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SUSTAINABLE CORPORATE FINANCE AND INVESTMENT

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THE FINAL MASTER'S THESIS (PROJECT)

Pavadinimas: Viešojo Ir Privačiojo Sektorių Partnerystė Gynybos Finansavimo Srityje: Efektyvumo Analizė	<i>Title: Public-Private Partnerships In Defense Financing: An Analysis Of Effectiveness</i>
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Summary

The rising complexity of international security features and the rising financial pressures have made governments consider innovative funding for the process of modernization of the defense. Among them, the model of Public–Private Partnerships (PPP) has also become a very important one to unite the regulation of the state with the innovation, efficiency, and financial resources of the private sector. This research explores the success of PPPs in financing defense, the relationship that exists between these types of partnerships in relation to cost-efficiency, innovation, and governance in defense systems. The research is based on a mixed-method research design that incorporates quantitative analysis on secondary data on defense projects and performance indicators and qualitative research through case studies. The study is conducted based on the Resource Dependence Theory (RDT), Principal Agent Model, the Transaction Cost Theory (TCT), and the Public Value Theory (PVT) through which interaction between the public accountability, technological improvement, and institutional cooperation are analyzed. Results show that PPPs are effective in increasing innovation and operational flexibility. The research concludes that adaptive governance structure and clear-cut contract models are a necessity in ensuring the success of the long-term defense PPPs. These results lead to theoretical enhancement and provide policy insights to defense ministries and commercial developers who want to balance the innovation, cost-effective and national security imperatives. However, conflicts may arise between the desires of private companies to go for proprietary innovation and military need for secure and sovereign control.

Santrauka

Didėjantis tarptautinio saugumo elementų sudėtingumas ir didėjantis finansinis spaudimas privertė vyriausybes apsvarstyti novatoriškas gynybos modernizavimo proceso finansavimo galimybes. Tarp jų viešojo ir privačiojo sektorių partnerystės (VPP) modelis taip pat tapo labai svarbiu, siekiant sujungti valstybės reguliavimą su privačiojo sektoriaus inovacijomis, efektyvumu ir finansiniais ištekliais. Šiame tyrime nagrinėjama VPP sėkmė finansuojant gynybą, šių tipų partnerystės ryšys sąnaudų efektyvumo, inovacijų ir valdymo gynybos sistemose atžvilgiu. Tyrimas pagrįstas mišrių metodų tyrimo dizainu, apimančiu kiekybinę antrinių duomenų apie gynybos projektus ir veiklos rodiklius analizę bei kokybinius tyrimus atliekant atvejų studijas. Tyrimas atliekamas remiantis Išteklių priklausomybės teorija (RDT), Pagrindinio agento modeliu, Sandorių sąnaudų teorija (TCT) ir Viešosios vertės teorija (PVT), kuriomis remiantis analizuojama viešosios atskaitomybės, technologinio tobulėjimo ir institucinio bendradarbiavimo sąveika. Rezultatai rodo, kad VPP yra veiksmingos didinant inovacijas ir veiklos lankstumą. Tyrimo išvada yra ta, kad adaptivi valdymo struktūra ir aiškūs sutarčių modeliai yra būtini siekiant užtikrinti ilgalaikių gynybos VPP sėkmę. Šie rezultatai leidžia teoriškai išplėtoti teoriją ir suteikia politinių įžvalgų gynybos ministerijoms ir komerciniams kūrėjams, norintiems suderinti inovacijų, ekonomiško ir nacionalinio saugumo imperatyvus. Tačiau gali kilti konfliktų tarp privačių įmonių noro diegti patentuotas inovacijas ir karinio poreikio užtikrinti saugią ir suverenią kontrolę..

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ABBREVIATIONS

PPP-Public Private Partnership

SIPRI- Stockholm International Peace Research Institute

DEA-Data Envelopment Analysis

MSMEs-Micro, Small and medium enterprises

RDT-Resource Dependent Theory

RBV-Resource Based View

TCT-Transaction Cost Theory

PVT-Public Value Theory

PAM-Principal Agent Model

FCS-Future Combat System

GAO-Government Accountability Office

NAO-National Audit Office

ECA-European Court of Audits

VIF-Variance Inflation Factors

MOD-Ministry of Defense

DOD-Department of Defense

MHP-Maritime Helicopter Project

ASEAN- Association of South East Asian Nations

Keywords: Public–Private Partnerships (PPPs), Defense Financing, Innovation, Governance.

INTRODUCTION

Background of Study

Defense finance has become a very multifaceted sphere under the influence of the growing security needs in the world, limited state budgets, and increasing technical evolution. With the defense spending constantly on the increase, governments are getting harder-pressed to guarantee not only the fiscal effectiveness but also the technological dominance (Okromtchedlishvili, 2022). Conventional patterns of state-based defense procurement are sometimes constrained in terms of agility, innovation, and cost-effectiveness, and so typically the policymakers seek other models that incorporate non-state players. In that regard, Public–Private Partnerships (PPPs) have become an effective option to deploy a combination of both the principles of a greater responsible approach to the development of the defense capability and the influence of the private sector, its innovative strength, and capabilities (Pena et al., 2021; Soroka et al., 2023a). The spending on defense was immense, and the global amounts spent on defense hit all-time highs of roughly 2.7 trillion in 2024, equating to a real-term growth of about 9 percent annually- the highest percentage increase in decades- and constituting nearly a quarter of the world’s GDP. There is a growing concern amongst governments to provide fiscal effectiveness as they seek technological supremacy. Traditional structures of defense procurement by the state are at times limited in the areas of speed, creativity, and cost-efficiency. In that respect, Public–Private Partnerships (PPPs) have become a viable alternative to implement the mix of the ideals of more responsible attitude towards the development of defense capability and the impact of the private world with its innovative power and abilities. As an example, capital spending related to security and defense PPPs in Europe alone was estimated to be approximately 18.9 billion, which demonstrates that the frameworks of the PPP have become a significant repercussion of such major defense spending (SIPRI, 2025)

PPPs in defense funding support joint efforts by governments and contractors in a variety of activities, including procurement, logistics, research and development (R&D) and the management of infrastructures. This kind of arrangement allows combining capital and technical expertise and letting the states keep the jurisdiction over the results of national security independent (Kim, 2023; Mekh et al., 2022). PPPs could help to solve the problem of inefficiency in cost management and expedite the technological development process in the defense systems by aligning the incentives to innovation with those of the public defense (Rausser et al., 2023). PPPs are also mechanisms of knowledge transfer and diffusion of innovations in the military, as (Pena et al., 2021) conceded; they act as both systems of knowledge transfer and diffusion of

innovation in the defense sectors, creating competitive advantages in such sectors through collaboration.

Elsewhere, in other industries, like transport and energy as well as medical care, PPPs have proven to be quite effective in enhancing service delivery and balancing funding disparities by sharing the risks and resources (Chishti & Sinha, 2022; de Almeida et al., 2021). Nonetheless, applied to defense, these alliances also bring about increased complexity because the sector has specific needs in secrecy, accountability and geopolitical sensitivity. Defense PPPs exist through national security requirements, according to which the procurement choices are not solely guided by market effectiveness but also by tactical independence and battlefield latitude (Soroka et al., 2023a). The international security framework, which is constantly evolving toward cyber threats, warfare in hybrid form, and transnational terrorism, requires partnerships that are cooperative but regulated to create a balance between innovation and control of secretiveness and governance integrity (Karn et al., 2025).

This study offers a fresh input into the research on the topic of defense financing by leaving the largely conceptual or industry-focused coverage of the Public-Private Partnerships (PPPs) that is present in the literature (Kim, 2023; Pena et al., 2021; Soroka et al., 2023a). Although the theoretical potential of PPPs has been articulated in past studies and governance has been identified as a significant challenge, this study provides the first comprehensive, empirical comparison, of PPP and traditional procurement models, in standardized performance measures, such as cost efficiency, innovation and risk sharing. These well-defined quantitative results interconnected with comprehensive qualitative case studies give this research a proven and comprehensive model of measuring the effectiveness of defense PPP with an open gap in the literature to test the applicability of theoretical models to data-driven, defense-specific performance evaluation.

Problem Statement

Despite the increasing popularity of the use of Public–Private Partnerships (PPP) as a beneficial tool toward increasing innovation, cost efficiency, and flexibility in defense funding, its overall effectiveness is disputed (Pena et al., 2021; Soroka et al., 2023a). Based on literature the fact is that although PPPs can help their use to drive resources optimization and technology evolution, these arrangements tend to run into systematic obstacles that inevitably sabotage the purposes of their use. They are the lack of governance, inadequate accountability practices, and varying regulation policies, which impede transparency and coordination among the different stakeholders (public and private) (Chishti & Sinha, 2022; Kim, 2023). As far as defense is

concerned, empirical evidence indicates that the reason behind the high vulnerability of PPPs to performance constraints are overlapping institutional mandates, lack of effective oversight mechanisms, and asymmetric risk-sharing structures (Mekh et al., 2022).

Although the Public–Private Partnerships (PPP) model of defense financing has been increasingly adopted as a means to improve innovation, efficiencies, and flexibility, their efficacy is still questionable as their accountability, regulatory, and risk-sharing issues are yet to be fully addressed by a lack of empirical and performance-driven, and defense-specific evidence within the prevailing literature.

Research Aim and Objectives

The present study will primarily assess the relevance of Public-Private Partnerships (PPP) in defense funding and analyse how this type of partnership affects defense innovation, cost-effectiveness, and military resilience.

Specific objectives are to:

- a. Analyze how much Public–Private Partnerships (PPPs) make defense financing mechanisms more cost-effective and efficient.
- b. Evaluate management systems and risk-spreading schemes in defense-based PPPs and impact on accountability, performance and long-term military sustainability.
- c. Determine the role of the innovation and technological development enabled by PPPs in enhancing the defense capability and operational resiliency.

Significance of Study

The work is of theoretical and practical importance because it leads to the further development of the knowledge of Public- Private Partnerships (PPP) in the defense sector especially in the context of complicated environment with secrecy, high-technology and other strategic risks. In principle, it extends the use of Resource Dependence Theory (Ozturk, 2020), Transaction Cost Theory (Cuypers et al., 2021) and Public Value Theory (MacLean & Titah, 2022) to defense-sector collaborations providing a unified concept of studying the phenomenon of interaction between governments and privates, maximizing their resources and reducing costs, and creating public value in terms of national security. As research, its significant data gap, which Soroka et al. (2023) and Mekh et al. (2022) identify, is that the existing study of the PPP has mostly been restricted to civilian industries or has not been validated in relation to defense. The study to be presented with the mixture of the quantitative efficiency analysis and the qualitative case studies of large-scale defense programs including the Skynet 5 and F-35 ones can offer fresh perspectives into the determinants of PPP effectiveness. In practice, it can provide policymakers,

defense ministries and individual contractors with evidence-based advice on how to organise PPPs that are cost-effective, innovative and transparent without subjecting the interests of national security to risk (Kim, 2023; Pena et al., 2021; Rausser et al., 2023). Finally, the results reinforce conceptual discussion and good governance to enhance the establishment of competent and responsible PPP models in the field of defense financing.

1. LITERATURE REVIEW

This literature review examines the usefulness of public-private partnerships (PPP) in the military field, basing on articles that examine the concepts underlying the concept, performance, innovativeness, and technology enhancement and the role played by government policy and regulating bodies. Various theoretical insights, including Resource Dependence Theory, the Transaction Cost Theory, the Public Value Theory, the Principal- Agency Model, and the Triple Helix Model, are used to provide an organized picture of the dynamics of operation of PPPs in sensitive defense settings.

1.1. Public–Private Partnerships (PPPs) in the Defense Financing

Soroka et al. (2023) concentrated on how the state and its citizens collaborated in national security, but rather on the development of the defense system of Ukraine under external aggression. In their case study, they have highlighted the importance of the PPPs to adjust the lack of resources and strengthen the defense resilience. They, however, observed that legal ambiguities and organizational challenges curtailed the optimum of such alliances. Strengths of the research were analysis of the relationship between the defense PPPs and the national security requirements, but it was limited on focused research involving Ukraine, which limits the findings to other countries. Soroka et al. also recognized that PPPs were good in innovation, but they did not have a sustainable form of governance. The case study, whose foundation is based on case study in one country, renders the findings irrelevant in a universal state. A common governance issue including legal and coordination are also replicated in the analysis of poor governance in Pena et al, but with more generalizable information about PPPs and innovation.

(Mekh et al., 2022) opted to use an integrated design where they analyzed a document to facilitate the analyses of the topic by using interviews with experts, as well as to examine the role of PPPs during the COVID-19 outbreak and the armed conflict in Eastern Ukraine. It was decided that PPPs were able to serve as good responses to the fast-changing security credentials based on the use of the resources of the private sector to finance and provide the defense of the logistics. This study was very informative on how PPPs might evolve during the crisis. The study was, however, methodologically problematic with small sample size and possibly bias owing to the participation of stakeholders of the war. Irrespective of these constraints, the research mentioned the adaptability of PPPs in unstable defense settings. The absence of longitudinal data, however, did not provide any answers regarding the future sustainability of such alliances after the crisis

was over. Although Mekh et al. have shown the flexibility of PPPs during the crisis period, their results were restricted by a lack of long-term data, which Soroka et al. have also noted in their study. Besides, the reliability of the study was also compromised by the small sample size and possible biases.

(Pena et al., 2021) investigated the ways PPPs can help bring defense innovation to the U.S. microelectronics industry with how the relationship aided the transfer of knowledge, cost reduction, and accelerated research, particularly those with the most critical need of technology. The fact that the study had the capacity to directly relate the design of PPP to its outcomes in the field of defense innovation was one of the strong points of the study considering the intention of the research to determine PPP efficacy. Nevertheless, the work conducted by Peña was rather theoretical and did not involve empirical analysis of the performance indicators, which makes it less applicable in practice. Nevertheless, the paper has pointed at the challenges in governance, especially poor fit between government and firms incentives, which might cripple the success of such alliances. The findings of Peña apply to the defense financing because instead of being just operational mechanisms, PPPs are found to be innovation drivers. Nevertheless, it can be noted that Pena is more interested in the theoretical discussion of the issue, not yet accompanied by empirical counterparts, unlike Kim, who presents a more rigorous methodology of PPP analysis.

In his defense financing typology, (Kim, 2023) has worked out a comparative case study method, identifying the differences in the finance structure, operational management and strategic objectives. The study found that various PPP structures signaled an innovation and risk-sharing, and that collaborative governance rules were a breakthrough of a success factor. The main strength of the study was that it was systematic, and the typological structure given could be used in other sectors, such as the military. Nevertheless, it was not expansive enough, as it was only focused on the space industry and thus did not familiarize findings with the defense. Although the use of PPPs has gained recognition in space-based defense systems such as satellite surveillance, the paper failed to explicitly cover defense-based procurement, which has a knowledge gap on how the PPP typologies can be applied in the defense system. The typology presented by Kim with its innovation and risk-sharing also presents some interesting conceptual understanding, but this is limited by the fact that the concept is only spatial. Rausser et al. on the other hand had empirical evidence over the effectiveness of PPP, but their study was not defense specific.

The research done by (Rausser et al., 2023) is on the topic of PPPs in innovations in space, with their usage of empirical data on patents, R&D spending, and joint project work. Their results were also able to indicate that PPPs facilitated the rapid acceleration and shortening of the processes of technological progress and cost savings in the high-risk areas of innovation. The research was investigative in nature, and this contributed to its strength given that it has used data as a strong point in proving that PPPs are effective. Nevertheless, the study was not targeted directly on the issue of defense funding because the innovations related to space cannot be directly applied to a military context. However, the results can be used to identify how the innovation of the private sector would help in supporting national security. The lack of defense-specific metrics, nevertheless, became a gap in the study that should be filled in the further research. Although the work by Rausser et al. on high-risk innovation is comparative to the study by Peña et al. on PPP-driven innovation, it does not provide defense specific measures and performance evaluations, which is the conceptual focus of the work by Pena.

1.2. Effectiveness in the Defense Financing

(Okromtchedlishvili, 2022) used the quantitative method via Data Envelopment Analysis (DEA) to assess the efficiency level of the defense industries through the comparison between military expenditure and military output on the state level. The analysis of the findings demonstrated high variations between the inputs (defense budgets, staffing, and infrastructure) and the outputs (security levels and preparedness) and indicated a strong dependence on the effectiveness of the financial resources alone, whereas effective management of the institution and distribution of resources was also required. The application of a powerful quantitative methodology was one of the strengths of this study which enabled establishing the level of efficiency. However, a disadvantage was that the use was limited to macro-level data, winding up ignoring qualitative factors such as strategic flexibility and innovation. This weakness applies to the present study, in that it indicates that not only inputs and outputs can be observed in terms of performance of defense PPPs. Rather, there is a need to have non-obvious performance hints. DEA, with its display of relative efficiency, only provides opportunity to conduct additional research to bring about a direct relationship between efficiency indices and governance regimes in PPPs. Although Okromtchedlishvili approach is handy in studying defense efficiency, it does not consider the qualitative factors and, therefore, can only be used to evaluate defense PPPs in a broader context.

