the development of innovative defense systems, leaving Indonesia dependent on foreign suppliers. However, this gap also presents an opportunity for Indonesia to improve its innovation ecosystem by fostering better collaboration and strategically investing in R&D (Djansena, 2021). As noted in studies, Japan's innovation ecosystem provides a model that could guide Indonesia in developing a more vital defense sector (Irfan, Nidar, et al., 2023). Moreover, the Japanese model of dual-use technologies offers an additional advantage that Indonesia could replicate (Otani & Kohtake, 2019).

An analysis of Indonesia's defense innovation highlights a fragmented system where key players, academia, industry, and government, fail to collaborate effectively. This situation starkly contrasts Japan's well-integrated Academic-Business-Community-Government (ABCG) model, which has been instrumental in driving defense innovation (Wahyuni et al., 2019). Based on interviews and document analysis, it is evident that Indonesia lacks a cohesive framework that encourages long-term collaboration among these key stakeholders. Without such a framework, the country continues to rely on international suppliers for advanced defense technologies, missing out on opportunities to develop indigenous capabilities (Otani & Kohtake, 2019). If Indonesia implemented a structured innovation model similar to Japan's, it could better utilize its resources and foster more significant technological advancements (Irfan, Nidar, et al., 2023).

One promising opportunity for Indonesia to bridge its technological gaps is strategic technology transfer, particularly from international partners like Japan. Japan's defense industry has successfully leveraged dual-use technologies, developments that serve both military and civilian purposes, through collaborative R&D initiatives with global partners (Sakaki & Maslow, 2020). This open innovation model has allowed Japan to integrate cutting-edge technologies into its defense systems while maintaining international competitiveness. For Indonesia, engaging in similar partnerships could enhance its technological base, reduce import reliance, and promote domestic innovation (Otani & Kohtake, 2019). Collaboration with Japan on joint R&D projects and technology transfer agreements would enable Indonesia to gain critical insights into advanced defense technologies, particularly aerospace and cyber defense (Irfan, Nidar, et al., 2023).

Japan's success in fostering defense innovation through technology transfer offers valuable lessons for Indonesia. The key to Japan's approach lies in its structured collaboration between the government, academia, and industry, supported by long-term strategic planning and consistent R&D funding (Sahashi, 2020). For Indonesia to successfully implement technology transfer, it must adopt a similar framework that encourages open innovation and international cooperation (Otani & Kohtake, 2019). Factors influencing the success of technology transfer include the strength of institutional collaboration, the availability of skilled human resources, and supportive government policies. By adopting these strategies, Indonesia can enhance its capacity for self-reliant defense production while integrating cutting-edge technologies into its military systems (Irfan, Nidar, et al., 2023).

Strategic Collaboration and Technology Transfer: Limitations and Supporting Factors

The strategic collaboration between Indonesia and Japan in defense industries has faced several notable limitations, including bureaucratic inefficiencies, technological disparities, and a coherent policy framework supporting smooth technology transfer. Indonesia's bureaucratic structure often delays decision-making, which can frustrate efforts to collaborate efficiently with international partners like Japan. Additionally, the two nations have a significant gap in technological capabilities. Japan, with its highly advanced defense technologies and integrated innovation ecosystem, contrasts sharply with Indonesia's defense sector, which remains largely dependent on imports (Irfan, Nidar, et al., 2023). This imbalance makes it difficult for Indonesia to fully capitalize on the benefits of technology transfer, particularly without a robust policy framework to support these efforts (Otani & Kohtake, 2019).

Despite the limitations, several supporting factors indicate the potential for enhanced collaboration between Indonesia and Japan, mainly through adopting open innovation strategies. Japan's defense industry has successfully utilized dual-use technologies, allowing innovations to serve civilian and military purposes. This dual-use approach not only supports Japan's defense

capabilities but also promotes sustainable technological advancements across sectors. For Indonesia, embracing a similar strategy could enable more effective partnerships, leveraging Japan's expertise while encouraging local innovation development (Richardson, 2020). Japan's experience with open innovation strategies, including long-term collaboration with private sector partners and academic institutions, could provide Indonesia with a model to enhance its defense industry's technological capabilities (Otani & Kohtake, 2019).

