

A Global Analysis of the Role of Offsets in Aerospace Industry

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Abstract

There has been an exponential increase in the number of countries that have adopted offset policies as a means to develop a capable, ready and cost-effective aerospace industry. Offset transactions generate billions of dollars annually, prompting aerospace companies to increase their compliance systems and economic models (Jurgen and Paul, 2004). This purchasing and sales arrangement is used by numerous governments around the world to negotiate high-tech public procurement contracts and has also been adopted by most private organizations. This research noted that for private businesses, offsets are instrumental in establishing global development capabilities and access to emerging markets. For buyers, especially in emerging countries, offsets are a way to accelerate industry and businesses development. The main purpose of this study is to critically analyze the role of offsets and offset management within the aerospace industry. The study conducted thirteen (13) interviews with Offset Managers from most of the prominent firms in the prime contractor and supplier ranks. The key findings of this study indicate that prime contractors view offsets as a major issue for their firms but the majority of supplier companies do not have this view. Results show that offsets organizational structures follow a decentralized, narrow, and functional focus. Offset satisfying activities are well aligned to achieve the goals of the foreign governments that procure aerospace products. The study pointed out that suppliers are not fully engaged in the aerospace industry offset process. It also identified opportunities for improving offset practices in the aerospace industry. The study enhances insight into understanding buyer and seller alignment on the business and strategy; a long-term approach to the relationship; good communication and transparency; and having a single government agency responsible for offsets in order to avoid confusion, corrupt practices, and conflicting demands.

Keywords: Aerospace, offset, direct offset, indirect offset, prime contractor, supplier, tier.

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INTRODUCTION

Aerospace is one of the major industries in the world economy. The issues that affect this industry often draw a wide range of attention from various quarters around the globe. Customers in large-scale international aerospace sales may insist that the aerospace system seller provide the buyer's country with certain kinds of industrial benefits as a condition of sale. Commitments to provide these compensatory industrial benefits known as offsets are often a condition of sale. Offset in the aerospace industry is a topic that has become highly controversial. An offset agreement is a contract between a purchasing government or entity and a foreign supplier. As a condition for the sale of goods or services (the "base good"), the foreign firm is required to provide additional economic benefits beyond the base transaction to the purchasing government's economy [1, 2]. The additional economic benefits can take the form of countertrade, industrial compensation packages, investment, technology transfer, subcontracting, and so

forth. In essence, offset arrangements facilitate a degree of reciprocity in the purchase and sale transaction.

In view of globalization and the increasing pace of international trade, emerging and developing market governments are in a strong position to develop their domestic aerospace industries. As most industrialized countries have embarked on austerity measures such as cutting on military budgets, most emerging economies are investing heavily in the aerospace industry. As a consequence, emerging markets can now leverage their aerospace spending to fulfill national goals for in-country aerospace capabilities and general socio-economic development. These are important goals within economies because domestic aerospace industries bestow important developmental benefits such as high-quality products and services, high-tech jobs, effect of aerospace technologies on other economic sectors, national pride, and greater room for maneuver in security and foreign policy as a result of greater domestic industrial control.

Many countries around the world have adopted offset policies to develop a capable, ready, and cost-effective aerospace industry, create employment, and enhance economic growth. For example, BRICS countries (Brazil, Russia, India, China and South Africa) have no hesitation in implementing offset measures. However, there are still some barriers to investing in India. In China, industrial investment is only possible through the creation of jointly and equally-owned subsidiaries. Access to government procurement markets and services remain very limited with major partners who sign contracts in exchange for offsets only.

Aerospace industry is home to key skills and technologies as well as an important driver of innovation. Due to its role in transportation, communication, security and defense, the industry is regarded as a strategic industrial sector. Nevertheless, not many nations have managed to develop substantial aerospace industries. Global aerospace is concentrated in a few countries; however, it is perhaps one of the fastest globalizing industries in terms of both market structure and production system (Deloitte, 2016). Therefore, this research seeks to analyse the role of offsets within the broad aerospace industry.

Research objectives

The main purpose of this study was to conduct a critical review and analysis of the role of offsets in the growth and development of the aerospace industry.

- To explore the significance of offset arrangements within the aerospace industry.
- To critically analyze the approaches to managing offset transactions within the aerospace industry.
- To determine the fundamental benefits of offset transactions in economic transformation and development.
- To explore the key components of an effective offset agreement at institutional and national levels.

Significance of the Study

With the increasing pace of globalization, there is no doubt that the aerospace is one of the major industries in the world economy. Empirical literature shows that the challenges affecting the aerospace industry often draw a wide range of attention from various quarters around the globe. Reports indicate that the annual worldwide turnover of offset obligations is \$225 billion and it grew by 42% until 2016. This is a strong argument for examining the offset issue closer [3]. The study is also of importance to the academic field in as far as enhancing awareness of offset and offset management and the benefits of offset transactions in economic development of emerging and developing economies. There seems to be limited research in this field particularly within the aerospace industry, hence this research will be of significant academic value.

The peculiar nature of the aerospace industry necessitates the need for continuous research and government support. Examples of the industry's unique characteristics that facilitate the need for strong government support include its technology and capital-intensive nature, the complexity of production and the high risks involved in new product development.

LITERATURE REVIEW

Aerospace industry

The term aerospace refers to the industry that conducts research, designs, manufactures, operates, and maintains vehicles moving through air and space. Aerospace is a very diverse sector, with a multitude of commercial, industrial and military applications. This study adopts the definition of aerospace industry as "the research and development, design, manufacture, support, maintenance, conversion and upgrade of: rotary and fixed wing aircraft; satellites, satellite launch and tracking systems; air traffic control systems; unmanned aircraft; and weapons systems as well as their relevant subsystems and components" [4].

Aerospace Market Classification

The aerospace industry has been generally associated with national security and defense objectives, yet aerospace technologies have also been used for commercial purposes. The aerospace industry is divided into two main sectors: the military and the civil sector. The aerospace industry and marketplace are diverse and multi-dimensional spaces; hence they are by no means compartmentalized, and do not readily lend themselves to classification in well-defined segments.

The challenge of defining aerospace industry segments emanates from the fact that the market can be arbitrarily classified in numerous ways. The segments can be identified based the aircraft size; such as airliners, commuter transports, business jets, and general aviation airplanes. Alternatively, the market can be divided into two broad categories: civil products and military products, or by the technological nature of the products, such as avionics, propulsion systems, structural components, hydraulic systems, and flying vehicle. The aerospace market can also be segmented into products that operate within the earth's atmosphere.