The study by (Kheljani et al., 2023) employed a mixed-method design, which involves surveys as quantitative and qualitative analysis as a means of data collection and analysis, to

determine the effectiveness of risk management systems in a military organization. The findings revealed that successful management of the risk was dependent on the commitment of the leadership, well-structured systems and conformity with the strategic objectives. This study has strength in the sense that it has highlighted essential aspects in organizations contributing to relevant risk management, which is closely related to the PPP model in the defense field where risk-sharing poses a critical need. One of the weaknesses, though, was that the study was on one industry only and thus less generalizable. The study was topical and appropriate as it proved the inability of PPPs in defense to operate in the absence of a robust risk management framework. Nevertheless, the study did not necessarily separate the effects of risk management and its contribution to physical defense capabilities, and this might have been significant in offering a clear picture of risk controls effects on defense effectiveness. Also, the research study did not have systematic performance measurement model. The results provided by Kheljani et al. are very good since they show the critical role of risk management in defense PPPs, but the scope of the study is limited and a lack of a performance measurement framework makes the research fall short on how risk management affects defense preparedness.

The qualitative study of policy presented by (Riyadi & Dewi, 2022), based on secondary data, examined the issue of the importance of the defense diplomacy in the development of the defense industry in Indonesia. Their results suggested that cooperation between the state defense forces and commercial manufacturers also helped to maintain the industrialization process and improve the defense potential in an indirect way. One of their strengths was that defense diplomacy was introduced as a factor to increase the conventional extent of PPP mechanisms. Nonetheless, the research was not empirical but descriptive, making it weaker in validating the performance indicators. The study is applicable to the present study because most defense PPPs are based on international relations regarding the transfer of technology and industry collaboration. The disadvantage though was that the study was specific to Indonesia where it was hard to extrapolate the results. Also, the lack of relationship between defense diplomacy in PPPs and visible defense preparedness had not been properly researched. Despite the useful conceptual knowledge of Riyadi and Dewi on the role of diplomacy in defense PPPs, the study is limited in its contribution of the performance evaluation in the defense PPPs based on the reliance of descriptive accounts and failure to provide empirical evidence on the preparedness of defense.

To validate a defense-based model to promote the safety of financial networks with the help of artificial intelligence (AI), (Karn et al., 2025) used experimental and computational

modeling techniques. According to the study, AI-based defense measures have improved the stability of the system, the response times, and predictability in a significant manner. The technological innovation and empirical rigor of this study were its strong points since it showed the benefits of AI in defense and their practicality. Nonetheless, the research was conducted mainly in the case of the financial services industry, which restricts its relevance to the general defense situations. The study is applicable to the present research because PPP performance in defense can be associated with the exploitation of advanced technologies such as AI. Nevertheless, as the paper concerned financial networks, it is not clear that the results can be transposed directly to the specific needs and system of governance of national defense systems. Although the results of the AI-based defense model validation provided by Karn et al. are encouraging, it needs to be aligned to defense PPPs, which have different governing mechanisms and security issues.

(Prihantoro et al., 2021) presented a qualitative descriptive approach of studying the process of integrating a tourism village program in Indonesia and focusing on its use by the national defense in terms of economic development. Their results revealed that the economic resiliency, which was enabled by the local economic empowerment and citizens' participation, was an indirect factor in defense preparedness. This study was strengthened by the innovative nature of it which saw it integrate economic development and defense resilience. The research, however, was weak in its approach of using a descriptive approach as opposed to an analytical approach and this constrains the strength of the research. What makes the study relevant is the fact that defense effectiveness may go beyond that of military to encompass that of socio-economic aspects, something that is ignored in defense studies. Nevertheless, the fact that the study did not provide systematic performance evaluation tools and concentrated on one setting made it challenging to directly apply it towards defense PPPs considerations. Although the work carried out by Prihantoro et al. presents a new idea, through its connection between economic development and defense resilience, it is less appropriate to measure defense PPPs because of its descriptive methodology and absence of defense-related performance indicators. The study is conceptually informative, which needs to be supported by stronger analytical frameworks to be usable in PPP evaluations.

In this case, (Risman et al., 2025) examined how civic education contributes to the defense strategy in Indonesia through the qualitative interpretive method. The researchers discovered that non-material defense strategies, including civic action and education were determinant of defense efficacy. This research was strongly based on sociocultural view because it focused on the impact

of public participation in the defense that is not based on technology or economic factors. Nonetheless, the primary drawback of the research was its use of normative arguments, and there were few empirical data to back up the arguments. The study is valuable in that it points out that efficient defense PPPs must have social and cultural elements, not technological or financial systems. But the emphasis of the study on education programs and the absence of empirical evidence contain shortcomings to comprehend the role of the factors in formal defense systems. Although the study by Risman et al. has introduced a new sociocultural aspect of defense effectiveness, it lacks empirical evidence due to its primary subject (education programs) and does not cover much in formal defense systems, which leads to gaps in comprehending the dynamics of defense PPPs.

1.3. Role of Innovation and Technology Development

(Howells & Thomas, 2022) article is a qualitative case study that uses the significance of innovation intermediaries in the firm technological search process. They determined that intermediaries brokered their knowledge, there are middlemen between organizations and technological opportunities i.e. reducing the cost of search. The strength of their work was the conceptual input of how middlemen contribute to the popularization of the innovation and is indirectly connected with the defense PPPs where more than one party participates in the process of working on the complex technologies. However, the study failed to help the quantitative validation hence it is not possible to generalize the findings in other industries. The work can be applied to the defense since it demonstrates how intermediate structures such as PPP structures could be applied in unlocking the sophisticated military technologies. The absence of the expert attention to the defense and the need to be able to adjust to the national constraints on the security makes the application of the findings only too direct, though. Even though the framework can be transferred conceptually, it must be reformed to meet the demands of defense. The study is educative as to the need to innovate through mediators in PPPs but lacks an empirical backup and implementation in the defense domain.

(Fan et al., 2021) conducted a survey among SMEs in an emerging economy regarding the impacts of the entrepreneurial orientation and capacity to innovate on the adoption of social media and the performance of the company. Their results indicated that there is positive correlation between innovation capabilities and digital adoption whereby more innovative firms have been established to have a competitive edge. The study was also empirically well-grounded, which is a strong aspect of the research because it was supported by structural equation modeling. However, it does not apply to the defense and security agencies due to its bias towards

SMEs and social media. The findings are helpful to defense PPPs because they imply the significance of innovation capacity that enables it to use modern technologies and to become more effective. However, the smaller companies and social media under study do not permit extension of it directly to the major defense projects. Whereas the innovation capacity can be used with the context of defense PPPs, additional research must be based on how the concept can apply to the context of defense where the magnitude and the security need do not translate to the one of the SME.

The role of innovation in mediating between the organizational culture and the performance in the banking sector of Pakistan is a study that was carried out in survey-based research by (Imran et al., 2022). These showed that performance-based long-term improvements had been achieved based on the organizational culture that was compatible with innovation. The research study had a positive side, as the author had incorporated organizational culture, the performance, and innovation into a single concept theory. The study is also restricted to unify on the banking world and thus cannot be applied to the field of defense. The implication on the area of defense PPPs is that viable PPPs must possess organizational culture that is responsive to innovation, as opposed to contractual agreements. The study did not cover specific technological developments but created a gap in application within the industry. Practically, the research by Imran et al. is useful in terms of developing a conceptual model of the role of innovation that mediates the organizational culture and performance, but the absence of innovation associated with the banking sector and the inability to defend financing structures reduces the relevance of the research to the issue of defense finance.

(Triwahyono et al., 2023) designed a mixed-methods study and aimed to explore how technological innovation would be useful in enhancing the operational efficiency of MSMEs. They demonstrated that digital tools and process innovations translated into an increase in productivity, cost-effectiveness and competitiveness. The strong side of this study was that it was practical and empirical because it provided proof of the superiority of innovation on the operational outcomes. However, the same cannot be applied to the sphere of defense since the scope of attention to MSMEs cannot be directly translated into this area since the scope is too different, and the security boundaries do not correspond. The study has some implications for defense PPPs in that it demonstrates that operational level of innovation is a contributive factor in some elements of efficiency that is a main variable in the performance contrast comparing the results of the defense PPPs. The limitation however is that MSMEs are conducting their activities in free markets whilst defense is a determinant of security measures. In this way, the outcomes cannot

be totally transferred to the sphere of defense. According to the research carried out by Triwahyono et al., the implementation of technological innovation to the newly developed operational efficiency can intensify its operation but is restricted due to its predominantly MSMEs focus and non-concern of the issue of defense governance and secrecy when applied to the defense system of any country.

The policy-legal analysis system used by (Lescrauwaet et al., 2022) was intended to study the adaptive legal system in terms of its contributions to improving the innovation of new technologies. They found out that more lax legal systems encourage responsible innovation because of balancing between economic growth and regulation. It focuses on governance that is significant in the PPPs in defense, and this is the strength of their work especially at the intersection of law, economics and technology. However, the general approach to the study, and its lack of empirical validation, when used with the issue of defense financing, limit its immediate use. It can be applied in the defense PPPs in that the military groupings tend to encounter rigid regulatory processes that hinder creativity. However, the paper did not explain how adaptive legal frameworks were able to be used in high-security situations or national security concerns. The study provides useful information on governance in the PPPs but fails to provide empirical data when applied to defense matters and fails to factor in issues of security, thus limiting its application to the military and defense field.

(Chishti & Sinha, 2022) employed econometric instruments to evaluate the effects of technological and financial innovations on the BRICS countries environment in their article. The findings implied that innovations brought about improvement in the rate of economic growth, but the impacts on the environment sustainability resulted differently across policies and depended on the regulation frameworks. This was the strength of the study as it is broadly applicable to several countries making information about the impact of innovation globally. However, when it is focused on environmental impacts rather than defense innovation, its use is limited to defense PPPs. The study is valuable to defense as it determines risks of over-reliance on supply chains or the morbid hazard of innovation but fails to identify the indicators of security-related nature. The article by Chishti and Sinha shows that the innovations have two sided effects on the economy and the environment that can potentially reach the defense PPPs, but the specified research only considers the environmental sustainability aspect, and it does not explicitly look at innovations in the context of military defense systems in which technological advancement needs to be appropriately balanced between innovation and security.

1.4. Influence of Government Policy and Regulatory Frameworks

(Chishti & Sinha, 2022) conducted a qualitative study of the system of policy and regulation in the transport sector, and the change to the green economy is in the middle of the stage. The study concluded that an effective regulatory framework resulted in an improved policy coherence, less gap in practice and increased sustainability besides showing the impacts of the government structure on the effectiveness of the industry. The study was good in that it contained a comprehensive oversight of the institutions of regulation which provide an implicit perspective of policy and its impact on the industry performance. However, it cannot be applied directly to defense or security sectors because of its focus on transport sector. The mobilization of the interaction between the government and the industries in the defense PPPs is centered on government laws and regulations in particular cases which involve sensitive industries. The impact of secrets and national security complications on the effectiveness of regulating was out of the scope of the study; hence, the influence on defense PPPs falls under a knowledge gap. Nevertheless, regardless of the specifics of the sector's findings, the findings indicate the role of the government policy in aligning the multi-actor arrangements with the national purposes. However, the inability to address defense security demands presupposes that the adaptations would be demanded to the conditions of the defense environment.

Some of the suggested regulations that De Almeida et al. (2021) proposed regarding artificial intelligence (AI) included a policy and governance procedure. Their discoveries indicated that adaptive management rules are required in AI technology, and these rules could guarantee innovativeness as well as responsibility as ethically warranted. The sufficiency of the research was that it possessed a persuasive governance design, which could be applied to the area of defense contexts in which AI has a significant dilemma in the context of surveillance and warfare. The paper was not empirical but more theoretical. The study can be applied to the defense PPPs because AI projects often involve the interrelation of states and entrepreneurs and efficient regulation is one of the prerequisites. The lack of case studies in the field of AI regulation, specifically in military information space, creates a gap in the knowledge base on the applicability of these frameworks to the management of high space security. Though the findings of de Almeida et al. offer the positive concepts about governance, the small number of empirical studies, and the focus on the conceptual frameworks, limit the potential of the application of the findings within

the context of the defense market, where the issues of the greatest importance should remain the security ones.

(Sawmar & Mohammed, 2021) used qualitative content analysis to establish the relationship between governance and compliance to zakat. They also found in their study that the solid governance structures led to improved compliance, transparency, and trust in the stakeholders. They were the first to connect governance with effectiveness of compliance, which can be applied to the governance systems of the defense PPPs. Additionally, the fact that they are focused on religious financing limits their personal elucidation of results into defense. Good mechanism of governance is of essential importance in defense PPP to promote transparency, legitimacy and trust, but the study did not provide empirically tested implementation of defense sector. Although the conceptual framework developed by Sawmar and Mohammed could be used in the current study of defense PPPs, it is still not concentrated enough to be implemented decisively in the context of defense since the governance has to prioritize both operational and security concerns. Modification of these concepts of governance in a defense context and their empirical validation within a research study should be part of the research studies in the future.

(Mehedi et al., 2023) used the empirical research design of a survey to investigate the way in which cultural norms influence sustainable entrepreneurship with respect to the SMEs in Bangladesh. Their findings presented the fact that informal cultural norms and formal rules were no less important in predicating the outcome as much as conformity and creativity were concerned. Their greatest advantage was the fact that they had both the cultural and the regulatory factors, hence proving that the dynamics of governance is shaped by both the informal and the formal system. However, the study was conducted in the framework of SMEs, and it limits its implications to the defense market. The institutional trust and political culture constitute a significant proportion of the informal norms of the defense PPPs since they define the relationships of the formal policies. It is difficult to imagine any implementation of the findings to the international defense scenario because of the geographical and sectoral field of the study. The situational-grounded study by Emon and Khan bolsters the assumption that governance operates in the environment of proper and informal organization, but its study is limited only to

SMEs and regional-based limitations, which limits its implementation in big and complex bodies of a defense alliance.

(Taeihagh, 2021) conducted a qualitative review of the literature about policy and governance, the focus of which is the international AI regulatory frameworks. The paper has highlighted the need of multi-level and adaptation approaches in the governance to cope with the dynamic technologies at an extremely high rate. One of the strengths of the study was the fact that it was carried out systematically and the issues that the research incorporated included common challenges of governance and slow pace at which policies are being adopted. However, this inquiry was not an empirical study since the focus of the study was principally on theoretical argument. It can be used in the context of defense PPPs as the dynamism of technology in the domain requires an administrative make-up that is dynamic. The study was not however conducted on case studies of specific scenarios within the defense context and therefore the study did not give the understanding as to how these frameworks would apply in defense contexts where security issues are predominant in nature. It is highly educative that Taeihagh reviews adaptive governance in rapidly transforming technologies, but the lack of defense special empirical evidence also makes this research less applicable to the defense PPPs, according to which, adaptive governance must establish the convergence of technological innovation and national security.

1.5. Theories and Models

1.5.1. Resource Dependence Theory

In the framework of a bibliometric review, (Ozturk, 2020) attempted to understand more with respect to the practical use of the Resource Dependence Theory (RDT) in different areas, the number of times the theory was published, the number of times it was cited, and orientation on which the theory was being developed or not developed. The paper has cited the broad applications of RDT in management, governance and inter-organization relations that have earned its applicability in stating how the organizations lose their alignment to machismo of the external environment as far as alliances and partnerships are concerned. It is a merit of this work of literature since it is critically examined and presents a broad scope of the academic direction of RDT. The descriptive design in the study also restricts the study be it in empirical validation or in context application. Concerning the defense PPPs, RDT is applicable as it contributes to the understanding that governments want to cooperate with the privates to have access to the special

defense resources. However, the analysis does not have access to the literature on defense, and therefore, it presents a partial picture of how governments and defense contractors rely on each other. Even though the contribution of the general knowledge of the RDT is the input of work by Ozturk, these are the peculiarities of the defense, including the issues of confidentiality and national security, which are relevant in this case, and complicate such kind of partnerships. The subsequent study should not be confined to citation mapping to determine the models that consider these issues of the peculiarities of defense.

