

## **Optimising Offset Defence Implementation as Fulfilment Efforts in Fighters Aircraft Materials and Technology**

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### **Abstract**

*This research aims to investigate the implementation of defense offset as a strategy to address the gap in the supply of materials and technology for fighter aircraft among countries. In this context, the gap arises due to the complexity and high costs associated with fighter aircraft development. Many countries, particularly those with limited technological and manufacturing capabilities, face challenges in acquiring and developing advanced aircraft. This gap negatively impacts their defense capability enhancement efforts. Therefore, the concept of defense offset emerges as a potential solution. Defense offset is a strategy in which foreign aircraft manufacturers provide compensation in the form of technology transfer, investment in the local defense industry, or research and development collaboration to the purchasing country. Through steps such as identifying material and technological needs, planning clear offset agreements, transferring relevant technology, developing the local industry, supplying materials, research and development collaboration, as well as monitoring and evaluation, the implementation of defense offset can be optimized. This research employs a qualitative method with a descriptive approach, involving a literature study to gain in-depth information about defense offset implementation and its impact on the material and technology gap in fighter aircraft. The results include the identification of factors influencing the success of defense offset implementation, political, economic, and strategic implications, as well as the benefits obtained by purchasing countries. In conclusion, through the optimization of defense offset, purchasing countries can reduce the gap in materials and technology for fighter aircraft, enhance domestic defense industry, and strengthen national defense capabilities. With the right strategy, defense offset can be an effective tool in addressing the gap in fighter aircraft material and technology, thereby fortifying national defense.*

**Keywords:** *Defence Offset, Combat Aircraft, Material Optimization, Technology Gap, Defence Industry.*

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## **INTRODUCTION**

In the contemporary age, the importance of weaponry and its associated technology has grown significantly when it comes to safeguarding national security (Jarmon, 2014). Within the realm of defence, one of the critical components is the air force, and a fundamental element in achieving air superiority and projecting military power is fighter aircraft. Nevertheless, the advancement of fighter aircraft often entails intricate and costly technology and materials. Many nations, particularly those with limited technological and manufacturing capabilities, encounter challenges when it comes to acquiring and developing advanced aircraft (James etc, 2020). This technology and material disparity has had a negative impact on countries striving to enhance their defence capabilities. As a result, the concept of defence offset emerges as a potential solution to address this issue.

Defence offset is a strategy whereby foreign aircraft manufacturers providing aircraft to a nation are obligated to meet additional conditions aimed at generating economic and technological advantages or establishing industrial collaborations with the recipient country (Santos, Agua & Frias, 2023). Employing defence offset can help mitigate the material and technological disparity, as follows technology transfer, foreign aircraft manufacturers have the capability to share their relevant knowledge and technology with the recipient nation. This

includes manufacturing process, aircraft and electronic system design, and other essentials elements. Therefore, the recipient country may obtain the knowledge and skills required to develop its aircraft production and technological capabilities.

Defence offset is also able to encourage aircraft manufacturers to invest in the defence industry of the recipient country (Matthews & Anicetti, 2021). This includes the construction of production facilities, research, and development centres, as well as local workforce training. This investment will support the recipient country in strengthening its defence industry capabilities and developing its own research and innovation capabilities. Defence offset often involves partnerships between foreign aircraft manufacturers and local companies in the recipient country. This can encompass the production of aircraft components, system integration, or the development of other air defence systems. This particular partnership allows greater knowledge and technology transfer while creating business opportunities and long-term cooperation. This research aims to examine the implementation of defence offset as a tool to reduce the gap in materials and technology in fighter aircraft. Through the analysis of relevant case studies and related literature, this research evaluates the effectiveness and challenges in implementing defence offset in the context of defence aircraft development. The following table outlines countries implementing defence offset in the development of defence aircrafts:

Table 1. List of countries using defence offset strategies in fighter aircraft development.

Country	Offset Defence Strategy
USA	Requires defence fighter aircraft manufacturers to invest in the domestic defence industry and transfer technology.
France	Requires defence aircraft manufacturers to provide opportunities for employment, training, and technology transfer to the French defence industry.
Brazil	Requires defence aircraft manufacturers to provide technology transfer and invest in the defence industry.

By carefully leveraging defence offset, the recipient country can reduce the gap in materials and technology for their fighter aircraft (Balakrishnan, 2018). This will assist them in gaining access to advanced fighter aircraft, developing a strong defence industry, and enhancing their national defence capabilities. With appropriate strategy, defence offset may become an effective tool in reducing the gap in aircraft material and technology as well as strengthening national defence.

## RESEARCH METHODS

The purpose of this research is to investigate how the implementation of defense offset can be used as a strategy to address the gap in the supply of materials and technology for fighter aircraft between countries. The implementation of defense offset refers to the practice in which foreign aircraft or defense equipment manufacturers provide compensation or contributions in the form of technology transfer, investment in the local defense industry, or research and development collaboration to the purchasing country.

