



THE ECONOMIC TRADE OFFS OF AI DRIVEN DEFENSE TRANSFORMATION: EXPLORING HOW MILITARY AI INVESTMENT RESHAPES PUBLIC SPENDING, INDUSTRIAL DEVELOPMENT, AND HUMAN CAPITAL IN DEVELOPING COUNTRIES

Mekaeel Sadiq Gondal¹

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Affiliations:

¹ Independent Researcher,
Economics
Rahim Yar Khan, Pakistan
Email: mekaeel459@gmail.com

Corresponding Author's Email:

¹ mekaeel459@gmail.com

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Abstract

Military artificial intelligence investment presents developing countries with competing priorities concerning national security, public expenditure, and economic development. This study explores these trade-offs through interviews with sixteen participants in Pakistan. Guided by the defense-welfare trade-off and dual-use technology and knowledge spillover perspectives, the study employs reflexive thematic analysis to examine perceived implications for public spending, industrial development, and human capital. Six themes were developed: conditional fiscal pressures, domestic supplier participation, civilian technology transfer, skills expansion and talent concentration, technological dependence, and investment accountability. Participants associated potential developmental benefits with sustainable financing, accessible procurement, research partnerships, and transferable workforce training. Conversely, recurring costs, restricted commercialization, foreign supplier dependence, and competition for scarce professionals were identified as possible constraints. The findings suggest that military AI investment's developmental value depends on institutional arrangements and implementation choices. The study recommends phased investment, comprehensive ownership-cost assessments, domestic capability development, and independent evaluation. It contributes an integrated understanding of perceived economic mechanisms within Pakistan, while recognizing that interviews cannot establish causal effects or support unrestricted generalization across developing countries with different institutional circumstances.

Keywords: Military Artificial Intelligence; Defense-Welfare Trade-Offs; Dual-Use Technology Spillovers; Industrial Development; Human Capital Development.

1. Introduction

1.1 Background of Research

Artificial intelligence (AI) is transforming economic activity by expanding opportunities for automation, data analysis, and organizational decision-making. Its applications increasingly connect technological innovation with questions of productivity, institutional capacity, and national competitiveness (Abbas Khan et al., 2024). Within international affairs, AI also raises questions about how technological capabilities influence security priorities and relations between states (Cummins et al., 2018). These developments make defense-related AI investment relevant to economic development as well as military modernization.

Military applications include intelligence analysis, cybersecurity, logistics, predictive maintenance, and decision support. Their implementation requires complementary investments in infrastructure, skilled personnel, and organizational processes (Rashid et al., 2023). Consequently, adopting military AI involves



continuing commitments rather than the purchase of isolated technological products. Borchert (2024) emphasizes the extended institutional process involved in defense AI adoption, drawing attention to the capabilities required to sustain technological change.

For developing countries, this transformation presents choices concerning the allocation of resources between security requirements and wider development objectives. Investment may support domestic research, supplier development, and technical education, while imported systems and recurring operating costs may create additional financial obligations. Strategic competition further shapes the environment in which governments evaluate these opportunities and pressures (Horowitz et al., 2018). Different defense innovation trajectories nevertheless indicate that technological advancement follows diverse institutional pathways rather than a universal model (Raska & Bitzinger, 2023).

Pakistan provides the empirical setting for this study, which examines interviews with sixteen participants concerning the economic implications of military AI investment. The analysis focuses on perceived relationships between defense modernization, public spending, industrial development, and human capital. By connecting these dimensions, the study explores the conditions under which military AI investment might support broader development objectives. Participants' accounts are examined as qualitative evidence of perspectives and anticipated mechanisms, rather than direct measurements of national expenditure changes, industrial performance, or employment outcomes.

1.2 Problem Statement

Military AI investment raises a development dilemma: how can governments strengthen security capabilities while sustaining public services and building productive capacity? Budgetary tradeoffs depend on financing arrangements and expenditure priorities rather than an inevitable reduction in welfare spending (Mintz & Stevenson, 1995). Resource-constrained AI adoption nevertheless requires consideration of affordability and competing needs (Frimpong, 2025), while technological asymmetries may limit opportunities for domestic value creation (Garcia, 2024).

In Pakistan, this study investigates how participants understand these tensions across public spending, industrial development, and human capital. Organizational capabilities influence defense AI adoption (Chedrawi & Atallah, 2022), and computing and energy requirements broaden its resource implications (Hunter, 2026). Strategic choices must also reflect institutional capacity and operational requirements (De Spiegeleire et al., 2017). The research problem concerns how these pressures and opportunities interact, and which conditions participants identify as necessary for aligning military AI investment with broader development priorities within the Pakistani context.

1.3 Research Questions

1. How do participants in Pakistan perceive the trade-offs between military AI investment and public expenditure on healthcare, education, and infrastructure?
2. Under what conditions do participants perceive military AI investment as contributing to domestic industrial development and technological capabilities?
3. What opportunities and barriers do participants identify concerning the transfer of defense-related technologies and knowledge to civilian sectors?
4. How do participants understand the implications of military AI investment for skills formation, employment opportunities, and competition for specialized professionals?
5. Which governance, procurement, and evaluation arrangements do participants consider necessary to align military AI investment with Pakistan's broader development priorities?

1.4 Research Objectives

1. To examine participants' perceptions of the trade-offs between military AI investment and expenditure on essential public services in Pakistan.
2. To identify the conditions under which military AI investment is perceived to support domestic industrial development and technological capability formation.
3. To explore perceived opportunities and barriers affecting the transfer of defense-related technologies and knowledge to civilian sectors.