In a panel study of regression models and based on the panel data on natural resources dependence, (Asiamah et al., 2022) provided econometric research of the natural resources dependence and resultant quality on the institutional in Sub Saharan Africa. They established that the dependence on extraneous resources undermined the institutional performance in terms of corruption and inefficiency and the diversification plans diluted the negative impact of the latter. It is also a good study because of its empirical rigor as it gives some insight into the dependency of resources -governance. The focus on natural resources renders the inapplicability of the findings to the defense PPPs which can be characterized by the elements of technology and organizational dependencies limited yet. This work can be utilized in defense because over time none in history has been turning to privately owned companies to supply key resources such as cyber security and the production of weapons. The biggest weakness is that the principle to governance that can be used to offset the destructive nature of over-reliance, especially in defense, has not been discussed in the study. The gap is that the dependence of the private sector on the institutional responsibility and autonomy of the defense PPPs must be carried out by studies. The outcomes presented by Asiamah et al. indicate how institutional strength can be compromised due to the reliance on the resources highly applicable in the context of the defense, once again, the paper does not provide the information on the mechanisms which can absorb such risks in the context of defense.

The interdependence between the reliance in external resources and the development of the in-house capabilities has been formulated through a conceptual model by generating the composite of the Resource Dependence Theory (RDT), and the Resource-Based View (RBV) (Barney et al., 2021). The effort discovered that organizations gain value by utilizing external sources of value and developing internal competencies that is a twofold model of organization effectiveness. It is one of the strongest advantages that gives a better insight into interdependence and an organizational strategy as RDT and RBV have been incorporated. Nevertheless, the biggest weakness it has is that the framework is more theoretical since it has

not been developed empirically. Defense PPPs can be applied with reference to this model since the governments need to be able to create a balance between utilizing the resources of the private sector and self-defense development of their resources to the point that they are not over-reliant on these resources. Nonetheless, the model is hard to apply to the situation in defense because the case studies involving defense are unavailable. The research lacks the issue of whether the defense PPPs have a contributory or contributory role in the development of dependence, on a long-term basis. There is a substance theory to the work by Barney but it must undergo an empirical validation in the defense sector to determine the importance of the need of being dependent on external sources as opposed to internal capacity development of the defense PPPs. The research offers an industry-cutting lens that does not include the industry-specific application of the knowledge of the relations of the defense wholesomely.

1.5.3. Transaction Cost Theory

(Cuypers et al., 2021) performed a thorough search of the existing knowledge in the field of Transaction Cost Theory (TCT) through the synthesis of existing literature and the analysis of its development throughout time since Williamson wrote his original piece in the field. The researchers discovered that TCT can be particularly effective in the explanation of the reasons of internalization or outsourcing of activities in firms. Even then, they identified its shortcomings in considering dynamic capabilities, the complexity of inter-organizational governance and changing environments. The quality of this research is that it has depth in terms of the theory as it has addressed the development and implementation of TCT in a broad manner. Nevertheless, one of the major limitations is that the research will be rather conceptual and lacks empirical confirmation of the phenomena in different industries. TCT applies to defense PPPs due to its role in explaining why governments form alliances with privatized companies to gain defense assets that cannot be internally developed. Nonetheless, the focus of the research on corporate governance and disregard of the contexts of defense, where many other factors frequently prevail over the necessity of efficiency, inhibit the applicability of this research. The loophole is the empirical analysis of the transaction costs in the defense PPPs that must take into consideration secrecy, sovereignty, and long-term contracts. However, although the scope of Cuypers et al. is also extensive, TCT in application to the field of defense will need more development of adjustment to the specific aspects of security and strategy issues.

(Chen et al., 2022) used TCT to apply to blockchain governance in the global value chain based on conceptual and exploration models. According to their findings, blockchain will likely lead to lower costs of transactions by means of elimination of information asymmetries, building

of trust and traceability enhancement. Their research has strength as an innovative approach towards the application of TCT to new technologies, on the one hand, blockchain, in the context of governance. Nevertheless, the crucial flaw of the research is that it is speculative given that blockchain has not been experimented in the field of defense or security. Applicability to defense PPPs is the blockchain itself because it has the potential to factor out what many areas of defense procurement and logistics would otherwise be more costly due to monitoring and contracting, which are susceptible to inefficiencies and corruption. The weakness though is that radical transparency in blockchain can be conflicting with secrecy needed in a defense environment. The identified gap is the absence of empirical research on the capability of blockchain in cutting costs of transactions in defense PPPs. The study by Chen et al. provides some interesting thought-provoking ideas, yet blockchain governance would have to be modified to fit into the classified type of defense procurement.

(Stranieri et al., 2022) selected a mixed-method design to analyze the use of environmentally friendly certifications within the Italian wine supply chain via the TCT perspective. They discovered that certification introduced new transaction costs in terms of monitoring, auditing and compliance, and that the companies that were more capable could absorb these costs. This empirical feature was an asset since TCT was applied to a practical supply chain, which justified that the theory was able to explain it. Nevertheless, the limited scope of the study about the Italian wine industry restricted the generalizability of the study findings to the other industries especially the defensive industry. The importance of the study to defense is because there is transaction costs associated with both governments and private contractors as the study recognizes security protocols, auditing, and certification agencies as an element of the cost of doing business. Nevertheless, the study was silent as to the intricacies of security, geopolitical risks and long-term commits that add even more complications to transaction costs of defense PPPs. The results of Stranieri et al. of certification and compliance are applicable to the defense PPPs, but their study is limited to the wine industry, serving as the restricted reminder of the generalizability of their results to defense, where compliance concerns not only the environment but also the national security.

(Majumdar et al., 2021) prioritized the risk mitigation approaches in sustainable clothing supply chains through analytical hierarchy procedures with a multi-criteria decision-making approach. They found that the use of transaction costs was a major determinant of risk mitigation strategies used by firms and a good governance system contributed towards the balancing of transaction costs and sustainability functions. The strength of the research strategy that linked

TCT and sustainability was the possibility of overcoming the effects of transaction costs in the complicated supply chain through governance structures. Nonetheless, the research focus on the clothing industry does not ensure that it is closely related to the field of defense because the latter is associated with a significant amount of uncertainty and risk. Just like sustainable supply chains, in defense PPPs, proficiency must be balanced with endurance in risk mitigation approaches. The key limitation of the research is that it did not focus on high-security environments, which is one of the key elements in the process of defense procurement. The gap is that there exists no research to connect the utilization of transaction costs governance in sustainable supply chains and that of the defense PPPs where the stakes and risks involved are significantly more serious. In the paper by Majumdar et al, the research shows how governance might be significant in controlling the nature of transaction costs and it needs to be extended to defense application.

(Casady et al., 2023) have provided a comparative case study aimed at evaluating the role of transaction costs and the government capacity in government procurement, in this case infrastructure project procurement. They discovered that failures of procurements occurred because of miscalculated costs of transactions, misdesigned governance frameworks, and dysfunctional execution of government contracts. This research has been a strength with the empirical approach as it established firsthand information about the role of transaction costs in the success or failure of public contracting. Nevertheless, the fact that infrastructure projects were the focus of the study made it not quite applicable to defense where secrecy and politics make procurement more difficult. Delays, cost escalation or cancellation of projects are some of the common outcomes of similar miscalculations in the transaction costs, weak governance structures in defense PPPs. The constraint of the work lies in the fact that the area of specifics of the political and strategic pressures related to the defense procurement is not considered in the work. The research lag is in comprehending the role played by transaction costs on the defense PPPs, particularly where the capability of the government is put to the test by the national security and strategic issues. Casady et al. have a solid empirical basis of TCT in the context of public procurement but should investigate the influence of the transaction costs and the form of governance on the procurement of defense under the conditions of high pressure and political delicacy.

(Cuypers et al., 2021) have outlined the literature review in detail on the Transaction Cost Theory (TCT), which has been extensively applied in the analysis of organizational decision-making, which is mainly applicable regarding internalization or outsourcing of activities. The paper has pointed out the TCT capability to describe the way organizations decide to cut down on

transaction costs. They, however, noted as well the weaknesses of TCT to dynamically respond to capabilities, complex inter-organizational governance and changing nature of the external environments. One of the significant contributions of this work is the exhaustive testing of the theory and comprehensiveness of concepts. However, this descriptive method of the study, although insightful, does not allow its empirical validation and usage in industries. TCT can be used in the framework of defense PPPs because it reasons why governments form alliances with commercial organizations to procure defense capabilities which are out of capability to generate independently. Nevertheless, the short scope of corporate governance and deficiency of analysis in defense realms provides a vacuum in comprehending the distinct interdependence between governments and private contractors in the defense field. According to a review, although Cuypers et al. work it is worthwhile developing the theoretical breadth of TCT, its implementation in the defense context requires a further streamlining process to cover such issues as secrets, sovereign, and end-of-term and relational contracts.

(Chen et al., 2022) developed the Transaction Cost Theory (TCT) by discussing its application to blockchain governance in global value chains. They indicated that one of the roles of the blockchain technology is that it would substantially reduce transaction costs by reducing information asymmetry, indirectly boosting trust, and raising traceability among participants in the field. The main asset of the research was that TCT was used creatively to study new technologies, which provides information about how governance mechanisms develop with the development of innovations. Nevertheless, the research was hypothetical because it failed to prove blockchain applications in defense or crazy scenarios. Its applicability to the defense PPPs lies in the capability of blockchain to lower the monitoring and contracting expenses in the defense buying, one of the historically inefficient sectors. Nevertheless, blockchain radical openness can be against the requirements of secrecy on the defense. The research gap in this case is the absence of empirical research that focuses on the impact of blockchain in minimizing the transaction cost of defense purchase. Although the study by Chen et al. presents conceptually blockchain can be beneficial in governance, speculative, and unprovable in the field of defense restricts its applicability.

(Stranieri et al., 2022) dealt with a mixed-method design in their study, which investigated the transaction costs of using environmentally friendly certifications in the Italian wine supply chain. They discovered that certification led to the imposition of new costs of transactions like monitoring and auditing, but it was only those firms that had greater capabilities that could absorb such costs. The strength of the study was the empirical nature since it put TCT into practice on

an actual supply chain, which proved the theoretical framework. Still, its small sample scope of the Italian wine industry does not allow the expansion of the results to other industries. Certification and compliance in defense PPPs bring about a transaction cost especially in matters of security. Auditing and quality checks. The researchers, however, failed to consider the compounding factor of security, geopolitical risks, and long-term commitments in buying defense. The paper by Stranieri et al. is applicable in monitoring costs and compliance with the defense PPPs, but its implication of environmental certification in the wine industry limits its applicability. More studies are required in applying these results to the military field where certification also meets the issues of national security.

(Majumdar et al., 2021) transferred TCT to the supplies of environmentally friendly clothes, as a multi-criteria decision-making model with the help of analytical hierarchy processes. They discovered that the costs of transaction had a strong effect on the risk mitigation strategies, in which effective governance system neutralized these costs. The inclusion of TCT and sustainability issues in the study was also a strength as it demonstrated how the effects of transaction costs could be reduced through governance. But because of the specialisation in the clothing industry, it is less applicable to the defense sector where there are greater levels of uncertainty and risk. Like in sustainable supply chains, balancing between efficiency and resilience in defense PPPs is essential in reducing the risks. The study, however, did not focus on high-security environment which is a determining aspect of defense purchases. The gap is in the fact that the relationship between transaction cost governance in the sustainable supply chains and defense PPPs requires empirical research. Although the explanatory power of TCT is confirmed by the study by Majumdar et al., the implementation specific to the sector would be required to solve the problem of cost and resilience of the defense operations.

(Casady et al., 2023) evaluated how transaction costs can be important in the public procurement process, especially in infrastructure projects. In their research, they concluded that failure to estimate the cost of transactions and poor governance structures resulted in procurement failures. The key strength of the study was its empirical character as firsthand information was availed regarding the effects of transaction costs in public contracting. But its emphasis on infrastructure projects constrains its use in defense where the secrecy and political factors complicate the situation. Poor estimation of transaction costs and poor governance may cause delays, costs to be inflated or the project being cancelled in defense PPPs. The existing research gap in this area is explained by the knowledge of the impact of transaction costs on defense PPPs in cases where government capacity is put to the test by political and strategic

compulsions. Although the study by Casady et al. can contribute some insights on the transaction costs, it concentrates on infrastructure thus creating a gap in the knowledge of the dynamics of the transaction costs playing out in defense situations that have higher political and strategic sensitivities.

1.5.3. Public Value Theory

(MacLean & Titah, 2022) provided a systematic literature review of empirical research on e-government through an analysis of more than ten years of research on the subject in terms of human values. They have found that e-government projects generated value in addition to efficacy that comprised transparency, trust, and empowering citizens. The fact that a variety of different empirical studies were synthesized in the study is the strength of the study that improved the credibility of its results. Nevertheless, the study has a drawback of using secondary data which was not empirically always tested. Regarding the defense PPPs, this paper recommends that such alliances cannot be assessed based on factors of cost-effectiveness only, but their capabilities of generating civic benefit, including legitimacy, assurances of security and trust in its stakeholders. The limitation of the study is that it fails to cover security sensitive features such as defense where secrecy is a nuisance to generally determine the opinion of people. The review by MacLean and Titah offers valuable information on various aspects of public value other than efficiency but not empirically validated nor specifically involving the difficulties of implementing the concept of public value to the defense industry, where transparency and the issue of security make it difficult to quantify value.

(Mazzucato & Ryan-Collins, 2022) evaluated old definitions of the concept of public value, citing the need to change the market-fixing approach to market-shaping approaches. They developed the view that governments were not supposed to simply remedy market failures, but they would build markets that were beneficial to society. The merit of the research is that it presents a normative case of an active role by the government on market creation. The limitation of this study is, however, the absence of empirical data that can be used to back up the market-shaping argument. This criticism applies in the case of defense PPPs because the military industry tends to define the markets based on the government intervention in investments, innovation, and procurement. This weakness of the study is that it does not apply the concept of market-shaping on defense or does not offer any quantifiable systems of effectiveness. The gap is the empirical research that can be used to transform markets by means of defense of PPPs without creating the monopolies. The theoretical framework developed by Mazzucato and Ryan-Collins is useful but requires practical testing in the context of defense, where preventing the

existence of a monopoly of enterprises is a major issue to consider with the need to transform markets.

(Grandia & Volker, 2023) also comprehensively examined the topic of public procurement through the theoretical, practical, and methodological strategies and points out that procurement is not a simple technical procedure but an effective strategic instrument to generate public value. The strength of their study is its practical approach, the combination of the procurement theory and the real-life instruments to implement such theories. Yet, its specialization on the general procurement is a drawback as opposed to defense procurement which remains secret. Procurement policies also play a vital role in achieving an efficiency level and legitimacy in the context of defense PPPs and inefficient contracts may damage the trust of the population. In the research, there is no detailed content about the procurement process in defense especially in the high-security scenarios. The gap in this case is the lack of empirical studies implementations of the public value theory in defense procurement decisions. The paper of Grandia and Volker on the strategic significance of procurement is applicable to PPPs in defense, but their emphasis on the overall procurement restricts its applicability to the defense case of secrecy and security in influencing procurement decisions.

(Keppeler & Papenfuß, 2023) use field experiments to investigate such value propositions and offerings provided by employers in the public sector and associate the organizational type with perceived value. In their research, the scholars established that distinguished value propositions enhanced credibility, enthusiasm, and honesty among the stakeholders. This research can be strengthened by the fact that acts of causation are given out in a manner that is empirical hence its strength is found in its rigor. The study is, however, limited in its application to PPP arrangements due to the fact that it is directly focused on the general sector of the population and the employment situations. Its significance to defense PPPs is the fact that, depending on the stakeholders, such as governments, contractors, and citizens, these have different perceptions of value. Nevertheless, the focus of the research on human resource and employment contexts creates a gap in knowing the application of these value propositions to the case of defense partnerships. Although its focus is specific to the sector, the insights provided by Keppeler and Papenfuuss encourage one to consider how the differentiated value propositions can be encouraging trust and legitimacy, but more research should be conducted to analyze its application to defense PPPs because the stakes are extremely high, and the expectations of stakeholders are quite different.

(Skålén, 2022) applied the practice theory in understanding how the development of innovation in the public service can create added value to the people by relying on case studies conducted qualitatively. On the one hand, it was discovered that value was created by the innovation practices in which user, professional, and institutional actors collaboratively created the design of the service. This study is a strong one as it provides practical information on the value creation in service delivery and how innovation is about. Nevertheless, the small case studies used in the research restrict the generality of the study. Defense PPPs require innovation and co-creation in collaboration with the private player in value creation, especially in military technologies and logistics. The limitation is, however, the fact that the study has not considered defense scenarios, where innovation is mission-critical and its application is linked with security complications. According to Skalens study, co-creation is significant in value-generation which applies to defense PPPs. Nevertheless, since it has a narrow focus in its case study, it cannot be generalized in defense where innovation is not merely about service delivery but also about national security. Further empirical research in the defense fields is required to put these insights to use.

