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The future of defense industrialization 5.0 in Indonesia: The potential role of the enforced autonomy model

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Abstract This study examines how Indonesia can advance its Defense Industrialization 5.0 goals by adopting an Enforced Autonomy Model—an approach that treats industrial development not as a market-driven evolution but as a state-mandated mission. Through qualitative policy analysis and diagnostic tools like the Ishikawa diagram and Arms Production Ladder, the paper identifies persistent challenges that hinder progress, including fragmented governance, outdated technology, limited R&D investment, and weak integration of local suppliers. These challenges, while well-known, are often addressed through voluntary policies that lack binding force. The Enforced Autonomy Model proposed in this study introduces a shift in perspective: it argues that without enforcement mechanisms—such as presidential-level authority, mandatory local content rules, and structured talent pipelines—Indonesia will remain dependent on foreign suppliers and struggle to meet long-term strategic goals. Drawing lessons from countries like South Korea, Turkey, and Singapore, the paper demonstrates that meaningful transformation in the defense sector requires strong political leadership, clear targets, and institutional accountability. To operationalize this approach, the study outlines six strategic roadmaps covering human capital, production line modernization, supply chain development, product innovation, export promotion, and governance reform. Each roadmap includes enforceable targets tied to legal or regulatory instruments, ensuring alignment across ministries, state-owned enterprises, and research institutions. The findings suggest that by embedding enforcement into national policy, Indonesia can not only achieve the targets set in its 2045 development agenda but also emerge as a key defense supplier for the Global South. In doing so, the country would shift from being a passive participant in global defense markets to a proactive industrial actor capable of innovation, autonomy, and strategic relevance.

Keywords: civil-military collaboration, defense innovation, industrial policy, strategic autonomy, supply chain integration, technology transfer

1. Introduction

The transformation of global defense industries is increasingly shaped by the paradigm of *Industry 5.0*, where advanced technologies such as artificial intelligence, autonomous systems, and digital twin integration intersect with strategic imperatives of national resilience (Nahavandi, 2019; Xu et al., 2021). Countries such as South Korea, Turkey, and Singapore have demonstrated that defense industrialization cannot rely merely on market forces but instead requires deliberate state intervention to secure technological autonomy and reduce dependence on foreign suppliers (Bitzinger & Raska, 2022; Kurç et al., 2025). In this context, Indonesia faces both an urgent challenge and an unprecedented opportunity to accelerate its defense industrial transformation in line with the *Rencana Pembangunan Jangka Panjang Nasional* (RPJPN) 2025–2045.

Despite significant progress in policy frameworks and institutional restructuring, such as the establishment of Defend ID and the strengthening of the Defense Industry Policy Committee (KKIP), Indonesia's defense ecosystem continues to suffer from fragmented governance, limited technological innovation, and overreliance on imported materials and platforms (Damanik et al., 2024; Gindarsah & Priamarizki, 2015). These systemic weaknesses highlight the absence of a coherent long-term mandate, underscoring the need for a more assertive and integrated strategy (Raba, 2025).

This paper introduces the *forced autonomy model* as a conceptual and strategic framework for Indonesia's Defense Industrialization 5.0. The model emphasizes the necessity of state-driven enforcement mechanisms, including presidential-level authority, mandatory local content (TKDN) enforcement, offset policies with technology transfer obligations, and structured collaboration between the government, private sector, and academia (Hartley & Belin, 2019; Scott, 1998). By embedding autonomy as a nonnegotiable principle of industrial development, Indonesia can ensure that defense industrialization not only achieves self-reliance but also enhances export competitiveness (Gindarsah & Priamarizki, 2015).

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The objective of this study is to analyze the future trajectory of Indonesia's defense industrialization through the lens of the forced autonomy model. Building empirical evidence and international best practices, this study employs diagnostic tools such as Ishikawa root-cause mapping and policy gap analysis to identify structural barriers and design a strategic roadmap for 2045 (Damanik et al., 2024). In doing so, this paper seeks to fill a critical gap in literature by linking conceptual framework of enforced autonomy with practical policy instruments to drive Indonesia's long-term defense resilience.

2. Materials and methods

2.1. Research Design

This study adopts a qualitative descriptive research design integrated with a policy analysis framework aimed at diagnosing systemic bottlenecks and exploring the potential role of the *forced autonomy model* in Indonesia's Defense Industrialization 5.0. A case study approach was employed, positioning Indonesia's defense industrial ecosystem as a single bounded case within the Southeast Asian context (2020–2025) and focusing on its transition trajectory from Industry 3.0 maturity levels toward the envisioned Industry 5.0 paradigm. This design is suitable for addressing "how" and "why" questions in institutional transformation, particularly in complex, multiactor sectors such as defense, where causal linkages are not easily quantifiable (Creswell & Poth, 2016; Yin, 2017).

2.2. Data collection

Data were collected via a triangulated strategy to enhance credibility and robustness. Four complementary techniques were applied:

1. Document Review: Analysis of key national and sectoral documents, including *Rencana Pembangunan Jangka Panjang Nasional* (RPJPN 2025–2045), strategic guidelines from the Ministry of Defense and KKIP, transformation plans from the Defend ID holding company, and legislative instruments regulating defense procurement and local content (TKDN).
2. Academic Literature Review: Targeted searches of Scopus-indexed journals and defense policy reports, particularly on industrial policy, defense innovation, and the integration of AI and autonomous systems.
3. Semi-Structured Expert Interviews: Engagement with 15 stakeholders, including policymakers (Ministry of Defense, KKIP), engineers from BUMNIS (e.g., PT Pindad, PT DI, PAL, LEN), defense procurement experts, and scholars specializing in military innovation.
4. Participant Observation: Attendance at defense expos and public forums (e.g., Indo Defense Expo), allowing observation of stakeholder interactions and defense industry narratives.

In addition, benchmarking with international cases, South Korea, Turkey, and Singapore, was incorporated to contextualize Indonesia's trajectory and assess the potential application of enforced autonomy strategies in comparable settings.

2.3. Analytical Framework

The study employed a multilayered analytical framework combining four diagnostic and prescriptive tools:

1. Ladder of Arms Production (Alami et al., 2025; Krause, 1992), to classify Indonesia's defense industrial maturity within six stages, from licensed assembly to full-spectrum innovation, and benchmark it against global producers.
2. Ishikawa (Fishbone) diagram (Karkhanis & Thompson, 2020) to map the root causes of industrial stagnation across six domains: leadership, production capability, human capital, materials and supply chains, regulation, and market access.
3. The policy gap model (Daneswara & Nasution, 2024; Scott, 1998) is used to assess mismatches between Indonesia's current defense industrial capacity and future objectives, particularly in alignment with RPJPN 2045.
4. The forced autonomy model, operationalized as a normative and prescriptive lens to evaluate state-driven enforcement mechanisms (e.g., presidential directives, mandatory local content enforcement, offset policies with technology transfer, and export facilitation mandates) could accelerate defense against sovereignty. This model was used not only as a conceptual contribution but also as a comparative reference against global best practices in enforced autonomy strategies.

The model itself does not originate from a single theorist but is instead a synthesis of multiple academic contributions on strategic autonomy and state-led industrial policy in the defense sector. Key scholars whose work underpins this framework include (Fiott, 2019), who elaborates on *strategic autonomy* in the context of EU defense industrial policy, and (Meershoek, 2023), who explores the interplay between sovereignty and interdependence in EU military procurement regulation. Further contributions come from Lee & Furter (2009), Savitri (2016), and Mawdsley (2013), who discuss the role of offset policies, technology transfer, and state directives in building national defense industrial capacity.

Taken together, the *forced autonomy model* represents a comprehensive approach to understanding how states can proactively shape their paths toward defense sovereignty through assertive policy instruments while benchmarking their efforts against international practices for strategic optimization.

2.4. Validity and Reliability

Validity was ensured through the triangulation of documents, interviews, and observations, with peer debriefing and reflexive journaling reducing bias. An audit trail supported transparency and replicability. This approach enabled both diagnosis and policy recommendations, using the forced autonomy model to show how Indonesia can institutionalize enforcement as a driver of defense industrialization 5.0 and long-term resilience.

