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Defense R&D Policies, Innovation Capability, and Firm Profitability in Emerging Economies: A Scoping Review

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Abstract: This study maps policy instruments, influence pathways, and research gaps connecting defense research and development (R&D) policies, innovation capability, and firm performance in emerging markets, addressing scattered evidence linking these policies to firm profitability. A scoping review was conducted using PRISMA-ScR guidelines. Open-access Scopus records were screened using a Population-Concept-Context (PCC) framework; 160 records were identified, and 18 studies were included after title, abstract, and full-text assessment. Key instruments identified include public R&D funding, procurement, civil–military integration, offsets, technology transfer, institutional collaboration, cluster or national champion formation, financing support, and business model innovation. These policies are primarily associated with increased R&D intensity, patents, absorptive capacity, technological readiness, commercialization, sales, exports, and productivity. However, direct accounting evidence based on ROA or NPM remains limited, descriptive, or self-reported. This review uniquely synthesizes fragmented evidence on defense R&D policy effectiveness in emerging economies, identifying critical gaps in objective financial performance measurement. Findings guide policymakers in designing evidence-based defense R&D instruments while highlighting the need for standardized accounting metrics to evaluate firm-level outcomes. This research contributes a comprehensive policy-instrument taxonomy and identifies pathways linking defense R&D to innovation and performance, offering a foundational reference for future empirical studies in emerging market contexts.

Keywords: Defense R&D Policy; Emerging Economies; Firm Profitability; Innovation Capability; Scoping Review

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A. Introduction

Global defense investment increasingly supports security and technological-industrial development through R&D, domestic procurement, and strategic funding (Ana Elena Sancho, 2025). In developed economies, government-funded defense R&D can stimulate private R&D and productivity spillovers (Moretti et al., 2025), while emerging economies use offsets, technology transfer, industrial partnerships, and domestic procurement to strengthen defense innovation and competitiveness (Kahl & Vestner, 2026). In Indonesia, this agenda is reflected in state-owned defense firms such as PT Pindad, PT Dirgantara Indonesia, and PT PAL Indonesia. Indonesia shows a gap between R&D policy expectations and firm-level financial performance. Law No. 16 of 2012 requires defense-industry firms to allocate at least 5% of net profit to R&D and permits government funding for research and engineering (Republic of Indonesia, 2012). However, this allocation does not necessarily equal R&D expenses reported in financial statements because funding, capitalization, project expenditure, and accounting recognition may differ.

PT Pindad illustrates this gap. In 2023, ROA was 0.74% against an RKAP target of 2.80%, while NPM was 1.51% versus 4.81%. NPM declined from 1.60% in 2021 to 1.51% in 2023, and total asset turnover fell from 55.35% to 50.26%. Sales increased from approximately IDR 3.40 trillion in 2019 to IDR 7.98 trillion in 2023, while net profit reached IDR 120.77 billion. Thus, higher sales and earnings did not automatically improve margins or asset-use efficiency (PT. Pindad, 2019, 2020, 2022, 2021, 2023). Using the reported "research and development" and "development" items within distribution expenses, estimated R&D intensity was 0.061% in 2019, 0.031% in 2020, 0.0048% in 2021, 0.058% in 2022, and 0.016% in 2023, indicating a low and volatile pattern (PT. Pindad, 2019, 2020, 2021, 2022; 2023). Although R&D expenditure reached 16.55% of net profit in 2020, this mainly reflected lower profit rather than increased R&D spending. The evidence indicates a gap between regulatory R&D commitments, accounting recognition, firm growth, and profitability, while accounting-based R&D expenses may not fully capture Pindad's broader innovation activities.

Table 1. Five-Year R&D Intensity and Financial Performance Context at PT Pindad, 2019–2023

Year	R&D-related expense proxy (IDR bn)	R&D/Sales (%)	R&D / Net profit (%)	NPM (%)	TATO (%)
2019	2.076	0.061	2.05	2.97	52.94
2020	1.097	0.031	16.55	0.19	47.99
2021	0.219	0.0048	0.30	1.60	55.35
2022	3.723	0.058	3.66	1.58	51.28
2023	1.259	0.016	1.04	1.51	50.26

Source: Author calculation from PT Pindad Annual Reports 2019–2023 and the accompanying financial-statement notes (PT Pindad, 2019, 2020, 2022, 2021, 2023) R&D-related expense proxy = "research and development" + "development" items reported within distribution expenses. R&D/Sales is used as the primary R&D-intensity indicator; R&D/Net profit is presented only as contextual evidence and should not be treated as a standard R&D-intensity measure. The 5% statutory allocation under Law No. 16/2012 is not accounting-equivalent to these expense items and should not be used to infer compliance from this table and charts alone.

The academic literature on the relationship among defense R&D policies, innovation capability, and firm profitability remains scattered across defense economics, innovation management, industrial economics, and strategic studies, and has not been systematically synthesized in the context of emerging economies which present institutional, fiscal, and technological characteristics that differ markedly from developed countries. The absence of systematic literature mapping risks producing defense R&D policies that are insufficiently evidence-based, and makes it difficult to identify the conditions under which defense R&D policies may be associated with firm profitability directly through contracts and subsidies, and indirectly through technology spillovers and the strengthening of absorptive capacity (Cohen & Levinthal, 1990). Based on this gap, this article aims to develop a conceptual foundation for a scoping review that will map: (a) how empirical evidence links defense R&D policies to innovation capability and firm profitability in developing countries; (b) the theoretical pathways explaining this relationship; and (c) research gaps requiring further research agendas. Scoping review was selected as the study design due to its exploratory nature and orientation toward broad mapping of a heterogeneous and developing field of study, rather than answering narrow questions as in conventional systematic reviews (Arksey & O'Malley, 2005) This approach is consistent with PRISMA-ScR reporting guidelines (Tricco et al., 2018).