The arbitrary system of classification has its weaknesses in that most delineation between the categories tends to be ambiguous, and that many products fit into several categories. Examples are that much equipment is used for space applications as well as conventional aerospace. Regardless of these limitations, it is evident that the aerospace industry and marketplace is divided into natural major segments. The firms in these segments shares common affinities, and governments and economic observers use the segments

as practical means of classifying firms and measuring market activity.

The US Department of Commerce (US DoC) uses Standard Industrial Classification (SIC) codes to categorize industrial activity of firms in the United States. The SIC codes are four-digit classifications that are sub-categories of three-digit industry groups of a broader nature.

The DoC considers most aerospace activity to fall with industry group 372: Aircraft and Parts, group 376: Guided Missiles & Space Vehicles and Parts. The specific SIC codes are shown in Table-1. Table-1 also shows the corresponding North American Industrial Classification System (NAICS) codes adopted by the US Office of Management and Budget.

Table-1: Aerospace classification codes : SIC and NAICS

SIC	Industry Segment	NAICS
3721	Aircraft	336411
3724	Aircraft Engines	336412
3728	Aircraft Parts	336413
3761	Guided Missiles & Space Vehicles	336414
3764	Space Vehicle Propulsion Units	336415
3769	Guided Missile & Space Vehicles Parts	336419

The broad categories shown in Table-1 are further refined in other systems of classification, notably by the aerospace industry itself. Table-3 shows the typical breakdown by major product categories and subcategories.

The classification in Table-3 includes engines, but does not include aerospace electronics, commonly called avionics, or other items of aerospace equipment such as landing gear, hydraulics, control systems, electrical systems, environmental control systems, and aircraft interiors. The value of these product-lines is a significant part of the overall aerospace market, and although firms sometimes classify them as member of other industries, such as the electronic industry. These product-lines also have a strong identity as part of aerospace market. The other classifications include aircraft maintenance, repair, and overhaul activities,

which are an important segment of the market in terms of transaction value and number of people employed.

As shown in Table-2, aerospace market segments are also described through stratifying the market into tiers. By using this classification in offset transactions, the prime contractor, who contracts to deliver the completed aerospace product to the final customer, is at the top of the hierarchy. The prime contractor is followed by subordinate tiers of suppliers that feed intermediate products into the manufacturing process. Procurement and selling activities occur at the transition from one tier to the next. The tiered structure is a widely recognized characteristic of the aerospace market. However, empirical literature indicates that the tiered structure is imprecise and of limited usefulness in terms of establishing meaningful identification of market segments.

Table-2: Contract Tiers

Contractual Tier	Characteristics
Prime Contractors	Design, develop and assemble complete systems
Major Subcontractors	Perform assembly or manufacture of major components of systems
Second Tier Subcontractors	Manufacture sub-assemblies
Third Tier Subcontractors	Manufacture components
Fourth Tier Subcontractors	Manufacture parts or perform specialized processes

Table-3: Aerospace Product Categories

Category	Products
Military Fixed-Wing Aircraft	Attack Bombers Cargo/Transport/Refueling Early Warning Electronic Warfare Fighters Observation Patrol/ASW Reconnaissance Research/Test Bed Training Utility
Commercial Fixed-Wing Aircraft	Narrow-body Turbofans Wide-body Turbofans Turboprops
Rotary-Wing Aircraft	Naval Scout/Attack Tiltrotor Training Transport Utility
Business & General Aviation Aircraft	Turbofan Turboprop Reciprocating Engine Powered
Gas-Turbine Engines	
Unmanned Aerial Vehicles & Drones	
Space/Launch Vehicles	Manned Systems Unmanned Systems
Missiles	Air-to-Air Air-to-Surface Anti-Armor Anti-Ballistic Anti-Ship Anti-Submarine Surface-to-Air Surface-to-Surface

The State of Global Aerospace

The aerospace industry is growing at an exponential rate. In 2015 the global aerospace industry achieved the size of US\$675 billion at an annual growth rate of 3.8% [3]. 75% of the sales corresponded to the defense segment of aerospace and the remaining 25% was civil aviation. The aerospace industry is concentrated geographically in the United States followed by the European Union (EU). USA and EU concentrate over 80% of the global turnover in aerospace: the US represents one-half while the EU accounts for approximately a third of the global turnover. The UK, France, Germany and Italy are the main European producers, while in Asia, Japan is the dominant player.

The US and EU dominance in global markets is mainly at the level of first-tier or primary contractor, while other countries have acquired relative competitive advantages as lower-tiers. For instance, the Japanese aerospace industry has managed to design and produce

its own aircraft; however, Japan has globally developed a role as high-tech subcontractor to foreign (essentially US) aerospace companies [5].

Opportunities in global aerospace markets will increase considerably for newly emerging economies in the coming years [5]. The opportunities are mainly driven by the civil aviation segment. Civil aviation relates to the exponential growth in infrastructure and transportation in certain Asian, African and Latin American regions. Few emerging economies, such as Taiwan, Indonesia, Brazil, China and South Africa, have managed to establish their own 'indigenous' aerospace industries, which are impacting on international markets. Aerospace activities in these countries are growing at unprecedented rates although their share of global turnover is still very small. Most emerging economies still suffer from severe limitations, such as lack of specific skills, design capabilities and maturity of supplier base to keep up with the rapid advances in aerospace products. Literature indicates the

tendency for emerging markets to move towards forming strategic alliances and performing as low-cost platforms to major players in the global industry.

Brazil produces regional aircraft (with approximately 10% of the world regional aircraft market) and is involved in a number of minor military aerospace co-operations. Indonesia also competes in the regional aircraft market. India is rapidly developing its capabilities in aerospace, and has been identified as low-cost sourcing destination for low-batch precision machined parts & assemblies [6].

Aerospace Opportunities for Emerging Economies

The dynamics in global aerospace production chains have large implications for emerging economies. Consolidation has raised entry barriers at top-tier levels, and the emergence of global outsourcing has provided increasing opportunities for lower cost sites in developing countries at the lower tier level. Emerging economies' companies are competing with suppliers at higher cost locations in more mature economies. For example, the industrial area of Nouaceur in Casablanca (Morocco), is totally dedicated to aeronautical subcontracting activities for major international groups.

Researchers have pointed out the challenges for developing countries to sustain a competitive position in this technology-intensive and global industry. Major limitations are generally related to the questioned ability of developing and emerging countries to maintain the rapid sophistication of skills and capabilities necessary to serve international demands [7]. However, opportunities and threats in developing regions do not only come from the industrialized regions, but also from the developing countries themselves. Foreign Investment and Industrial Cooperation Programs (Offset Programs) are widely used globally to assist countries in developing their economic base and to increase export potential.