3. Results

3.1. Structural Diagnosis of Indonesia's Defense Industry

The structural evaluation of Indonesia's defense industry reveals a series of persistent and interconnected weaknesses that collectively hinder its transformation into an autonomous, innovation-driven, and globally competitive ecosystem. These weaknesses are not new, but their persistence amidst rapid regional and global defense modernization makes them increasingly urgent. To provide a comprehensive picture, this subsection presents five core dimensions of structural diagnosis: governance fragmentation, technological backwardness, limited domestic content, financial vulnerability, and human capital deficiency. Each dimension is then analyzed through the lens of the *forced autonomy model* to highlight how stronger state-led enforcement could address these shortcomings.

3.1.1. Governance Fragmentation

Governance fragmentation remains one of the most critical barriers to Indonesia's defense against industrial transformation. Although the Defense Industry Policy Committee (KKIP) was established to coordinate strategy across ministries, in practice, its role has remained largely advisory, lacking executive powers or direct budgetary control. This weak authority limits its ability to enforce alignment among the Ministry of Defense, the Ministry of State-Owned Enterprises, and the National Research and Innovation Agency (BRIN). Stakeholder interviews confirm that overlapping mandates have led to duplicated programs, regulatory inertia, and inefficient resource allocation. For example, while Defend ID was formed in 2022 to consolidate key defense SOEs such as PT Pindad, PT DI, PT LEN, and PT PAL, strategic decision-making is still subject to approval from supervising ministries, thereby limiting organizational autonomy.

From the perspective of the *forced autonomy model*, governance fragmentation is a symptom of weak enforcement mechanisms at the national level. Unlike Singapore's DSTA or South Korea's DAPA, which operate under prime ministerial or presidential authority, Indonesia lacks a presidential mandate that vertically integrates defense industrial development into national security objectives. The absence of a binding presidential regulation or a Defense Industrial Act results in a "coordination without compulsion" model, where alignment depends more on goodwill than on enforceable obligations. This governance weakness is perhaps the single greatest structural bottleneck preventing Indonesia from accelerating toward Defense Industrialization 5.0.

3.1.2. Technological Backwardness

Technological capacity is a key determinant of strategic autonomy. Field research and internal reports indicate that most Indonesian defense SOEs still operate with infrastructure that belongs to the industry 2.0–3.0 maturity levels. The production lines in PT Pindad, PT DI, and PT PAL rely heavily on manual fabrication and assembly processes, with limited automation, robotics, or cyber-physical system integration. Although digitalization initiatives have been proposed, including smart manufacturing pilots within Defend ID, their implementation remains at an early stage, with no full-scale adoption as of 2025.

This technological backwardness is particularly problematic compared with regional peers. South Korea's LIG Nex1 and Turkey's TAI have already embraced digital twin simulations, predictive maintenance systems, and AI-powered optimization in their production lines, enabling not only efficiency but also the integration of autonomous systems into their defense platforms. Indonesia's lag reduces its deterrence credibility and limits its ability to participate in high-value joint ventures with global defense OEMs.

Here, again, the *forced autonomy model* provides a corrective path. By embedding digitalization benchmarks into enforceable national policy, for example, mandating that all major production lines reach Industry 4.5 standards by 2026, the state can ensure that digital transformation is not merely aspirational but compulsory. Enforcement mechanisms such as fiscal incentives tied to compliance, penalties for delays, and earmarked funding streams can accelerate the modernization process and reduce Indonesia's technological lag.

3.1.3. Limited Domestic Content

Indonesia's inability to achieve meaningful domestic content, despite TKDN regulations, underscores the gap between regulation and enforcement. In practice, the enforcement of the TKDN is inconsistent, and many critical subsystems, such as avionics, propulsion systems, and electronic modules, are imported under licensed assembly or joint production arrangements.

For instance, in the Harimau medium tank program, only approximately 30–35% of components are locally produced, whereas the remainder rely on imports from Turkey and other suppliers.

This low level of domestic participation is a structural vulnerability, leaving Indonesia exposed to supply disruptions, embargoes, and conditional dependencies. Moreover, the absence of certification regimes prevents local SMEs from qualifying as defense suppliers, thereby excluding them from participation in value chains. As a result, opportunities for indigenous innovation and economic spillover remain underutilized.

From a *forced autonomy* perspective, the solution lies in binding enforcement. TKDN should not be treated as a guideline but as a mandatory threshold, with transparent audits and penalties for noncompliance. Moreover, a vendor certification program, mandating the qualification of at least 300 SMEs by 2027, could be embedded into national policy, thereby creating an enforceable pathway for local suppliers to enter defense value chains.

3.1.4. Financial Vulnerability and Low R&D Investment

The financial fragility of Indonesia's defense SOEs is another significant structural weakness. As of 2024, Defend ID collectively carried debts exceeding IDR 15 trillion, much of which were inherited from legacy liabilities. With shrinking export revenues and limited operational margins, these enterprises remain heavily dependent on state procurement contracts for survival. Compounding this financial strain is the extremely low investment in R&D, averaging less than 1% of gross revenue, far below the 5–10% benchmark among global defense innovators such as Israel and South Korea.

BRIN's role in national research coordination has also been limited by reactive, project-based funding models that lack mission-oriented direction. This underinvestment perpetuates technological stagnation and leaves Indonesia ill-prepared for disruptive technologies such as AI-enabled warfare, quantum encryption, and swarm robotics.

The *forced autonomy model* offers an important corrective here by mandating minimum R&D spending quotas as a percentage of defense SOEs' revenues, linked to performance-based funding allocations. Furthermore, enforced co-financing arrangements with the private sector could help distribute fiscal burdens while stimulating dual-use innovation. Without such compulsory measures, Indonesia risks remaining a consumer rather than a producer of defense innovation.

3.1.5. Human Capital Deficiency

Perhaps the most underestimated structural challenge lies in human capital. The workforce in BUMNIS is aging, with many engineers above 50 years old and possessing limited proficiency in digital tools, AI systems, or systems integration. Recruitment of young STEM graduates remains insufficient, particularly in critical domains such as AI engineering, cybersecurity, material sciences, and autonomous system design. Moreover, university–industry linkages are weak, with minimal collaboration in applied defense R&D.

Countries such as the United States have long recognized the importance of dedicated defense talent pipelines, exemplified by the National Defense Education Program (NDEP). In contrast, Indonesia lacks a comparable national fellowship or cadet program that integrates STEM with defense needs. This talent vacuum restricts innovation capacity and slows technology transfer, undermining Indonesia's long-term resilience.

Here, the *forced autonomy model* suggests embedding mandatory mechanisms for talent renewal. Programs such as the National Defense Engineering Fellowship (NDEF), mandatory curriculum reforms introducing Defense-AI modules in polytechnics and military academies, and the establishment of STEM cadet corps within the armed forces could be enforced as national requirements. These measures ensure a continuous pipeline of digitally skilled engineers capable of driving Defense Industrialization 5.0.

3.2. Gap Analysis Using the Arms Production Ladder

The Arms Production Ladder, originally developed by Krause (1992) and later refined by Alami et al. (2025), provides a structured framework for assessing a country's defense of industrial maturity across six progressive stages: direct import, licensed assembly, component fabrication, reverse engineering, collaborative R&D, and full autonomy in design and innovation. Applying this model to Indonesia's defense industrial ecosystem reveals not only the current developmental gaps but also the structural barriers that prevent upward mobility. More importantly, when analyzed through the lens of the forced autonomy model, Indonesia's stagnation on the ladder is clearly due not only to technical deficits but also to the absence of binding enforcement mechanisms that could compel systemic transformation.

3.2.1. Stages 1 and 2: Import Dependence and Licensed Assembly

Indonesia has long oscillated between Stage 1 (direct imports) and Stage 2 (licensed assembly). Major procurement programs such as fighter aircraft acquisitions, naval platforms, and missile systems continue to rely heavily on foreign suppliers. While licensed assembly arrangements, such as the Harimau medium tank in collaboration with Turkey and the CN-235 aircraft with Spain, have contributed to basic manufacturing capabilities, they have offered limited technology transfer or intellectual

property rights. This reflects a structural pattern in which Indonesia functions more as a consumer and assembler than as an innovator in defense technologies.