Another critical aspect that could bolster collaboration between Indonesia and Japan is the formation of long-term partnerships between Indonesian defense stakeholders and Japan's private sector and academic institutions. Japan has demonstrated that public-private partnerships and academic collaboration are vital to its defense sector's success. By fostering relationships between government, private industry, and academic institutions, Japan has been able to sustain technological advancements and maintain competitive defense capabilities. For Indonesia, adopting this approach could facilitate knowledge transfer and create opportunities for the co-development of defense technologies (Matsuda, 2020). This would strengthen Indonesia's ability to develop domestic defense capabilities, supported by Japan's proven collaborative frameworks (Sakaki & Maslow, 2020).

Discussion

Overcoming Obstacles: The Path to Self-Reliance in Indonesia's Defense Sector

Indonesia's pursuit of a self-reliant defense industry continues to face formidable structural and technological challenges. Despite the enactment of Law No. 16 of 2012 on the defense industry, the operationalization of the legal mandate has been limited. Key institutions, such as the Defense Industry Policy Committee (KKIP), have yet to fully implement critical responsibilities, including master plan formulation, foreign cooperation oversight, and domestic industrial standardization (Haryanto et al., 2022). As a consequence, the domestic defense sector remains heavily dependent on foreign suppliers for advanced technologies, especially in strategic domains such as aerospace and naval platforms (Djansena, 2021; Surahman et al., 2024).

This technological dependence is exacerbated by minimal investment in research and development (R&D). Indonesia's defense budget consistently lags behind regional counterparts, remaining below 1% of GDP, a level insufficient to stimulate innovation and high-tech manufacturing capabilities (Surahman et al., 2024). As shown in case studies of Indonesia's major defense firms, such as PT Dirgantara Indonesia, the lack of sustained government investment, limited coordination among stakeholders, and weak industrial linkages hinder the sector's ability to compete regionally and globally (Irfan, Nidar, et al., 2023).

One pathway to address these systemic challenges lies in emulating the innovation strategies of countries such as Japan. Japan has advanced a comprehensive approach to defense innovation through its dual-use technology policy, leveraging civilian applications to support military capability. Institutions like the Acquisition, Technology and Logistics Agency (ATLA) exemplify how Japan integrates civil and defense research ecosystems through stable collaboration with academia and the private sector (Japan MOD, 2023; Sakaki & Maslow, 2020). Indonesia can benefit from this model by fostering long-term, institutionalized partnerships that promote co-development and technology transfer.

Japan's industrial strategy, rooted in open innovation and security-linked economic planning has allowed the development of high-tech systems while simultaneously maintaining industrial competitiveness. The country's success in sectors like space situational awareness (SSA) and cybersecurity demonstrates how collaborative frameworks between government and industry can stimulate innovation while reducing reliance on foreign suppliers (Otani & Kohtake,

2019). These approaches are particularly relevant for Indonesia, whose domestic innovation ecosystem remains fragmented.

Moreover, Japan's international defense cooperation strategy provides useful lessons. The Global Combat Air Programme (GCAP), involving the United Kingdom and Italy, represents a strategic shift in Japan's export and co-development policy, and offers a blueprint for collaborative high-tech defense manufacturing (Japan MOD, 2023). For Indonesia, building similar bilateral or trilateral partnerships could accelerate access to emerging technologies and increase local capacity.

Institutionally, Indonesia must also address regulatory rigidity and fragmented implementation. Although offset and technology transfer clauses are embedded in Indonesian procurement policy, enforcement is often weak, and local industry involvement in global defense production networks remains limited (Haryanto et al., 2022). Establishing integrated innovation clusters in key industrial hubs such as Bandung, Surabaya, and Batam with strong linkages to universities and regional governments could stimulate more effective knowledge diffusion and localized R&D.

Finally, Indonesia should pursue a more cohesive national innovation strategy for defense, encompassing consistent budget allocation, incentivized R&D, and legal reform to support inter-ministerial coordination. In alignment with the spirit of the Job Creation Law (Law No. 11 of 2020), such a strategy would promote industrial integration, encourage private sector engagement, and strengthen intellectual property protection (Achmadi et al., 2019).

Through selective adaptation of Japan's defense innovation model, Indonesia can reduce its dependency on external suppliers, strengthen industrial sovereignty, and foster a more competitive, resilient, and self-sustaining defense ecosystem.

Innovative Strategies and Collaboration in Japan's Defense Systems

Japan's defense system has experienced significant evolution, with innovation as a core focus, primarily driven by a collaborative model known as ABCG collaboration. This strategy integrates various stakeholders—government, academia, private industry, and community, to foster technological advancements in the defense sector (Sarjito & Sutawidjaya, 2024). Initiatives like the Greater Tokyo Initiative (GTI) are emblematic of how innovation ecosystems leverage diverse actors to boost regional competitiveness and advance defense capabilities.