Industrial Offsets

The Origins of Offset

After the Second World War, the U.S. assisted Western Europe financially and materially at no cost to protect them from the threat of Communism. However, the U.S. government put pressure on each country to buy weapons to recover a balance of payments deficit. This was the origin of offsets. The offset process was then first used in Germany. In 1961, the U.S. government engaged Germany to buy U.S. weapons in exchange for U.S. troops in Germany to reduce a growing balance of payments deficit [8]. The U.S. government then changed its policy of providing military equipment to the UK, France, and Germany from free of charge to for-a-fee, while providing offsets to Western European countries to support reconstruction of NATO allies and to enhance national security by improving diplomatic and military ties with other countries.

Researchers indicate that after 1960, Western European countries accumulated aviation defense technology by using cooperative development and component manufacturing offsets during aircraft procurement from the U.S. For European countries, offsets were an additional practice condition for dealing with the U.S., but that practice became a prerequisite because most countries required some benefit in return.

From 1976 to 1980, several disadvantages arose from co-production, and most European countries required offsets to develop their own weapons system. The U.S. government faced several requirements from customers, and it realized the necessity of technology protection; hence there was a change in the weapons purchase system. The U.S. government gave positive aid to Europe to participate in the development of weapons and license production. The Soviet Union did as well with its allies. At the time, offsets were focused on research and development (R&D), technology transfer, buy-back, and cooperative development between the U.S. and Europe.

After 1980, most developing countries proposed offsets as a compulsory condition to build their defense industry. Moreover, the worldwide economic recession made suppliers allow a greater number of offsets and offsets became a common economic matter. European countries started joining with suppliers based on acquired technology by license production and co-production. Industrial-based countries manufactured weapons systems to sell using a broker country, which acted like a black market. The increase of the supplier-made weapons market became fiercely competitive, and there was a greater tendency of using offsets in bargaining. Most countries adopted offsets as a way of saving foreign currency, improving export, and transferring high-technology products. It became a standard practice in the international weapons market.

Since the Gulf War, however, sellers have begun reinforcing regulations as a national policy and law to protect their defense technology. The buyer's need for technology transfer for self-defense started increasing. Today, offset is a considerably more complicated and delicate way of trade, which presents difficulties for sellers and buyers.

Definition of Offsets

Experts have defined the concept of offsets academically, because the offsets model has been studied and developed over the five decades. "An offset occurs when the supplier places work to an agreed value with firms in the buying country, over and above what it would have bought in the absence of the offsets" [9].

In consideration of the legal aspect, an offset is a contract imposing performance conditions on the

seller of a good or service so that the purchasing government can recoup, or offset, some of its investment. In most offset transactions, reciprocity beyond that associated with the normal market exchange of goods and services is involved. Stephen [10] asserts, "Offsets, coproduction, barter, and countertrade are compensatory trade agreements - agreements that incorporate some method of reducing the amount of foreign exchange needed to buy an aerospace item or some means of creating revenue to help pay for it".

Categories of Offsets

There are different forms of offset arrangements, dictated primarily by the industrial policy needs of the buyer country and the imagination of the parties to each transaction. The two principal categories of offset arrangements are direct and indirect offsets. Direct offsets are arrangements in which the benefit provided to the buyer country is directly related to the aerospace system sold in the underlying transaction. For example, in a sale of military aircraft, the seller might be required to assemble part of the aircraft structure in the buyer country instead of in the prime contractor's facility. Indirect offsets involve activities unrelated to the system sold in the underlying transaction. An indirect offset arrangement might require the vendor to purchase office furniture from a company within the buyer country. This would be termed an indirect offset because, even though office furniture is in no way related to aircraft, the furniture sale is nonetheless a component of the underlying aircraft transaction.

Sub-Categories of Offset Arrangements

The US Government Accountability Office (GAO), one of the several US government institutions that have studied the impact of aerospace offset practices on the American economy, has identified a number of sub-categories of offset arrangements.

Co-production and Subcontracting

In the co-production arrangements studied by GAO, US vendor contracted with one or more companies in the buyer country to assemble, build, or produce articles related to the underlying sale. In the subcontracting arrangements, US vendor agreed to buy goods or services related to the underlying sale from suppliers in the buyer country. Co-production and subcontracting offsets appear in 20% of the transactions reviewed by GAO. An example of co-production offset program was the 1991 Korean Fighter Program, in which the Government of South Korea and General Dynamics concluded a \$5.2 billion transactions involving the purchase of F-16 fighter aircraft. The parties structured the deal so that the South Korean government purchased 12 of the aircrafts off-the-shelf and bought 36 in the form of aircraft kits to be assembled in South Korea. In addition, South Korea obtained the right to manufacture an additional 72 F-16s under license [9].

Other procurement

In this type of indirect offset arrangement, the prime contractor agrees to purchase goods and services unrelated to the aerospace item sold. According to GAO, this form of offset was present in 9% of the transactions reviewed. An example of procurement involving indirect offset was Lockheed Martin's agreement, as part of its sale of C-130 aircraft to Canada, to purchase assemblies and avionics from Canadian industry for Lockheed's C-5 transport plane.

Technology Transfer

This involves the vendor transferring technology, technical assistance, or training to the buyer country. The technology is in some cases unrelated to the underlying aerospace transaction. In GAO's review, this form of offset appeared in 48% of transactions studied. An example was Lockheed's agreement, as part of its sale of F-16 fighter aircraft to South Korea, to transfer manufacturing and assembly expertise, enabling South Korea to assemble from kits and manufacture many of the aircraft sold as part of the deal.

Marketing Assistance

Aerospace contractors help foreign companies market their products overseas. The basis of this type of offset arrangement is that the firm with the offset obligation has greater marketing expertise access than the foreign firm that benefits from the agreement. Such offsets were present 23% of the transactions reviewed by GAO. An example was Donnell Douglas' agreement, as part of its \$3 billion sale of F/A-18 fighters to Finland, to provide international marketing assistance for the REDIGO training aircraft produced by the Finnish company Valmet Aviation, Inc.

Financial Assistance/Investment/Joint Venture

In this form of offset arrangement, contractors took equity positions, provided start-up financing, or provided other services to support a new or existing business entity in the buyer country. According to GAO, such offsets appeared in 13% of the transactions reviewed. An example was McDonnell Douglas Helicopter Company's initiative to enter into several joint ventures in the United Arab Emirates as part of its sale of Apache attack helicopters to UAE. The joint ventures, mostly unrelated to aerospace, developed products to clean up oil spills and recycle printer cartridges used in photocopiers and laser printers.