The theoretical framework integrates five bodies of theory to develop a conceptual understanding of how defense R&D policies may be associated with innovation capability and, potentially, with firm-level financial performance. This framework is evidence-informed rather than empirically validated as a complete causal model. The reviewed literature provides comparatively stronger support for the policy-to-innovation segment of the proposed pathway; the downstream relationships connecting innovation capability to firm growth, asset utilization, and accounting profitability remain under-tested and are positioned here as propositions warranting future empirical examination

Schumpeterian Innovation Theory and Creative Destruction

The fundamental theoretical framework for explaining the relationship between R&D and firm performance is Schumpeterian innovation theory, which views innovation as a process of "creative destruction" that provides temporary monopolistic advantages to first-mover firms (Kaufman et al., 2003). In the context of the defense industry, this logic is relevant because defense R&D often produces dual-use technologies that, once commercialized, give firms a temporary competitive advantage in civilian markets before other competitors imitate or adopt similar technologies.

Defense R&D Spillover Theory

The defense economics literature shows that government-funded R&D expenditure for defense purposes generates a "crowding-in" effect on private R&D: a 10% increase in government-funded R&D in an industry is associated with an additional 5–6%

increase in privately funded R&D in the same industry, accompanied by cross-country spillovers that also boost private R&D in other countries (Moretti et al., 2025). This finding is important for the scoping review's theoretical framework because it affirms that defense R&D policies influence firm profitability not only through firms receiving direct contracts, but also through the supply chain and broader industrial innovation ecosystem. Innovation policy studies in developing countries highlight the importance of strategic alignment, absorptive capacity, and institutional support as prerequisites for R&D benefits to materialize (Zuniga, 2023).

Defense Industrial Policy and the Context of Developing Countries

Developing countries face a trade-off between fully pursuing defense autarky, which is costly, and a more moderate defense industrialization strategy focused on indigenizing specific technology domains. Offset mechanisms, technology transfer, and industrial partnerships are used by countries such as Brazil and Turkey to gain access to avionics, sensors, and advanced aircraft systems, while building domestic political support through job creation and local production (Kahl & Vestner, 2026). This framework is relevant for understanding the Indonesian case, where state capital participation policies and R&D partnerships with state-owned defense enterprises are directed at building industrial independence and global competitiveness, although limited R&D funding and technology gaps remain structural challenges (PT. Pindad (Persero), 2026).

Institutional Theory

Institutional theory provides the foundational lens for understanding why and how defense R&D policies emerge and shape firm behavior. North, (1990) and Dimaggio & Powell, (1983) emphasize that institutions formal rules, regulations, norms, and enforcement mechanisms structure the incentives and constraints facing organizations. In the defense sector, institutional pressures manifest through legislation mandating domestic R&D allocation, government procurement rules favoring indigenous producers, offset and technology-transfer requirements embedded in foreign defense contracts, state ownership structures, and industrial policy frameworks promoting national champions. These institutional arrangements reduce demand uncertainty for defense firms, signal government commitment to long-term industrial development, and create both opportunities and obligations for innovation investment. Institutional theory thus helps explain the origins of the policy instruments identified in this review, including public R&D funding, procurement priorities, self-reliance mandates, military–civil integration programs, and offsets as responses to both security imperatives and industrial development objectives.

Resource-Based View (RBV)

The resource-based view (RBV) argues that sustained competitive advantage arises from firm-specific resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Applied to the defense context, the RBV suggests that defense R&D support through public funding, procurement, technology transfer, and collaborative partnerships may enable firms to accumulate R&D capabilities, technological knowledge, skilled human capital, proprietary routines, patents, and organizational resources that are difficult for competitors to replicate. These accumulated resources constitute the basis for innovation capability. The RBV accordingly helps explain why policies that strengthen resource endowments may be associated with improved innovation outputs, even as the conversion of those outputs into accounting profitability depends on additional conditions related to commercialization capacity, market access, and cost management.

R&D Investment, Asset Efficiency, Growth, and Profitability

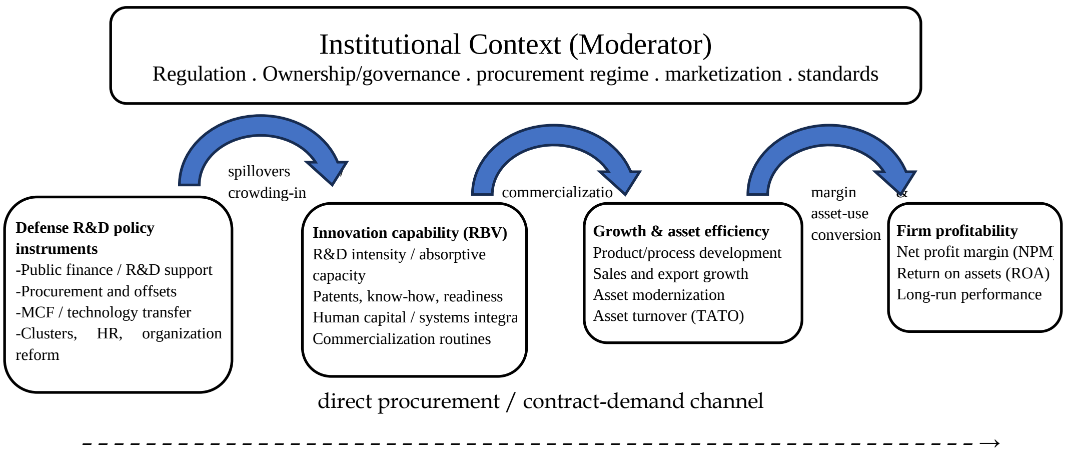
The relationship between R&D expenditure and financial performance is better viewed as a long-term investment effect rather than an immediate accounting outcome. Lev & Sougiannis, (1996) show that R&D capital has economic and value relevance, while Ehie & Olibe, (2010) report a positive relationship between R&D investment and firm value. These findings support the use of lagged R&D measures, particularly in defense industries where development, testing, certification, and procurement often require long time horizons. DuPont-style financial analysis provides a second foundation by separating profitability into margin and asset-utilization components. Fairfield & Yohn, (2001) show that changes in asset turnover and profit margin contain useful information for forecasting changes in profitability. NPM therefore captures the firm's ability to retain profit from sales, whereas asset turnover captures how efficiently the asset base generates revenue. This distinction is relevant for capital-intensive defense manufacturers. Firm growth provides a third link in the proposed framework, Del Monte & Papagni, (2003) identify a positive association between research intensity and firm growth, suggesting that R&D can support expansion through product and market development. However, growth does not always lead to higher profitability. Jang & Park, (2011), show that growth and profitability can be dynamic and bidirectional. Growth may create scale and market expansion, yet it can increase assets, working capital, financing needs, and coordination costs; consequently, higher sales or assets do not necessarily translate into higher ROA or NPM. The proposed pathway is therefore: R&D intensity → innovation capability → product/process development and commercialization → firm growth and market expansion → asset utilization and profit margin → ROA and NPM. This framework is derived from the identified literature gap and has not been jointly tested by the 18 reviewed studies.