Overall, these papers provide useful information about public value, governance, and innovation, but can hardly be applied to defense PPPs. Although they mention such critical aspects as transparency, trust, market-shaping, and value co-creation, they do not commonly touch on the peculiarities of the defense partnerships, including secrecy, security, and long-term relational contracts. Future studies ought to concentrate on modulation of these structures to the defense field with consideration of empirical evidence to explain the multifaceted dynamics of the defense procurement, stakeholder control and national security issues.

1.5.4. Principal–Agent Model

(Zeng et al., 2024) designed a quantitative model and simulation to deal with the issue of cold chain logistics in fresh food supply chains, using the principal agent theory (PAM) to implement incentive approaches to deal with asymmetric information among agents. The observation indicated that congruence between incentives lowered opportunistic conduct and enhanced prosperity. The predominant strength of the study was that it had sound mathematical modeling, which successfully proved coordination of agents. The study, however, is geared towards food supply chains, as opposed to defense, which restricts its relevance to the defense context in direct application. In defense PPPs, there are principal-agent issues when governments (principals) depend on private contractors (agents), and the opportunistic behaviour may be caused by the incompatibility of incentives. Its application in the context of defense is also evident

since the model offers an insight into the way contracts should be structured to reduce risks. The key weakness is empirical validation has not been empirically validated in the defensive situation where security and secrecy introduce further complications on the principle-agent issue. The model proposed by Zeng et al. illustrates the efficiency in supply chains, enhanced by incentive congruence, although the required changes and its subsequent empirical testing need to be implemented on the defense PPPs, where the confidentiality issue is a big concern.

The study conducted by (Gabison & Xian, 2025) discussed the problems of liability in large language models (LLM) systems in terms of the principal-agent theory based on conceptual and legal analysis. Their results showed that new AI systems create new levels of ambiguity of agency and liability. The use of PAM in its pioneering application to AI governance is an asset of the study, as it attempts to solve new complexities present because of AI technologies. The research though speculative has not been applied empirically in defense applications. Contractors in defense PPPs, using AI-based systems, present new agency dilemmas in which they tend to create systems that are not easily accountable. The application of AI governance to defense is that the study demonstrates that AI governance may pose challenges to accountability, however, not using concrete real-life cases related to the defense field. Although the article by Gabison and Xian is rich in conceptual information, its absence of empirical investigations in the field of defense applications suggests the necessity of additional research on how AI and agency-principal relationships operate when defense PPPs become dominant and emphasis is on security issues.

In the article by (Li et al., 2023), the main agent model of the hazardous material transportation in China was developed, including the elements of risk perception and regulatory fullness as part of the incentive framework. They found that with good regulation opportunities were minimized and the performance of safety was maximized. This study had a strength as it incorporated some risk and policy variables into the principal-agent framework which made the model very realistic. Nevertheless, the fact that the study covers the transportation industry only in China constrains its general use particularly in the defense. Its application to the defense PPPs is in the aspect that it showed the importance of regulation and risk management in aligning the incentives of the agent(s) in high-risk situations, like transportation of weapons. This restriction is the fact that the sample is limited because of focusing strictly on one industry and one place that does not enable the generalization of the results. Although the work of Li et al. is one that can be transferred with great ease to defense PPPs, especially in a high-risk scenario, it did not have empirical validation in defense. More studies are necessary to implement this model to the

contexts of defense-related dynamics to comprehend how regulation and risk management can be performed to resolve the issues of principal-agent in military supply chains.

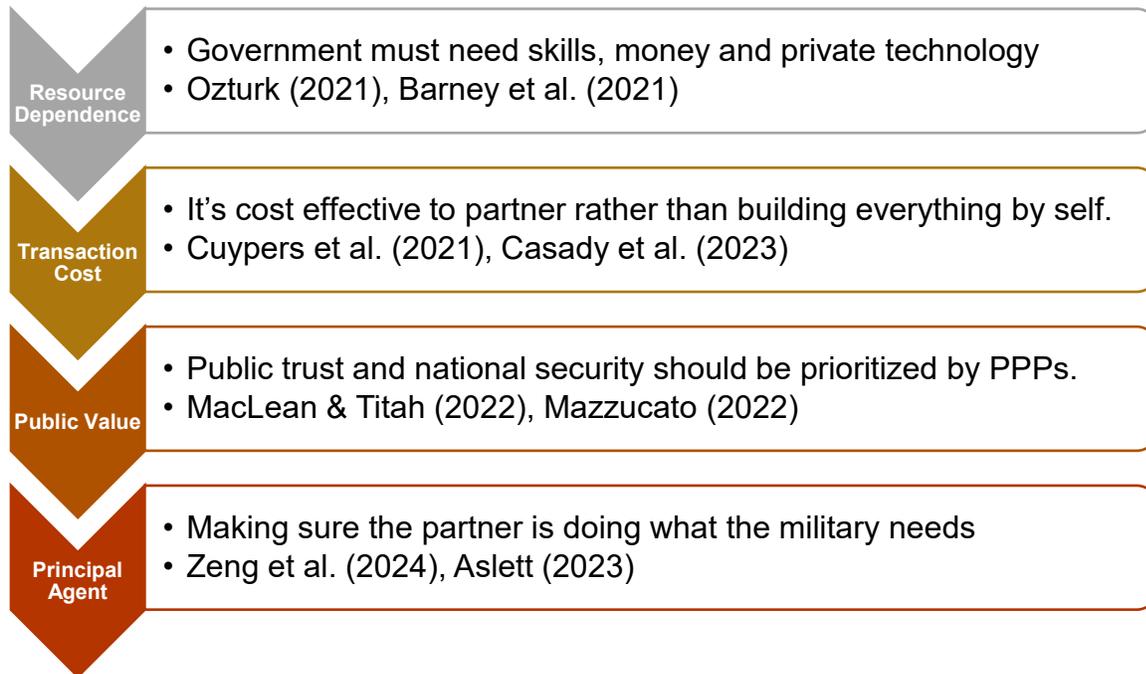
(Lin & Zhang, 2023) made an extension of the primary-agent theory by incorporating third parties, the text plan of a societal orchestrator. Their results showed that externalities contributed to the improvement of the information flow and the reduction of the inappropriate incentives. The scholarly value of the work is that it has developed the theoretical aspect of study to offer a different dimension on how to solve the agency problems. Nevertheless, the research is completely theoretical and has not been supported empirically. The relevance of this study to defense PPPs is high because the oversight authority or the international organization can act as a third party in defense contracts to address agency issues. Nevertheless, its applicability is constrained by the fact that it is not applied practically in the defense sphere. Although the extension of the theory as by Lin and Zhang is promising, it needs to be proven empirically in the context of defense domains to ensure coverage of the special requirements of oversight and secrecy in defense-related contracts. Their method presents a fresh insight into the agency problems, although empirical research is required to validate its use in the military context.

The authors (Aslett & Magistro, 2023) based their study on the principal-agent theory (PAM) and studied the allocation of the EU funds in Hungary and analyzed their findings through qualitative case studies. Their results brought to focus the effects of patronage, opportunism and misaligned goals in principals and agents in public funding. The merit of the research is that it is empirically based, giving practical evidence of the impact of the principal-agent issues on public funding. Nonetheless, it does not directly apply to defense PPPs because its aims at Hungary and state subsidies. Its significance to defense is in the fact that the role of misplaced incentive, which can be promoted by political patronage, may impair the working of defense PPPs. The context-specific focus of the study, however, limits its generalizability to the field of defense, in which consequences are greater, and secrecy is highly important. The analysis made by Aslett and Magistro offers lessons on a great caution to the possibilities of disruption by political influence and wrong incentives of defense PPPs. Nevertheless, their results should be implemented into the defense context, where the conditions of the transaction costs and governance are far more different than those in the case of public funding.

Such studies provide helpful information on the theory of principal-agency, and how it can be applied to different industries, yet their impression on the context of defense PPPs need more empirical research and contextualization. Though they dwell upon some of the important matters

of incentives, governance, and transparency, they do not pay much attention to the other sectors other than the defense, which controls its direct intimacy. The prospective conduct of research ought to involve the application of principal-agency to the defense setting considering the special issues of secrecy, security and stakes involved in defense alliances.

Figure 1 Main Theories Used in Defense PPP Research



Source: Compiled by Author 2025

The **Figure 1**, describes four major theoretical frameworks applied in the defense PPP research. Resource Dependence Theory provides the reasons why governments make alliances with the private sector to acquire the required skills and technology. Transaction Cost Theory is the theory that centers on cost efficiency as a key motivation of cooperation. The Public Value Theory focuses on such non-financial benefits as the trust of the people and national security. Lastly, Principal- Agency Theory deals with issues guaranteeing that the contractors meet the needs of the military and are in tandem with the objectives of the government.

Table 1 Literature Matrix

Research Theme	Key Citations	Collective Focus & Contribution	Methodological Commonalities	Relevance & Gaps for the Present Study
Introduction to Public-Private Partnerships (PPPs) in Defense Financing	Soroka et al. (2023), Mekh et al. (2022), Peña et al. (2021)	Discusses the importance of PPPs in military matters and specifically in the context of emergency and war conditions. It shows their role in resilience, resource gaps as well as achievement of innovation but also suggests governance and coordination challenges.	Qualitative case studies, document analysis, interviews with stakeholders, and policy analysis.	Shows the possibility of PPPs to be flexible and resilient in defense yet discovers problems in governance, implying the need to enhance institutional transparency and sustainability.
Effectiveness in Defense Financing	Okromtchedlishvili (2022), Kheljani et al. (2023),	Concentrates on gauging the efficacy of defense funding using risk management, comparisons of efficiency, and logistics models based on performance.	Quantitative (e.g., Data Envelopment Analysis), combined types of surveys, secondary data-based case studies.	Makes an argument about the cruciality of subtle performance indicators that extend beyond input to output ratios and emphasizes that longitudinal data are required to determine sustainability and efficacy in the long term.
Role of Innovation and Technology Development	Peña et al. (2021), Rausser et al. (2023), Kim (2023)	Discusses how innovation has contributed to the future of the defense systems and how PPPs have enabled breakthroughs in technology as well as lowered	Qualitative policy examination, Patent and R&D expenditure quantitative analysis, Technology-oriented project case studies.	Much to the significance of technological innovation in defense, however the research has not used defense-specific measures and

		costs and facilitated R&D.		draws on the transfer of technology as opposed to defense, implying an absence of defense-specific innovation appraisal models.
Influence of Government Policy and Regulatory Frameworks	(Chishti & Sinha, 2022), de Almeida et al. (2021), Taeihagh (2021)	Explores regulatory structures and government strategies in facilitating PPPs, especially in fast maturing technology such as AI and a cybersecurity division within the military.	Policy and governance analysis, qualitative analysis and comparison.	Identifies the importance of dynamic regulatory frameworks to handle the newer technologies, but in the context of the defense sector does not provide empirical case studies, which is a weakness in providing more specific policy applications when option is defense financing.

Source: Compiled by Author (2025)

The literature matrix in **Table 1**, provides an organized synthesis of key research themes related to Public–Private Partnerships (PPPs) in defense financing, outlining collective contributions, methodological patterns, and existing research gaps. The first theme, Introduction to PPPs in Defense Financing, represented by (Soroka et al., 2023a), (Mekh et al., 2022), and (Pena et al., 2021), explores the role of PPPs during crises and wartime contexts. The second theme, Effectiveness in Defense Financing, addressed by (Okromtchedlishvili, 2022), (Kheljani et al., 2023), focuses on evaluating defense PPP performance through efficiency, risk management, and performance-based logistics models. They underline that assessing effectiveness requires

multidimensional indicators beyond basic input-output ratios and call for longitudinal research to evaluate sustainability and long-term efficiency in defense partnerships. The third theme, Role of Innovation and Technology Development, as discussed by (Pena et al., 2021), (Rausser et al., 2023), and (Kim, 2023), examines how PPPs drive technological advancement in defense through cost reduction, innovation acceleration, and R&D collaboration. The final theme, Influence of Government Policy and Regulatory Frameworks, represented by (Chishti & Sinha, 2022; de Almeida et al., 2021; Taeihagh, 2021), explores the impact of regulatory systems and government governance structures on PPP efficiency, especially in high-technology areas such as artificial intelligence and cybersecurity

1.6. Summary of the Literature Review

Based on the literature review, it has been observed that Public-Private Partnerships (PPP) in defense can do more to improve efficiency, innovation and resilience. However, governance problems, risks, associated with external dependencies and regulatory factors tend to constrain their performance in particular businesses that are sensitive to national security. Regardless of these benefits, none of the bodies of explaining force has been convinced despite the theoretical frameworks around which one negotiates the performance of PPP to interpret the present circumstances in the domain of defense. The military PPP defense data has been supplemented both on an empirical level and to other fields and with insufficient military evidence. This has shown important loopholes in the role of such partnership in the defense hospital in specific elements of accountability and sustainability of performance measurement. This is a unique problem of affiliate in defense that should be addressed in research concerned with the need to establish long-term sustainability, establish social value and address the issue of national security demands and strengthen governance initiatives to mitigate threats and dependence. Overall, the field of defense can find ways to enhance the evaluation of PPPs through the assistance of down seeking studies that would help in filling these gaps of knowledge to create more accurate research findings.

2. METHODOLOGY

2.1. Research Design

This thesis assumes a mixed-method design that incorporates both quantitative and qualitative research designs to examine the issue of the role and efficacy of Public-Private Partnerships (PPP) in the financing of defense. This combination of secondary data and case studies give a deep, detailed insight into how these partnerships work within the defense industry. Both quantitative analysis with the help of SPSS and qualitative research through case study enable a comprehensive assessment of the PPPs in defense considering not only the results of their performance but also the dynamics of their operations (Pena et al., 2021).

2.2. Case Study

UK Skynet 5

Skynet 5 is a project involving the Ministry of Defense of the United Kingdom and the partners in the private sector to offer secure satellite communication services to the UK Armed Forces. Chosen for its complex technology and private sector involvement in satellite communications, providing insights into cost management and innovation in defense technology.

Lightning II (Lockheed Martin) F-35 US.

F-35 Lightning II project is a significant and the most complicated military acquisition program of the US government and Lockheed Martin with the PPP model and selected for its international cooperation and technological advancements, illustrating the role of PPPs in managing cost and innovation in large defense programs.

Germany's HERKULES Project

In Germany, it is the HERKULES Project that aims to improve the military logistics with the help of the heavy-lift aircraft. Focuses on military logistics and heavy-lift aircraft, highlighting how PPPs address logistical challenges and foster sophisticated military capabilities.

Maritime Helicopter Project in Canada.

This is a project that entails the acquisition of new maritime helicopters by the Canadian armed forces as a private-public partnership with contractors. Researching the challenges and outcomes of this project offers critical insights into risk management, government procurement and stakeholder coordination.

Future Combat Systems (FCS)- USA

Future Combat Systems (FCS) program is a military modernization program by the United States involved in implementing the modern technologies in ground warfare. Its importance is linked with the challenges of managing technology-driven complex defense projects. Its suspension further highlights issues of cost overrun, delays and too much technical expectations.

2.3. Research Design

The study uses a mixed-method approach, which consists of quantitative data analysis and qualitative case studies as part of developing a comprehensive evaluation of PPPs in defense. Quantitative part of the study is based on the use of the secondary sources of data and SPSS analysis to compare the indicators of efficiency and performance in the defense projects (Soroka et al., 2023a). In the meantime, the qualitative domain includes case studies of important PPPs in the field of defense which enables the further discussion of the operational realities, governance systems, and risk-sharing mechanisms that are inherent in PPPs (Kim, 2023).

Variables:

- Independent Variable (IV): Public-Private Partnerships (PPPs)
- Dependent Variable (DV): Defense Financing
- Moderator (Mod): Effectiveness

2.4. Hypothesis Development

H1: There is a significant positive relationship between Public-Private Partnerships (PPPs) and Defense Financing.

Public-Private Partnerships (PPPs) are positively related to Defense Financing. The input of the private sector in the development of defense projects is likely to introduce more effectiveness and innovation that can translate to better utilization of the financial resources). The partnerships may pool to fund innovative defense technologies and major defense programs, which, in turn, will allow boosting the overall financing of national security (Soroka et al., 2023a). For H1, the regression model will be used to focus on the predictive relationship between PPPs and defense financing.

H2: The effectiveness mediates the relationship between PPPs and Defense Financing.