Offsets as a components of aerospace trade

The evaluation of a tender for an aerospace trade is normally balanced between different components: technical, commercial and offset components. The higher the value of a contract, the more important offset becomes in the tendering process [2]. Furthermore, the high values of aerospace trades are nearly always dependent on a business network and surrounded by a political sphere (see figure-1).

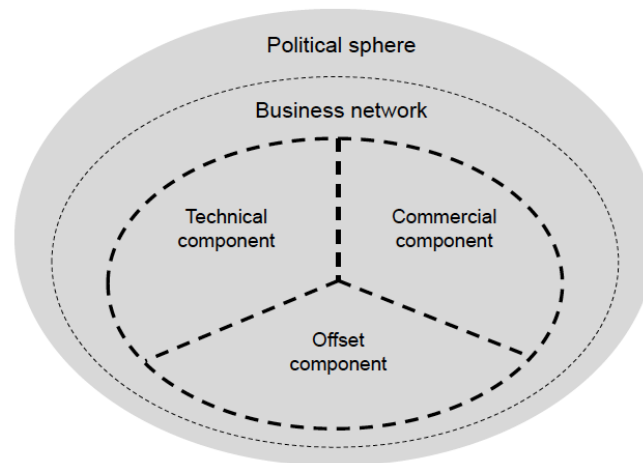


Fig-1: Offset as a component in an aerospace trade

There are different ways of considering offset in the tender process. One is to utilize offset as an award criterion, that is, offset stands as one of the parameters in the bid. Offset is normally measured against price and performance in terms of economic advantage. Another way to consider offset is as a condition for participation, in that either failing to include or fulfilling certain criteria with the offset bid can disqualify the bid. Some countries accept offset without it being either of the two.

Offset Terms and Conditions

Three conditions distinguishing an offset agreement are a) purchasing government involvement, b) supplier reciprocity and c) preferential treatment. Purchasing government involvement means intervention through laws or public policy, as well as scrutiny of offset transactions during the approval processes. This includes a review of the offset arrangement to ensure that specific types of offsets are pursued, or that satisfactory arrangements are made to cover instances of non-fulfillment (e.g., payment of liquidated damages).

Supplier reciprocity refers to the requirements of the purchasing government that obliges the supplier to contractually provide some form of additional, secondary compensation as a prerequisite to the primary contract award. This reciprocity may be either an explicit statement or implicit understanding by a purchasing government that a contract award for goods or services will be based upon cost, schedule and performance as well as additional factors unrelated to the goods or services that the seller must provide as a condition of sale.

Preferential treatment refers to the privilege of the supplier as a result of agreement to provide reciprocal compensation. Preferential treatment may appear in a variety of forms such as decreased tariffs, lower taxes, or favorable financing [11].

From a contractual side, two other general concepts underlie offset agreements are identified as additionality or incrementality and casuality [12]. The concept of additionality or incrementality requires that for an offset activity to count as offset credit, the activity must be in addition to the activity that the offset obligor is already performing in the country. For example, if the offset obligor proposes to purchase \$16 million of printed circuit boards from Country A, it cannot count towards this \$16 million any purchases of printed circuit boards it had already been purchasing [13]. Casuality requires that for an offset activity to count as offset project, the project must have been one that came about because of the offset obligor's efforts. Thus, if a third-party approached an offset obligor with the opportunity to claim offset credit for establishing a plant in Country A (that the third party was already going to build there), the project could not count towards the offset obligation.

Reasons for Offsets

Countries have both economical and political motives for demanding and/or providing offsets. Results expected from offsets vary, depending mainly on the country's policies. Considering the majority of world economies are in the "offset receiving" group and about 60% of the world military spending belongs to developing countries, offset receiving nations are generally developing countries. Developed countries with established aerospace industries use offsets to channel work or technology to their domestic companies. Countries with newly industrialized economies are utilizing both military and commercial related offsets that involve the transfer of technology and know-how. Policymakers in the buying nations use offset agreements to address a variety of economic and political issues. The desired effects are generally identified as: labor market corrections, promotion of capital investment, support for strategic industries, adjustments for asymmetric information, reduction of risk and uncertainty, alternative sources of financing, and political support for strategic purchases.

The dynamic and complex nature of offsets as an industrial tool is an essential factor to be considered while analyzing the underlying motivations of offset. Reasons for offsets are continuously revised both by the developed and developing nations. Turkey is a developing country with an emerging defense industry. The initial goal in the mid 1980s was to compensate for foreign currency shortfalls occurring as a result of defense related procurements. The revised policy in 2007 considers offsets as a tool in order to meet Turkey's strategic goals. In a more detailed expression, offsets are used to enhance the use of domestic industry capabilities, increase the competitiveness of national defense industry through exports, and constitute technological cooperation, investment and R&D capabilities.

A Review of Offset Examples

Turkey

In Turkey, offsets are a means of obtaining revenues, increase exports, create employment, and skills and technology transfer and training. Turkey is a significant purchaser of aerospace equipment from Western firms and puts a stronger focus on military capability building. Sikorsky Aircraft signed a contract to supply 109 S-70 Black Hawk military utility helicopters to Turkey. The state-owned Turkish Aerospace Industries (TAI) will build the aircraft under license, modifying them to local specifications, and will name them the T-70. The total program is worth US\$3.5 billion. Sikorsky will provide over \$1 billion of training and maintenance work for TAI over 10 years, will expand its Alp Aviation joint venture (with Turkey's Alpata Group) dynamic components manufacturing facility, and will incorporate Turkey into its global supply chain [14].

Saudi Arabia

Saudi Arabia is highly dependent on petroleum. Approximately 95% of Saudi Arabia exports comes from petroleum, hence the bold oil exports strategy and flexible pricing approach [15]. There is an increased focus on trying to transform the economy and becoming less dependent on oil. Saudi Arabia does have a massive trade surplus; therefore, offset arrangements are not instruments for balance of trade. The emphasis is on projects that improve the skill level of the population and increase technological capabilities, enhance private sector business projects, mutually beneficial partnerships between Saudi and foreign companies, usually in the form of joint ventures.