From a *forced autonomy* standpoint, this persistent reliance on licensed assemblies highlights the absence of mandatory offset and technology transfer clauses. Countries such as South Korea deliberately embedded contractual requirements for coproduction and intellectual property sharing, enabling a gradual climb up the ladder (Park, 2024). In Indonesia's case, licensed assembly deals have remained transactional rather than transformational because they lack binding obligations for local knowledge transfer.

3.2.2. Stage 3: Component Fabrication

Progress toward Stage 3, where domestic industries begin to fabricate specific components for defense systems, has been sporadic and uneven. Some limited progress has been achieved in producing low-tech components, such as vehicle chassis and structural parts for aircraft. However, Indonesia remains critically dependent on imports for advanced subsystems such as avionics, propulsion, radar, and electronic warfare modules. The lack of domestic precision machining and aerospace-grade material capabilities further constrain component fabrication.

Through the *forced autonomy model*, this stagnation reflects weak or nonexistent vendor certification systems. Without enforced certification schemes to qualify SMEs as defense-grade suppliers, local industries remain excluded from higher-value segments of the defense supply chain. In contrast, Turkey created state-enforced SME development programs that compelled foreign contractors to integrate local vendors into their supply chains (Adaçay & Misirlioğlu, 2023. For Indonesia, enforcing similar mechanisms could accelerate the progression from component assembly to subsystem fabrication.

3.2.3. Stage 4: Reverse Engineering

Reverse engineering, often considered controversial, is nonetheless a transitional strategy employed by many emerging defense industries to acquire tacit knowledge and reduce dependency. Indonesia's experience in this domain has been minimal. While some efforts have been made in developing UAV prototypes and refurbishing imported systems, regulatory barriers, limited technical capabilities, and risk aversion have prevented large-scale reverse engineering initiatives.

From the standpoint of enforced autonomy, this reflects an absence of state-backed mandates for experimental prototyping. Reverse engineering is not merely a technical exercise but also a political choice. For example, China advanced rapidly through enforced reverse engineering programs supported by the state (Kania, 2020). Without similar enforcement, Indonesian institutions remain risk averse, prioritizing compliance with international licensing agreements over long-term sovereignty.

3.2.4. Stage 5: Collaborative R&D

Indonesia's presence at Stage 5, which involves collaborative R&D with international partners, is limited to a handful of projects and remains largely symbolic. For example, joint ventures in UAV development between universities and small domestic startups have produced demonstrators but lack industrial follow-through. International collaborations tend to prioritize foreign technology dominance, leaving Indonesia in a subordinate role.

An enforced autonomy approach would mandate collaborative R&D agreements include co-ownership of intellectual property, co-financing of research projects, and mandatory joint prototyping. Turkey, for instance, embedded such clauses into its partnerships, ensuring that collaboration led to capacity building rather than dependency (Adaçay & Misirlioğlu, 2023). Without enforceable rules, Indonesia's collaborative projects risk becoming token exercises rather than substantive leaps toward autonomy.

3.2.5. Stage 6: Full autonomy in design and innovation

Stage 6 represents the ultimate aspiration, full-spectrum autonomy in design, innovation, and production of defense systems. Indonesia remains far from achieving this stage. While some indigenous prototypes, such as UAVs developed by research universities, exist, these initiatives often lack state funding, scalability, or integration into procurement cycles.

On the basis of document analysis and stakeholder feedback, Indonesia remains largely entrenched at Stage 2 of defense industrial development, as shown in Table 1. This stage is characterized by reliance on licensed assembly agreements with foreign manufacturers, such as the Harimau medium tank developed in collaboration with Turkey and the CN-235 aircraft with Spain. While these programs contribute to domestic manufacturing capabilities, they offer limited transfer of knowledge and intellectual property rights.

Here, the *forced autonomy model* emphasizes the need for national mandates for indigenous product pipelines. For example, a policy that requires at least three fully indigenous platforms to achieve international certification by 2030 could provide an enforceable target. Without such obligations, Indonesia risks remaining stuck perpetually in lower stages of the ladder.

3.2.6. Implications of Gap Analysis

The gap analysis reveals a four-stage developmental deficit between Indonesia's current position (Stage 2) and its long-term aspirations (Stage 6). This gap is not just technical but also institutional and political. While Indonesia has ambitions for autonomy, the absence of enforceable policies, whether in TKDN, offset arrangements, vendor certification, or indigenous product mandates, ensures that progress remains slow and fragmented.

Table 1 Indonesia's Position in the Arms Production Ladder.

Stage	Description	Indonesia's Status
Stage 1	Direct Import	Frequently applied
Stage 2	Licensed Assembly	Dominant model
Stage 3	Component Fabrication	Limited capability
Stage 4	Reverse Engineering	Minimal
Stage 5	Collaborative R&D	Few international projects
Stage 6	Full Autonomy in Design & Innovation	Not yet attempted

Source: Adapted from Krause (1992), Alami et al. (2025), and stakeholder interviews.

By applying the *forced autonomy model*, these gaps can be reframed not as insurmountable challenges but as governance failures that can be corrected through stronger state intervention. Enforcing technology transfer, mandating SME integration, institutionalizing reverse engineering, and setting compulsory indigenous development targets would transform Indonesia's defense industry from a consumer into a producer.

3.3. Root Cause Mapping (Fishbone Diagram)

To further unpack the underlying barriers that constrain Indonesia's defensive industrial transformation, the Ishikawa or fishbone diagram was employed. This diagnostic tool enables a systematic categorization of problems into multidimensional "bones," each representing a distinct domain of stagnation. For Indonesia, six domains were identified as critical: leadership, production capability, human capital, materials and supply chain, regulation and policy, and market access. The strength of this approach lies in its ability to reveal the interconnections between barriers, emphasizing that these are not isolated weaknesses but mutually reinforcing systemic problems. When analyzed through the lens of the *forced autonomy model*, the findings highlight that the persistence of these root causes is less about technical incapacity and more about the absence of binding enforcement mechanisms.

3.3.1. Leadership Deficiencies

Leadership challenges are perhaps the most foundational barrier. The lack of a long-term mandate for defense industrialization enshrined in national legislation has resulted in ad hoc and fragmented strategies. Without a presidential-level directive, there is no single authority capable of synchronizing policies across ministries, defense SOEs, and research institutions. The result is a fragmented vision in which the Ministry of Defense prioritizes procurement needs, the Ministry of SOEs emphasizes financial restructuring, and research agencies pursue academic outputs with limited industrial application.

The *forced autonomy model* suggests that leadership deficiencies can be resolved only by institutionalizing a presidential mandate, such as the National Strategy on Defense Industrialization 5.0 (RIPIN-5) issued via presidential regulation. This would provide a 20-year charter aligned with RPJPN 2045, ensuring strategic clarity, budgetary discipline, and mandatory KPIs across all institutions.

3.3.2. Production capability gaps

Indonesia's production capacity remains hindered by deficiencies in precision machining, heat treatment, aerostructure fabrication, and testing facilities. Overreliance on manual assembly lines means that production remains labor intensive, slow, and prone to quality inconsistencies. Moreover, limited investment in dual-use infrastructure prevents defense industries from benefiting from economies of scale with civilian sectors.

From an enforced autonomy perspective, these gaps persist because there are no mandatory modernization benchmarks. For example, the absence of national requirements for Industry 4.5 integration allows SOEs to postpone digitalization indefinitely. Enforcing a policy that mandates digital twin deployment by 2030 or that requires at least three smart factory pilots by 2028 would compel industry actors to modernize rather than merely plan.

3.3.3. Human Capital Limitations

The aging workforce in defense SOEs (BUMNIS) and the insufficient recruitment of next-generation experts represent critical weaknesses. Current recruitment pipelines do not adequately address the shortage of AI engineers, cybersecurity specialists, or system integrators, roles central to Defense Industrialization 5.0. Furthermore, weak linkages between universities and industry limit opportunities for applied defense innovation.