The success of the Public-Private Partnerships (PPP) mediates the medium correlation of PPPs and Defense Financing. (Mekh et al., 2022) have found that the dynamics of the relationship between the public and the private partner through financial theory is an important determinant of the success of projects such as the HERKULES project. For H2, a mediation model will test whether the effectiveness of PPPs influences the relationship between PPPs and financing outcomes.

Quantitative Design: The quantitative approach involves the use of secondary data, which will be the publicly available reports on projects, official statements, transfer of technology, and outputs of projects. Such datasets will undergo an SPSS analysis to determine the relationship between investment in PPPs and other performance indicators. Data Envelopment Analysis (DEA) will be used to make comparisons of efficiency of various defense systems imposed by PPP financing (Okromtchedlishvili, 2022).

Qualitative Design: The initial step of the methodology procedure is a rigorous analysis of secondary literature such as academic sources, governmental sources and publications of industries to determine the background of each case study. The case studies will be examined one by one and in a systematic manner to give a detailed account of the project. The sections of the descriptive case study will involve. A detailed description of the project, the stakeholders in the project, the financial structure and the general objectives of the project. These underlying factors are important to be aware of since they tend to be vital in defining the effectiveness of PPPs (Pena et al., 2021).

2.5. Data Collection

Quantitative Data Collection: The secondary data (2000-2024) will be obtained based on well-regarded sources like government reports, defense industrial publications, and project results. Quantitative performance information will be extracted from official defense reports such as GAO, NAO, ECA etc. Each KPI project will be assigned a specific score based on a structured (1-10) scoring rubric. Scores will be assigned based on explicit qualitative evidence from reports, official statements and independent media analysis.

Qualitative Data Collection: The secondary sources used in gathering data to be used in this research will be diverse enough to give a comprehensive and objective analysis of data. The sources will include:

- **Government Reports:** These will include government data on the extent of the project, funding, performance of the project, audit reports, and evaluations. The government reports to be used include the UK Ministry of Defense Report (2023), U.S. Department of Defense Report (2023), Germany Defense Ministry Report (2022), Canada Ministry of National Defense Report (2023), and U.S. Future Combat Systems Report (2009).
- **Industry Publications:** Articles, research reports, and publications by the defense contractors will give us an understanding of the role played by the private sector in any given project, as well as pointing out the technological advancements that came as a result of PPPs.
- **Case-Specific Publications:** It contains reports of other companies such as Lockheed Martin and Boeing, which provide important information about the role of the private segment in the innovations of the defense sector (Kim, 2023).

2.6. Data Analysis

2.6.1. Quantitative Analysis

The SPSS will be used to analyze the secondary data collected in this study to determine the outcomes of defense projects under PPPs. The hypotheses will be tested with the help of regression analysis to determine whether the use of PPPs is more effective than the use of traditional government procurement models (Kim, 2023). In regression analysis multiple linear models will be built for testing and in correlation test, coefficients will be calculated to find the relationships between the KPIs. KPIs that we are going to use are below:

- Cost Efficiency
- Innovation Rate
- Operational Readiness
- Technology Transfer
- Risk Sharing
- Governance Quality

2.6.2. Qualitative Analysis: Thematic analysis will be used in analysing the data gathered and through this, the identification of critical themes among the case studies will be possible. The analysis will be done based on the following areas:

- **Governance and Management** How was the division of responsibilities between public and the private partners, and how did this impact project results? (Pena et al., 2021).

- Innovation and Technology Transfer: The contribution of innovation in the private sector (Rausser et al., 2023).
- Cost and Risk Sharing: The performance of financial models and risk-sharing plans will be studied, particularly in a successful project such as F-35, Herkules and Skynet 5 (Soroka et al., 2023a).
- Performance Indicators: The performance indicators will be compared throughout the case studies to establish aspects that have led to success or failure, including, but not limited to, cost overruns, delivery schedules and technological successes.

2.7. Chapter Summary

This chapter discusses the approach to the research of the role and efficiency of the Public-Private Partnerships (PPP) in defense funding. The paper uses mixed research methodology, which consists of quantitative analysis of data using SPSS and qualitative case studies to give a comprehensive analysis. The quantitative analysis will involve the secondary data which will be analyzed by the regression and correlation techniques to determine the connection between the variables. The qualitative component entails case studies of such high profile PPPs in the defense sector as Skynet 5 of the UK and the F-35 of the US to examine the governance structures, innovation and risk-sharing mechanisms. This is a combined method of carrying out research that would give us the whole picture in regard to the working dynamics and efficiency of the PPPs in financing the defense.

3. FINDINGS

3.1. Quantitative Findings

This chapter presents the results of the empirical analysis conducted to evaluate the effectiveness of Public-Private Partnerships (PPPs) in defense procurement, using both quantitative and qualitative data. The primary objective of this chapter is to examine how key performance variables—such as cost efficiency, innovation rate, technology transfer, risk sharing, and governance quality—contribute to the overall effectiveness of PPP projects compared to traditional (non-PPP) procurement models. Descriptive statistics, correlation analysis, and multiple regression techniques were employed to assess the strength and nature of these relationships. The findings are organized to reflect differences between PPP and non-PPP models, followed by detailed statistical analyses identifying the most significant predictors of overall project success. These results offer a data-driven understanding of how governance structures, financial models, and collaborative frameworks influence defense procurement outcomes.

Table 2 Comparison between the PPP and non-PPP procurement models

Group Statistics					
	Procurement Model	N	Mean	Std. Deviation	Std. Error Mean
	Non	15	24.6667	6.39940	1.65232
Cost Efficiency (1-10)	PPP	15	6.5333	1.95911	.50584
	Non	15	4.8000	1.61245	.41633
Innovation Rate (1-10)	PPP	15	7.8000	1.01419	.26186
	Non	15	8.7333	.79881	.20625
Tech Transfer (1-10)	PPP	15	6.8667	1.12546	.29059
	Non	15	5.5333	1.59762	.41250
Risk Sharing (1-10)	PPP	15	6.5333	1.18723	.30654
	Non	15	4.2000	1.47358	.38048
Governance Quality (1-10)	PPP	15	6.6000	1.35225	.34915
	Non	15	5.4667	1.18723	.30654
Overall Effectiveness (1-10)	PPP	15	6.8667	1.01887	.26307
	Non	15	5.7467	.95459	.24647

Source: Compiled by Author 2025

The analysis in Table 2, shows that Public-Private Partnerships (PPP) model exhibits a very high degree of cost effectiveness in contrast to the non-PPP model of defense procurement.

To be more precise, the average cost efficiency of PPPs was 6.53 (SD = 1.96) and non-PPP projects were characterized by the smaller mean of 4.80 (SD = 1.61). This implies that the PPPs are more efficient in controlling and optimising costs in defense projects. The findings are consistent with the previous literature that suggests that risk-sharing, performance-based contracting, and performance-based innovation in PPP systems tend to increase cost discipline (Peña et al., 2021). PPPs are very innovative compared to non-PPP procurement procedures. The PPP projects recorded an average innovative score of 7.80 (SD = 1.01) and the non-PPP models had very lower scores at 4.80 (SD = 1.61). The decreased standard deviation in PPP projects means that there is increased consistency in the output of innovation. This validates earlier assertions in the literature that the PPPs promote technology development by drawing upon the capability of the private sector research and development, promoting agility, and speeding up the adoption of new technologies in defense systems (Rausser et al., 2023). The PPP procurement models were more effective in the transfer of technology. The average of non-PPP models was 8.73 (SD = 0.80) which is higher than the mean of PPP projects whose mean was 6.87 (SD = 1.13). This finding indicates that conventional government-controlled procurement can offer more direct and sovereign access to sensitive technologies. The discovery is not surprising by fears that PPPs tend to entail intellectual property restrictions, joint several controls, or constraints owing to international contracting, which is likely to hinder the total technology transfer (Kim, 2023). The effectiveness of risk-sharing was higher in PPP models than in non-PPP models. The mean of PPPs stood at 6.53 (SD = 1.19) and that of non-PPP models were lower 5.53 (SD = 1.60). The results indicate that PPPs are more effective in spreading financial and operational risks among the stakeholders, lessening the load on the public agencies.

Table 3 Independent Samples T-test

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cost Efficiency	.178	.676	2.646	28	.013	1.7333	.6551	.391	3.075
Innovation Rate	.561	.460	-2.800	28	.009	-.9333	.3333	-1.616	-.251
Tech Transfer	2.465	.128	2.642	28	.013	1.3333	.5045	.299	2.366
Risk Sharing	1.833	.187	4.776	28	.000	2.3333	.4886	1.332	3.334
Governance Quality	.142	.710	2.439	28	.021	1.1333	.4646	.182	2.085
Overall Effectiveness	.236	.631	3.107	28	.004	1.1200	.3605	.381	1.858

Source: Compiled by Author 2025

Illustrated in Table 3, to determine the cost efficiency between PPP and non-PPP models of defense procurement, independent samples t-test was used to compare the two models. The findings showed that there was a large difference, $t(28) = 2.65$, $p = .013$, and PPPs ($M = 6.53$) were more cost efficient than non-PPP models ($M = 4.80$). The mean difference was 1.73 with $SE = .66$ with 95 percent interval of 0.39-3.08. This upholds the hypothesis that PPPs allow less cost-efficient defense acquisitions in cooperative funding and performance-based contracting. The difference in the rate of innovation also existed statistically significantly between procurement models, $t(28) = -2.80$, $p = .009$. Surprisingly, the interest rates of non-PPP models ($M = 8.73$) indicated better scores on innovation compared to PPP models ($M = 7.80$) with a mean of -0.93 ($SE = 0.33$). The confidence interval was between -1.62 to -0.25 (95 percent). This negative result is opposite to the general expectations and can suggest that the innovation is more regulated or even measured in different ways in PPP context or that the innovation activities in the private

sector are not as evidently reflected in the governmental reports. The t-tests results revealed that there was a significant difference in technology transfer towards non-PPP models $t(28) = 2.64$, $p = .013$. The mean difference was 1.33 (SE = 0.50), and the interval of confidence to 95% was 0.30 to 2.37. These observations indicate that the conventional procurement patterns can provide more access or power over the technology transfer, probably because of the sovereign ownership or more stringent control systems in military acquisition. One of the most significant changes was seen in the sharing of risks between the two models where $t(28) = 4.78$, $p = .001$. PPP projects indicated a higher level of effectiveness in risk sharing ($M = 6.53$) than non-PPP projects ($M = 4.20$), and the mean difference between the two is 2.33 (SE = 0.49). The confidence interval was 1.33 to 3.33, which confirmed that PPPs had the theoretical power to allocate financial and operational risks between the public and private stakeholders (Peña et al., 2021). The quality of the governance of PPPs was much greater than that of non-PPP projects, $t(28) = 2.44$, $p = .021$. The average was 1.13 (SE = 0.46) with the 95% confidence interval of 0.18 to 2.09. This result is indicative of the formal contractual management that tends to be instilled in PPPs that can foster accountability, transparency, and performance watch (Kim, 2023). The effectiveness of PPP projects was much greater than that of the non-PPP projects, $t(28) = 3.11$, $p = .004$. The mean difference was 1.12 (SE = 0.36) with the confidence interval (0.38, 1.86). These finding highlights that a more integrated and effective model of defense procurement can be found in the PPPs, in case the performance indicators, including cost, innovation, and governance, are taken as a single entity.(Okromtchedlishvili, 2022).

Table 4 Descriptive Statistics of the Study

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Cost Efficiency	15	7.00	2.00	9.00	6.5333	1.95911	-1.077	.488
Innovation Rate	15	4.00	6.00	10.00	7.8000	1.01419	.455	.399
Tech Transfer	15	4.00	5.00	9.00	6.8667	1.12546	-.050	-.232
Risk Sharing	15	4.00	4.00	8.00	6.5333	1.18723	-.682	-.083
Governance Quality	15	4.00	4.00	8.00	6.6000	1.35225	-.944	-.032
Overall Effectiveness	15	3.60	4.60	8.20	6.8667	1.01887	-.908	.564

Source: Compiled by Author 2025

Cost efficiency means the score of PPP defense projects was 6.53 (SD = 1.96), with a range of 2.00 to 9.00, which is quite a broad variation in cost-saving performance. (Table 4). The negative skewness (-1.08) indicates a skewed distribution towards the left, that is, more projects were rated at the high end of the scale. The kurtosis (-.49) is slightly greater than normal. This implies that although the majority of PPP projects are cost-effective, there are some low performers that push the minimum down. The rate of innovation had the mean of 7.80 (SD = 1.01) and the range of 6.00 to 10.00 is not very wide. The skewness (.46) indicates that the data is just inclined slightly towards the left, with a few cases with very high scores on innovation. The kurtosis (.40) gives a similar implication that the peak is almost normal, and therefore the majority of the projects are concentrated around the mean. All in all, the results of innovation in PPP projects are high and stable. The mean score (SD) of technology transfer was 6.87 (SD = 1.13) with a range of 5.00 to 9.00. Distribution is almost devoid of skewness (skew = -0.05) and slightly platykurtic (kurtosis = -0.23), which means that the distribution is spread out without extreme scores. This is an indication of moderate success and even distribution of technology transfer cases. The risk sharing scores were between 4.00 and 8.00, with a mean of 6.53 and an SD of 1.19. The skewness (-0.68) is negative, indicating that higher scores on risk-sharing are more likely to occur in more projects, and the value of the kurtosis (-0.08) is quite close to zero, indicating a reasonably

normal distribution. This is an indication that the PPP projects always have moderate to high effectiveness when the operational and financial risk is shared.

The mean of the governance quality was 6.60 (SD = 1.35), and the range of the scores was 4.00 to 8.00. The negative skewness (-0.94) and small negative kurtosis (-0.03) indicate a left skewed distribution where most of the projects were high performing in terms of governance. The dispersion is moderate as a number of lower scores are also experienced, PPPs tend to enjoy better structures of governance. The total effectiveness mean was 6.87 (SD = 1.02), and the score was between 4.60 and 8.20. The distribution was skewed to the lower part (-0.91), which indicated a higher number of projects between the high and low end. The kurtosis of 0.56 represents slightly peaked distribution and tight clustering of the scores as they get closer to the higher end of effectiveness. This also proves that the overall effectiveness of PPPs is usually good, and there is little difference in their dimensions.

Table 5 Correlation among the Variable

		Cost Efficiency	Innovation Rate	Tech Transfer	Risk Sharing	Governance Quality	Overall Effectiveness
Cost Efficiency	Pearson Correlation	1	-.194	.294	.882**	.949**	.868**
Innovation Rate	Pearson Correlation	-.194	1	.788**	.036	-.010	.304
Tech Transfer	Pearson Correlation	.294	.788**	1	.431	.385	.694**
Risk Sharing	Pearson Correlation	.882**	.036	.431	1	.854**	.901**
Governance Quality	Pearson Correlation	.949**	-.010	.385	.854**	1	.912**
Overall Effectiveness	Pearson Correlation	.868**	.304	.694**	.901**	.912**	1

Source: Compiled by Author 2025

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

In Table 5, Some of the key variables were strongly and positively correlated with cost efficiency. It found a very high correlation with the level of governance ($r = .949$, $p < .01$) and risk sharing ($r = .882$, $p < .01$), which indicated that the higher the quality of governance and clearer mechanisms of risk allocation, the higher the degree of cost efficiency of PPP projects. Also, overall effectiveness was closely linked with cost-efficiency ($r = .868$, $p < .01$), meaning that cost-effective projects are more successful in general. Cost efficiency and innovation rate had a weak and negative relationship ($r = -.194$), which indicates that the two dimensions do not necessarily develop concurrently. The rate of innovation was strongly and significantly positively correlated with technology transfer ($r = .788$, $p = .01$), which suggests that high levels of innovation activities are also correlated with more effective technology transfer. But it was found that innovation was not significantly related to cost efficiency ($r = -.194$), risk sharing ($r = 0.36$), governance quality (r

= -.10), or overall effectiveness ($r = .304$). There was a moderate correlation between technology transfer and the overall effectiveness ($r = .694$, $p < .01$) and the rate of innovation ($r = .788$, $p < .01$), which confirms that successful transfer of knowledge and technology leads to innovation and project success in general. It had a positive, but statistically insignificant, correlation with its relationships with governance quality ($r = .385$), cost efficiency ($r = .294$), and risk sharing ($r = .431$), which indicates that although tech transfer is related to performance, it may not be directly affected by financial or governance organization in PPP settings. The governance quality ($r = .854$, $p < .01$) and the overall effectiveness ($r = .901$, $p < .01$) had very strong relationships with risk sharing, which showed that, the higher the risk is distributed, the better the governance and overall project effectiveness. The fact that its correlation is high with the cost efficiency ($r = .882$, $p < .01$) also underscores the importance of risk sharing as a key point of performance results. Nevertheless, there was no significant correlation between risk sharing and innovation rate ($r = .036$) and this result suggests that innovation does not have a significant level of dependence on the risk factor in these alliances.