Saudi Arabi seeks to promote direct offset mechanism rather than largely symbolic indirect offsets. Al-Sawary II was a programme for purchase of frigates from France for the Saudi Navy at a cost of \$3 billion, carrying an offset investment obligation of about 35%, in various fields including glass, precious metals, smart cards and agro industry. The ships were anti-air warfare

frigates based on the La Fayette class. Additionally, the contract included training, maintenance, spare parts and construction of shore based facilities. A number of high ventures lower in technology content but with more favorable long-term business prospects have been established. Cutting-edge technology is generally not shared due to national security concerns of the selling party. Technology that is mature or soon to be replaced can be shared. The Saudi offset program has therefore stressed transfer of medium commercial exploitable technology, rather than high technology. Saudi Arabia also focused on trying to manufacture components and sub-assembly lines of main systems under license.

United Arab Emirates

The United Arab Emirates (UAE) is growing its fledgling aerospace industries through state ownership and particularly Mubadala, and its subsidiary Strata, and Tawazun (all in Abu Dhabi). The offset policy set in 2010 focuses on technology transfer, employment of Emirati citizens, and a system of credits that values net profitability and export sales in favored fields such as advanced materials, precision manufacturing, and electronics. The UAE offsets program focuses on creating wealth generating opportunities for the private sector. The offset program was introduced in the late 1980 in a bid to modernize the UAE armed forces. Annual milestones have been introduced over a seven-year period.

RESEARCH METHODOLOGY

This research began by identifying individuals responsible for managing offsets within specific aerospace industry firms. Although their actual titles varied, they are all referred in this study as Offset Managers. This was accomplished using personal sources as well as acquiring contacts from the European Club for Countertrade & Offset (ECCO) and the Aerospace Industry Association (AIA). A list of contacts was developed in an attempt to cover a range of firms within the prime contractor and supplier segments of the industry.

A mixed research method approach has been used for this research to complement the deductive research approach of this study. Mixed method of research integrates both quantitative and qualitative research. In studying the role of offsets and how they have impacted the aerospace industry, the study used Offset Managers in aerospace companies as research subjects. The subjectivist approach seeks to obtain feedback through interviews; the perceptions of individual Offsets Managers and how they interpret events and challenges faced due to the practice of offsets.

This research adopted a purposive sampling since only Offsets Managers are the ones who can give reliable answers in examining the role of offsets in aerospace industry. Thirteen (13) interviews were

conducted with Offsets Managers from six prime contractors and seven suppliers during the first quarter of 2017.

This research used interviews where researchers were asked questions in line with the research objectives. The thirteen (13) interviews were used to develop an overall picture of the offsets practices. Furthermore, interviews were used as a tool to identify problem areas and to widen the understanding of offset arrangements.

In conducting this study, to avoid participant error, the respondents were interviewed during their less busy times by pre-booking the appointments with their secretaries. This flexibility provided respondents with the chance to be in a relaxed atmosphere and to share information more freely without any interruption.

DATA PRESENTATION, ANALYSIS & INTERPRETATION

Offsets take a central place in aerospace trade. Most foreign sales are accompanied by offset agreements. More than 78 countries around the world

practice offsets and outstanding offsets obligations run into billions of US dollars. Countries and organizations must enhance their capacity to deal with offsets in the changing environment. A set of questions were posed to the Offset Managers of the selected companies in an attempt to understand the following aspects of offset active within each company including a sense of their offset management practices:

- **Company profile:** questions about the company's size, products and customers.
- **Offset program:** importance of offset in the current business.
- **Offset management:** questions about approach to managing offsets and key benefits in economic development.
- **Offset implementation:** questions about the most critical aspect of offsets and the extent to which sub tier suppliers are engaged in offset activities.
- **Offset improvement:** questions about offset improvement proposal.

Figure 2-4 shows participants' response data concerning the importance of offset transactions for businesses within the aerospace industry.

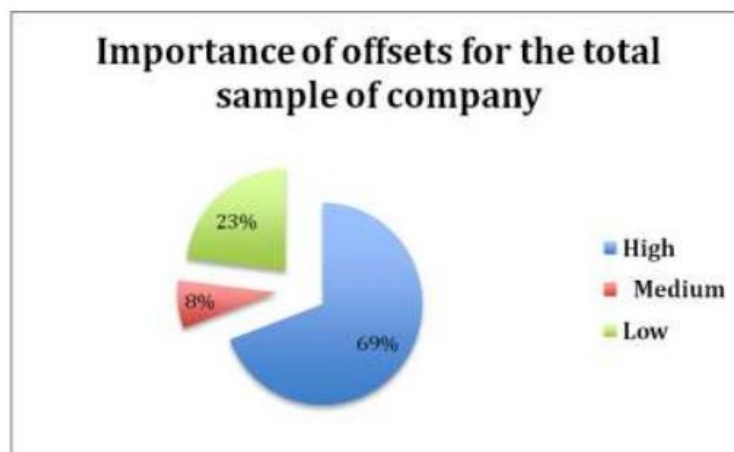


Fig-2: Importance of offset transaction within business
Source: research data collected by the authors

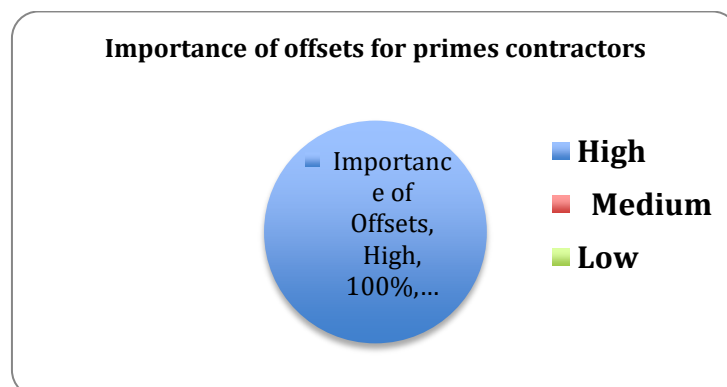


Fig-3: Importance of offset transaction for Prime contractors
Source: research data collected by the authors

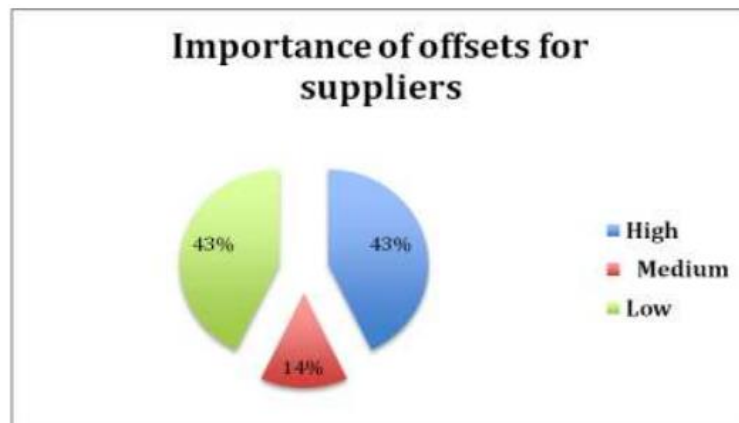


Fig-4: Importance of offset transaction for suppliers

Source: research data collected by the authors

The majority of Offset Managers (69%) viewed offsets as an important issue for their companies and for economies in general. 31% of Offset Managers interviewed, indicated that offsets are not a prominent issue for their companies. Results show that 100% of the prime contractor Offset Managers affirmed the importance of offsets, whilst, 57% of the suppliers regarded offset as of "medium" or "low priority."