In order to achieve these objectives, this research will use a qualitative method with a descriptive approach. This approach will involve a literature study to gather relevant and in-depth information about the implementation of defense offset and its impact on the material and technology gap in fighter aircraft. Through the analysis of literature studies, it is expected that

this research can provide a more comprehensive insight into the effectiveness of defense offset implementation as a strategic solution. The objectives of this research can be detailed as follows:

- 1) Analyse the effectiveness and success of defence offset implementation in reducing the gap in the supply of the material and technological requirements in fighter aircraft development.
- 2) Identify the factors influencing the success of defence offset implementation.
- 3) Investigate political, economic, and strategic implications of defence offset in the context of fighter aircraft development.
- 4) Explain the benefits from defence offset obtained by purchasing countries.
- 5) Formulate policy recommendations for countries looking to leverage defence offset to narrow the material and technology gap in their fighter aircraft.

In this journal, it is expected that there will be a thorough analysis of defence offset practices and their impact towards the development of fighter aircrafts, as well as discussions on the potential benefits and challenges associated with the implementation of this strategy.

## **RESULT AND DISCUSSION**

### **Theoretical Framework**

Defence offset is a mechanism whereby a country purchasing weapon systems or defence technologies also expects technology transfer and domestic investment (Smith, 2022). This can be mean that the selling countries must commit to transferring on technologies, investing in domestic defence industry, or providing other benefits to the purchasing country. Defence offset is often used as a strategy to reduce a nation's reliance on imports and enhance the capabilities of local defence industry.

The gap in material and technology of fighter aircraft development refers to the inequality or disparity in the technological capabilities and resources held by countries in terms of fighter aircraft development and production (Mahajan, Mehta & Garg, 2023). Some countries may have limited access to the required raw material or cutting-edge technology needed to manufacture advanced fighter aircraft. This could result in a military power imbalance among these nations. In the context of defence offset implementation to reduce the gap in materials and technology for fighter aircraft, some relevant theories may include:

#### 1) Exchange Theory

In this context involves negotiations and agreements between the purchasing country and the selling country of defence systems. The exchange principal captures awarding a purchase contract to a foreign manufacturer with the condition that the purchasing country will also receive benefits in the form of technology transfer and domestic investment.

#### 2) Dependency Theory

This theory demonstrates that countries relying on imports of weapons or defence technology from other nations have a higher level of dependence on those supplying countries. In this context, the implementation of defence offset can be a strategy to reduce such dependency and develop domestic defence industry's capabilities.

#### 3) Partnership Theory

The implementation of defence offset can be considered as a form of partnership between selling and purchasing countries. Partnership theory involves long-term cooperation between nations in addressing common challenges and achieving mutual benefits (Horan, 2019). In this case, the purchasing country will unsure to leverage defence offset agreements to strengthen the material and technology capabilities of their fighter aircraft, while the selling country gains access to a broader defence market.

## **Issue Analysis**

The issue analysis in this journal will involve evaluating specific aspects that need to be considered in the context of using defence offset to reduce the gap in the supply of materials and technology for fighter aircraft. The following issues are observed in this context:

- 1) **Limited Access to Advanced Technology:** Countries with lower defence industry capabilities may encounter difficulties in accessing advanced technology required for the development of materials and technology for fighter aircraft (Darby & Sewall, 2021). This access gap can pose a barrier to leveraging defence offset as a tool to reduce this disparity.
- 2) **Complexity of Technology Transfer:** The implementation of defence offset programs involving technology transfer from fighter aircraft manufacturers may develop into a complex and challenging process (Bezuidenhout, 2022). This disparity in technical expertise, export control policies, and regulations may deter effective technology transfer. This can slow down progress in reducing the material and technology gap in fighter aircraft.
- 3) **Discrepancies in Resources Availability:** Countries with limited resources, whether financial or infrastructure, may face limitations in optimising the use of defence offset implementation (Situmeang, Suyudi & Susilo, 2020). Hence, the investments required to develop superior materials and technology for fighter aircraft can be unaffordable for countries with resource limitations.
- 4) **Dependency on Third Parties:** Countries dependent on third parties in carrying out the defence offset program may face the risk of dependency (Brauner & Dunne, 2004). Whereby difficulties faced by third parties such as changes in policies or organisational failures could directly affect purchasing countries in meeting their aircraft material and technological needs.
- 5) **Legal and Regulatory Constraints:** Legal and regulatory differences between purchasing countries and fighter aircraft manufacturers could be obstacles the implementation of defence offset programs (Udis & Maskus, 1991). These differences can impact technology transfer, ownership of intellectual property, and collaboration of the aircraft material and technology.

The issue analysis in this journal will provide a more comprehensive understanding of the issues and challenges related to the implementation of defence offset in reduce the gap in fighter aircraft material and technology.

## **Solutions and Measures**

Based on the issue analysis presented, there are several efforts for resolution that can be considered in the context of defence offset implementation as a tool to reduce the gap in materials and technology for fighter aircraft. some proposed solutions and actions for consideration include evaluation of technology transfer quality, negotiation to ensure fair exchange, multilateral partnerships, increase investment in domestic defence r&d, and security and confidentiality maintenance.