4. To analyze participants' perspectives on skills development, employment opportunities, and the distribution of specialized professionals across defense and civilian organizations.
5. To develop context-sensitive recommendations concerning governance, procurement, and investment evaluation that could align defense modernization with Pakistan's development priorities.

1.5 Significance of the Study

This study contributes to understanding the economic implications of military AI investment by examining public spending, industrial development, and human capital together. Its theoretical significance lies in integrating the defense-welfare trade-off perspective with the dual-use technology and knowledge spillover perspective. This combination enables analysis of competing resource demands alongside potential civilian benefits, without assuming that modernization necessarily produces either welfare losses or economic growth.

Empirically, interviews with sixteen participants in Pakistan provide insight into how these opportunities and constraints are understood within a developing-country setting. The analysis identifies perceived mechanisms connecting financing choices, procurement arrangements, research partnerships, and workforce development. Its contribution concerns contextual understanding rather than statistical representation of Pakistan's population or developing countries generally.

Practically, the findings may inform policymakers, procurement institutions, universities, technology firms, and training providers. Attention to recurring costs, domestic participation, transferable skills, and independent evaluation can support more comprehensive consideration of investment proposals.

The study also provides a foundation for subsequent comparative and longitudinal research. By identifying relationships that warrant further investigation, it can guide examination of whether anticipated industrial and educational benefits materialize. Broader relevance depends on similarities in institutional and economic conditions, with transferability requiring careful assessment rather than automatic cross-country generalization.

2. Literature Review

2.1 Theoretical Framework

This study integrates the defense-welfare trade-off perspective with the dual-use technology and knowledge spillover perspective. The former explains how defense commitments interact with other expenditure priorities through fiscal constraints, financing arrangements, and political decisions. It does not imply that every increase in defense investment necessarily reduces social expenditure; the relationship depends on how governments mobilize and allocate resources (Mintz & Stevenson, 1995). Defense expenditure may also support industrial objectives, creating connections between security provision and productive capability development (Cypher, 1987).

The dual-use perspective considers how defense-related research, infrastructure, and expertise might benefit civilian activities. Evidence concerning defense R&D and productivity provides a basis for examining these possibilities, although broader findings cannot automatically establish equivalent returns from military AI investment in Pakistan (Moretti et al., 2025). Machine knowledge capital further directs attention toward the ownership and accumulation of technological capabilities (Ciuriak, 2024).

Open innovation connects defense organizations with external sources of knowledge and commercialization opportunities (Reuven & Shamir, 2025), while economic and regulatory arrangements influence the distribution of technological benefits (Girasa, 2020). Together, these perspectives guide analysis of participants' accounts through three interconnected pathways: fiscal pressure, domestic industrial learning, and human-capital development. Procurement arrangements, institutional capacity, and governance condition these relationships.

2.2 Military AI Investment, Fiscal Space, and Public-Service Priorities

Military AI expenditure should be evaluated through its full financial commitments rather than acquisition costs alone. Maintenance, software updates, computing infrastructure, technical support, and specialist personnel can shape affordability over time. The defense-welfare trade-off perspective directs attention toward how these commitments interact with healthcare, education, and infrastructure priorities.



Financing through additional revenue, borrowing, or expenditure reallocation may produce different consequences for public services (Mintz & Stevenson, 1995). Frimpong (2025) examines AI investment in resource-constrained African economies, providing a contextual comparison for considering financial and strategic choices. Although this setting differs from Pakistan, it helps frame questions about affordability and competing development needs. Hunter (2026) connects AI with data centers and energy capabilities, broadening the assessment of infrastructure commitments.

Organizational preparedness also affects whether expenditure can translate into usable capabilities. Tarraf et al. (2019) provide a defense-institutional reference point for examining readiness, while De Spiegeleire et al. (2017) address the strategic circumstances of smaller force providers. These contributions support a capacity-sensitive approach to investment assessment.

For the Pakistani study, the relevant question is therefore how participants understand financing choices, recurring obligations, and public-service opportunity costs. Their accounts can illuminate perceived mechanisms, while establishing actual expenditure displacement would require budgetary evidence beyond interviews.

2.3 Domestic Industrial Development and Dual-Use Innovation

Defense investment can support domestic industry when procurement and research expenditure strengthen local production, technological learning, and supplier capabilities. Cypher (1987) provides a foundation for examining military spending as an instrument of industrial policy. This perspective shifts attention from the size of expenditure toward its composition and connections with domestic economic activity.

The spillover literature further considers whether defense-supported research contributes to civilian productivity and innovation. Moretti et al. (2025) offer relevant evidence concerning defense R&D, but their findings should be distinguished from direct evidence about military AI investments in Pakistan. Reuven and Shamir (2025) examine open innovation in defense, providing a basis for considering partnerships with civilian firms and research institutions.

Such connections depend on organizational resources and institutional arrangements. Chedrawi and Atallah's (2022) study of the Lebanese Armed Forces offers a comparative perspective on resource capabilities and adoption pressures. Soare (2023) examines European military AI coordination, illustrating the relevance of arrangements beyond individual organizations.

These contributions inform questions about local software development, maintenance, systems integration, and commercialization in Pakistan. Purchasing sophisticated systems and developing domestic productive capabilities are analytically distinct outcomes. The present study therefore examines participants' perceptions of procurement access, supplier readiness, and the conditions necessary for technological expenditure to generate broader industrial benefits.