All prime contractor Offset Managers were applying considerable resources to gain support from their suppliers. In all of the sampled companies, the actual offset credits gained through suppliers were minimal. This is a growing problem because the effort expended by prime contractors did not justify the benefits derived. Suppliers are expected by the prime contractors to accept some level of offset obligations on programs in which 'flow-down' purchase orders are awarded. Obligations that give rise to the offsets for prime contractors result from sales contracts with foreign governments.

Suppliers are engaged only through purchase orders with the prime contractors. When a prime contractor lands a contract with onset obligations attached, they attempt to negotiate a 'flow-down' of the offset requirements as part of the purchasing activity with their supply base. It is the flow-down requirement that engages the suppliers to establish offset activity in a given country, generally in supplied of a specific program that includes some content from the supply company.

This disparity is explained by managers in the supplier companies in several ways. Some supplier's

Offset Managers indicated that there is a lack of coordination on the part of the primes - especially those primes that are in the process of consolidation. A major by-product of consolidation is the period of confusion that trails a merger. One supplier manager stated that he would get numerous calls from different operating units of the same corporation requesting support for offset obligations sometimes in the same country. Coordination within a large (and growing larger) prime contractor company needs to include its supply base. The lack of coordination hinders the management and synergistic possibilities within the supplier companies, which most likely contributes to the suppliers' limited engagement in offsets. The supplier companies are seemingly unable to see the strategic benefit of onsets to the aerospace industry and their company. As consolidation continues, an emphasis on dealing with suppliers for offset will need to be addressed.

The other frequently mentioned reason referred to the lack of business volume for smaller companies from a program in a specific country. These companies just did not have enough business in a given country to justify a foray for offset activities alone (even if it meant displeasing a customer). In light of this situation, the suppliers thought the prime contractor' expectations were unreasonable. They expected the suppliers to satisfy large portions of offset obligation in proportion to the amount of business the suppliers would obtain from a program.

The management of offset within the company

Figure-5 depicts the data concerning the process of managing offset transactions.



Fig-5: Offset management organization (Total Sample)
Source: research data collected by the authors



Fig-6: Reporting lines of Authority (Prime contractors)
Source: research data collected by the authors



Fig-7: Reporting lines of Authority (Suppliers)
Source: research data collected by the authors

The statistics in the chart represents the percentage of companies that report to each function displayed. The most prevalent overall structure has the Offset Manager reporting to Program. However, suppliers are over represented in this "program focus". The implication of Figure-7 is that offsets are an outgrowth of a particular program in the supplier

company. This is a more narrowly focused view of offsets than found in the primes.

In program management, Offset Managers deal with offset obligations just like they deal with other program obligations. In a majority of program

support functions, a clear line of responsibility is established for each area.

Research participants indicated that manufacturing issues are handled by production management design efforts are coordinated through engineering management, and so on. However, offsets do not have a similar focal point. In these companies, offsets are not handled as a function but as an ad hoc activity. This makes the process of satisfying offset obligations a difficult one for the program oriented managers.

In other companies, Offset Managers reported to Contracts (15%), the Board of Directors (8%) or the procurement arm of the organization (8%). The relationship to Contracts reflects an integration of offset agreements into a majority of contracts with foreign-based governments and state-owned companies. This reporting line is more prominent in prime contractors than it is in the supplier companies. This reflects the emphasis placed on offset agreements in relation to the actual prime sales agreements.

The Board of Directors reporting relationship applies to two small companies wherein the CEO messages the limited offset responsible personally. This situation is no doubt driven by the size of the company, the infrequency of offset issues and, the potential exposure associated with offsets. In these small companies, with limited resources, the CEO's probably get involved to monitor and control any commitments made.

The linking of procurement with Offset Managers is more prevalent in primes than suppliers. The companies employing this organizational relationship tighten the companies supply base to offset obligations. Most Offset Managers interviewed involved their supply base in the quest for offset satisfying activities. The companies that formalized this involvement said they had a high utilization of suppliers in offset activity.

The other organizational question focused on the extent of centralization or decentralization of offset management approaches. The results are as presented in Figures 8-10.



Fig-8: Centralized Vs Decentralized (Total)

Source: research data collected by the authors

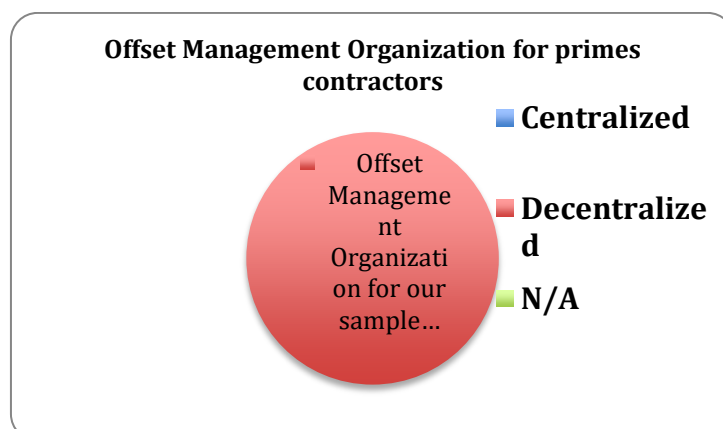


Fig-9: Centralized Vs Decentralized (Primes contractors)

Source: research data collected by the authors



Fig-10: Centralized Vs Decentralized (Suppliers)

Source: research data collected by the authors

Results indicate that the tendency toward decentralized management of offset activity is closely related to the practice of program management reporting. There is a strong tendency to assign responsibility for managing offset obligations to the business unit that created the obligation.