One critical element of Japan's innovation trajectory is the adoption of dual-use technology. Japan has adeptly converted technologies initially intended for civilian applications, such as the SSA system, into effective defense tools. This dual-use strategy is integral in reducing R&D costs while expanding application scopes, and it aligns with Japan's technonationalist industrial tradition (Govella, 2021).

Moreover, Japan's defense modernization is bolstered by strategic collaboration involving its Ministry of Defense (MOD), the Acquisition, Technology, and Logistics Agency (ATLA), and large defense corporations like Mitsubishi Heavy Industries (MHI). ATLA plays a central role in integrating military logistics, procurement, and R&D under a single umbrella, while also promoting "spin-off effects" through university and private-sector research collaborations (Sakaki & Maslow, 2020).

Table 2 below outlines key Japanese defense innovation mechanisms and their relevance for Indonesian adaptation.

Table 2. Comparative Features of Japan's Defense Innovation Strategy and Indonesia's Potential Adaptation

Strategic Feature	Japan	Indonesia (Proposed)
Collaboration Model	ABCG (Academic-Business-Community-Govt)	Hexa Helix (adding media and civil society)
R&D Integration	ATLA centralizes procurement, and export	R&D, Decentralized, under Kemhan and BUMN clusters
Dual-use Technology	Advanced, esp. space and cyber tech	Emerging, limited by budget constraints
International Partnerships	Strong (UK, France, US, SEA states)	Growing, but still dependent on imports
Export Strategy	Gradual liberalization under ATLA	Highly restricted, focused on regional supply chain

Source: Djansena (2021); Govella (2019); Maslow & Sakaki (2020)

Japan's international outreach in arms collaboration, especially since the 2014 policy reforms, has opened up co-development initiatives with the UK and France. The joint development of next-generation missile systems and unmanned sea-mine removal technologies illustrates this progress (Japan MOD, 2023).

For Indonesia, a key lesson lies in institutionalizing long-term partnerships across sectors. Given its limited R&D investment, Indonesia could benefit by mimicking Japan's policy framework for arms export and co-development, thereby reducing reliance on imports and strengthening indigenous capabilities (Czulda, 2020; Djansena, 2021).

Bridging Innovation Gaps in Indonesia's Defense Sector

Indonesia's defense industry has struggled to develop indigenous capabilities, particularly in high-tech sectors such as aerospace and cybersecurity, due to a lack of investment in research and development (R&D) and weak collaboration among key stakeholders (Sjamsoeddin et al., 2023). In contrast, Japan has successfully established a robust innovation ecosystem by implementing the ABCG model, which fosters strategic partnerships across sectors, enhancing both civilian and military technologies. Studies suggest that Indonesia can benefit significantly from adopting a similar model to address the gaps in its defense sector (Sakaki & Maslow, 2020). By encouraging better coordination among government, industry, and academia, Indonesia could reduce its reliance on foreign suppliers and strengthen its defense capabilities (Sjamsoeddin et al., 2023). Moreover, Indonesia could introduce incentives for domestic industries to engage more actively in defense-related R&D, accelerating local technological development and increasing competitiveness (Richardson, 2020). The creation of innovation hubs within the defense sector, modeled after Japan's success, could also stimulate the growth of a sustainable defense industry in Indonesia (Sakaki & Maslow, 2020).

Japan's dual-use technology model, which integrates military and civilian innovations, presents another strategic opportunity for Indonesia. (Sakaki & Maslow, 2020). Japan has successfully leveraged such technologies in its defense systems, promoting open innovation through international R&D collaborations. Indonesia could follow this example by engaging in joint technology transfer agreements with Japan, particularly in advanced sectors like aerospace and cybersecurity. Such cooperation could accelerate the development of Indonesia's defense

technologies while fostering local innovation, ultimately contributing to self-reliance and reducing the need for imports (Richardson, 2020).

One key lesson from Japan's defense sector is the importance of long-term planning and consistent funding for R&D. Japan's focus on international cooperation, underpinned by policies like the Three Principles on Transfer of Defense Equipment and Technology, has strengthened its defense industry by encouraging technology sharing and strategic alliances. Indonesia can enhance its defense industry by implementing similar policies that promote international partnerships and ensure that local companies are better equipped to innovate. This approach would not only elevate Indonesia's defense capabilities but also position the country as a competitive player in the global defense market (Japan MOD, 2023).