The quality of governance appeared to be one of the most significant variables with a strong correlation with cost efficiency ($r = .949$, $p = .01$), risk sharing ($r = .854$, $p = .01$) and overall effectiveness ($r = .912$, $p = .01$). Surprisingly, the correlation with innovation rate ($r = .304$) was positive but not statistically significant, which supports the previous observation on the fact that innovation can be a parallel or solitary process in defense PPP system.

Table 6 Dependent variable Overall Effectiveness (1-10)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	4.438	1.374		3.229	.007	1.444	7.433		
Innovation Rate	-.644	.284	-.641	-2.267	.043	-1.264	-.025	.378	2.643
Tech Transfer	1.086	.256	1.199	4.239	.001	.528	1.644	.378	2.643
R-square	.637								

Source: Compiled by Author 2025

Multiple linear regression analysis was done to determine how much the rate of innovation and technological transfer predicts the overall performance of defense projects under Public-Private Partnerships (PPPs) as shown in **Table 6**. It was also noted that the model would be statistically significant, $R^2 = .637$, which shows that about 63.7 percent of the overall effectiveness can be attributed to the two predictors. Quite the contrary, it turned out that the rate of innovation is a considerable negative predictor of overall effectiveness, $B = -0.644$, $t(12) = -2.27$, $p = .043$. The 95 percent confidence interval of this coefficient was between -1.264 and -0.025. The standardized beta coefficient ($\beta = -.641$) indicates that, other things being equal, the rate of innovation has a very negative relationship with the total effectiveness. Although this might appear counterintuitive, the misalignment of resources may be observed, in which the innovation activity is not directly linked to the mission results or tied by procurement governance (Rausser et al., 2023). Conversely, technology transfer was an excellent positive predictor of overall effectiveness, $B = 1.086$, $t(12) = 4.24$, $p = .001$. The confidence interval was between 0.528 and 1.644 and the standardized beta ($\beta = 1.199$) value shows that the effect is significant. It indicates that technology transfer is a key factor in enhancing defense project performance, probably via instilling improved capabilities and knowledge-sharing processes that have direct perks on

performance, preparedness, and effectiveness (Pena et al., 2021). The diagnostics of collinearity showed satisfactory multicollinearity levels, with Tolerance values of 0.378 and Variance Inflation Factors (VIF) of 2.643 for both predictors. Since Tolerance values below 0.1 or VIF values above 10 typically indicate problematic multicollinearity, the current results suggest that the predictors are not excessively correlated with one another. This means that each independent variable contributes uniquely to the model and the estimated regression coefficients are reliable. Therefore, multicollinearity is not a concern in this analysis, and the interpretation of the regression results remains statistically valid and robust.

Table 7 Dependent variable Overall Effectiveness (1-10)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	3.916	.487		8.049	.000	2.865	4.967		
Cost Efficiency	.452	.072	.868	6.314	.000	.297	.606	1.000	1.000
R-square	.754								

Source: Compiled by Author 2025

Simple linear regression was used to test the predictive impact of cost efficiency on the overall effectiveness in defense PPPs (Table 7). The model was significant and had a high explanatory power since it had an R^2 of .754 which means that 75.4 per cent of the overall effectiveness can be explained by cost efficiency alone. The cost efficiency regression coefficient was also significant with $B = 0.452$, $t(13) = 6.31$, $p < .001$, and a 95% confidence interval, 0.297 to 0.606. The standardized beta coefficient ($\beta = .868$) implies that the effect is very strong and positive, which means that with each unit change in cost efficiency, the general effectiveness will be affected by about 0.452 units. This finding confirms that cost effectiveness is one of the key

determiners of perceived or actual success in PPP defense projects. The fact that this is a simple regression with a single predictor does not cause any concern with collinearity, and the Tolerance and VIF values (Tolerance = 1.000, VIF = 1.000) prove the lack of multicollinearity. The results are very indicative of the hypothesis that cost efficiency is an essential element to the realization of the greater overall performance in the PPP-based procurement of the defense. This finding corresponds to the available literature highlighting the fiscal austerity, performance-related incentives, and principles of value-for-money inherent in PPP models (Okromtchedlishvili, 2022). This relationship is strong enough to propose cost-performance metrics as the main indicators of any analysis of the PPP success in the defense settings.

3.2. Qualitative Findings

3.2.1 UK Skynet 5

The Skynet 5 project of 20 years (2003-2023) is one of the most complex and strategic Public-Private Partnerships (PPPs) in the defense Industry between the Ministry of Defense (MOD) of the United Kingdom and the companies of the private sector, mostly Airbus, to provide secure satellite communication services to the UK Armed Forces. The main aim of the project was to achieve dependable, safe and globally accessible satellite communication on military operations which is an urgent need to the contemporary warfare especially in the light of the current military conflicts in areas with the need to have a solid communication system. What is important about the project is not only its magnitude, but also the fact that the private sector has been brought in the technological, as well as the operational aspects of the defense infrastructure, which in the past had been more tightly regulated by the governmental agencies. This PPP allowed the MOD to keep the initial capital expenditure on infrastructure at a minimum besides capitalising on the innovation of the private sector to provide state-of-the-art satellite technology. Nevertheless, there were significant risks associated with the sophistication of the technology that was used in the establishment and functioning of the satellite systems(Davison & Miles, 2013). The satellite systems in question were extremely high in terms of reliability and resilience: a system issue may have affected the entire military, and this is where the involvement of the private sector can be ascertained to inject expertise and efficiency in highly technological-advanced spheres(Defense Advancement 2024). However, this partnership with Airbus pointed to the large role of risk sharing that the private sector played in it because the private sector assumed the responsibility of constructing and running the system over the period of 20 years (Ash et al., 2016). The government still owned and controlled the main aspects of the system, whereas the private sector had an opportunity to use the commercial opportunity, like selling bandwidth to allied states. This structure helped to transfer the risk yet posed difficulties in addressing the needs of the military without affecting the security and sovereignty.

Another important governance and management issue that was brought out by the Skynet 5 PPP concerns the distribution of roles between the government and the citizens. With the collaboration with the private sector, the MOD had the challenge of sustaining control of the project to achieve its distinctive and dynamic requirements of communications in the defense. This was compounded by the fact that the partnership was long-term and this needed continuous negotiations between the MOD and Airbus particularly when there was a change or development in the technological requirements. Delay in meeting some deadlines and cost overruns was one

of the problems that emerged and this raised the concern of dealing with a large-scale infrastructure project where there is the involved technological complexity and long timelines. This forced the governance structures of the project to be continually realigned in order to respond to the risk that surfaced along with the need to make sure that there were clear performance indicators and punishment entrenched in the contract to ensure that there was compliance and to reduce risks of cost and time overruns in the project. Besides, the MOD too had to ensure that the advantages of commercialisation of the satellite services were matched against its operational needs as the project was going on, a fine balancing exercise that influenced the cost structure and strategic application of the technology. The private sector was encouraged to increase efficiency, but the fact that the government required the sovereign ability over the communication system was that some type of operational decisions could not be left to the government. This was a twofold aim of attaining both operational effectiveness and control the existence of which is commonly mentioned when the notion of defense PPPs is discussed, as more often than not, the convergence of commercial interests and the purpose of serving the population results in tension and even conflict (Pena et al., 2021).

The relationship between the Airbus and the MOD in its technological aspect was crucial in pushing the satellite communication systems to a new level. The combination of enhanced bandwidth management, introduction of more efficient satellite operations, and incorporation of best encryption systems played a significant role in making the communications network more secure and scalable. But these technological improvements were associated with high prices, and PPP model allowed distributing these expenses between the private sector and the MOD, but the financial consequences were not less important. The private sector was charged with the responsibility of supplying the hardware and also with the sustained operational capability over a long period. This change in the procurement model which was traditionally characterized by the government owning the whole system and running of the system to a more shared common model where the everyday service delivery falls on a private company brought about new complexities on the issue of accountability and risk sharing. The features of the project prove that on one hand PPPs may lead to innovation and the presence of financial and operational efficiency, on the other hand, it is necessary to consider the long-lasting effect of such partnerships, in particular, the ability to balance the cost, innovation, and strategic control (Sturman et al., 2007). Moreover, the need to have a clear and accurate management of contracts is one of the lessons that come through the Skynet 5 project that can guarantee the success of the PPPs in the field of defense. The contract was not only to take into consideration the first delivery and installation of satellite

systems, but also the long-term maintenance and technological improvement, which demanded a continuous dialogue and adaptation to new challenges of each other. In the absence of proper management, such long-term engagements can result in huge financial and operational risks as seen in the delays and overruns that were experienced in the initial stages of the project. In general, Skynet 5 demonstrates the opportunities and constraints of engagement of the PPP model in the defense communication and proves that although the participation of the private sector can contribute to technological progress and cost-effectiveness, the involvement of this sector involves highly efficient governance and risk-sharing systems to balance the achievement of the goals of the public sector with the security and sovereignty of the military system (Pena et al., 2021).

3.2.2. Lockheed Martin F-35 Lightning II: Fighter Jet Development.

F-35 Lightning II program Ongoing since 2001 (initial development, expected full deployment by 2030) can be characterized as one of the most ambitious and expensive military procurement programs of the U.S. government that involved Lockheed Martin and a number of foreign partners significantly. The program was meant to come up with a next-generation multi-role fighter jet that was to form the foundations of air combat in the U.S. and its partners over the next several decades. The F-35 program, as a PPP, engaged the cooperation of the U.S. Department of Defense (DoD) and Lockheed Martin alongside many other international stakeholders, such as the United Kingdom, Italy or Australia. This alliance was basically to share the excessive costs of development and production of such an advanced fighter jet and also ensuring that there was advancement in technology which would have a positive effect to all the countries that were involved in the alliance (Gerrits & Marks, 2022). The PPP concept enabled the United States government to transfer some of the financial cost to the international allies whereas Lockheed Martin was able to tap on its experience to produce both technical and operational capability, which eventually resulted in a state of the art air frame able to fulfill various roles, including air superiority and ground attack. Nonetheless, the program did not pass without its troubles especially in the area of cost overruns, delays and technical failures. The growing cost was among the greatest problems that bedevilled the F-35 program; it was way more than it was projected to be originally. The cost spiral was also of great concern to the government, particularly bearing in mind that the program was supposed to yield a huge payoff in terms of operational capability of the U.S and its allies.(Bolkcom, 2009)

The relationship between the DoD and Lockheed Martin taught a number of valuable lessons about how large-scale PPPs operate in the defense industry, qualitatively. The first lesson

is the role of proper governance frameworks and contractual arrangements, particularly with regard to such complicated technologies. The F-35 showed the governance model to be put into question by the sheer size of the project, the participation of several countries, and the dynamic nature of the technology (van Noije & van Boven, 2024). The U.S. Department of Defense had serious challenges with keeping the costs, schedules, and technical requirements under control, which were constantly modified during the project implementation. The changing needs resulted in the regular redesigns of the plane that caused a further rise in expenses and prolonged the development time frame. On the side of the private sector, Lockheed Martin was on the pressure to deliver on an ever-ambitious technological ambitions as well as deal with the cost and risk involved in such a complicated project. This led to serious delays in the milestones of the program and the end product was not within budget and timelines.

The second major problem was that the integration of the latest technologies into the F-35 was quite complicated, and it demanded the involvement of the partners in the private sector, such as Lockheed Martin (Van Noije, 2024). The PPP model gave the American government an opportunity to access the innovation and skills of the business sector, yet the dangers of such complex technologies were not easy to foresee. The F-35 development had some significant technological setbacks, including software problems, radar technology, and even stealth ability, which led to delays and increased the financial cost. Moreover, the international cooperation model brought with it other layers of complexities since each partner nation had its own unique demands of the aircraft and in some instances, it created delays in responding to the decisions, and additional costs. The PPP model in the context of innovation offered the opportunity to integrate high-technological solutions, which included the special stealth features of the aircraft, sensor fusion, and advanced avionics systems, which were important in giving the U.S. and its allies an advantage in air battles against enemies. The timeline of development and the overruns however failed the pay back on the investment that the US government had expected the program to bring.

The governance issues in the program were also reflected in the management of the program because the process of oversight became more challenging as the project became more complicated. The DoD lacked control of the activities of Lockheed Martin and its subcontractors, and that posed challenges in making the private sector responsible to the delays and cost overruns that characterized the program. Moreover, as the project advanced toward development to the stage of production and deployment, the DoD was growing increasingly disoriented in its ability to handle the changing needs of the F-35 and at the same time keeping the fiscal restraint

to ensure no further cost increase. Lesson gained during this project is that PPPs in the defense sector need to go beyond just good management of contracts, to be able to adapt to new technological environments and new political priorities. In the absence of this flexibility the dangers of PPPs, especially within the military arena, may become costly both monetarily and operationally. In general, the F-35 project sheds light on possible advantages and disadvantages of PPPs in massive military programs and the importance of proper governance, well-defined risk-sharing practices, and sound project management, which would help to bring complex defense technologies to fruition (Kivinen, 2021).

3.2.3. Germany's HERKULES Project

The HERKULES initiative in Germany 2008-2020 (development, operational until present) was an effort to enhance the military logistics in the country through the acquisition of a fleet of heavy-lift aviation to satisfy the air mobility demands of the Bundeswehr. It was a joint venture between the German government and the nongovernment contractors such as Airbus to offer the armed force of the country with the required airlift to facilitate quick deployment and flexibility in operations. The main aim of the HERKULES project was to improve the logistic capabilities of the Bundeswehr especially in the light of the participation of the Germany in the multi-national military operations in the different regions. The purchase of heavy-lift aircraft was regarded as the critical element of the modernization of the German army as it would be able to react to the crisis more effectively and deploy its forces to the foreign lands. Nevertheless, the project was experiencing some obstacles especially on the cost, technological interplay, and partnership governance between the government and the contractors of the private sector. Among the major lessons of the HERKULES project is the role of effective communication and rules of governance in PPPs, especially when it comes to the defense systems that are more complicated. By means of involvement of the private sector in the design and building of the heavy-lift aircraft, it was important to make sure that the Bundeswehr possessed the most up-to-date technologies and innovations in air mobility. Nevertheless, the project also showed the possible negative aspects of PPPs in the defense, specifically, the need to balance the interests of the government and the corporate sector (Mekh et al., 2022).

The HERKULES project highlighted the necessity of effective systems of risk-sharing and distinct performance indicators in defense PPPs. This herein is the role of the private organization, Airbus, to deliver the aircraft on time and on budget, the government had to cope with the risks involved in the project such as technological difficulties, cost increases and delays that might arise during delivery. Regarding governance, the partnership between the German government and

Airbus needed constant supervision to make sure that the project remained within the schedule and all the problems were solved in a timely fashion. Another major problem and issue of the project HERKULES was the integration of new technologies into the aircraft and this necessitated a close coordination between the military and the contractors. The aircraft delivery was a success that was well managed by technological innovation and understanding of the needs of the military operations among others and capability to evolve with the changing requirements during the project. Furthermore, the partnership needed to solve the logistical problem concerning the delivery and deployment of the aircraft that meant a need to coordinate the work of various military forces and make sure that the aircraft would be able to fit into the operational situation within a short period of time.

Furthermore, the HERKULES project demonstrated the fact that long-term contractual relations between the government and the private sector should be kept clear. The contract between the German government and Airbus was designed to ensure that the partner in the private sector will be encouraged to deliver the aircraft in time and at the cost besides sharing the risks of both operational and technological performance. The project success was based on the technological aptitudes of the partner in the industry as well as the government capacity to handle the contractual relationship and to ensure that both parties fulfilled their roles during the lifecycle of the project. It is a very important component of governance, which is vital in ensuring that PPPs in defense projects are able to provide the intended results without falling into the traps of cost overruns, time wastages and lack of focus.

The HERKULES project eventually proved that PPPs can bring serious improvements in military logistics and air mobility, yet it also broadcasted issues of large-scale military projects. The successful implementation of the project required clear structures of governance, mechanisms of risk sharing and a continuous partnership between the public and the private sectors. But as the project was progressing, it became evident that the handling of the complexities of defense PPP takes high level of expertise and supervision especially when it comes to incorporating new technologies in the current military systems (Mekh et al., 2022). Overall, the HERKULES project provides some useful lessons about how the PPPs can be used in the context of the defense procurement to improve the capabilities of the operations, yet it also draws attention to the necessity to make sure that the management and governance of the partnership can be effective over the course of its existence.