The *forced autonomy model* reframes this as a failure of enforcement in human capital development. Programs such as the National Defense Engineering Fellowship (NDEF), which mandates overseas training with return-service obligations, or the establishment of STEM cadet corps within the armed forces, would institutionalize talent renewal. Curriculum reforms introducing defense-AI modules into polytechnics and military academies could be made compulsory, ensuring that workforce renewal is not optional but enforced by policy.

3.3.4. Materials and Support Chain Weaknesses

Indonesia lacks the domestic capacity to produce strategic materials such as titanium alloys, aerospace-grade composites, and microprocessors. The absence of a national reserve of rare metals further exacerbates supply chain vulnerability. Compounding this is the lack of certification regimes that would allow local SMEs to qualify as defense suppliers, preventing them from contributing to high-value production.

The persistence of these weaknesses reflects the absence of an enforced supply chain strategy. The *enforced autonomy model* suggests that a state-managed strategic reserve for rare materials must be mandated alongside a vendor certification program that trains and certifies at least 300 SMEs by 2027. Without such enforcement, Indonesia will remain locked in dependency on foreign suppliers.

3.3.5. Regulation and Policy Gaps

Regulatory weaknesses manifest in three ways: weak enforcement of TKDN regulations, lack of incentives for R&D or defense exports, and procurement cycles that exclude emerging technologies. Existing TKDN policies are often bypassed, R&D remains underfunded, and procurement officers tend to favor proven platforms over experimental innovation.

This reflects a gap between policy aspirations and actual enforcement. The *forced autonomy model* proposes the creation of binding mechanisms, such as mandatory innovation quotas in defense procurement, tax breaks tied to R&D expenditures, and penalties for failing to meet TKDN thresholds. Without enforceable instruments, regulatory frameworks remain symbolic rather than transformative.

3.3.6. Market Access Constraints

Finally, market access remains one of the most underdeveloped aspects of Indonesia's defense industrial ecosystem. Domestic procurement is unpredictable and often dictated by short-term budget cycles, whereas defense exports lack institutional support. Despite the regional demand for affordable platforms, Indonesia has no institutionalized export strategy and no dedicated export facilitation agency.

To further unpack the underlying barriers that constrain Indonesia's defensive industrial transformation, the Ishikawa or fishbone diagram was employed. This diagnostic tool enables a systematic categorization of problems into multidimensional "bones," each representing a distinct domain of stagnation. For Indonesia, six domains were identified as critical: leadership, production capability, human capital, materials and supply chain, regulation and policy, and market access.

The strength of this approach lies in its ability to reveal the interconnections between barriers, emphasizing that these are not isolated weaknesses but mutually reinforcing systemic problems. The overarching bottleneck is not simply technological backwardness but rather the absence of binding enforcement mechanisms that ensure coherent progress across all fronts.

This fishbone diagram illustrates that each root cause, be it leadership voids, policy inertia, human capital gaps, or inadequate market facilitation, traces back to a common structural deficit: the lack of state-enforced mandates. Whether in the form of absent presidential directives, noncompulsory digitalization standards, or voluntary recruitment and certification schemes, the recurring issue is the nonbinding nature of national initiatives (Figure 1).

When analyzed through the forced autonomy model, the findings underline a critical insight: technical capacity alone will not lead to transformation without a state apparatus that enforces modernization targets, synchronizes institutional mandates, and holds stakeholders accountable through clearly defined performance indicators (KPIs).

Thus, reform must move beyond aspirational roadmaps toward a regulatory regime that institutionalizes defense industrialization as a mandatory, cross-sectoral national mission.

3.3.7. Synthesis of Root Causes

The fishbone analysis demonstrated that Indonesia's defense industry stagnation is systemic, multidimensional, and deeply interconnected. Leadership failures weaken governance; production gaps hinder efficiency; human capital deficiencies limit innovation; supply chain vulnerabilities perpetuate dependency; regulatory gaps undermine policy credibility; and market access constraints reduce competitiveness.

Viewed holistically, these are not simply technical or managerial problems. They are fundamentally enforcement problems. Indonesia does not lack strategies, but it lacks mechanisms to compel compliance, align incentives, and punish

nonperformance. The *forced autonomy model* thus provides the missing link, by converting policy intentions into binding obligations, it transforms aspirations into enforceable commitments.

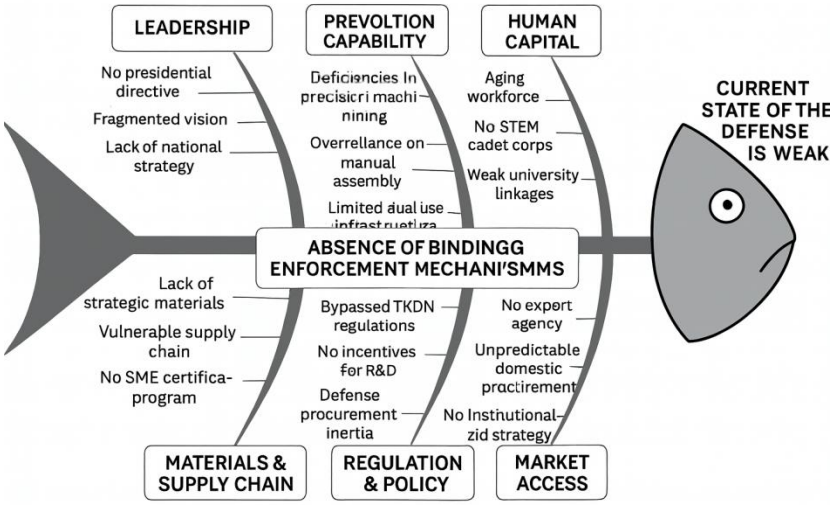

Figure 1 Root cause analysis of Indonesia's weak defense industry performance: fishbone (Ishikawa) diagram.
Source: Adapted from Karkhanis & Thompson (2020) and modified by the author on the basis of stakeholder interviews and policy analysis.

3.4. Strategic Roadmaps Proposed

Building upon structural diagnosis, gap analysis, and root cause mapping, this study proposes a comprehensive set of six interlinked strategic roadmaps to guide Indonesia's defensive industrial transformation toward 2045. These roadmaps, Human Capital, Production Line Digitalization, Material & Component Ecosystem, Defense Product Priority Plan, Market Mastery, and Policy & Governance Reform are designed not as isolated initiatives but as mutually reinforcing pathways. The central principle underpinning them is the *forced autonomy model*, which frames each roadmap as an enforceable mandate rather than a voluntary aspiration. By embedding compulsory mechanisms, Indonesia can avoid the pitfalls of fragmented implementation and ensure progress toward Defense Industrialization 5.0.

3.4.1. Human Capital Roadmap

The first roadmap addresses the structural talent deficit that hampers innovation and adoption of advanced technologies. Key initiatives include the National Defense Engineering Fellowship (NDEF), which would sponsor Indonesian engineers to study leading global defense institutions under return-service obligations; curriculum reforms to integrate defense-AI and cybersecurity modules into polytechnics and military academies; and the creation of a STEM cadet corps within military branches to fast-track technical leadership. While talent pipelines are often proposed in policy documents, the *forced autonomy model* transforms these pipelines into binding national mandates. For example, participation in NDEF could be enforced through state funding tied to service contracts, whereas universities could be legally required to integrate defense innovation curricula by 2027. These compulsory measures ensure the continuous replenishment of digitally skilled engineers, bridging the generational gap in BUMNIS.

3.4.2. Production Line Digitalization Roadmap

The second roadmap focuses on accelerating the modernization of industrial facilities. By 2026, all major production lines in PT Pindad, PT DI, and PT PAL must achieve Industry 4.5 digital integration benchmarks, including automation, robotics, and smart data systems. By 2030, digital twin technologies should be deployed to enable simulation-based design and predictive maintenance across all new platforms. To build operational experience, at least three smart factory pilot programs must be initiated by 2028. The *forced autonomy model* reframes these not as optional modernization targets but as legal obligations tied to procurement eligibility and state financing. For example, state contracts could mandate compliance with Industry 4.5 benchmarks as a prerequisite for funding, whereas delays in digitalization could trigger fiscal penalties. Such enforcement mechanisms would close the implementation gap that has historically undermined Indonesia's industrial transformation.