In all of the prime contractors a formal decentralized reporting structure exists. The responsibility for meeting the offset obligations is placed at the various operating units. However, some form of informal central network was also evident. Most Offset Managers expressed an interest to formalize these central management approaches. In one multi business aerospace conglomerate the informal central network was referred to as central assistance. The process was one of monthly-centralized reporting and, bi-annual conferences to foster networking and deal making among the various divisions. This is when training and information sharing would also take place.

Of the managers in the supply companies, 29% of those interviewed said that they did not have a centralized process but wanted one. These Offset Managers wanted a management process that would

facilitate support from the entire enterprise in meeting offset obligations. The vast majority of the Offset Managers work in an operating unit of a large corporation. The rest of the corporation includes units beyond aerospace such as automobile components divisions, air-conditioning companies, etc. Many companies in the aerospace industry are now consolidating with other large multi-faceted entities creating more diverse conglomerates. These multi industry enterprises have the opportunity to leverage various aspects of their businesses to satisfy offset obligations. The management practices that seem to work best in these companies are those that employ aspects of both centralized and decentralized approaches for handling offset obligations. A central function that nurtures and supports the operating units without stifling the entrepreneurial spirit of the operating units is evident in the central assistance network mentioned above.

Offset activities in relation to economic development activities

Figures 11-13 shows the data concerning the nature of offset activities in relation to economic development.

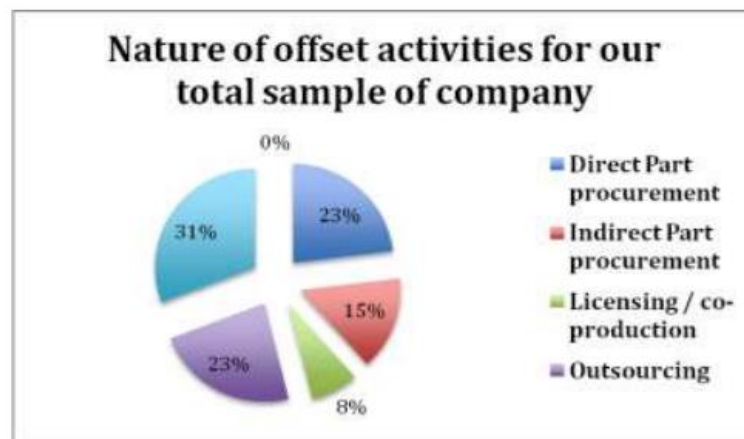


Fig-11: Nature of offset activities (Total)

Source: research data collected by the authors

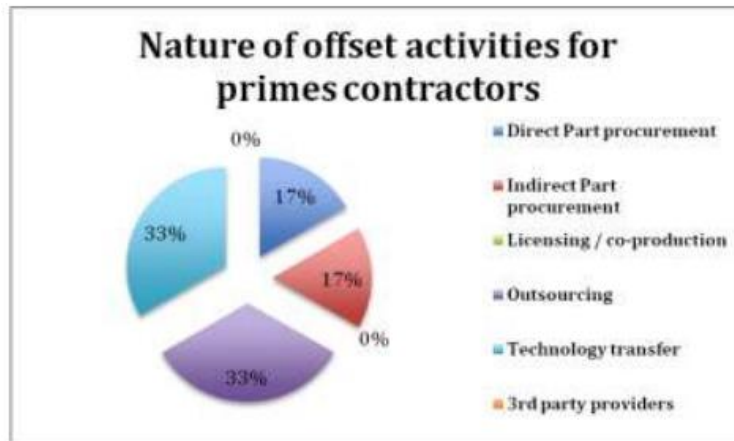


Fig-12: Nature of offset activities (Prime contractors)

Source: research data collected by the authors

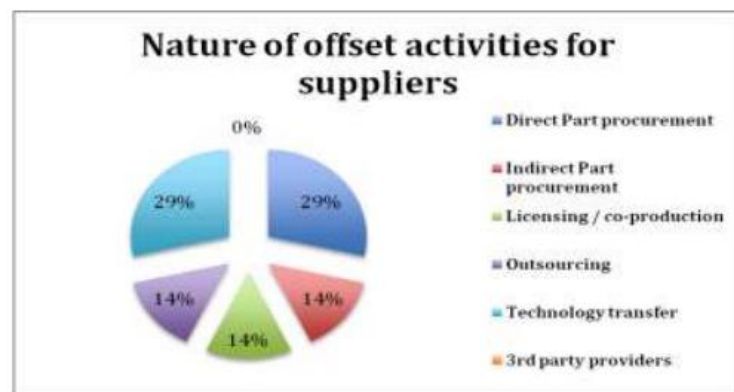


Fig-13: Nature of offset activities (Suppliers)

Source: research data collected by the authors

Parts procurement refers to materials purchased from sub-tier suppliers in the country where the offset obligation exists. The direct portion relates to materials that are used in aerospace products and indirect refers to materials that are used for other "non-aerospace" items produced by the companies.

Direct procurement from foreign-based companies diminishes business for existing US suppliers. Suppliers might be naively engaged in offsets to seize opportunities for their foreign ventures or they might at least be trying to understand the current situation so their company's strategy can reflect current realities. What is not clear, however, is whether direct procurement was shifting to foreign suppliers for reasons other than offsets obligations (cost, location, market access etc). Some of the Offset Managers said that foreign-based procurement was "something that was happening anyway". Most of the sampled companies were shifting supply sources. Few instances were uncovered where supply shifts resulted specifically from the need to achieve an offset obligation.

Licensing/co-production, outsourcing and technology transfer represents the major of offset

satisfying activities. These three activities, either directly or indirectly, lead to aerospace service or manufacturing capabilities for the buying countries. The goal of most of the buying countries is to establish and or expand their indigenous aerospace industry.

This process often starts with technology transfer, which then leads to cooperative operations (either through license agreements or co-production) and ultimately leads to outsourcing operations that were formerly accomplished within the respective company. Nearly 60 % of the offset active falls into these categories and as such, offset activities create or expand the aerospace industry within the buying countries.

Third-party providers are independent agencies that will, for a fee, help a arm create or acquire offset active that generates offset credits in a given country. This service covers a wide range of activities from finding a suitable in- country partner for a joint venture with the selling company, to locating existing businesses with excess offset credits for sale. This data suggests third-party providers are used sparingly by only a few of the prime contractors. In the opinion of the Offset Managers of these companies, this process is

costly and their experience with this method has thus far proved unproductive.

Figures 14-16 shows the data concerning the supply chain integration into the offset process.