3.2.4. Canada – Maritime Helicopter Project (MHP): Technological Innovation and Acquisition

Another interesting case of a Public-Private Partnership (PPP) 2004-2015 (delivery and integration) in the field of defense procurement is the Canadian Maritime Helicopter Project (MHP), which entailed the purchase of the CH-148 Cyclone helicopters by the Canadian Armed Forces. The major aim of the project was to substitute the old collection of maritime helicopters that were invaluable in the anti-submarine warfare, search and rescue and overall maritime reconnaissance. The project involved incorporation of current technologies and the ability to work in harsh and in most cases unpredictable conditions especially in the Arctic and coastal regions of Canada. Sikorsky Aircraft (now Lockheed Martin) was charged with the contract to manufacture the MHP with the agreement that the commercial partner would not just produce the helicopters but also provide in-service support over the next 20 years. This lifecycle commitment of service shows the ability of the PPP model to lift-off the initial acquisition period to offer lifecycle support which is a huge benefit of such alliance in the defense industry. The role of the private sector in this set up was to lend technical knowledge and operational capabilities that the government could not have easily established without the input of the private sector. The background of Sikorsky in design and maintenance of high-tech helicopters was essential towards providing a state-of-the-art platform to the Canadian Forces (Soroka et al., 2023a). Nevertheless, the project had its share of hitches especially in cost over-runs, delay in the delivery and the adoption of new technologies. It was signed in 2004, and the first operational helicopters were only delivered in 2015, much later than was anticipated. This was delayed a lot, especially by the performance of the helicopters and integration of the technology needed to be incorporated in their desired functionalities. As the report by the Parliamentary Budget Officer on defense procurement in Canada states, this time contributed a significant amount to the overall cost of the project, with the costs growing since the CAD 5.7 billion initial cost to far above CAD 8 billion by the time the first helicopters were delivered(Soroka et al., 2023a).

Governance wise, the MHP illustrates the essence of the definition of roles and responsibilities in PPPs in a project of such long-life span. Here the Canadian government was bestowed with the responsibility of seeing Sikorsky fulfill the requirements of the project whereas Sikorsky was to not only deliver the helicopters, but also a complete system of the project, incorporating simulators, training facilities and maintenance of the system in the long term. Nevertheless, the absence of proper control and project management at the initial phases of the program led to the delays, and cost increase. Among the most important things that are learned in this project, one of the lessons is that PPPs may have some positive aspects in terms of cost-sharing and technological innovation, but they also need a strict control and specific performance

indicators, which will help to provide the needs of the public sector in timely and economical way. The flexibility of the government in control over the contract, as well as dealing with unanticipated issues and holding the private sector responsible, were vital in the eventual success of the program, though it can be seen that the delays in delivery and upsurge in costs contributed negatively to its overall worth.(Canadian Government 2004)

The MHP technologically gave the Canadian Armed Forces a very powerful platform featuring advanced avionics, anti-submarine warfare equipment, and increased range of operation. These inventions played a pivotal role on improving the defensive capability of Canada especially in the defense of its vast and remote coastlines. Despite the delays, the Cyclone helicopter is now an indispensable component of the work of the Canadian military, representing a sign of how PPPs can provide solutions to the demands in the sphere of defense at a sophisticated level. The adoption of these technologies was however not without its challenges. The complexity of the program was further explicated by the fact that the continuous technical support and changes were needed to address the specific operational requirements of the Canadian Forces. The contributions of the private sector in terms of continuous service and technical support were invaluable to make the helicopters be effective in the field, however, the timeframe and the changing technological requirements made it cost more and take time.

Regarding the risk-sharing, government of Canada shared part of the blame regarding the delays and cost overruns because Sikorsky was supposed to deliver the helicopters within a particular time. The technical aspect of the technology and the unanticipated difficulties of adapting the helicopters to the particulars of the Canadian operation, however, placed both parties in the same position in the delays. Finally, the MHP identifies the potential advantages of the use of PPPs in defense, specifically, in the form of the transfer of technology and the possibility of applying the experience of the private sector to projects of complex character in the military. The project however also illustrates the dangers of such a set up especially when the partner in the private sector endures hardships in fulfilling the tough performance conditions and deadlines. The moral of the story with the MHP is that though PPPs may give companies sources of innovation and cost sharing, they must be under robust governance, with effective risk sharing models, as well as have the capability to adjust to unexpected problems in a bid to record positive results (Soroka et al., 2023a).

3.2.5. The Future Combat Systems (FCS): Modernization and Governance Failures, USA

Future Combat Systems (FCS) 2003-2010 (cancelled in 2009) was a program launched by the U.S. Department of Defense (DoD), which was among the most ambitious projects in military modernization, and this project was meant to transform the manner in which the U.S. Army operated, by implementing the latest technological inventions like unmanned vehicles, robotics and networked sensors. The FCS was supposed to be a system-of-systems approach, which would integrate several new high-tech technologies into a unified platform that will revolutionise ground warfare. The first phase of project was opened in 2003 and aimed at providing a completely modernized force that will be able to effectively reach the battlefield and improve its operational performance with high speed and efficiency. The program, though, was challenged by many governance and technical issues and in the year 2009 the program was officially canceled and many of its parts were considered impossible because of cost overrun, delays and performance problems. A significant issue with the FCS program was that it based its work on the PPP model in which the government collaborated with many privable contractors, such as General Dynamics and Boeing, to create the different systems that would be a part of the project. Although the private sector contributed a lot of technological innovation to the table, the sheer complexity of the project rendered it manageable and risks of developing untested technologies in a highly dynamic defense environment were underestimated (Pena et al., 2021).

The key feature of the FCS program was the incorporation of various technologies of the defense into one system, whereby components of this program, including, unmanned ground vehicles, network sensors, and superior communications systems, are all set to work together. This system-of-systems approach brought new such technical challenges especially on how all the technologies would be able to collaborate in combat situations. Nevertheless, the technical intricacy of the program was one of the factors that proved to work against it. The innovative contractors of the private sector could not achieve the expectations of the Army in performance and integration, and this caused the occurrence of successive delays and increases in costs. This was made worse by the fact that there was a disjointed and disorganized governance format that could not monitor the different technologies being developed and see to it that they addressed the operational requirements of the Army. The fact that the program had to use numerous private contractors also provided a disjointed management environment in which the DoD could not easily exercise control and coordinate all the various aspects of the program(Kaeser et al., 2009). The FCS project can serve as an example of the difficulties in applying a PPP model to a highly complex defense project wherein technological development and integration not only are risky but also demand extraordinary governance and oversight (Pena et al., 2021).

Another issue to the FCS program was governance. Lack of good management of the scope, schedule, and budget of the project by DoD resulted in the project becoming characterized with cost escalations and schedule slippage becoming the order of the day instead of the exception. In addition, there were no explicit means of risk sharing between the government and the privately contracted individuals and as such, the DoD was left to shoulder a large part of the financial weight when the project started to fall behind schedule and overly stretched its budget. As a report compiled by the U.S. Government Accountability Office (GAO) indicated, the program had unclear requirements, was characterized by a shifting goal and shifting priorities, which helped in causing it to miss its deadlines or to fail to deliver on the technological advances that were promised (GAO, 2009). Moreover, the program was severely politically and organizationally challenged, as various stakeholders both in the military and the government had a different interest and vision of how combat systems should be. These obstacles added to the problems of the DoD and its partners in the private sector, and the end result was the cancellation of the program.

The FCS program was also leading in innovation with the potential to bring disruptive changes to the defense technology, such as autonomous vehicles and real-time sharing of battlefield operations. Nevertheless, this was not the case as the absence of a viable and efficient governance structure stipulated that the grand objectives of the program in terms of technological aspects could not be achieved within the time limits and budgetary provisions. The lesson acquired during the FCS program is that even though PPPs may be used to facilitate innovation, they have to be backed by well-established governance systems, realistic and achievable project timelines, and well-structured risk-sharing systems. The unsuccessful FCS program underscores the dangers of becoming too technology-dependent and neglecting the difficulties of the functioning and implementation of the emerging technologies (Zahn, 2000).

Finally, the FCS program is a lesson to the upcoming giant defense projects based on PPPs to pursue technological breakthroughs. The termination of the program does not reduce the merits of the technological developments that it was aimed to present, but it highlights the necessity of defense procurement being managed and overseen closely. The FCS experience has taught that even though PPPs in defense may result in innovation, they have to be designed with proper oversight and risk-sharing mechanisms in place to make sure that the high expectations of such projects may be met without succumbing to cost increases, delays, and technological overambition (Pena et al., 2021).

Table 8 Comparison Table Using Tags and Constructs of Each Project

Project	Country	Partners	Main Goal	Main Problems	Governance Issues	Result
Skynet 5	UK	Airbus, Ministry of Defense	Secure satellite communication for the military	Delays and high costs	Long-term contracts required constant negotiation	System works well, but management issues remain
F-35 Lightning II	USA	Lockheed Martin, international partners	Advanced multi-role fighter aircraft	High costs, delays, technical problems	Weak oversight and changing requirements	Aircraft operational, but late and over budget
HERKULES Project	Germany	Airbus, German Government	Transport aircraft for military logistics	Technical and cost challenges	Needed ongoing supervision	Aircraft delivered, but cost and governance issues
Maritime Helicopter Project	Canada	Sikorsky (Lockheed Martin)	Helicopters for naval operations	Delays and technology integration issues	Unclear roles and complex contracts	Delivered late, successful after deployment
Future Combat Systems (FCS)	USA	Private contractors, DoD	Modernize military combat systems	Major technical and management failures	Poor oversight and repeated redesigns	Project cancelled

Source: Compiled by Author 2025

Table 8 shows how different defense projects used Public–Private Partnerships (PPPs) in several countries. In most cases, PPPs helped governments get advanced military equipment by working with private companies. However, many projects faced similar problems. These included high costs, delays, and difficulties managing long-term contracts. Governance was a common issue, especially when roles were unclear or when technology requirements changed over time. Projects like Skynet 5, F-35, HERKULES, and the Maritime Helicopter Project were eventually completed and became operational, but they still struggled with cost and management issues. In contrast, the Future Combat Systems (FCS) project failed completely because of poor oversight and repeated design changes. Overall, the table shows that PPPs can work in defense projects, but strong management, clear responsibilities, and effective oversight are essential for success.

3.3. Summary

The results show that although Public-Private Partnerships (PPP) provide a framework of a superior structure in defense procurement, the success of such contracts is extremely conditional. Quantitative analysis proves that PPPs have much greater Overall Effectiveness than conventional models that are contributed by better Cost Efficiency, Risk Sharing and better Governance Quality. Nevertheless, this model presents severe weaknesses as it lags in Technology Transfer and achieves an uncharacteristically low Innovation Rate. This mixed performance is supported by in-depth case studies of big international projects conducted qualitatively. They confirm the quantitative benefits: the availability of innovation in the private sector and risk sharing but are always willing to reveal the operational issues that destroy them: excessive cost overruns, schedule slippage, and technological integration issues. More importantly, qualitative data pinpoints the cause of the problem: it is the effectiveness of the governance structures and contractual management which determines the success or failure of a defense PPP in the end. Those projects that had strong and adaptive managerial efforts managed to overcome the uphill challenges, and those that were poorly managed like the Future Combat Systems program were terminated. Thus, the findings indicate that the potential of the PPP model is not a given; it is a risky and rewarding strategy that can only be of great benefit to the extent there is exceptional governance to deal with the complexities involved and harmonize the performance of the private sector with the strategic needs of the public sector.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION

This paper has attempted to explore the efficiency of Public-Private Partnerships (PPP) in defense financing along three fundamental dimensions of cost-efficiency, defense innovation and military resilience. Based on a mixed-method approach and the experience of larger defense PPP projects and literature, the results confirm that PPPs are a conditionally important but strategically significant tool in the modern process of defense funding

1. Based on the cost-effectiveness purpose, the findings partially confirm the assumption that PPPs enhance efficiency in defense finance. As PPPs were found in quantitative data and case studies, they have the potential to minimize procurement inefficiencies, optimization in life-cycle costs, and also enhance logistics performance, especially in long-term infrastructure, satellite communications, and performance-based logistics models, Skynet 5 and HERKULES are prime examples of projects. The results, however, also show that these gains are curtailed by cost overruns, transaction costs associated with secrecy and bad incentives, especially in large-scale programs like the F-35 Lightning II. This validates the theory that cost efficiency is not a given product of PPPs but moderated by the quality of the governance and control mechanisms.
2. Contributing to the defense innovation aim, the study is quite powerful in proving the hypothesis that PPPs assist the technological progress and innovation of the defense systems. Throughout the considered cases and empirical research, PPPs prove to be efficient channels of access to the expertise of the private sector in the field of the advanced means of satellite communications, artificial intelligence, cybersecurity, and autonomous systems. A combination of private innovation capability has proven to shorten R&D times and has made it possible to implement a dual use technology which is essential in contemporary defense preparedness. However, the results also indicate the unequal nature of innovation as well as its significant reliance on flexible regulatory frameworks and intellectual property regulation. Institutional mandates inaccessible through rigorous procurement regulations, and divided across institutional bounds limit innovation spillovers, which points to the conclusion that PPPs can only add to defense innovation when underpinned by a supple innovation-enabling governmental framework. Previous logistics, communications as well as crisis-response case studies demonstrate that the use of PPPs enhances responsiveness, supply-chain stability, and operational flexibility. Simultaneously, the results also demonstrate structural weaknesses related to excessive

dependence on private and contractors, unequal risk distribution, and sovereignty. In weak governance systems, the PPPs would jeopardize resilience in the long perspective by enhancing strategic dependency and diminishing the state capacity to control important capabilities. Accordingly, the research multiple types of PPPs can benefit military resilience, provided resilience is a strategic governance goal, but not a by-product of performance or creativity.

3. The research empirically supports the main assumption that PPP effectiveness regarding defense funding is indirect and conditional, but not direct. The quantitative and qualitative findings indicate that the effectiveness of governance is a significant mediating variable between the arrangements of PPP and the outcomes of the cost-efficiency, innovation, and resilience. This observation is in line with the theoretical lenses used namely Resource Dependence Theory, Transaction Cost Theory, Public Value Theory and the Principal 94 and Agent model which all illustrate that defense PPPs are not simple financial properties but intricate governance mechanisms that act within high-risk, secret, and strategic stakes.

To sum up though PPPs are capable of significant opportunity to modernize defense financing, improve technological capability and strengthen military resilience, its effective implementation requires good governance, clear accountability, flexible regulation, and balanced risk-sharing mechanisms. In their absence, PPPs have the danger of they becoming mechanisms of inefficiency, strategic dependency and institutional fragility. This paper has thus highlighted a requirement that performance measurement frameworks of defense specific should be whereby cost-effectiveness, the outcomes of innovation, and the effects of resiliency in the long term are combined measurements. On the one hand, the underpinning of coherent policy direction and responsible governance, the PPPs may develop into transformational instruments with the capacity to deliver sustainable, innovative, and resilient defense systems that are applicable to the needs of the security environments of the 21st century.

RECOMMENDATIONS

This study has practical implications to governments, defense ministries, and private defense contractors working on PPP arrangements which are as under:

A. Practical Recommendations

1. **Contract of "Mission-Aligned Innovation:** Innovation success in the form of contracts should then be specified in terms of certain KPIs related to operational readiness or costs reduction in the lifecycle, and this will direct the ingenuity of the private-sector toward the strategic goals.
2. **Pre-Negotiate IP Frameworks and Technology Transfers.** Future contracts should actively harmonize the IP rights and the sovereign operations requirements. Government licensing rights and required training need to be listed in the protocols because the delays of the Canadian Maritime Helicopter Project demonstrated the dangers of informal knowledge transfer.
3. **Institute Review of Dynamic Partnership.** PPPs were very effective in Risk Sharing but the long-term case of Skynet 5 showed that initial assignments become obsolete. The recalibration of risks and incentives can be achieved through the creation of formal review points into long-term contracts to reduce the strategic drift identified throughout the qualitative findings.
4. **Enhance Autonomous technical supervision.** The frequent difficulty in managing complex private development, as was the case in F-35 cost overruns, requires the national audit institutions to be given the mandate of conducting real-time informed technologically reviews of significant PPPs.