Financial Performance Logic: DuPont Analysis

Understanding why innovation capability and sales growth may not automatically translate into improved accounting profitability requires a financial decomposition framework. The DuPont identity decomposes return on assets (ROA) into net profit margin (NPM) and asset turnover, making explicit that profitability reflects both the ability to retain profit from sales and the efficiency with which assets generate revenue. Fairfield & Yohn, (2001) demonstrate that changes in asset turnover and profit margin contain distinct information relevant to forecasting profitability changes, and this distinction is particularly relevant for capital-intensive defense manufacturers, where large asset bases may suppress ROA even as sales and innovation outputs grow. Lev & Sougiannis, (1996) show that R&D expenditure has long-term economic and value relevance not immediately captured in accounting measures, and Ehie & Olibe, (2010) report a positive association between R&D investment and firm value. The relationship between growth and profitability is further complicated by the finding of Del Monte & Papagni, (2003) that R&D intensity is positively associated with firm growth, while Jang & Park, (2011) show that growth and profitability can be dynamic and bidirectional: higher sales or asset expansion may increase working capital requirements, financing costs, and coordination complexity without proportionate gains in profit margins, resulting in flat or declining ROA and NPM even as absolute earnings and innovation capability improve

Integrated Conceptual Model and Link to the Research Questions

Figure 2 integrates the four theoretical lenses. Schumpeterian and spillover theories explain why public support and defense demand can stimulate innovative search and private R&D. Institutional theory specifies the regulatory, ownership, procurement, and normative context that moderates whether policy instruments are implemented effectively. RBV treats the resulting innovation capability as a strategic resource that must be converted into product/process development, commercialization, growth, and efficient asset use before stronger profitability is expected. The model also allows a direct demand channel from procurement or contracts to revenue, while distinguishing it from the longer indirect innovation channel. RQ1 maps the policy instruments entering the model; RQ2 evaluates the mechanisms and conversion sequence; and RQ3 identifies the missing mediation, moderation, longitudinal, and accounting-performance tests required to validate the integrated pathway.



Schumpeterian innovation + defense R&D spillovers	*Institutional theory + resource-based view*	*Growth / commercialization Growth/commercialization+ DuPont asset efficiency*	*Accounting outcomes ROA and NPM*

Figure 2. Integrated Conceptual Model of Defense R&D Policy, Institutional Context, Innovation Capability, Asset Efficiency, And Profitability

B. Methods

Review Rationale and Methodology

A scoping review was selected as the appropriate study design because the relationship among defense R&D policies, innovation capability, and firm profitability in emerging economies is heterogeneous, spans multiple disciplines, and has not been systematically mapped. Scoping reviews are well suited to exploratory objectives involving broad evidence mapping rather than the precise effect estimation that systematic reviews or meta-analyses pursue (Arksey & O'Malley, 2005) framework: (1) identification of research questions, (2) identification of relevant studies, (3) study selection, (4) data charting, and (5) collection, summarization, and reporting of results. This framework is complemented by PRISMA-ScR reporting guidelines containing twenty essential reporting items to ensure transparency and reproducibility of the review process (Tricco et al., 2018). No protocol was prospectively registered in OSF Registries or another registry. This non-registration is stated explicitly in accordance with the PRISMA-ScR protocol/registration reporting item. The review was designed as an evidence-mapping exercise and did not estimate a pooled treatment effect.

Review Protocol and Reporting

A review protocol specifying the research questions, PCC framework, search strategy, inclusion and exclusion criteria, and data charting approach was developed prior to the screening and synthesis process. The protocol was not formally registered in a public registry. The complete Scopus search strategy is provided in Appendix A.

Research Question Formulation

The research questions were formulated using the PCC method: *Population*, Firms in domestic defense industries in developing countries, including defense firms, state-owned defense enterprises, defense contractors, and dual-use companies related to the defense sector; *Concept*, Defense R&D policies, innovation capability, and firm profitability, including direct and indirect relationships between these variables; *Context*, Emerging economies, namely developing countries or new economies building domestic defense industrial capacity. The resulting Research Questions (RQs) are:
RQ1. What types of policies regarding defense R&D have been examined in relation to innovation capability and firm profitability in developing countries?
RQ2. Through what pathways do defense R&D policies affect innovation capability and firm profitability among defense-related firms in developing countries?
RQ3. What gaps methodological, theoretical, sectoral, and geographical exist in the literature on defense R&D policies, innovation capability, and firm profitability in developing countries?

Search Strategy

The search was conducted with a filter covering the period 2010–2026, using a systematic bibliographic search through Scopus. Three alternative search queries (SQ) were formulated; SQ3 was selected as the most appropriate compared to SQ1 and SQ2, and entered into the document search field: *(defense OR defense OR military OR arms) AND ("research and development" OR "R&D" OR innovation OR innovat* OR technology OR "technology transfer" OR "industrial policy" OR "innovation policy") AND (performance OR profitability OR profit OR productivity OR competitiveness OR efficiency OR growth).* Additional filters applied were: subject area limited to Business, Management and Accounting, and Economics, Econometrics and Finance; document type limited to articles; language limited to English; and open access limited to all open access.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Empirical articles; (2) Focus on the defense industry or a defense-related industrial ecosystem; (3) Discusses defense R&D policies, support, or instruments; (4) Discusses innovation capability and/or firm profitability/performance; (5) Context of emerging economies/developing countries; (6) Relevant to at least two main relationships in the topic; (7) English-language, open-access journal articles.