3.4.3. Material and Component Ecosystem Roadmap

A resilient defense industry requires secure access to strategic materials and certified local suppliers. This roadmap proposes a vendor certification program to train and certify 300 SMEs for defense-grade production by 2027, thereby expanding the domestic supply base. Simultaneously, the state must establish strategic reserves for rare materials such as

Titanium and Cobalt, which are essential for aerospace and naval platforms. Finally, a dual-use technology accelerator under BRIN–KKIP supervision will incubate civilian startups with defense application potential. Within the enforced autonomy framework, these initiatives become compulsory. Certification targets for SMEs could be written into law, whereas strategic reserves could be managed under presidential authority to prevent geopolitical supply disruptions. By enforcing these measures, Indonesia can mitigate dependency and stimulate domestic innovation.

3.4.4. Defense Product Priority Plan

The fourth roadmap identifies key technological focus areas to concentrate resources: unmanned aerial vehicles (UAVs) and AI-enabled ISR platforms, maritime autonomous surface vessels (ASVs), and secure communication suites integrated with C5ISR capabilities. To operationalize this focus, the roadmap mandates that at least three indigenous platforms must undergo full-cycle development and achieve international certification by 2030. This shifts product development from scattered initiatives to a legally enforceable pipeline. Under the *forced autonomy model*, procurement policies require ministries and SOEs to prioritize these indigenous platforms, ensuring that they are not sidelined in favor of foreign acquisitions. This creates a demand-pull mechanism that compels industry actors to deliver.

3.4.5. Market Mastery Roadmap

The fifth roadmap addresses Indonesia's weak defense export performance. Core initiatives include an ASEAN Integration Strategy, coordinating with the ASEAN Defense Ministers' Meeting (ADMM) to pursue joint production and procurement; the creation of a Defense Export Promotion Agency (DEPA) by 2028 to facilitate negotiations, sales, and aftermarket support; and offsetting policy reform mandating technology transfer in all foreign defense acquisitions above USD 50 million. Under enforced autonomy, export readiness is embedded into product design, and the DEPA is legally mandated to institutionalize export promotion. This ensures that defense diplomacy becomes part of Indonesia's foreign policy toolkit, positioning the country as a "Global South Arsenal" that supplies cost-effective, interoperable platforms to emerging markets.

3.4.6. Policy & Governance Roadmap

The final roadmap serves as the institutional backbone. It calls for the issuance of a National Strategy on Defense Industrialization 5.0 (RIPIN-5) via Presidential Regulation, providing a 20-year charter aligned with RPJPN 2045. The RIPIN-5 mandates performance KPIs across all institutions, enforces interministerial synchronization, and ensures accountability. Additionally, KKIP must be restructured into an executive agency with budgetary control, whereas BRIN and Defend ID should be integrated under a unified command framework for defense innovation. Through the *forced autonomy model*, these governance reforms become enforceable state obligations rather than advisory guidelines, thereby resolving the chronic leadership fragmentation diagnosed earlier.

3.4.7. Synthesis of the Six Roadmaps

Taken together, the six roadmaps form a cascading system of enforced autonomy. Human capital mandates supply skilled talent; digitalization benchmarks modernize production; material and SME certification ensures resilient supply chains; product priorities channel R&D into indigenous platforms; export enforcement integrates defense diplomacy; and governance reforms provide the leadership spine to synchronize all efforts. Without enforcement, these initiatives risk remaining aspirational. With enforcement, they become the backbone of a coherent and binding strategy.

Building upon structural diagnosis and root cause mapping, this study proposes six interlinked strategic roadmaps to guide Indonesia's defensive industrial transformation toward 2045. These include Human Capital, Production Line Digitalization, Material & Component Ecosystem, Defense Product Priority Plan, Market Mastery, and Policy & Governance Reform, which are all designed as mutually reinforcing systems.

What sets this approach apart is that each roadmap is embedded within the forced autonomy model, making them legally enforceable mandates rather than aspirational policies. Implementation is ensured through binding mechanisms such as presidential regulations, budgetary conditions, and procurement-linked obligations, eliminating the policy fragmentation seen in previous reforms, as shown in Figure 2.

The diagram above visualizes the relationships among the roadmaps. At its core, the forced autonomy model serves as the scaffolding that binds each roadmap with enforceable mechanisms. The upper layers, human capital, production line digitalization, and the material and component ecosystem, supply the industrial base with talent, technology, and inputs. The next tier, Defense Product Priorities and Market Mastery, focuses these inputs on outcomes that are both nationally strategic and globally competitive. Finally, the Policy & Governance Reform acts as the foundation that synchronizes, monitors, and enforces these efforts across institutions.

By embedding enforcement in every layer, from talent pipelines to export mandates, this cascading structure ensures that Indonesia's defense industrialization is not left to voluntary compliance but driven by binding national strategies aligned with RPJPN 2045. This integrated and enforceable roadmap system forms the backbone of Defense Industrialization 5.0.

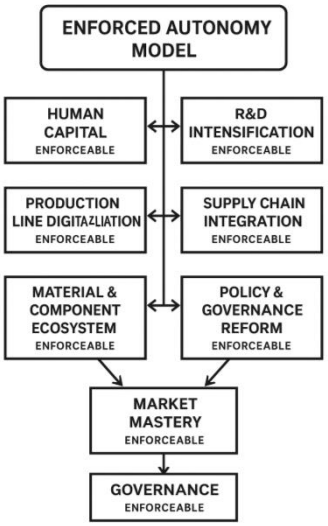

Figure 2 Cascading strategic roadmaps anchored in the forced autonomy model.

4. Discussion

4.1. Strategic Implications of Enhanced Autonomy

The application of the *forced autonomy model* to Indonesia's defense industrialization trajectory reveals a critical redefinition of strategic transformation. Traditionally, industrial reform in the defense sector has been approached as a gradual process of capacity building, dependent on voluntary compliance, discretionary resource allocation, and fragmented institutional initiatives. This incrementalist approach has produced some progress, such as the formation of Defend ID and the partial enforcement of local content (TKDN) regulations, but overall outcomes remain modest, inconsistent, and vulnerable to reversal. By introducing enforcement as a central organizing principle, the forced autonomy model reframes defense industrialization not as a set of aspirational reforms but as a compulsory structural realignment embedded in law, governance, and policy instruments.

Strategically, enforced autonomy has three key implications for Indonesia. First, it elevates defense industrialization into the national security domain by binding it to presidential authority. This mirrors the experience of South Korea's Defense Acquisition Program Administration (DAPA), which directly reports to the president and therefore integrates industrial planning with strategic defense requirements (Chung-In, 2017; Park, 2024). In Indonesia, the absence of such a mandate has allowed sectoral interests to dilute reform agendas. By making defense industrialization a matter of presidential directive, the model ensures strategic clarity, prioritization in budget allocation, and enforcement of interministerial discipline.

Second, enforced autonomy shifts innovation incentives from optional to obligatory. Under current arrangements, defense SOEs may engage in R&D or digitalization if resources permit, but they face no binding requirement to do so. As a result, R&D intensity remains below 1% of gross revenues, and modernization initiatives are often delayed. Through enforcement, however, innovation becomes a legal obligation, for example, mandating that a minimum of 5% of revenues be allocated to R&D, tied to fiscal incentives and procurement eligibility. This transforms innovation from a discretionary cost into a strategic necessity, accelerating Indonesia's technological leap toward Industry 5.0 standards.

Third, the model embeds export readiness and defense diplomacy into industrial policy. Historically, Indonesian defense platforms have been developed primarily for domestic use, with exports treated as supplementary opportunities rather than strategic objectives. Enforced autonomy compels the integration of export certification, aftermarket support, and regional defense diplomacy into the product development cycle. This transforms export promotion from an optional pursuit into a state-mandated strategy, thereby positioning Indonesia as a "Global South Arsenal" capable of offering modular, interoperable, and cost-effective platforms to emerging markets.