2.4 Human Capital, Skills Formation, and Labor-Market Adjustment

Human capital connects technological investment with the capacity to develop, operate, and adapt AI systems. Broader research on AI and economic transformation provides context for examining changing demands for technical expertise and organizational learning (Abbas Khan et al., 2024). Girasa (2020) similarly situates AI within economic and regulatory change, encouraging consideration of consequences beyond individual adopting institutions.

For military AI, workforce development involves both specialized researchers and supporting occupations in software maintenance, electronics, network security, and data management. Investment may encourage education and training, but increased recruitment does not necessarily expand the national supply of expertise. Where professionals move between employers, organizational gains may coexist with shortages elsewhere.

Mhlanga's (2022) human-centered perspective provides a contextual basis for considering access, inclusion, and social objectives. Broader reflections on technology and national development also support examining educational institutions and transferable capabilities rather than technological acquisition alone (Tiwari et al., 2025). Ciuriak (2024) adds a defense-specific perspective through machine knowledge capital.



Applied to Pakistan, these arguments guide examination of participants' expectations about scholarships, technical education, apprenticeships, and civilian career opportunities. The analysis distinguishes potential skills creation from talent redistribution. Assessing actual employment gains, wage pressures, or recruitment difficulties would require complementary labor-market evidence and examination over time.

2.5 Technological Dependence, International Competition, and Strategic Autonomy

Military AI development occurs within international networks of technology suppliers, research institutions, and infrastructure providers. Access to foreign systems can facilitate modernization while creating continuing relationships involving updates, maintenance, technical support, and data services. Shields (2017) provides a contextual link between foreign investment regulation, national security, and technology transfer, making these relationships relevant to investment assessment.

Garcia (2024) examines technological asymmetries affecting the Global South. This perspective raises questions about whether access to advanced systems also produces domestic learning and control over essential capabilities. Strategic autonomy consequently requires consideration of which dependencies are manageable and which capabilities merit domestic development, rather than assuming complete technological self-sufficiency.

Kania's (2019) examination of Chinese military innovation offers a comparative account of technological ambition within defense transformation. Horowitz et al. (2018) situate AI within strategic competition, while Zai and Fei (2025) discuss its implications for international power relationships. These works explain external pressures but do not establish the economic effects of particular investments in Pakistan.

2.6 Governance, Accountability, and Responsible Defense AI Adoption

Governance influences how military AI projects are selected, financed, implemented, and evaluated. Strategic importance does not remove the need to assess affordability, institutional readiness, and alternative uses of public resources. Dafoe's (2018) AI governance agenda provides a broad foundation for examining the decision processes and institutions surrounding technological development.

Within defense, these questions intersect with legitimate restrictions on information disclosure. Hynek and Solovyeva (2022) situate military AI within technological and regulatory debates, providing context for considering oversight alongside security requirements. Osimen et al. (2024) address arms control, contributing an international governance perspective rather than direct evidence of economic returns.

Rickli and Mantellassi (2023) examine military applications and security implications, while Cummings et al. (2018) consider AI within international affairs. Together, these contributions establish why adoption decisions involve institutional responsibilities extending beyond technical performance. However, strategic or regulatory discussions alone cannot demonstrate that an investment supports broader development.

In the Pakistani context, the analytical focus concerns participants' views on financial transparency, independent review, procurement justification, and measurable milestones. Appropriate accountability need not require disclosure of operationally sensitive details. The relevant issue is whether review arrangements allow expenditure commitments and project outcomes to be assessed against defined security needs and realistic development objectives over time.

2.7 Gaps in Existing Research

The reviewed literature provides substantial discussion of military AI adoption, strategic competition, and innovation. Borchert (2024) emphasizes the extended process of adoption, while Raska and Bitzinger (2023) examine variation in strategies, capabilities, and trajectories. These contributions motivate a closer examination of how defense modernization connects with public spending, industrial participation, and workforce development within a single analytical framework.

A second issue concerns contextual transferability. Soare's (2023) European analysis offers comparative insights, but institutional arrangements and investment capacities cannot be assumed to operate similarly in Pakistan. Likewise, an overview of military AI applications identifies capabilities and challenges



without establishing their economic consequences in a particular national setting (Rashid et al., 2023). Broader reflections on technology and development reinforce the importance of examining these contextual relationships (Tiwari et al., 2025).

The present study addresses an analytical need within this literature by examining how sixteen participants in Pakistan understand interconnected economic opportunities and constraints. It distinguishes capability acquisition from domestic learning, anticipated civilian spillovers from realized benefits, and workforce expansion from talent redistribution. The contribution is a context-sensitive interpretation of perceived mechanisms rather than a claim that prior research is absent. Subsequent comparative and longitudinal investigation would be needed to evaluate these mechanisms across institutions and countries.

3. Methodology

3.1 Research Design

This study adopts an exploratory qualitative design to examine perceptions of the economic trade-offs associated with military AI investment in Pakistan. Interviews with sixteen participants provide the empirical material for investigating public expenditure priorities, domestic industrial development, and human-capital implications. A contextualist orientation recognizes that participants' accounts reflect interpretations shaped by their circumstances rather than direct measurements of economic outcomes. Reflexive thematic analysis supports the development of patterns of meaning across these accounts (Braun et al., 2022). The defense-welfare trade-off and knowledge spillover perspectives guide interpretation without restricting analysis exclusively to predetermined categories, maintaining methodological coherence and reflexivity (Hole, 2024).