Exclusion criteria: (1) Non-empirical articles; (2) Does not discuss the defense industry/firms; (3) No element of R&D, innovation, technology, procurement, offset, or industrial policy; (4) Does not discuss innovation capability or firm performance/profitability; (5) Context is only developed countries; (6) Focus purely at the macro level without firm/industry relevance; (7) Focus purely on technology without policy or organizational performance aspects.

Data Extraction and Synthesis

Data were extracted from included studies and organized into a standardized charting table (Table 2) recording: author(s), year, country studied, sector, research objective, data source, type of defense R&D policy or instrument, innovation capability indicators, profitability or performance indicators, proposed pathway or mechanism, and reported study gaps and limitations. A narrative synthesis was conducted, grouping findings by research question and comparing policy instruments, mechanisms, innovation indicators, and performance indicators across studies. Evidence strength was assessed qualitatively, distinguishing between relationships comparatively better supported across studies and those that remained limited or insufficiently tested.

C. Results and Discussion

The database search identified 160 articles from Scopus. After title screening, 30 relevant articles remained (130 excluded). Thirty reports were sought for retrieval, of

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which two could not be retrieved. The remaining 28 full-text reports were assessed for eligibility. After full-text assessment, 10 articles that did not meet the criteria were excluded, leaving a final set of 18 articles, as illustrated in the PRISMA flow chart (Figure 1).

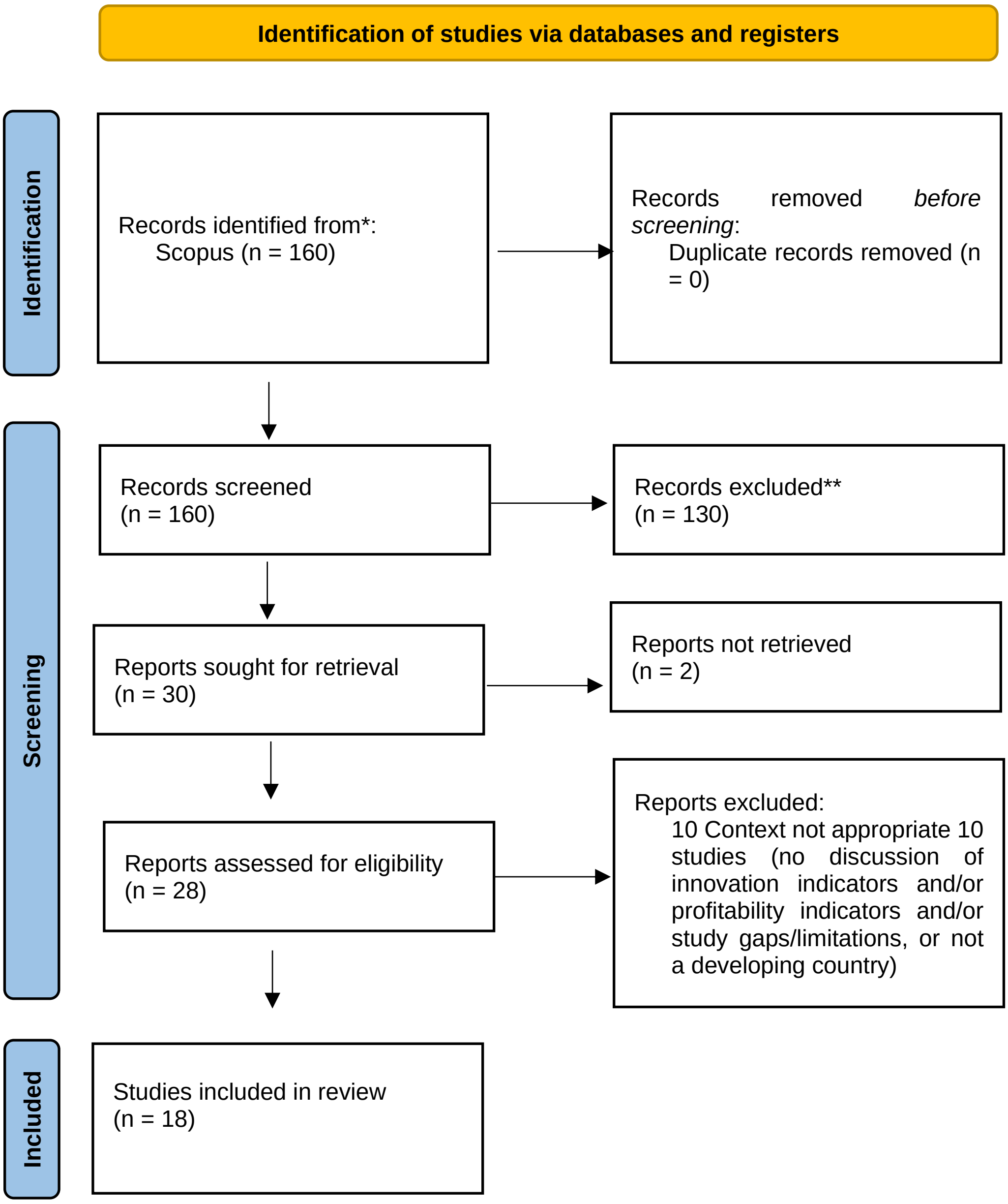

Figure 1. PRISMA Flow Chart of the Data Selection Process

A synthesis of the 18 extracted studies shows that defense R&D policies affect innovation capability and firm profitability in developing countries through patterns that vary according to each country's stage of industrialization, as described below:

Table 2. Summary of Included Studies

No	Title	Year	Country Studied	Type of Defense R&D Policy/Instrument	Innovation Capability Indicator	Firm Profitability/Performance Indicator	Study Gap/Limitations
1	Can Private Enterprises Improve Their Technological Innovation by Joining the Military Business? Evidence from China	2022	China	Military–civilian integration through military industry access certificates/permits and private enterprise participation in military contracts and business activities.	R&D intensity = R&D expenditure/operating revenue; patent applications; invention patents as substantive innovation; utility model and design patents as strategic innovation.	Does not measure profitability or ROA/NPM. Main outcomes are R&D inputs and patent outputs.	Confidentiality causes small treatment sample; short military participation period; only listed companies; financial performance, not tested as outcomes.
2	Defense Industry Business Performance Model in Developing Countries	2023	Indonesia	Policy context of self-reliance, import substitution, defense offsets, and domestic procurement priorities; constructs tested: HPWS, technological innovation, and business model innovation.	Product innovation and process innovation; adoption of new or improved technologies/research results; improvement of production methods, quality, skills, and standardization.	Composite business performance based on balanced scorecard: increased sales, profitable financing products, profit growth, labor productivity, quality, customer, internal processes, learning and growth.	Small, purposive sample; one informant per company; all indicators self-reported; ROA/NPM or accounting data not used; cross-country generalization limited; future research recommended to separate financial and non-financial performance.
3	Development of the Defense Industry of Ukraine to Ensure National Security	2024	Ukraine	Proposed Defense Industry Development Fund; budget subsidies, unsecured loans, financial leasing, R&D financing through defense orders, asset modernization investment, laboratories/technology parks, tiered education, and NATO standard adoption.	Updating weapons models, modernization and technical re-equipment, innovation activity/potential, new technologies and equipment, R&D capacity, laboratories/research centres, and human-resource readiness for NATO standards.	Profitability/loss on product sales and profitability spread for several industry groups; also production volume, sales, exports, and ability to meet armed forces' needs.	Martial law and confidentiality limit data; analysis is descriptive and sectoral; does not evaluate causality or fund effectiveness as the instrument is still a proposal; firm-level generalization limited.

https://doi.org/10.59175/pijed.v5i2.917

No	Title	Year	Country Studied	Type of Defense R&D Policy/Instrument	Innovation Capability Indicator	Firm Profitability/Performance Indicator	Study Gap/Limitations
4	Ensuring the High Performance of Design and Engineering Firms in Mexico's Aerospace Industry: A Qualitative Comparative Analysis	2022	Mexico	R&D and technology promotion, export promotion, joint ventures, technology transfer, CONACYT support for alliances/joint research, economic incentives, training, and university–industry collaboration.	Absorptive capacity, innovation capacity, entrepreneurial capacity, R&D activities, specialized human resources; patenting discussed as R&D outcome.	High performance level measured by average annual sales; not profit margin or ROA.	Only 17 cases, one subsector and one country; fsQCA identifies configurations, not marginal/causal effects; outcome is only annual sales; future research needs to include financial strategies and profitability indicators.
5	The Flight from Defense to Civilian Space: Evolution of the Sectoral System of Innovation of India's Aerospace Industry	2010	India	Public R&D and space budgets, public technology procurement, opening the sector to private companies since 2001, aerospace SEZs/parks, FDI and R&D outsourcing, and defense offset policy.	Diversity of actors, domestic/foreign knowledge sources, research–manufacturing linkages, indigenous design/production capabilities, aircraft/satellite development, and technology transformation.	Aerospace exports, sectoral competitiveness, commercialization, and cluster dynamics; does not measure firm profitability.	Descriptive working paper; sectoral and historical data; limited Indian aeronautical literature; no firm-level analysis, profitability, asset turnover, or causal identification.
6	Financial, Credit and Budgetary Support for the Transfer of Modern Technologies for the Modernization of the Aerospace Complex	2025	Ukraine	Budget funding, preferential credit, grants, guarantees, venture capital, public–private partnership, cluster support, BRAVE1, Horizon Europe, ESA/STCU, localization, licensing, and international technology-transfer programs.	Intangible asset investment; software/databases; patents, licences, know-how; technology transfer; equipment modernization; digital methods; human capital; transfer infrastructure and cluster linkages.	Capital investment, budget absorption, loan exposure/credit risk, modernization, competitiveness, and export potential; does not measure firm profit/ROA.	Martial law and closed airspace limit application; 2022 data partially imputed due to confidentiality; international technology transfer information limited; no firm-level profit, causal design, or evaluation of commercialization.
7	Impacts of R&D Expenditures on High Technology Product Exports in BRICST Countries	2018	Brazil; Russia; India; China; South Africa; Turkey	Allocation of national R&D expenditure and researcher development; education, FDI, training/industrial cooperation and technology transfer recommendations. Not specific to defense R&D.	R&D expenditure and number of researchers per million population as innovation capacity input.	High-technology exports (US$) as macro-outcome; does not measure firm performance or profitability.	Country-level aggregate data with only two predictors; not defense-specific; period ends 2014; high structural heterogeneity; bidirectional relationship suggests reverse causality; no firm-level profitability.