The overarching implication is that without enforcement, Indonesia risks remaining trapped in a cycle of partial reforms, dependent procurement, and limited innovation. With enforcement, however, the country can reorient its defense industry into a disciplined, innovation-driven, and globally competitive ecosystem. In short, enforcement is not merely a governance tool; it is the structural backbone that transforms policy aspirations into tangible industrial autonomy.

4.2. Benchmarking with Regional and Global Cases

Comparative analysis of international defense industrialization experiences offers valuable lessons for Indonesia, particularly regarding the role of enforced autonomy in overcoming structural stagnation. The cases of South Korea, Turkey,

and Singapore illustrate how state-led enforcement mechanisms can transform vulnerable, import-dependent industries into globally competitive defense ecosystems within two to three decades.

South Korea presents one of the most relevant precedents. In the aftermath of the Korean War, its defense industry was almost entirely dependent on U.S. imports. However, the establishment of the Defense Acquisition Program Administration (DAPA), which is directly accountable to the president, institutionalized a centralized command structure (Chung-In, 2017). Enforcement mechanisms such as mandatory local participation in procurement contracts, state-directed cofinancing of R&D, and compulsory SME integration gradually shifted South Korea from licensed assembly (Stage 2) to indigenous production and export competitiveness (Stages 5–6 of the Arms Production Ladder). Today, Korean defense companies such as Hanwha and the LIG Nex1 are not only self-sufficient but also leading exporters, underscoring the effectiveness of enforcement in catalyzing autonomy.

Turkey's *trajectory* provides another compelling example. Historically reliant on NATO suppliers, Turkey began enforcing offset policies in the 1980s, requiring foreign contractors to integrate local vendors and transfer technology (Adaçay & Misirlioğlu, 2023; Kurc et al., 2024). Over time, these policies evolved into a more assertive form of enforced autonomy, compelling indigenous development of UAVs, armored vehicles, and missile systems. By embedding strict contractual obligations and leveraging state funding, Turkey transformed dependency into innovation leadership. The Bayraktar UAV program exemplifies this shift: what began as modest prototyping became a globally exported platform, widely deployed in conflicts and recognized for its cost-effectiveness. This success demonstrates how enforcement can compensate for resource constraints by structuring innovation incentives and ensuring institutional discipline.

Singapore highlights the role of governance enforcement. Despite its small domestic market, Singapore has institutionalized the Defense Science and Technology Agency (DSTA), which reports directly to the prime minister (Xie et al., 2021). DSTA's mandate ensures alignment across defense planning, procurement, and innovation. Through the compulsory integration of the private sector and academic actors, Singapore created a defense ecosystem that balances autonomy with strategic international partnerships. Enforcement mechanisms such as strict performance audits and centralized oversight have allowed Singapore to innovate efficiently despite resource limitations, making it a benchmark for governance effectiveness.

These cases provide three core lessons for Indonesia. First, the enforcement of presidential or prime ministerial authority is indispensable for preventing fragmentation and ensuring cross-ministerial alignment. Second, offset and localization policies must evolve into enforceable contracts that mandate SME participation and technology transfer rather than symbolic guidelines. Third, institutionalized export promotion is critical for scaling industrial growth beyond domestic procurement cycles. Each of these lessons aligns with the proposed forced autonomy model, affirming its relevance as a framework for Indonesia's Defense Industrialization 5.0.

4.3. Policy recommendations in the lens of enhanced autonomy

The findings of this study emphasize that Indonesia's defense against industrialization challenges is not rooted solely in technical or resource limitations but also in the weak enforcement of existing policies. Thus, the pathway forward must prioritize binding mechanisms that convert aspirations into obligations. Policy recommendations framed within the *forced autonomy model* emphasize enforceable instruments in leadership, innovation, supply chains, product development, exports, and governance. These recommendations are supported by existing theoretical perspectives in the field of defense policy and autonomy (Hartley, 2012; Fiott, 2019; Creswell & Poth, 2016; Markowski et al., 2009).

First, enforce presidential authority through the RIPIN-5. A National Strategy on Defense Industrialization 5.0, issued via presidential regulation, should serve as a 20-year charter aligned with RPJPN 2045. Unlike existing sectoral roadmaps, RIPIN-5 must carry legal force, mandating performance-based KPIs across ministries, SOEs, and research institutions. This aligns with the findings of Fiott (2019), who argued that presidential mandates are critical in overcoming policy fragmentation in dual-use sectors, particularly in nations seeking strategic autonomy through industrial policy.

Second, innovation obligations in R&D and production should be enforced. Defense SOEs should be legally required to allocate a minimum percentage of annual revenues, at least 5%, to R&D, with compliance linked to state contract eligibility. Digitalization targets, such as achieving Industry 4.5 benchmarks by 2026 and deploying digital twin systems by 2030, should be codified into enforceable procurement criteria. These mechanisms ensure that innovation is no longer discretionary but rather a condition for institutional survival. This reflects lessons learned from Kim (2015), whose study on South Korea's autonomous defense R&D model shows that long-term procurement commitments and binding R&D obligations can drive national technological sovereignty and reduce foreign dependency. However, strict enforcement mechanisms must be applied carefully. In highly regulated sectors, overly rigid mandates can unintentionally suppress innovation and trigger institutional resistance if not accompanied by adaptive flexibility (Iftikhar et al., 2025).

Third, ensure accountability in digital transformation by integrating performance-based governance, transparent tracking systems, and interagency alignment. As Bitzinger (2015) notes in his analysis of developing countries' defense markets, fragmented implementation without oversight often leads to inefficiencies and policy failure.

Fourth, *enforce indigenous product pipelines.* A Defense Product Priority Plan must legally obligate at least three indigenous platforms, such as UAVs and ASVs, and secure C5ISR suites to undergo full-cycle development and achieve

international certification by 2030. Embedding export readiness into product design ensures that Indonesia's platforms are competitive in global markets, transforming industrial output from domestic consumption to international relevance.

Fifth, *market mastery should be enforced through institutionalized export promotion.* The establishment of a Defense Export Promotion Agency (DEPA) by 2028 should be mandated by law, with the authority to manage negotiations, facilitate after-market support, and integrate export promotion into defense diplomacy. Furthermore, offsetting policy reform must require technology transfer clauses in all foreign defense acquisitions above USD 50 million, ensuring reciprocal benefits from international procurement.

Finally, *governance reform should be enforced by restructuring KKIP.* Converting KKIP into an executive agency with budgetary control and integrating BRIN and defending ID under its command framework would streamline defense innovation governance. With presidential backing, this restructuring would end the chronic fragmentation of responsibilities across ministries.

Collectively, these recommendations operate the enforced autonomy model by embedding autonomy into law, budgetary instruments, and institutional design. Rather than depending on voluntary compliance, Indonesia would enforce its path to Defense Industrialization 5.0, ensuring resilience, innovation, and competitiveness by 2045.

4.4. Risks and mitigation strategies

While the forced autonomy model offers a compelling pathway to accelerate Indonesia's defense industrialization 5.0, it is not without potential risks. Enforcement mechanisms, if poorly designed or implemented rigidly, may generate unintended consequences such as bureaucratic overload, fiscal strain, talent drain, or even technological isolation (Cheung, 2021; Hartley, 2012). Policymakers must avoid a one-size-fits-all enforcement approach, particularly in sectors requiring cross-institutional cooperation. Operational enforcement must be balanced with participatory governance (Ghimire, 2025; Sarjito & Lelyana, 2024) A balanced approach is therefore necessary, one that recognizes enforcement as indispensable but tempers it with adaptive flexibility.