3.2 Sampling Strategy

The study includes sixteen participants from Pakistan, and all sixteen interview transcripts are incorporated into the analysis. The accounts address complementary dimensions of military AI investment, including expenditure priorities, technological capabilities, workforce development, and accountability. However, the recruitment procedure, eligibility criteria, and participants' professional backgrounds have not been specified in the information available for this manuscript. Consequently, the study does not characterize recruitment as purposive, convenience-based, or representative. Sample adequacy is considered in relation to the research questions and the interpretive scope of the material, rather than inferred from participant numbers alone. No claim of thematic saturation is made (Byrne, 2022).

3.3 Data Collection

Data comprise interview transcripts from sixteen participants in Pakistan. The interviews address perceived economic opportunities, competing expenditure priorities, industrial participation, educational requirements, and governance considerations associated with military AI investment. For analysis, the transcripts are organized using identifiers P1–P16, preserving the association between each participant and their account. Interview dates, locations, mode, duration, language, recording arrangements, and transcription procedures remain to be documented from the researcher's records. These procedures are not inferred from the transcript content. Repeated reading of the available interview text supports familiarization and identification of passages relevant to the research questions, consistent with thematic analytical practice (Byrne, 2022).

3.4 Data Analysis

Analysis follows six recursive phases: familiarization, coding, generating candidate themes, reviewing themes, defining and naming themes, and constructing the analytical account (Byrne, 2022). Initial coding identifies explicit concerns and opportunities, including expenditure displacement, procurement access, technology transfer, skills formation, and supplier dependence. Related codes are examined together to develop themes capturing shared meanings and contrasting positions. Interpretation moves between individual transcripts, the complete dataset, and the theoretical framework. Participant identifiers provide traceability between interpretations and source material. Consistent with reflexive thematic analysis, themes are treated as researcher-developed interpretations rather than objectively discovered categories requiring statistical agreement between coders (Braun et al., 2022).



3.5 Ethical Considerations

Reporting uses participant identifiers P1–P16 and excludes names or inferred institutional affiliations. Interpretation preserves differences between accounts and avoids attributing professional roles or personal characteristics that participants have not supplied. Reflexive attention to analytical assumptions supports responsible representation of participants' perspectives (Braun et al., 2022; Hole, 2024). Details of informed consent, permission to use interview material, institutional ethical review, and data-storage arrangements have not yet been provided for this manuscript. These details must be completed from the actual research records before submission. Their absence from the current documentation is not treated as evidence that ethical procedures were either undertaken or omitted.

3.6 Participants' Profile

The table below includes the sixteen participants from Pakistan, the principal focus of their interview accounts, and their contribution to the analysis. Because demographic and professional information has not been provided, the table describes the perspectives expressed rather than assigning occupations, qualifications, or organizational positions. Discussion of healthcare, education, industry, or public policy does not establish employment in those sectors.

Table 1

Participant Profiles

Participant identifier	Principal focus of interview account	Opportunities identified	Concerns identified	Analytical relevance
P1	Balancing security investment with public-service priorities	Improved security through phased and sustainable investment	Opportunity costs for hospitals, schools, and infrastructure; maintenance requirements	Public expenditure priorities and fiscal sustainability
P2	Financing alternatives and continuing technological commitments	Additional revenue, expenditure efficiency, research partnerships, and employment	Underestimated maintenance costs, imported services, and debt implications	Conditional budgetary trade-offs and ownership costs
P3	Domestic technology firms and procurement opportunities	Local economic activity generated by investment; university research and institutional partnerships	Competing healthcare needs, restricted access, and limited civilian suitability	Welfare priorities and technology-transfer conditions
P4	Public confidence through appropriate disclosure and independent auditing	Innovation in machine learning, cybersecurity, cloud computing, and analytics	Limited scrutiny, unnecessary technological competition, and external dependence	Transparency and strategic justification
P5	Component production, software development, maintenance, and integration	Laboratories, postgraduate training, scientific expertise, and civilian applications	Restricted finance, research facilities, and access to government contracts	Domestic innovation and supplier participation
P6	Supply-chain opportunities, cybersecurity services, and technical training	Scholarships, professional qualifications, technical careers, and	Foreign expenditure outflows, skills gaps, and production constraints	Domestic value capture and industrial capabilities



Participant identifier	Principal focus of interview account	Opportunities identified	Concerns identified	Analytical relevance
		curriculum improvement		
P7	Specialist demand and national workforce development	Educational access and students' career opportunities	Research dependence on defense funding and reduced academic independence	Knowledge spillovers and research capacity
P8	Employment transitions and retraining	Small-business participation in technology development	Procurement exclusion and competition for skilled workers and finance	Distribution of industrial opportunities
P9	Skills creation versus talent redistribution	Specialist demand and national workforce development	Limited experienced personnel and recruitment pressures on civilian organizations	Skills creation versus talent redistribution
P10	Inclusive human-capital development	Educational access and students' career opportunities	Concentrated research opportunities and unequal access to learning facilities	Inclusive human-capital development
P11	Labor-market adjustment and retraining	Employment transitions and retraining	Unequal retraining access, wage pressures	Labor-market adjustment and distributional concerns
P12	Supporting technical occupations	Shorter vocational pathways and technical careers	Limited recognition of supporting roles	Broadening workforce development
P13	Imported capabilities and continuing dependencies	Selected domestic capabilities in cybersecurity and integration	Reliance on overseas software, chips, cloud infrastructure, and technical support	Technological dependence and selective autonomy
P14	Maintenance, workforce costs, and investment value	Periodic review and measurable outcomes	Underestimated life-cycle costs	Accountability and evaluation
P15	Institutional partnerships and commercialization	Government–university–industry collaboration	Regulations, international agreements, and insufficient commercial demand	Civilian spillovers and transfer pathways
P16	Realistic assessment of national financial capacity	Phased investment and transparent evaluation criteria	Fiscal capacity constraints and competing public needs	Fiscal sustainability and governance