No	Title	Year	Country Studied	Type of Defense R&D Policy/Instrument	Innovation Capability Indicator	Firm Profitability/Performance Indicator	Study Gap/Limitations
8	Indigenous Technological Capabilities, Emerging Market Firms and the Aerospace Industry	2015	China; Russia; comparative: Brazil, Japan, United States, Europe	FDI, offset arrangements, co-production, licensed production, national champions/anchor tenants, export subsidies, government as key customer, and international collaboration.	Number of patents and patent families, inventor participation, co-invention, academic–corporate networks, anchor tenant position, and indigenous patenting capability.	Does not measure profit. Outcomes are technological upgrading, competitiveness, entry into global supply chains, and capability to develop indigenous aircraft.	Patents do not capture all innovation, collaboration, or commercial value; not all patents are commercialized and patent quality varies; data ends 2012; does not test firm performance/profitability.
9	Model for Measuring Technological Maturity for Critical Sector Industries	2024	Colombia	Decision-support tool for resource allocation, project prioritization, technology transfer, open innovation, regulation, financing readiness and collaborative development; not an evaluation of one specific subsidy.	Technology Readiness Level (TRL), Integration Readiness Level (IRL), Regulatory Readiness Level (RRL), Market Readiness Level (MRL), industrial scalability and stakeholder integration.	Commercialization/adoption success, project risk, cost overrun/rework, and financing eligibility; does not measure firm profit.	Model is theoretical and based on expert validation; not yet tested with many real projects; small expert sample; cross-country and industry data are confidential; Colombian context limits transferability; requires iteration and confirmatory validation.
10	Modernizing a Giant: Assessing the Impact of Military-Civil Fusion on Innovation in China's Defense-Technological Industry	2026	China	Military-Civil Fusion, procurement liberalization and national R&D projects, government subsidies, state ownership, integration with the national innovation system, and long-term industrial plans.	Patent publications per year, R&D intensity, R&D expenditure, human capital/staff, proximity to research institutions, participation in national R&D projects.	ROA and revenue used as financial metrics/descriptive outcomes; efficiency measured by patenting relative to headcount. MCF–profitability relationship not causally identified.	Only listed companies; random effects do not prove causality; patents do not capture process innovation, novelty, or non-patented innovation; non-listed firm and survey data unavailable; profitability is descriptive only.
11	Self-Reliant in Defense Industries: Case Study Indonesia	2023	Indonesia	Self-reliance policy, import substitution, defense offsets, domestic procurement priorities, and state enterprise autonomy reform; organizational constructs: dynamic capabilities, HPWS, technological innovation and BMI.	Product and process innovation; dynamic capabilities: sensing, learning, integration, coordination and reconfiguration; business model innovation.	Composite business performance based on financial, customer, internal-process, learning-and-growth perspectives; including sales, profit, productivity, customer and employee outcomes.	Small, purposive top-management-only sample; self-reported indicators; Indonesia-only; some items excluded; accounting data not used; cross-level/country sample and moderators (assets, growth, debt, ownership) needed. Sample overlap with other Irfan et al. articles, limiting independence of evidence.

No	Title	Year	Country Studied	Type of Defense R&D Policy/Instrument	Innovation Capability Indicator	Firm Profitability/Performance Indicator	Study Gap/Limitations
12	Space Policy and Industrial Development in Middle Powers: Malaysia and Turkey in Comparative Perspective	2026	Malaysia; Turkey	National space agencies/programs, indigenous satellite development, national champions and sovereign supply chains in Turkey; PPP, tax incentives, matching funds, investment funds and commercial space infrastructure in Malaysia.	Domestic satellite manufacturing/deployment, launch capability, technical expertise, skilled workforce, informational capacity, research and industrial linkages.	Industrial upgrading, commercial space services, high-value-added activities, GDP contribution target and backward/forward linkages; does not measure firm profitability.	Two cases limit generalization; satellite counts are a crude measure; does not measure data-use chain quality, firm performance, or causality; future research needs informational-capacity index and more middle-power cases.
13	The Impact of New Relationship Learning on Artificial Intelligence Technology Innovation	2021	China	Military–civil integrated development, dual-use technology transfer/trading centres, coordination platforms, collaborative innovation networks, and New Generation AI Development Plan.	Conceptually: information sharing, common understanding, relationship memory, knowledge absorption/integration, and balanced military–civil AI innovation.	Not measured.	No empirical design, measurement, sample, or causal test; does not measure patents, commercialization, productivity, or financial performance; mechanisms need validation in real organizations and projects.
14	The Intellectual Spoils of War? Defense R&D, Productivity, and International Spillovers	2025	OECD countries; (firm-level)	Government-funded R&D grants and defense R&D subsidies; compared in policy terms with R&D tax credits.	Privately funded R&D, total R&D, R&D personnel, R&D wages, and cross-border private R&D spillovers.	TFP growth at industry-country level and labor productivity/output per worker in France; does not measure accounting profitability.	Context dominated by developed countries; outcome is productivity not profit; opportunity costs and cost-benefit not calculated; weak first stage in some models; comparability to emerging defense firms is limited.
15	The Role of Industrial Policy in the Development of the State's Defense Industry: International Legal and Economic Regulation	2024	United States; France; China; implications for Ukraine	State budget funding, subsidies and tax incentives, public procurement/long-term contracts, R&D agencies/programmes, international cooperation, joint ventures/consortia, clusters/technology parks, legal regulation and technology controls.	R&D investment, technological readiness, high-tech product quality, international collaboration, research infrastructure and adaptation capacity; no single standard index used.	Competitiveness, technological leadership, budget scale, product quality and national-security performance; does not measure firm profit or ROA.	Only three countries; secondary/descriptive and not firm-level; non-uniform indicators; policy impact on profitability not tested; comparisons influenced by differences in disclosure, budgets and institutional context.

No	Title	Year	Country Studied	Type of Defense R&D Policy/Instrument	Innovation Capability Indicator	Firm Profitability/Performance Indicator	Study Gap/Limitations
16	The Role of Stakeholders in Managing Government Research and Development Funding for Defense Industrial Innovation: The Case of Malaysia	2023	Malaysia	Government R&D allocation through MINDEF/STRIDE, Defense White Paper/Industry Blueprint, defense offsets/Industrial Collaboration Policy, long-term contracts; recommendations for independent platform, cross-sector fertilization and data-analytics tools.	Local ability to design, test, develop and market defense/dual-use technology; absorptive capacity, product/process innovation, R&D skills, stakeholder collaboration and innovation success.	Does not measure firm profit. Outcomes are modest defense industrial innovation, productivity and competitiveness, assessed qualitatively.	Only 8 interviews and low response rate; defense data difficult to access; practitioner/participatory observation bias; spending impact, dual-use outcomes, and profitability not quantitatively evaluated.
17	Tools to Measure the Technological Capabilities of the Aerospace Industry	2018	Mexico	Supplier-development support; certifications, software/equipment upgrades, training, university linkages, clusters, and government funding programs CONACYT-PEI, FOMIX and INADEM. General aerospace context, not specifically defense.	ICTD and ICTM; hardware, software, humanware, orgware; effectiveness of use, evaluation/quality, maintenance/improvement, production planning, design and manufacturing skills.	Supplier readiness, productivity/quality and technological gap; does not measure sales, profit, or ROA.	Small sample (6 companies) and single region; questionnaire/self-assessment; no external or longitudinal validation; commercial, financial, or profitability outcomes not measured.
18	‘Zero-Error’ versus ‘Good-Enough’: Towards a ‘Frugality’ Narrative for Defense Procurement Policy	2020	India	Public defense procurement, indigenous development, evolutionary acquisition, spiral development/induction, user–producer feedback and ‘good-enough’ technology approach.	Technological capability building, learning-by-doing, trial-and-error, indigenous system development, adaptive user feedback and incremental improvement.	Cost/time overruns, delays, performance gaps, induction success and end-user acceptance in programs; does not measure firm profit.	Three illustrative cases; qualitative and context-specific; scientist heuristics at each stage not explored; no counterfactual, firm-level financial outcomes, or profitability measures.