4.4.1. Risk 1: Bureaucratic Overload.

The institutionalization of enforcement measures, such as the RIPIN-5 mandate, SME certification programs, or innovation quotas, may generate administrative burdens. Without adequate capacity, enforcement risks degenerating into excessive bureaucracy that slows decision-making rather than accelerating reform. To mitigate this, Indonesia must streamline enforcement through digital monitoring systems and performance dashboards. Instead of creating new layers of bureaucracy, technology-enabled oversight can track compliance efficiently, reducing administrative friction (Cheung, 2021). Experiences in the UK aerospace sector suggest that resilience-building efforts fail when enforcement is not accompanied by capability investment and industry alignment mechanisms (Markowski et al., 2009; Patton & Jahankhani, 2026).

4.4.2. Risk 2: Fiscal overextension.

Mandating R&D spending quotas, smart factory pilots, and strategic reserves entail significant fiscal commitments. In a constrained budget environment, aggressive enforcement could strain defense finances and crowd out other priorities. This risk can be mitigated through cofinancing schemes with private sector actors, leveraging dual-use technology accelerators, and implementing public–private partnerships (PPPs). Such arrangements distribute financial burdens while stimulating innovation that benefits both civilian and defense sectors (Hartley, 2012; Hervas-Oliver et al., 2022).

4.4.3. Risk 3: Talent Drain and Institutional Resistance.

The enforcement of fellowship obligations and STEM cadet programs may lead to resistance from established institutions or failure to retain talent if domestic conditions remain unattractive. The risk is that highly trained personnel, once exposed to global opportunities, may seek careers abroad. Mitigation requires competitive compensation packages, research autonomy, and career progression pathways to ensure that enforced programs translate into long-term retention. Incentive mechanisms must complement compulsion to sustain motivation (Bitzinger, 2015; Li, 2024).

4.4.4. Risk 4: Technological isolation.

Enforced localization policies, if pursued excessively, could lead to technological isolation. Overreliance on domestic solutions without sufficient international collaboration risks technological stagnation and reduced interoperability with allies. Mitigation requires balanced enforcement, where local content rules are strict enough to build autonomy but flexible enough to allow selective global partnerships. Enforcement should compel meaningful technology transfer in foreign acquisitions rather than blocking them outright (Bitzinger, 2015; Nouwens & Legarda, 2018).

4.4.5. Risk 5: Political Turnover and Policy Inconsistency.

Finally, the sustainability of enforced autonomy depends on political will. Changes in leadership could dilute or reverse mandates, undermining long-term consistency. To mitigate this, enforcement mechanisms must be enshrined in law, such as through a presidential regulation with parliamentary endorsement, ensuring that defense industrialization is protected from short-term political cycles (Kotila et al., 2023).

While the forced autonomy model offers a strong framework, its implementation carries risks such as bureaucratic overload, fiscal strain, talent loss, and technological isolation. These challenges require careful mitigation to ensure that enforcement drives progress without creating new bottlenecks. Table 2 outlines key risks, their implications, and practical mitigation strategies to maintain a balance between compulsion and adaptability.

Table 2 Risk Mitigation Matrix for Defense Industrialization 5.0.

Risk	Implication	Mitigation Strategy
Bureaucratic Overload	Excessive mandates may slow down reform through admin burden	Use digital dashboards and streamline enforcement procedures
Fiscal Overextension	Budget strain may undermine other sectors	Use PPPs, dual-use R&D, and co-financing to share burden
Talent Drain & Resistance	Engineers may leave; institutions may resist reforms	Combine fellowships with incentives, career pathways, autonomy
Technological Isolation	Overlocalization may limit innovation and interoperability	Allow selective global partnerships and enforce tech transfer
Political Turnover	Leadership change may reverse long-term strategy	Legalize mandates through presidential regulation with oversight

Source: Developed by the authors on the basis of stakeholder interviews and risk modeling (2024–2025).

As shown, each risk can be addressed through targeted policy tools, ranging from digital oversight and blended finance to legal mandates and global partnerships, ensuring that enforcement remains effective yet responsive.

4.5. Novel Contribution of the Study

This study offers a novel contribution to the literature on defense industrialization by introducing and applying the *forced autonomy model* as both an analytical lens and a prescriptive framework for Indonesia's Defense Industrialization 5.0. While previous studies have extensively mapped Indonesia's industrial stagnation, fragmented governance, and technology deficits (Damanik et al., 2024; Daneswara & Nasution, 2024; Surahman et al., 2024), few have articulated how enforcement itself, understood as the binding conversion of policy aspirations into compulsory mandates, can function as the missing link between diagnosis and transformation.

The originality of this study lies in three key areas. Conceptually, it reframes industrial autonomy as the result of enforceable state action via presidential authority, fiscal obligations, and legal instruments rather than passive capacity building. Methodologically, it combines the fishbone diagram, the policy gap model, and the Arms Production Ladder with the forced autonomy model to link diagnosis with action. Practically, the six strategic roadmaps show how enforcement can be applied across all critical domains.

By centering on enforcement, the study challenges Indonesia's incrementalist defense approach, which argues that autonomy must be mandated, not expected, from market forces. This framework bridges the global defense literature and local policy discourse, offering a model tailored to Indonesia but relevant to other emerging producers.

5. Conclusions

This study finds that Indonesia's defense industrialization remains hampered by systemic weaknesses across governance, technology, finance, human capital, and market access. Fragmented mandates, low technological maturity, limited domestic content, and reliance on foreign partners, such as in the Harimau tank and CN-235 aircraft, trapped Indonesia in Stage 2: Licensed Assembly on the Arms Production Ladder. These arrangements provide minimal transfer of critical knowledge and fail to achieve true industrial autonomy.

Root cause mapping via the Ishikawa diagram confirms that these challenges are not isolated but are part of an interlinked system reinforced by weak enforcement, a lack of incentives, and institutional inertia. Although incremental reforms, such as TKDN regulations, Defend ID, and selective R&D efforts, show promise, they remain insufficient to overcome deep-rooted dependency on foreign supply chains.

This study introduces the forced autonomy model as a new framework to conceptualize Defense Industrialization 5.0, not as a natural outcome of capacity building but as a state-led, compulsory transformation. In this view, autonomy must be enforced through presidential mandates, fiscal obligations, and legal instruments.

To operationalize this, six enforceable strategic roadmaps are proposed: (1) human capital, (2) digitalized production, (3) domestic material ecosystems, (4) product priorities, (5) market access, and (6) governance reform. These are activated through binding tools such as mandatory R&D quotas and SME certification schemes.

By drawing from international models such as Korea, Turkey, and Singapore, yet tailoring them to Indonesia's context, the study offers a structured, enforceable path toward true defense sovereignty by 2045.

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Ethical considerations

This study did not involve human participants, animal testing, or clinical trials. All the data were collected from publicly accessible documents and secondary sources. The author confirms compliance with ethical standards set by the Multidisciplinary Science Journal and the Committee on Publication Ethics (COPE), ensuring originality, proper attribution, and accuracy of content.

Conflict of interest

The author declares no conflict of interest related to the content, authorship, or funding of this research.

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References

Adaçay, F. R., & Misirlioğlu, İ. (2023). Economic impact of defense expenditures in Turkey: A dual-approach analysis from 1974 to 2021. *Opportunities and Challenges in Sustainability, 2*(4), 404–418. https://doi.org/10.56578/ocs020404

Alami, I., Taggart, J., & Chodor, T. (2025). Rebuilding the ladder? Contemporary contests over industrial policy. *Global Policy, 16*(4), 522–534. https://doi.org/10.1111/1758-5899.70064

Bitzinger, R. A. (2015). Defense industries in Asia and the technonationalist impulse. *Contemporary Security Policy, 36*(3), 453–472. https://doi.org/10.1080/13523260.2015.1111649

Bitzinger, R. A., & Raska, M. (2022). Chinese and Russian military modernization and the fourth industrial revolution. In J. C. S. Wong & C. Y. Lo (Eds.), *Russia-China relations: Emerging alliance or eternal rivals* (pp. 121–140). Springer.