4. Findings and Discussion

4.1 Theme 1: Fiscal Sustainability Depends on Financing and Life-Cycle Costs

Participants associated military AI investment with competing demands on public resources, while differing on whether social expenditure would necessarily decline. P1 emphasized the opportunity costs of allocating funds to imported systems when healthcare, education, and infrastructure also require investment. P3 reinforced this concern through the resources needed to improve healthcare delivery. P16 similarly connected modernization with a realistic assessment of national financial capacity.

P2 introduced an important qualification by identifying revenue mobilization and expenditure efficiency as alternatives to reducing social spending. This account challenges a fixed interpretation of the defense-welfare relationship. Within these interviews from Pakistan, fiscal pressure was therefore understood as conditional on financing decisions rather than an unavoidable consequence of military AI investment.

Continuing expenditure provided a connection between these positions. P2 highlighted imported software and technical services, while P14 identified maintenance and workforce costs as relevant to investment value. These concerns suggest that initial affordability may conceal longer-term commitments. Frimpong (2025) provides a comparative context for examining AI investment under resource constraints.

The theme indicates that participants evaluated modernization through financial sustainability and public-service priorities together. Phased implementation, comprehensive costing, and periodic assessment emerged as proposed approaches for managing these competing demands without assuming that security and welfare objectives are inherently incompatible.

4.2 Theme 2: Domestic Industrial Benefits Require Deliberate Supplier Participation

Participants distinguished the acquisition of advanced systems from the development of domestic industrial capabilities. P5 identified opportunities for technology companies working in machine learning, cybersecurity, cloud computing, and analytics. P6 broadened potential participation to component production, software development, maintenance, and systems integration. These accounts suggest that investment could support several forms of productive activity rather than only highly specialized research.

However, procurement arrangements were central to whether such opportunities would become accessible. P5 expressed concern that exclusive reliance on foreign suppliers could limit domestic benefits. P8 similarly questioned whether substantial defense expenditure would generate meaningful opportunities for smaller businesses. Participants therefore did not treat spending growth as sufficient evidence of industrial development.

Capability constraints further qualified these expectations. P6 emphasized skills, infrastructure, financing, and production standards, while P15 recommended building on existing business and university strengths. Chedrawi and Atallah (2022) provide a relevant organizational comparison through their attention to resources and defense AI adoption.

For the Pakistani context, this theme identifies domestic participation as a deliberate policy and institutional undertaking. Participants' accounts suggest assessing investment through supplier learning, viable capabilities, productivity, and employment. These are anticipated pathways to industrial benefits, rather than evidence that particular procurement programs have already generated such outcomes.

4.3 Theme 3: Civilian Spillovers Depend on Transfer and Commercialization Pathways

Participants identified possible civilian benefits from defense-related technologies while emphasizing barriers to their realization. P3 discussed emergency coordination, disaster management, medical logistics, and diagnostics. P7 extended potential applications to agriculture, transportation, manufacturing, and environmental monitoring. These accounts portrayed knowledge generated through defense investment as potentially relevant to broader development needs.

Nevertheless, technological relevance did not guarantee transfer. P3 noted that restricted access and limited civilian suitability could prevent wider use. P15 added that regulations, international agreements, and insufficient commercial demand might constrain commercialization. Participants consequently distinguished the existence of advanced technology from its accessibility and economic usefulness outside defense organizations.



Institutional partnerships emerged as possible mechanisms for overcoming these barriers. P5 emphasized collaboration between government, universities, and technology companies. P7 proposed postgraduate training and civilian research opportunities within such relationships, while also expressing concern about excessive dependence on defense contracts. Reuven and Shamir's (2025) discussion of open innovation offers a comparative framework for interpreting these connections.

The theme suggests that civilian spillovers in Pakistan should be understood as conditional processes requiring adaptation, appropriate access, and viable applications. Preserving academic independence and research diversity also matters because narrow funding priorities could constrain the range of civilian problems that publicly supported expertise can address.

4.4 Theme 4: Skills Expansion Can Coexist with Talent Concentration

Participants presented military AI investment as a potential stimulus to technical education and specialized employment. P9 identified demand for machine learning engineers, cybersecurity specialists, data scientists, and software developers. P10 connected technological opportunities with students' educational choices, while P7 highlighted postgraduate training and research capacity. These accounts suggest that defense-related investment could encourage learning and professional development.

However, participants also distinguished new skills formation from competition for existing expertise. P9 and P11 described the possibility that defense organizations and contractors could attract professionals away from universities and civilian businesses. The perceived economic benefit therefore depends partly on whether investment expands the talent pool or concentrates available expertise within selected employers.

Access to training further shaped participants' expectations. P10 emphasized laboratories, internships, and accessible education, while P11 raised concerns about retraining opportunities outside major urban centers. P12 highlighted supporting technical occupations and shorter vocational pathways, broadening the discussion beyond advanced AI researchers.