RQ1: Defense R&D Policy Instruments

Across the evidence base, defense R&D policy instruments cluster into four groups. First, direct financial support includes public R&D budgets, grants, subsidies, preferential credit, guarantees, venture or investment funds, and proposed dedicated defense-industry funds. Ukraine provides the clearest descriptive examples of financing packages for modernization and technology transfer, while Malaysia emphasizes the governance of government R&D allocations. These are coercive and resource-provision mechanisms in institutional terms: they alter the availability and cost of strategic inputs, but their effectiveness depends on implementation capacity, coordination, and disclosure (Balakrishnan & Johar, 2023; Hmyria Viktorya et al., 2024; Kosova et al., 2025).

Second, demand-side instruments include procurement, long-term defense orders, import substitution, domestic-content priorities, and offsets. India's evolutionary or "good-enough" procurement logic illustrates how acquisition rules can reduce time and learning barriers, while Indonesia's self-reliance agenda combines domestic procurement with offsets and organizational reforms. From an institutional perspective, procurement is a coercive rule system and a market-creating device; from a Schumpeterian perspective, it creates demand for experimentation. Yet procurement can also lock firms into incumbent architectures or cost structures if incentives reward compliance rather than commercialization (Irfan et al., 2023; Patil & Bhaduri, 2020).

Third, collaboration and technology-transfer instruments include military–civil integration, licensing, joint ventures, international partnerships, university–industry collaboration, R&D alliances, and technology-transfer platforms. China's MCF is the most developed example: private participation in military business increases R&D intensity and substantive patenting, but effects differ by firm size and marketization, and SOEs retain advantages in subsidies and systems integration. (Dupont-sinhsattanak, (2026); Yang & Liu, (2022) Mexico similarly shows that absorptive, innovation, and entrepreneurial capabilities combine with R&D and specialized human resources to support higher sales in aerospace design and engineering firms (Manzo & Rodríguez, 2022). These findings fit RBV because external policy support becomes valuable only when firms possess complementary internal capabilities.

Fourth, capability-building instruments include national champions, clusters, supplier development, human-resource upgrading, technological-readiness systems, regulatory reform, and business-model innovation. Turkey's space strategy emphasizes indigenous capability and sovereign supply chains, Malaysia combines public-private partnership and commercial development, and Colombia's TRLI model integrates technology, market, regulatory, and integration readiness before commercialization (Apaydin, 2026; Zuluaga et al., 2024). The institutional-theory interpretation is that capability building combines normative standards and mimetic learning with coercive public policy, whereas RBV explains why the resulting skills, routines, and integration assets can become firm-specific strategic resources. RQ1 is therefore answered not by a single R&D subsidy category but by a portfolio of financial, demand-side, collaborative/transfer, and capability-building instruments.

RQ2: Pathways from Policy to Innovation Capability and Profitability

The most consistently supported pathway is policy → innovation capability. Public finance and procurement reduce financing or demand uncertainty; military–civil integration, offsets, and collaboration expand access to knowledge; and capability-building policies strengthen skills, routines, infrastructure, and absorptive capacity. China's DID evidence directly supports a link from military-business participation to R&D inputs and substantive patents (Yang & Liu, 2022), while Malaysia shows that weak stakeholder coordination can limit the innovation yield of government R&D funding (Balakrishnan & Johar, 2023); Institutional context therefore moderates whether nominally similar policy inputs are converted into real capabilities, exactly as Figure 2 proposes.

The second pathway is innovation capability → commercialization, growth, and asset efficiency. RBV predicts that R&D capability, patents, specialized skills, systems integration, and absorptive capacity contribute to competitive advantage only when firms can deploy them in products, processes, contracts, or civilian/dual-use markets. Mexico's aerospace evidence links capability configurations to higher sales rather than profit margins; India's aerospace development and defense procurement studies emphasize exports, learning, and sectoral upgrading; and China's MCF studies report patenting and R&D outcomes more strongly than accounting returns (Mani, 2010; Manzo & Rodríguez, 2022; Patil & Bhaduri, 2020). Thus, growth is an intermediate outcome, not proof of improved ROA or NPM.

The final conversion from growth and capability to profitability is weakly evidenced. Ukraine reports profitability descriptively at industry-group level, and (Dupont-sinhsattanak, (2026) includes ROA and revenue as descriptive financial metrics, but neither provides a causal policy-to-profit estimate. High R&D costs, long qualification and procurement cycles, project delays, cost overruns, secrecy, import dependence, financing burdens, and commercialization barriers can all interrupt the conversion sequence. In DuPont terms, a defense firm can expand revenue while simultaneously carrying a larger asset base or weaker margins, leaving ROA unchanged or lower.