B. Theoretical Recommendations

1. **Discover the paradox of innovation.** The case studies should be exploratory research on the causal mechanisms of the negative innovation-effectiveness relationship. This would be how and why R&D activities in PPPs lose their connection with integrated project results.
2. **Prepare a Defense-Specific PPP Evaluation Model.** Researchers are supposed to develop and confirm a holistic framework of performance the variables of this study. As a model, it must incorporate both quantitative measures in addition to defense qualitative constructions such as Strategic Autonomy.
3. **Implement Adaptive Governance Theories.** To overcome the rigidity described in case studies such as FCS, upcoming theoretical research must experiment with principles of adaptive governance and relational contracting
4. **Undertaking Comparative Policy Analysis.** Comparing the impacts of varying regulatory frameworks (e.g., in the UK, US, Germany) on the results of PPP would fill gap

in the literature and would offer a base of evidence to learn policies, putting the national differences in the case studies into perspective.

Future Research Directions

Considering the gaps and limitations, there are some potential directions of future research:

- a. Future studies should implement empirical studies found on narrow-access information in defense (vetted on an administrative, ethical basis) to confirm theoretical assumptions with respect to efficiency, administration, and innovation outcomes in a real PPP of the world.
- b. Cross-country analysis under different geopolitical contexts (e.g. NATO and ASEAN defense structures) can result in situating implications of cultural, institutional, and regulatory disparities on PPP performance in defense funding.
- c. With AI, quantum computing and autonomous technology transforms how the military conducts their tasks, researchers should realize how these technologies have transformed how PPP dynamics works especially accountability, liability and cybersecurity.

Concluding Insights

By definition, the implication of this research is that Public Private Partnerships are not only financing tools, but rather, the strategic co-governance tool. They can succeed in being defensive because of the ways in which countries will be able to balance the requirements to innovation to sovereignty, accountability to efficiency, and secrecy to transparency. Through adaptive model rule, stringent assessment, and ethically based coalition, the defense PPPs can transform transactional setups into strategic coalitions that would not only result in increased national security but also confidence of the people. Defense financing cannot rest on the idea of substituting the state with private actors because the answer to the future of defense financing is the development of robust, co-creating partnerships that generate value, capability, and trust in a swiftly evolving global defense environment.

BIBLIOGRAPHY AND LIST OF REFERENCES

- Ash, A., Scott, L., & Feline, W. (2016). *Findings from the UK and Canadian Space Situational Awareness (SSA) Experimentation during the Relocation of SKYNET 5A Satellite*. <http://www.nationalarchives.gov.uk/doc/open->
- Asiamah, O., Agyei, S. K., Bossman, A., Agyei, E. A., Asucam, J., & Arku-Asare, M. (2022). Natural resource dependence and institutional quality: Evidence from Sub-Saharan Africa. *Resources Policy*, 79, 102967. <https://doi.org/10.1016/J.RESOURPOL.2022.102967>
- Aslett, K., & Magistro, B. (2023). Principal-Agent Problems with EU Funds: A Case Study of Patronage in Hungary. *Europe - Asia Studies*, 75(8), 1286–1310. <https://doi.org/10.1080/09668136.2022.2122405>;REQUESTEDJOURNAL:JOURNAL:CEAS20;WGROU:STRING:PUBLICATION
- Barney, J. B., Ketchen, D. J., & Wright, M. (2021). Resource-Based Theory and the Value Creation Framework. *Journal of Management*, 47(7), 1936–1955. <https://doi.org/10.1177/01492063211021655>;WEBSITE:WEBSITE:SAGE;JOURNAL:JOURNAL:JOMA;WGROU:STRING:PUBLICATION
- Bolkcom, C. (2009). *F-35 Lightning II Joint Strike Fighter (JSF) Program: Background, Status, and Issues*.
- Casady, C. B., Petersen, O. H., & Brogaard, L. (2023). Public procurement failure: The role of transaction costs and government capacity in procurement cancellations. *Public Management Review*. <https://doi.org/10.1080/14719037.2023.2231945>;WGROU:STRING:PUBLICATION
- Chen, W., Botchie, D., Braganza, A., & Han, H. (2022). A transaction cost perspective on blockchain governance in global value chains. *Strategic Change*, 31(1), 75–87. <https://doi.org/10.1002/JSC.2487>;WGROU:STRING:PUBLICATION
- Chishti, M. Z., & Sinha, A. (2022). Do the shocks in technological and financial innovation influence the environmental quality? Evidence from BRICS economies. *Technology in Society*, 68, 101828. <https://doi.org/10.1016/J.TECHSOC.2021.101828>
- Cuypers, I. R. P., Hennart, J. F., Silverman, B. S., & Ertug, G. (2021). Transaction Cost Theory: Past Progress, Current Challenges, and Suggestions for the Future.

- <https://doi.org/10.5465/Annals.2019.0051>, 15(1), 111–150.
<https://doi.org/10.5465/ANNALS.2019.0051>
- Davison, I., & Miles, I. (2013). A SPAR Modelling Platform Case Study: Skynet 5. *Procedia CIRP*, 11, 431–434. <https://doi.org/10.1016/J.PROCIR.2013.07.001>
- de Almeida, P. G. R., dos Santos, C. D., & Farias, J. S. (2021). Artificial Intelligence Regulation: a framework for governance. *Ethics and Information Technology* 2021 23:3, 23(3), 505–525. <https://doi.org/10.1007/S10676-021-09593-Z>
- Fan, M., Qalati, S. A., Khan, M. A. S., Shah, S. M. M., Ramzan, M., & Khan, R. S. (2021). Effects of entrepreneurial orientation on social media adoption and SME performance: The moderating role of innovation capabilities. *PLOS ONE*, 16(4), e0247320. <https://doi.org/10.1371/JOURNAL.PONE.0247320>
- Gabison, G. A., & Xian, R. P. (2025). *Inherent and emergent liability issues in LLM-based agentic systems: a principal-agent perspective*. 109–130. <https://doi.org/10.18653/v1/2025.realm-1.9>
- Gerrits, L., & Marks, P. (2022). Learn and Adapt, or Perish: The Case of the F35 Lightning II. *Administration and Society*, 54(7), 1357–1378. <https://doi.org/10.1177/00953997221098776>
- Grandia, J., & Volker, L. (2023). Public Procurement. *Public Procurement: Theory, Practices and Tools*, 157. <https://doi.org/10.1007/978-3-031-18490-1>
- Howells, J., & Thomas, E. (2022). Innovation search: the role of innovation intermediaries in the search process. *R and D Management*, 52(5), 992–1008. <https://doi.org/10.1111/RADM.12534>;JOURNAL:JOURNAL:14679310;PAGE:STRING:ARTICLE/CHAPTER
- Imran, M., Ismail, F., Arshad, I., Zeb, F., & Zahid, H. (2022). The mediating role of innovation in the relationship between organizational culture and organizational performance in Pakistan's banking sector. *Journal of Public Affairs*, 22(S1), e2717. <https://doi.org/10.1002/PA.2717>;JOURNAL:JOURNAL:14791854
- Kaeser, H. U., Cordesman, A. H., & Chair, A. A. B. (2009). *THE FUTURE COMBAT SYSTEM What Future Can the Army Afford?*
- Karn, A. L., Ghanimi, H. M. A., Iyengar, V., Siddiqui, M. S., Alharbi, M. G., Alroobaea, R., Yousef, A., & Sengan, S. (2025). Applying the defense model to strengthen information security with artificial intelligence in computer networks of the financial services sector. *Scientific Reports* 2025 15:1, 15(1), 30292-. <https://doi.org/10.1038/s41598-025-15034-4>

- Keppeler, F., & Papenfuß, U. (2023). Employer Value Propositions for Different Target Groups and Organizational Types in the Public Sector: Theory and Evidence From Field Experiments. *Review of Public Personnel Administration*, 43(4), 701–726. <https://doi.org/10.1177/0734371X221121050;PAGEGROUP:STRING:PUBLICATION>
- Kheljani, J. G., Hossein, M., Gavareshki, K., & Tahmasbpour, A. (2023). Explaining the effective factors in the effectiveness of risk management system deployment in a defense industry. *Journal of Improvement Management*, 17(1), 109–136. <https://doi.org/10.22034/JMI.2023.378479.2897>
- Kim, M. J. (2023). Toward Coherence: A Space Sector Public-Private Partnership Typology. *Space Policy*, 64, 101549. <https://doi.org/10.1016/J.SPACPOL.2023.101549>
- Kivinen, M. (2021). *Constructing a Culture of War : A Frame Analysis of Statements Discussing the Lockheed Martin F-35 Lighting II Fighter by Members of the U.S. Congress between 2010–2020*. Helsingin yliopisto. URN:NBN:fi:hulib-202112144226
- Lescrauwaet, L., Wagner, H., Yoon, C., & Shukla, S. (2022). Adaptive Legal Frameworks and Economic Dynamics in Emerging Tech-nologies: Navigating the Intersection for Responsible Innovation. *Law and Economics*, 16(3), 202–220. <https://doi.org/10.35335/LAWECO.V16I3.61>
- Li, Y., Ba, Y., Ng, C. T., Wu, J., Yuan, W., & Li, J. (2023). A principal-agent model for hazmat transportation in China with risk perception and regulatory policy. *International Journal of Shipping and Transport Logistics*, 17(1–2), 1–20. <https://doi.org/10.1504/IJSTL.2023.132646>
- Lin, S., & Zhang, Z. (2023). *Principal-Agent Problem with Third Party: Information Design from Social Planner's Perspective*. <https://arxiv.org/pdf/2311.16959>
- MacLean, D., & Titah, R. (2022). A Systematic Literature Review of Empirical Research on the Impacts of e-Government: A Public Value Perspective. *Public Administration Review*, 82(1), 23–38. <https://doi.org/10.1111/PUAR.13413;JOURNAL:JOURNAL:15406210;ISSUE:ISSUE:DOI>
- Majumdar, A., Sinha, S. K., & Govindan, K. (2021). Prioritising risk mitigation strategies for environmentally sustainable clothing supply chains: Insights from selected organisational theories. *Sustainable Production and Consumption*, 28, 543–555. <https://doi.org/10.1016/J.SPC.2021.06.021>

- Maritime helicopter project - Canada.ca.* (n.d.). Retrieved January 5, 2026, from <https://www.canada.ca/en/public-services-procurement/services/acquisitions/defence-marine/air/maritime-helicopter-project.html>
- Mazzucato, M., & Ryan-Collins, J. (2022). Putting value creation back into “public value”: from market-fixing to market-shaping. *Journal of Economic Policy Reform*, 25(4), 345–360. <https://doi.org/10.1080/17487870.2022.2053537>;CTYPE:STRING:JOURNAL
- Mehedi, M., Emon, H., & Khan, T. (2023). The Impact of Cultural Norms on Sustainable Entrepreneurship Practices in SMEs of Bangladesh. *Indonesian Journal of Innovation and Applied Sciences (IJIAS)*, 3(3), 201–209. <https://doi.org/10.47540/IJIAS.V3I3.962>
- Mekh, Y., Georgiievskiy, I., Ignatchenko, I., Maslova, I., & Kostenko, I. (2022). Public-Private Partnership in the Security Sector: Updating in the Conditions of Counteracting the COVID-19 and Armed Aggression in Eastern Ukraine. *Revista de La Universidad Del Zulia, ISSN-e 2665-0428, ISSN 0041-8811, Vol. 13, No. 37, 2022 (Ejemplar Dedicado a: Revista de La Universidad Del Zulia, Vol. 13, Núm. 37, Mayo-Agosto 2022), Págs. 347-361, 13(37), 347–361.* <https://doi.org/10.46925//rdluz.37.22>
- Okromtchedlishvili, I. (2022). Using Data Envelopment Analysis (DEA) for measuring efficiency in the Defense Sector. *Studies Original Research*, 3, 83–100. <https://doi.org/10.37868/dss.v3.id199>
- Ozturk, O. (2020). Bibliometric review of resource dependence theory literature: an overview. *Management Review Quarterly 2020 71:3*, 71(3), 525–552. <https://doi.org/10.1007/S11301-020-00192-8>
- Pena, V., Slusarczuk, M. M., Mandelbaum, J., Tucker, M. A., Goldman, A. R., Grumbling, E. R., & Thrift, E. (2021). *Lessons Learned from Public-Private Partnerships (PPPs) and Options to Establish a New Microelectronics PPP.*
- Prihantoro, K., Suhirwan, Santosa, A. I., Pramono, B., Saputro, G. E., Rianto, Prakoso, L. Y., Prihantoro, K., Suhirwan, Santosa, A. I., Pramono, B., Saputro, G. E., Rianto, & Prakoso, L. Y. (2021). Tourism Village Government Program, Characterized By State Defense as the Economic Foundation of National Defense. *International Journal of Research and Innovation in Social Science*, 5(5), 197–201. <https://EconPapers.repec.org/RePEc:bcp:journl:v:5:y:2021:i:5:p:197-201>
- Rausser, G., Choi, E., & Bayen, A. (2023). Public–private partnerships in fostering outer space innovations. *Proceedings of the National Academy of Sciences of the United States of America*, 120(43), e2222013120. <https://doi.org/10.1073/PNAS.2222013120;WGROU:STRING:PUBLICATION>

- Report to Congressional Committees DEFENSE ACQUISITIONS Decisions Needed to Shape Army's Combat Systems for the Future.* (2009).
- Risman, H., Andayani, L., Timur, F. G. C., & Akmalina, A. (2025). Educating Bela Negara as Strengthening Element in Indonesia's Strategy of Main Island Defense Implementation. *International Journal of Demos (IJD)*, 7(1).
<https://doi.org/10.37950/IJD.V7I1.530>
- Riyadi, F. A., & Dewi, I. M. (2022). The Role of Defense Diplomacy for The Development of The Indonesian Defense Industry. *Jurnal Ekonomi, Bisnis & Entrepreneurship*, 16(1), 80–91. <https://doi.org/10.55208/6NYV7113>
- Sawmar, A. A., & Mohammed, M. O. (2021). Enhancing zakat compliance through good governance: a conceptual framework. *ISRA International Journal of Islamic Finance*, 13(1), 136–154. <https://doi.org/10.1108/IJIF-10-2018-0116>
- SIPRI Yearbook 2025 | SIPRI.* (n.d.). Retrieved January 5, 2026, from <https://www.sipri.org/yearbook/2025>
- Skålén, P. (2022). Public services and service innovation: A practice theory view. *Nordic Journal of Innovation in the Public Sector*, 1(1), 20–34.
<https://doi.org/10.18261/NJIPS.1.1.2>
- Skynet 5 Satellite Communication Technology Overview.* (n.d.). Retrieved January 5, 2026, from <https://www.defenseadvancement.com/resources/skynet-5/>
- Soroka, L., Danylenko, A., Sokiran, M., Levchenko, D., & Zubko, O. (2023a). Public-private collaboration for national security: challenges and opportunities. *Amazonia Investiga*, 12(70), 43–50. <https://doi.org/10.34069/AI/2023.70.10.4>
- Soroka, L., Danylenko, A., Sokiran, M., Levchenko, D., & Zubko, O. (2023b). Public-private collaboration for national security: challenges and opportunities. *Revista Amazonia Investiga*, 12(70), 43–50. <https://doi.org/10.34069/ai/2023.70.10.4>
- Stranieri, S., Varacca, A., Casati, M., Capri, E., & Soregaroli, C. (2022). Adopting environmentally-friendly certifications: transaction cost and capabilities perspectives within the Italian wine supply chain. *Supply Chain Management: An International Journal*, 27(7), 33–48. <https://doi.org/10.1108/SCM-12-2020-0598>
- Sturman, T. A., Bowyer, M. D. J., & Petfield, N. R. (2007). Skynet 5: MILSATCOM using SDR. *Proceedings - IEEE Military Communications Conference MILCOM*.
<https://doi.org/10.1109/MILCOM.2007.4455096>
- Taeihagh, A. (2021). Governance of artificial intelligence. *Policy and Society*, 40(2), 137–157. <https://doi.org/10.1080/14494035.2021.1928377>

- Tiger Meet debut of the F-35 Lightning II - ProQuest.* (n.d.). Retrieved January 5, 2026, from <https://www.proquest.com/openview/4a6e7a7900ce18532ae6a8fa8969b3c8/1?cbl=2028820&pq-origsite=gscholar>
- Triwahyono, B., Rahayu, T., & Kraugusteeliana, K. (2023). Analysing the Role of Technological Innovation in Improving the Operational Efficiency of MSMEs. *Jurnal Minfo Polgan*, 12(1), 1417–1426. <https://doi.org/10.33395/JMP.V12I1.12791>
- Zahn, B. R. (2000). *The Future Combat System: Minimizing Risk While Maximizing Capability*. <https://doi.org/10.21236/ADA574181>
- Zeng, M., Wu, Y., Xing, X., Tang, W., & Xu, H. (2024). Coordinating principal–agent and incentive strategy of cold chain logistics service in fresh food supply chain. *PLOS ONE*, 19(10), e0306976. <https://doi.org/10.1371/JOURNAL.PONE.0306976>