Mhlanga's (2022) human-centered perspective provides a contextual basis for interpreting these concerns through inclusion. In Pakistan, the interviews suggest that transferable qualifications and civilian career opportunities are important conditions for wider workforce benefits. The evidence identifies perceived tensions, but does not establish the magnitude of recruitment displacement, wage changes, or employment creation.

4.5 Theme 5: Imported Capabilities Create Continuing Dependencies

Participants viewed foreign technology as a source of immediate capability and a potential source of continuing economic exposure. P13 identified reliance on overseas software, specialized chips, cloud infrastructure, and technical support. P2 connected imported systems with recurrent financial obligations, while P4 emphasized longer-term technological vulnerabilities. Together, these accounts suggest that procurement establishes relationships extending beyond the initial transaction.

The perceived risks concern continuity, affordability, and control. Supplier concentration, maintenance requirements, and access to support may affect whether systems remain usable over time. Shields (2017) provides contextual relevance through the intersection of technology transfer and national security. Hunter (2026) further situates AI capabilities within computing and energy requirements, widening the resources considered in investment assessment.

Participants nevertheless avoided treating complete domestic production as an uncomplicated solution. P13 explicitly recognized its potentially prohibitive cost and proposed selected capabilities in cybersecurity and integration. P6 similarly identified maintenance and software as possible areas of domestic participation.

For Pakistan, the theme supports examining technological dependence through selective capability development and sustainable international cooperation. Participants' accounts favor assessing which competencies could reduce vulnerability while remaining financially realistic. They do not demonstrate that particular suppliers have caused disruptions or that domestic substitution would necessarily provide better value in every case.



4.6 Theme 6: Accountability and Evaluation Condition Developmental Value

Participants identified accountability as a condition for determining whether military AI investment serves security and development objectives. P4 distinguished legitimate protection of technical information from the need for financial scrutiny. Appropriate expenditure summaries, independent auditing, and explanations of investment objectives were proposed as ways to strengthen public confidence without disclosing sensitive operational details.

P14 extended this position by emphasizing measurable outcomes and periodic review. Projects should be considered in relation to procurement costs, maintenance, workforce requirements, industrial participation, and civilian applications. Repeated failure to meet objectives was presented as a reason for reassessment rather than automatic continuation. P1 and P16 reinforced the importance of phased investment and transparent evaluation criteria.

These accounts connect governance with decisions throughout the investment process. Dafoe's (2018) governance perspective helps frame the institutional responsibilities involved, while Tarraf et al. (2019) provide a defense-organizational reference point for considering implementation capacity.

Within the Pakistani interviews, accountability was presented as compatible with modernization and necessary for its justification. The theme suggests evaluating both strategic relevance and financial sustainability throughout a project's life cycle. However, the interviews describe participants' preferred arrangements rather than evidence that specific auditing or evaluation mechanisms have already improved military AI outcomes in Pakistan.

Table 2

Thematic Analysis of Findings

Theme	Analytical codes and subthemes	Supporting participants	Contrasting or qualifying evidence	Central interpretation	Theoretical relevance and implications
Fiscal sustainability depends on financing and life-cycle costs	Public-service opportunity costs; revenue alternatives; maintenance obligations; staged investment	P1, P2, P3, P14, P16	P2 challenges inevitable welfare displacement by identifying additional revenue and expenditure efficiency	Fiscal consequences depend on financing arrangements and continuing commitments	Defense-welfare trade-offs should be examined through funding sources and full ownership costs
Domestic industrial benefits require deliberate supplier participation	Procurement access; local software and components; maintenance; supplier readiness; domestic value capture	P5, P6, P8, P15	High expenditure may coexist with limited local opportunities when foreign suppliers dominate	Domestic learning requires accessible procurement and viable productive capabilities	Industrial benefits depend on institutional connections between defense demand and domestic firms
Civilian spillovers depend on transfer and commercialization pathways	University partnerships; civilian adaptation; research access; market demand;	P3, P5, P7, P15	Technical relevance may not overcome access restrictions, unsuitable applications,	Spillovers require transfer, adaptation, and commercially or socially useful applications	Dual-use benefits should be assessed through actual civilian access and use



Theme	Analytical codes and subthemes	Supporting participants	Contrasting or qualifying evidence	Central interpretation	Theoretical relevance and implications
Skills expansion can coexist with talent concentration	academic independence	P7, P9, P10, P11, P12	or weak demand	Broad workforce benefits require additional skills formation and accessible learning pathways	Human-capital spillovers interact with opportunity costs for universities and civilian employers
	Specialist demand; transferable qualifications; vocational education; recruitment competition; unequal training access		Defense recruitment may redistribute professionals rather than expand national expertise		
Imported capabilities create continuing dependencies	Foreign support; supplier concentration; maintenance; domestic substitution costs	P2, P4, P6, P13, P16	Complete domestic production may be prohibitively expensive	Selective capability development can reduce vulnerability	Capability retention requires sustainable international cooperation and targeted domestic investment
Accountability and evaluation condition developmental value	Financial scrutiny; independent auditing; measurable outcomes; periodic review	P1, P4, P14, P16	Protection of sensitive information must be balanced with financial transparency	Accountability is compatible with modernization and necessary for justification	Governance arrangements shape whether investment aligns with security and development objectives

4.7 Synthesis of Findings

The six themes converge on a distinction between acquiring military AI systems and developing capabilities that generate wider economic value. Participants recognized potential security, industrial, and educational benefits, but consistently attached conditions concerning financing, procurement, institutional collaboration, and workforce access. Developmental gains were therefore interpreted as contingent outcomes rather than automatic consequences of technological modernization.