PT Pindad's 2019–2023 data reinforce this conversion-gap interpretation without establishing causality. Recorded R&D/Sales remained very low and volatile (approximately 0.0048%–0.061%). After 2021, NPM declined from 1.60% to 1.51% and TATO from 55.35% to 50.26%, even as sales and net profit increased. The case is consistent with the integrated model's proposition that policy commitments and innovation activity must be converted through commercialization, scale, and efficient asset use before they can appear in accounting profitability. It also illustrates an institutional/accounting measurement problem: statutory R&D allocation and financial-statement R&D expense are not equivalent constructs. Consequently, RQ2 is answered as a multi-stage and institutionally contingent pathway rather than a direct policy → profit relationship.

RQ3: Methodological, Theoretical, Sectoral, and Geographical Gaps

Methodologically, the evidence base is dominated by cross-sectional surveys, qualitative case studies, conceptual models, descriptive sector analyses, and small samples. Yang & Liu, (2022), provide the clearest emerging-economy quasi-experimental design, while Moretti et al., (2025) provide causal benchmark evidence from OECD/France. Accounting profitability is rarely the primary dependent variable; patents, exports, sales, productivity, readiness, and self-reported performance are more common. Confidentiality and the concentration on listed firms further limit external validity.

Theoretically, few studies jointly test institutional moderation and RBV-style capability mediation. The integrated model therefore identifies specific missing links: policy instrument → R&D/absorptive capability; institutional context × policy implementation; innovation capability → commercialization/growth; growth and asset modernization → TATO; and margins/TATO → ROA/NPM. The literature also rarely distinguishes short-run accounting costs from long-run R&D returns, or tests lagged, nonlinear, and cumulative R&D effects.

Sectorally, aerospace and space are overrepresented relative to land systems, naval systems, electronics, ammunition, maintenance/repair, and lower-tier suppliers. Geographically, evidence is concentrated in a limited set of emerging economies and often mixes SOEs, private firms, SMEs, prime contractors, and suppliers without explicitly modeling ownership or position in the supply chain. These gaps justify multi-year panel research that reconstructs R&D intensity consistently and tests its association with asset turnover, growth, ROA, and NPM while controlling for ownership, firm size, leverage, age, subsector, procurement exposure, and macroeconomic conditions. Lagged R&D, multi-year averages, and alternative denominators such as sales, operating revenue, or total assets should be used as robustness checks.

Cross-Country Synthesis Through Institutional Theory and RBV

The country evidence is more coherent when organized by mechanisms rather than treated as a sequence of national cases. China demonstrates how institutional ownership and marketization moderate MCF: private firms gain access to military demand and increase innovative effort, yet SOEs retain privileged resource access and systems-integration roles. This is a joint institutional-theory/RBV pattern—policy opens an opportunity set, but accumulated organizational resources determine who can capture it. Indonesia shows a related distinction: survey-based evidence links technological innovation and high-performance work systems to business-model innovation and perceived business performance, whereas PT Pindad's accounting data show that sales growth and innovation-related expenditure do not automatically produce higher margins or asset efficiency offsets (Irfan, Rahman, et al., 2023; Irfan, Nidar, et al., 2023).

Ukraine, Mexico, and India illustrate different points in the same conversion chain. Ukrainian studies emphasize financial architecture, asset modernization, technology transfer, and sector resilience under severe institutional constraints, but profitability evidence is descriptive and confidentiality limited. Mexican aerospace studies show that R&D, absorptive capacity, specialized labor, supplier development, and technology upgrading can support sales and readiness; these are RBV-type resource bundles, yet margin and ROA outcomes are missing. Indian studies show how public R&D, offsets, procurement, and evolutionary acquisition can support indigenous learning, aerospace commercialization, and exports; however, financial conversion at firm level is not measured. These cases collectively support the innovation-capability mechanism while leaving the profitability link open.

Malaysia, Turkey, and Colombia further demonstrate that the institutional context determines which capabilities are prioritized. Malaysia's stakeholder-governance evidence shows that R&D funding alone is insufficient when roadmaps and inter-organizational coordination are weak. Turkey emphasizes sovereign technical capability and national champions, whereas Malaysia gives more weight to public-private commercialization and high-value-added applications (Apaydin, 2026). Colombia's readiness model makes regulatory and market readiness explicit alongside technological readiness, conceptually reinforcing the institutional moderation in Figure 2. Across these cases, policy creates or constrains access to resources; RBV explains why firms with stronger absorption, integration, and commercialization capabilities are better positioned to transform access into competitive outcomes.

D. Conclusions

Across the 18 reviewed studies, defense R&D policy in emerging economies clusters into four instrument types: direct financial support (funding, grants, credit, guarantees); demand-side measures (procurement, offsets); collaboration and technology transfer (military–civil integration, licensing, joint ventures, university–industry–government partnerships); and capability-building measures (national champions, clusters, self-reliance policy, human-resource development). These instruments are consistently associated with R&D activity, patents, absorptive capacity, technological readiness, sales, exports, and productivity, but rarely with audited profitability: only two studies report any accounting-based profitability indicator, and neither establishes a causal link to innovation. The evidence therefore supports the policy-to-innovation stage of the proposed conceptual framework far more strongly than the innovation-to-profitability stage. Mechanistically, defense R&D policy appears to affect profitability mainly indirectly, through resource accumulation, innovation capability, commercialization, and asset utilization, rather than through a direct effect on margins. PT Pindad's 2019–2023 data illustrate this gap descriptively R&D intensity was low and volatile, and NPM and asset turnover declined despite sales growth but this pattern is illustrative only and does not establish causality or non-compliance. Implications: governments should evaluate defense R&D policy using technological, commercialization, and asset-productivity outcomes, not only input expenditure; defense firms should explicitly link R&D portfolios to commercialization pathways and financial-performance metrics. Limitations: the review is restricted to Scopus-indexed, open-access, English-language articles (2010–2026); the evidence base is heterogeneous in method and sector; causal designs are rare; confidentiality constrains firm-level financial data; and the review protocol, while developed a priori, was not formally registered. Future research should pursue multi-year firm-level panel analysis of R&D intensity, asset turnover, and firm growth against ROA and NPM, using lagged R&D measures and controlling for ownership, size, leverage, age, subsector, and government-contract exposure the design direction the authors intend to pursue in a planned follow-up quantitative study.

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