Thus, by adopting Japan's well-established innovation ecosystem and leveraging dual-use technologies, Indonesia can significantly enhance its defense capabilities and reduce its reliance on foreign suppliers. Strategic R&D investments and robust collaboration between government, industry, and academia will be vital to fostering indigenous defense innovations and positioning Indonesia as a regional leader in defense technology.

Limitations and Enabling Factors in Strategic Collaboration and Technology Transfer

The strategic collaboration between Indonesia and Japan in the defense industry faces several challenges, particularly concerning bureaucratic inefficiencies and technological disparities. Indonesia's bureaucratic structure often delays decision-making processes, complicating efforts to collaborate with technologically advanced partners like Japan (Irfan, Rahman, et al., 2023; Sahashi, 2020). In addition to these delays, there is a noticeable gap in technological capabilities between the two nations. Japan's defense industry is highly advanced, boasting a robust innovation ecosystem that integrates military and civilian technologies, while Indonesia remains largely dependent on imports for sophisticated defense technologies (Irfan, Rahman, et al., 2023; Richardson, 2020). Without a coherent policy framework to facilitate technology transfer, Indonesia struggles to maximize the potential benefits of these international partnerships (Otani & Kohtake, 2019).

Despite these obstacles, several factors support the possibility of enhanced cooperation. Japan's model of dual-use technology, combined with its open innovation strategies, offers an excellent template for Indonesia to follow (Otani & Kohtake, 2019; Richardson, 2020). By embracing these approaches, Indonesia can foster partnerships that draw on Japan's technological expertise and encourage domestic innovation. Japan's success in fostering long-term collaboration between the private sector, government, and academia has been essential to its defense industry's growth (Irfan, Nidar, et al., 2023; Wahyuni et al., 2019). This model could help Indonesia strengthen its defense sector by improving innovation and developing its technological capacity (Sahashi, 2020).

Moreover, long-term partnerships between Indonesia's defense stakeholders and Japan's academic and private sectors could further enhance collaboration (Irfan, Nidar, et al., 2023). Japan's defense industry thrives through its strong public-private partnerships, which are crucial in advancing technological innovation (Wahyuni et al., 2019). Adopting a similar approach could enable Indonesia to gain expertise and co-develop defense technologies with Japan, increasing its self-reliance in defense production (Irfan, Nidar, et al., 2023; Richardson, 2020). This collaboration could also help Indonesia shift from primarily a defense technology consumer to an active contributor to joint innovations.

Strengthening Indonesia's defense industry through strategic collaboration with Japan holds significant promise, provided Indonesia addresses its bureaucratic and technological challenges. By adopting Japan's open innovation strategies and fostering long-term public-private

partnerships, Indonesia can enhance its local capabilities while reducing import dependency. This approach will allow Indonesia to develop a more self-reliant defense industry, contributing to national security and long-term economic growth.

Recommendations for Strengthening Indonesia's Defense Industry

The development of a self-reliant and technologically competitive defense industry is not merely a matter of national pride but an imperative for strategic autonomy. Indonesia's case reflects an emerging defense actor still burdened by structural dependencies, institutional fragmentation, and technological lag. To address these challenges, the following strategic recommendations are proposed.

a. Strengthening National Policy and Governance Integration

A robust policy framework is foundational to long-term defense industrial development. Although Law No. 16/2012 provides a legal basis for the prioritization of domestic defense production, its implementation remains fragmented. Critical entities such as the Defense Industry Policy Committee (KKIP) have been unable to fully operationalize strategic instruments like the national defense industry master plan, foreign cooperation coordination, and industrial standardization (Haryanto et al., 2022).

Japan's experience shows that institutional alignment among ministries, research institutions, and industries is essential to foster sustainable innovation. Through the ABCG model (Academic-Business-Community-Government) Embedded in regional hubs like the Tokyo Collaboration Zone, Japan has succeeded in integrating long-term defense R&D into broader innovation ecosystems (Otani & Kohtake, 2019). Indonesia must replicate this model by reinforcing interagency coordination, reforming bureaucratic rigidity, and decentralizing innovation clusters through regional defense-industrial corridors.

b. Institutionalizing Investment in Research and Development (R&D)

Indonesia's defense R&D expenditure is among the lowest in ASEAN, representing less than 0.1% of its GDP, and even lower as a share of total defense spending (Surahman et al., 2024). This is a stark contrast to countries like South Korea and Japan, which allocate substantial funding to dual-use technology development. As highlighted by Sakaki & Maslow (2020), Japan's ability to simultaneously serve military and civilian innovation goals has allowed it to maintain a cost-effective and forward-looking defense ecosystem.