Fiscal and industrial considerations intersect through procurement choices. Imported systems may address immediate requirements while generating continuing costs and limited domestic learning. Local participation may retain more value, but requires capabilities and support that cannot be assumed. Ciuriak's (2024) discussion of machine knowledge capital provides a conceptual connection between investment and the accumulation of useful expertise.

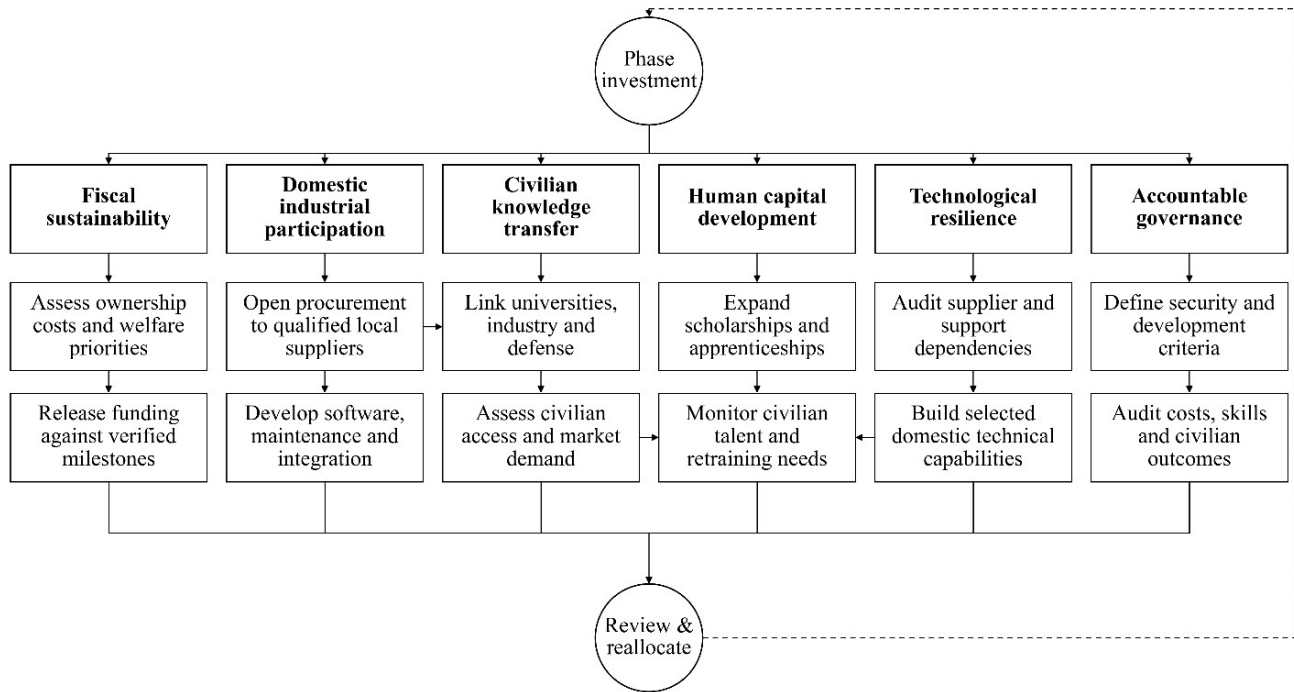
Human capital links these processes because trained professionals support adoption, supplier development, and civilian adaptation. Yet concentration of talent within defense institutions may create pressures elsewhere. Governance influences whether these competing consequences receive attention. Garcia's (2024) discussion of Global South asymmetries contextualizes the unequal technological conditions surrounding such decisions.



Taken together, the Pakistani interviews identify interconnected mechanisms through which military AI investment might support or constrain development. Their contribution is an interpretation of participants' expectations and concerns. Establishing the actual direction and scale of economic effects requires complementary evidence on expenditure, industrial performance, and employment.

Figure 1

Proposed action framework for aligning military AI investment with fiscal sustainability, industrial development, and human-capital formation through coordinated implementation and iterative evaluation.



The figure presents a framework linking fiscal sustainability, industrial development, and human-capital formation through coordinated implementation and iterative evaluation.

4.8 Discussion

The findings connect competing resource demands with the conditions required for capability development. Participants' emphasis on domestic suppliers supports examining defense investment through an industrial-policy perspective (Cypher, 1987). However, anticipated opportunities should be distinguished from demonstrated productivity gains. Moretti et al. (2025) provide evidence concerning defense R&D spillovers, but these results cannot establish equivalent outcomes for military AI investment in Pakistan.

The workforce findings add a distributional dimension. Participants associated modernization with new learning opportunities while recognizing possible pressures on civilian employers. Mhlanga's (2022) human-centered approach provides a basis for interpreting why access and transferable skills matter alongside technological performance. Supplier dependence introduces a related concern: acquiring technology does not necessarily secure continued access or domestic learning, making transfer arrangements relevant to investment evaluation (Shields, 2017).

Comparative defense AI research also highlights the importance of context. Kania's (2019) examination of Chinese innovation and Soare's (2023) European analysis provide contrasts rather than directly transferable models. De Spiegeleire et al. (2017) offer a complementary perspective on aligning technological ambitions with institutional capacity.