It is important to conduct a thorough evaluation of the quality of technology transfer facilitated through defence offset agreement (Coadour etc, 2019). This includes monitoring and assessing of the technology shared, the level of expertise provided, and its impact towards domestic defence industry capabilities. If deficiencies in the technology transfer are identified, corrective measures must be taken such as improvement in improved training quality, technical observation, or contract amendment. In a defence offset agreement, purchasing country should strive to ensure a fair equitable exchange (technology, material, skills, etc). This can be carried out through clear identification of expected benefits such as specific technology transfers or enhancements to specific industrial capabilities, and ensuring that the offset agreement value are

equivalent to the value of the purchase contract provided to foreign manufacturers. A fair equitable exchange should be a focal point in defence offset negotiation (Brown & Zartman, 2019). Multilateral partnerships can be an effective solution in the efforts to reduce gap in material and technological for fighter aircraft development. Purchasing countries can collaborate with other countries that possess advanced defence technologies and industry capabilities. This includes collaboration in research and development, expertise exchange, and broader technology transfer. Multilateral cooperation can help reduce dependence on a single supplier.

To address the gap in material and technological capabilities of fighter aircraft development, purchasing countries shall increase investments in research and development (R&D) as well as strengthen their domestic defence industry (Cheung etc, 2019). This can be achieved by allocating adequate R&D budget and providing incentives to the private sector to participate in the development of defence technology. Increased investment in the domestic defence sector will enhance the country's capabilities and self-reliance in fighter aircrafts materials and technology (Markowski, Bourke & Wylie, 2019). In a defence offset agreement, it is crucial to consider relevant security and confidentiality issues. National security concerns may arise from selling countries about the technology transfer interests. Therefore, a strong partnership and adequate framework must be developed to address issues related to security and confidentiality, including enhanced oversight and control, or the establishment of bilateral committees to manage any technology exchange. Countries like these that have reduced the gap in their fighter aircraft materials and technology:

- 1) Türkiye: Türkiye has leveraged the defence offset program to improve the local defence industry and reduce dependence on foreign aircraft imports. Through the defence offset agreements with foreign aircraft manufacturers, Türkiye successfully transferred technology and built new generation fighter aircraft, namely TF-X, designed and produced domestically.
- 2) India: India has utilised the defence offset program to enhance fighter aircraft material and technology capabilities. For instance, in the contract for purchasing Rafale fighter aircrafts from France, India secured a defence offset agreement involving technology transfer and domestic defence industry investment. This aimed to strengthen the capabilities of fighter aircraft capabilities and foster domestic production capability.
- 3) Brazil: Brazil has adopted defence offset strategy to reduce the material and technological gap in fighter aircraft development. For example, in cooperation with Sweden for the purchase of Gripen fighter aircraft, Brazil successfully obtained defence offset deal which involves technology transfer, improvement of industrial capabilities, and participation by Swedish manufacturers to produce aircrafts locally.
- 4) Saudi Arabia: Saudi Arabia has also utilised defence offset as a tool to reduce the gap in fighter aircraft materials and technology. When acquiring Typhoon fighter aircraft from the UK, Saudi Arabia secured a defence offset agreement involving technology transfer and investment in the defence industry. This aimed to build domestic defence industry capabilities and reduce dependence on imports.

The implementation of these resolution efforts should be carried out holistically and contextually according to the needs and situations of each country. It is important to involve relevant stakeholders such as government agencies, defence industries, and academics in formulating and executing effective defence offset utilization strategies to reduce the gap in fighter aircraft materials and technology.

## CONCLUSION

The issue analysis above has identified some relevant issues in the context of utilizing defence offset to reduce the gap in the materials and technology in fighter aircraft development. The identified issues include the effectiveness of technology transfer, fair equality exchange, limitations in technological access, sustainability and capabilities of the domestic defence industry, as well as security and confidentiality. Based on the analysis of the identified issues, the following recommendations have to consider in the context of utilizing defence offset as a tool to reduce the material and technological gap in fighter aircraft development:

- 1) Conduct in-depth evaluation on the quality of technology transfer facilitated through defence offset agreements. This involves monitoring and assessing the transferred technology, the level of expertise provided, and its impact on enhancing domestic defence industry capabilities.
- 2) Ensuring fair equitable exchange in defence offset agreement negotiations. The purchasing country should ensure that the benefits obtained are proportionate to the value of the purchase contract provided to foreign manufacturer.
- 3) Expansion of multilateral agreement with countries that possess advanced defence technology and industrial capabilities. This can involve active collaboration in research and development, skills exchange, and a broader technology transfer.
- 4) Increase investment in domestic defence R&D and industry. The purchasing country should allocate adequate R&D budget as well as provide better incentives for the private sector to participate in the development of local defence technology.
- 5) Address relevant security and confidentiality issues in defence offset agreements. It is important to establish strong partnerships and develop adequate frameworks to address these issues, such as enhanced oversight and control.

The implementation of above recommendations must consider the context and requirements of each country and involve the relevant stakeholders, particularly in the formulation and implementation of defence offset strategies in minimising the material and technological gap in fighter aircraft development

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