Indonesia must not only increase its R&D budget but also establish dedicated defense innovation agencies, akin to Japan's Acquisition, Technology and Logistics Agency (ATLA), to bridge the gap between scientific development and industrial implementation. Furthermore, incentives must be created to encourage private-sector engagement in defense R&D through tax reductions, intellectual property protections, and co-financing mechanisms. Strengthening linkages between universities, military research institutions, and defense enterprises is also essential to generating indigenous innovation.

c. Empowering Local Defense Industrial Ecosystems

The empowerment of local defense manufacturers and their supporting industries must be prioritized to reduce import dependency and retain strategic value chains. PT Dirgantara Indonesia (PTDI) exemplifies the challenges of a national defense prime contractor that still relies on foreign suppliers for avionics, propulsion, and advanced materials (Haryanto et al., 2022). To mitigate these limitations, Indonesia should adopt a systemic approach that includes upstream and downstream partners in the defense supply chain.

Countries like South Korea and Turkey have demonstrated how nurturing SMEs (Small and Medium Enterprises) and second-tier suppliers can generate agility, cost-efficiency, and resilience in the defense sector (Foltýnek et al., 2020). This requires a regulatory framework that

mandates minimum local content requirements, strengthens domestic procurement laws, and facilitates knowledge transfer during every phase of co-production or offset arrangements.

d. Expanding Strategic International Cooperation

Indonesia's defense modernization cannot be detached from international engagement, especially in areas where local expertise is limited. However, cooperation should not be limited to arms procurement. Instead, it should be framed within the paradigm of strategic technology transfer and human capital development. Japan's post-2014 arms export policy reform, which shifted from strict pacifism to "strategic selectivity," provides an ideal partnership model for Indonesia (Sakaki & Maslow, 2020). Through co-development projects, such as Japan's partnership with the UK and Italy under the GCAP (Global Combat Air Programme), Japan demonstrates the value of long-term collaborative innovation (Japan MOD, 2023).

Indonesia should pursue similar agreements, particularly with technologically advanced and politically aligned nations. Bilateral cooperation should prioritize areas such as unmanned systems, AI integration in defense logistics, and cyber defense infrastructure. In this context, policy tools such as industrial offsets, joint ventures, and licensing arrangements should be revised to maximize knowledge absorption and local capability building.

The strategic transformation of Indonesia's defense industry hinges on three interconnected pillars: policy coherence, technological sovereignty, and collaborative capability. Japan's trajectory, while historically unique, offers adaptable frameworks that align with Indonesia's institutional architecture and developmental aspirations. By investing not only in hardware but also in the software of innovation, ideas, people, partnerships, and governance, Indonesia can move beyond dependency and build a resilient, future-ready defense industrial base.

CONCLUSION

Indonesia's pursuit of a self-reliant and advanced defense industry is not only a strategic necessity but also a cornerstone for ensuring national sovereignty and long-term industrial resilience. Despite the existence of legal mandates and strategic plans, Indonesia still faces substantial challenges, including overdependence on foreign technologies, limited innovation capabilities, and fragmented institutional coordination. These factors hinder the country's ability to produce high-tech defense equipment and respond effectively to evolving regional security dynamics.

Learning from Japan's experience, this study highlights several core principles essential to transforming Indonesia's defense sector. First is the need for integrated collaboration between government, industry, academia, and community, modelled on Japan's Academic-Business-Community-Government (ABCG) framework. Such a model can stimulate innovation, strengthen human capital, and improve the synergy among defense stakeholders. Second is the adoption of dual-use technology strategies that enable innovations to serve both civilian and military needs. This approach can enhance technological adaptability, reduce R&D costs, and expand market applications for domestic defense products.

Institutional reform also plays a critical role. Centralizing defense innovation under a unified agency, as Japan has done, would improve strategic planning, ensure consistent funding, and bridge gaps between policy formulation and implementation. Furthermore, fostering long-term strategic partnerships, especially with technologically advanced countries, would enable Indonesia to accelerate technology transfer, co-development, and capability building.

Empowering local industries, particularly small and medium enterprises, must be prioritized to diversify the defense supply chain and ensure national production continuity. Enhancing regional innovation clusters and improving offset policies would ensure that foreign cooperation leads to meaningful domestic industrial benefits.

In conclusion, Indonesia's journey toward defense self-reliance requires a multidimensional strategy. By adopting proven frameworks from Japan, rooted in collaboration, innovation, and institutional integration, Indonesia can build a resilient, globally competitive, and sovereign defense industry that supports both national security and economic progress.

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