Government connects these economic concerns with security responsibilities. Arms-control and international-security scholarship contextualizes the institutional environment surrounding adoption without independently demonstrating developmental value (Osimen et al., 2024; Rickli & Mantellassi, 2023).

The study therefore contributes a Pakistan-based interpretation of how financing, procurement, knowledge transfer, and workforce development interact in participants' accounts. Its significance lies in identifying conditions and tensions for empirical examination, while avoiding causal claims about national economic outcomes that interview perceptions alone cannot substantiate.

5. Conclusion, Implications and Future Directions

5.1 Conclusion

This study explored the economic trade-offs of military AI investment through interviews with sixteen participants in Pakistan. Integrating the defense-welfare trade-off and dual-use technology and knowledge spillover perspectives enabled examination of public spending, industrial development, and human capital within a common framework. The findings indicate that participants viewed developmental benefits as conditional on financing arrangements, domestic capabilities, institutional partnerships, and accountable governance.

Concerning public spending, participants identified potential competition between military AI investment and essential services. However, they did not uniformly consider welfare displacement inevitable. Revenue mobilization, expenditure efficiency, and phased implementation were presented as possible means of managing fiscal pressure. Recurring maintenance, software, infrastructure, and workforce costs remained central to assessments of affordability.

Industrial benefits were associated with domestic supplier participation, research collaboration, and opportunities for technological learning. Participants distinguished purchasing advanced systems from developing productive capabilities within Pakistan. Civilian spillovers were similarly understood as requiring accessible transfer arrangements, adaptation, and viable applications rather than arising automatically from defense expenditure.

Human-capital implications involved a tension between expanding expertise and redistributing existing professionals. Defense-related opportunities could encourage technical education and specialized employment while increasing recruitment pressures on universities and civilian businesses. Accessible training, supporting technical occupations, and transferable qualifications were therefore considered important for broader workforce development.

Across these dimensions, participants emphasized selective domestic capability building, sustainable international partnerships, and independent investment evaluation. Financial scrutiny and protection of sensitive information were presented as compatible responsibilities.

The study concludes that assessing military AI investment requires consideration of how security capabilities connect with wider economic opportunities and costs. Its findings represent participants' perceptions within Pakistan, rather than measured changes in national expenditure, productivity, or employment. They provide a context-sensitive foundation for policy discussion and further empirical investigation, with relevance to other developing countries depending on comparable institutional, fiscal, and technological circumstances rather than assumed generalizability.

5.2 Theoretical Implications

The study connects defense-welfare trade-offs with the conditions governing dual-use technology and knowledge spillovers. Its contribution is to interpret fiscal pressures and capability development as interacting processes rather than separate consequences. The same investment may generate learning opportunities while creating recurring obligations or competition for skilled professionals.

Girasa's (2020) account of AI-driven transformation provides a broader basis for considering these economic relationships. Borchert (2024) emphasizes the sustained institutional process of adoption, supporting attention to implementation rather than acquisition alone. Variation in defense innovation strategies further suggests that development pathways depend on national capabilities and organizational



arrangements (Raska & Bitzinger, 2023). Regulatory considerations similarly shape the institutional environment surrounding military AI (Hynek & Solovyeva, 2022).

The Pakistani interviews identify procurement access, absorptive capacity, transferable skills, and accountability as conditions connecting the two perspectives. These relationships offer propositions for subsequent investigation rather than statistical validation of either theory or universally applicable causal conclusions.

5.3 Practical Recommendations

Pakistani policymakers should evaluate military AI proposals against defined security needs, financial capacity, and alternative public investments. Appraisal should include acquisition, maintenance, software, infrastructure, training, and support costs. Staged funding and measurable milestones can support reassessment as implementation proceeds.

Procurement institutions should enable qualified domestic suppliers to compete while addressing capability gaps through targeted research partnerships and development support. Participation should be evaluated through learning, performance, and viable civilian applications rather than contract allocation alone.

Universities and training providers should expand transferable competencies through postgraduate education, apprenticeships, and accessible professional development. Workforce assessment should consider recruitment pressures on civilian organizations alongside defense requirements.

Finally, procurement reviews should examine supplier concentration, continuity of support, and opportunities for selective domestic capability development. Appropriate financial disclosure and independent evaluation should accompany safeguards for sensitive information. These recommendations require adaptation to project circumstances and assessment against documented outcomes, including broader development priorities and financial sustainability.

5.4 Limitations and Future Research Directions

The study draws on interviews with sixteen participants in Pakistan and does not establish statistical representativeness. The available accounts primarily express expectations and policy preferences rather than documented experiences of specific military AI projects. Consequently, perceived mechanisms cannot be treated as verified changes in public expenditure, industrial performance, or employment.

Participant characteristics and recruitment details also require fuller reporting to support assessment of transferability. Interpretation is shaped by the selected theoretical perspectives and the researcher's analytical choices. The absence of longitudinal and quantitative evidence limits conclusions about the scale or persistence of economic effects.

Future research should compare perspectives across defense institutions, public-service organizations, industry, universities, and training providers. Studies combining interviews with procurement records, budget data, workforce indicators, and civilian commercialization outcomes could examine whether anticipated benefits materialize. Comparative research across developing countries would help identify how institutional capacity and financing arrangements influence the relationship between modernization and development.

Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflict of interest.

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Informed Consent

Informed consent was obtained from all participants.

Data Availability

This study relies exclusively on publicly available secondary sources, including corporate disclosures, industry reports, and peer-reviewed literature, all of which are cited in the References section.



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