Cheung, T. M. (2021). A conceptual framework of defence innovation. *Journal of Strategic Studies, 44*(1), 1–27. https://doi.org/10.1080/01402390.2021.1939689

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications. https://www.academia.edu/download/55010759/creswell_Qualitative_Inquiry_2nd_edition.pdf

Damanik, S., Tarigan, H., Sumarno, A., & Almubaroq, H. (2024). Investment dynamics in the Indonesian defense industry: A literature study analysis. *International Journal of Humanities Education and Social Sciences (IJHESS), 3*(4), 175–185. https://doi.org/10.55227/ijhess.v3i4.895

Daneswara, M. R., & Nasution, M. T. A. (2024). Rethinking Indonesia's defence strategy: Aligning Sishankamrata with contemporary security challenges. *The Indonesian Quarterly, 52*(4), 210–225. https://journals.csis.or.id/index.php/iq/article/view/2019

Fiott, D. (2019). *Defence industrial cooperation in the European Union: The state, the firm and Europe*. Routledge.

Ghimire, A. (2025). Substandard medicines in Nepal: A crisis of access, equity, and a call for action. *Frontiers in Public Health, 13*, 1584872. https://doi.org/10.3389/fpubh.2025.1584872

Gindarsah, I., & Priamarizki, A. (2015). Politics, security and defense in Indonesia: The pursuit of strategic autonomy. In C. B. Roberts, A. D. Habir, & L. C. Sebastian (Eds.), *Indonesia's ascent: Power, leadership, and the regional order* (pp. 130–154). Palgrave Macmillan UK. https://doi.org/10.1057/9781137397416_7

Hartley, K. (2012). *The economics of defence policy: A new perspective*. Routledge. https://doi.org/10.4324/9780203838778

Hartley, K., & Belin, J. (2019). *The economics of the global defence industry*. Routledge. https://doi.org/10.4324/9780203838778

Hervas-Oliver, J.-L., Sempere-Ripoll, F., & Moll, C. B. (2022). Zooming into firms' location, capabilities and innovation performance: Does agglomeration foster incremental or radical innovation? *European Research on Management and Business Economics, 28*(2), 100186. https://doi.org/10.1016/j.iedeen.2021.100186

Iftikhar, A., Hussain, F. B., Qureshi, K. N., Shiraz, M., & Sookhak, M. (2025). Securing edge-based smart city networks with software-defined networking and zero-trust architecture. *Journal of Network and Computer Applications, 244*, 104341. https://doi.org/10.1016/j.jnca.2025.104341

Kania, E. B. (2020). "AI weapons" in China's military innovation. *Brookings Institution Report*. https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_ai_weapons_kania_v2.pdf. Accessed on October 19, 2025.

Karkhanis, A. J., & Thompson, J. M. (2020). Improving the effectiveness of root cause analysis in hospitals. *Hospital Topics, 99*(1), 1–14. https://doi.org/10.1080/00185868.2020.1824137

Kim, S. (2015). Policy implications for third-tier countries considering ACTD programs: South Korea as a case study. *Technology in Society, 41*, 45–53. https://doi.org/10.1016/j.techsoc.2014.11.001

Kotila, B., Drezner, J. A., Bartels, E. M., Hill, D., Hodgson, Q. E., Huilgol, S. S., Manuel, S., Simpson, M., & Wong, J. P. (2023). *Strengthening the defense innovation ecosystem*. RAND Corporation.

Krause, K. (1992). *Arms and the state: Patterns of military production and trade*. Cambridge University Press. https://archive.org/details/armsstatepattern0000krau

Kurc, C., Egeli, S., Mevlutoglu, A., & Güvenç, S. (2024). Türkiye's defence industry: Which way forward? *ResearchGate Preprint*. https://doi.org/10.13140/RG.2.2.33596.04484

Kurç, Ç., Güvenç, S., Mevlütoğlu, A., & Egeli, S. (2025). Balancing aspiration and reality: Autarky in Turkish defence industrial policy. *Defence Studies, 25*(2), 383–406. https://doi.org/10.1080/14702436.2025.2472705

Lee, D., & Furter. (2009). The influence of legislation and government policy on patterns of international defence trade and future markets: The case of offset and directive. *Furter Defence White Paper*. https://www.furterdefence.com. Accessed on October 19, 2025.

Li, W. (2024). *Technology war frontier: Analyzing the impact of defense strategies and economic dependency on national policies towards Chinese 5G technology* (Master's thesis). University of Chicago. https://doi.org/10.6082/uchicago.12027

Markowski, S., Hall, P., & Wylie, R. (2009). *Defence procurement and industry policy: A small country perspective* (1st ed.). Routledge. https://doi.org/10.4324/9780203013694

Mawdsley, J. (2013). *A European agenda for security technology: From innovation policy to export controls*. Vlaams Vredesinstituut. https://vlaamsvredesinstituut.eu/wp-content/uploads/2013/02/a_european_agenda_for_security_technology_report_0-1.pdf

Meershoek, N. A. (2023). *Sovereignty and interdependence in EU military procurement regulation* (Master's thesis). Utrecht University Repository. https://dspace.library.uu.nl/handle/1874/428551

Moon, C.-I. (2017). The political economy of defense industrialization in South Korea: Constraints, opportunities, and prospects. *The Journal of East Asian Affairs, 5*(2), 438–465. http://www.jstor.org/stable/23253549

Nahavandi, S. (2019). Industry 5.0 – A human-centric solution. *Sustainability (Switzerland), 11*(16), 4371. https://doi.org/10.3390/su11164371

Nouwens, M., & Legarda, H. (2018). Emerging technology dominance: What China's pursuit of advanced dual-use technologies means for the future of Europe's economy and defence innovation. *International Institute for Strategic Studies / Mercator Institute for China Studies Report*, 12. https://chartaminuta.com/wp-content/uploads/2021/05/DOCUMENTO-LEGARDA.pdf. Accessed on October 19, 2025.

Park, Y. (2024). Will the one ring hold? Defense AI in South Korea. In H. C. Lim (Ed.), *AI and the future of defense* (pp. 505–527). Springer. https://doi.org/10.1007/978-3-031-58649-1_23

Patton, R., & Jahankhani, H. (2026). How can existing cyber frameworks be better implemented to ensure operational resilience within the UK aviation industry in the event of a cyber-attack against its mission critical, satellite-based services? In U. B. Chaudhry & H. Jahankhani (Eds.), *Autonomous revolution: Strategies, threats and challenges* (pp. 199–239). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-96782-5_7

Raba, W. J. (2025, March 7). Indonesia's defence strategy: Balancing autonomy and global partnerships. *Seasia.co*. https://seasia.co/2025/03/07/indonesias-defence-strategy-balancing-autonomy-and-global-partnerships

Sarjito, A., & Lelyana, N. (2024). Defense policy shaping and security governance: The role and impact of defense industry and military contractors. *Government & Resilience, 2*(2), 1–20. https://doi.org/10.62503/gr.v2i2.15

Savitri, C. M. (2016). *Contribution of offset to defence industrialisation in Indonesia* (Master's thesis). Cranfield University. https://dspace.lib.cranfield.ac.uk/server/api/core/bitstreams/14d3d8a2-00b6-4060-a747-ffb4f7e57674/content. Accessed on October 19, 2025.

Scott, W. R. (1998). *Organizations: Rational, natural and open systems* (4th ed.). Prentice Hall. https://doi.org/10.2307/2393090

Surahman, S., Putra, I., Khaerudin, K., & Asvial, M. (2024). Independence of the Indonesian defense industry and challenges in defense budget allocation. *International Journal of Humanities Education and Social Sciences (IJHESS), 3*(4), 155–170. https://doi.org/10.55227/ijhess.v3i4.738

Xie, F., Wang, C., & Xu, L. (2021). Whether to invest in terminal efficiency: A perspective considering customer preference and capital constraint in competitive environment? *Ocean & Coastal Management, 205*, 105563. https://doi.org/10.1016/j.ocecoaman.2021.105563

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. *Journal of Manufacturing Systems, 61*, 530–535. https://doi.org/10.1016/j.jmsy.2021.10.006

Yin, R. K. (2017). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications, Inc. https://us.sagepub.com/en-us/nam/case-study-research-and-applications/book250150