Fig-14: Utilization of sub-tier Suppliers (Total)

Source: research data collected by the authors

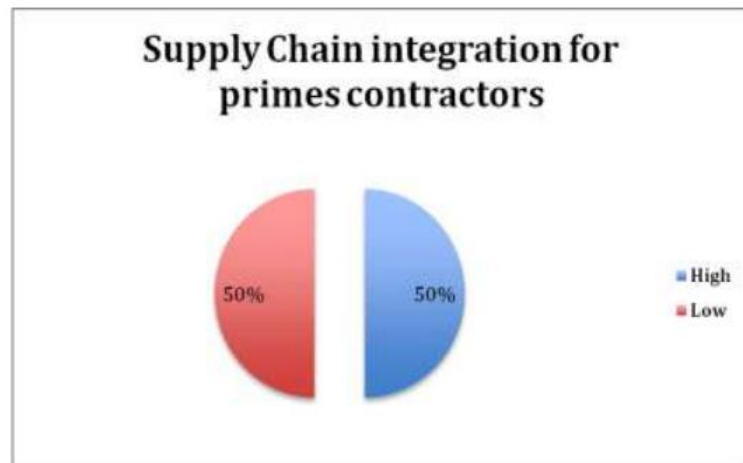


Fig-15: Utilization of sub-tier Suppliers (Primes)

Source: research data collected by the authors



Fig-16: Utilization of sub-tier Suppliers (Suppliers)

Source: research data collected by the authors

Sub-tier suppliers are companies that provide products and services to other organizations vertically along the value chain. For the prime contractors, sub-

tier suppliers are companies that supply them materials (first tier suppliers). First- tier Ranking suppliers also have sub tier suppliers (second tier suppliers). The

suppliers in my sample are first-tier suppliers. Figure-14 is the accumulation of responses from all the sample companies regarding their utilization of sub-tier suppliers for the purpose of satisfying offset obligations. Overall utilization of the sub-tier suppliers is relatively low. The prime contractors use their supply base much more than their own first-tier suppliers.

A review of the participants' results shows that there are two main factors that contribute to the low level of involvement of suppliers in offsets. First, as business moves through the supply chain, contracts become smaller and smaller. The low utilization of suppliers in the offset process reflects such a rule. If relatively low value, low volume orders mark supplier relations with primes, there is little incentive for the supplier to become involved in their customers' offset obligations.

Moreover, many supplier companies are diversifying into non- aerospace businesses and are becoming less dependent upon aerospace business. This is the second factor contributing to the low levels of engagement in offset activities by the supply base.

From the aerospace companies interviewed, offset agreements need several key characteristics to succeed:

- The two sides must align on the business and strategy behind the deal, which needs to make commercial sense.
- Agreements need to be long term and avoid a "hit and run" approach. The two sides are more likely to strike fair, mutually beneficial deals if they expect to work together over several years.
- Like any partnership, success hinges on good communication, transparency, openness, trust, and clarity around rules of the engagement and the measures of success.
- It is important for aerospace companies to work with a single party or authority within the government that is empowered to negotiate and carry out agreements. Agencies have different mandates according to their level of involvement. Some countries have multiple entities with competing or diverging views, which makes negotiating offset agreements difficult or impossible.

CONCLUSION, RECOMMENDATION & FUTURE CONSIDERATIONS

The review of empirical, theoretical and related literature showed that there is a wide category of offset arrangements that are applicable to the aerospace industry. The deployment of offsets is different within prime contractors and suppliers. Although all the Offset Managers from the prime contractor firms consider offsets as a major issue for their organizations, the majority (46%) of suppliers Offset Managers contradicts this view. Results indicate that suppliers and

prime contractors view offsets differently within aerospace industry. Moreover, consolidation among prime contractors seems to confuse matters and add to the difficulties prime contractors have with their supplier.

The majority (75%) of Offset Managers interviewed pointed out that supplier organizations were not fully engaged in the offset process. All of the prime contractor managers view offsets as a high priority for their firms. This indicates a lack of congruence between the views of the prime contractors and suppliers within the industry. Prime contractor managers and supplier managers interviewed exhibited different views on the importance of offsets to their respective firms. This divergence of opinions creates a challenge for effectively managing offsets within the aerospace industry.

The practice of offsets within aerospace groups requires a specific organization dedicated to complex projects. Results show that Offset Managers are located in Marketing within 38% of the sampled firms. In these firms, offsets seem in a position within the organization that allows for a broad view. However, 31% of Offset Managers were located in the Program functions. This may limit an organization's ability to discover enterprise-wide support necessary to manage and satisfy offsets successfully. Few firms (15%) employ a centralized approach.

Government procurement plays a pivotal role, is able to develop local capabilities and can channel investments to reach national goals and ensure technological and infrastructural development. As such, a demand for offset or localization, either formally or informally is usual practice.

Governments essentially require foreign suppliers to reinvest a percentage of the country value back into the importing country. The economic strategy of offset is based on market potential to develop knowledge-intensive industries domestically, ideally in high priority segment such as aerospace.

In this context and given the extent of capital-intensive requirement, aerospace policies generally give priority to offset arrangements as a means to drive systematic progression. Offset is a powerful development mechanism that maintains sovereignty and autonomy in a country's aerospace and security capabilities. One example is the Gulf Cooperation Council (GCC), where oil-rich countries consistently purchase aerospace equipment, demanding that foreign suppliers establish joint ventures in advanced technology sectors. This result in profits and facilitates the employment of skilled nationals to operate and manage businesses that guarantee exports. This affects supplier organizations that apparently take time to show interest in offset activities. Assuming this is a

representative sample of aerospace companies, the industry may be headed for trouble as supplier-prime relations are threatened by increased offset-based procurement. Beyond direct procurements, prime contractor firms deliver offsets in technology transfer, licensing/co-production and outsourcing. These activities seem to align with the primary goal of the buying countries, namely, creating and sustaining an indigenous aerospace capability.

How can the aerospace industry improve offset process and minimize negative effects of offsets on core business?

Four methodological elements have a significant impact on an offset's success: objectives, types, policy components, and governance. Each country will have its own particular national industrial strategy that directly shapes the vision of the offset program and drives the setting of program objectives. However, a number of interlinked best practice requirements are necessary to ensure that an offset program is successful.

- Offset objectives: These need to be clearly articulated in line with the strategy - such as building certain capabilities, creating jobs, or providing high-value training.
- Offset types: These need to be clearly articulated in line with the strategy. If the strategy is to build specific capabilities, then the government should strengthen direct offsets. However, if the goals are more socioeconomic, then a broader mix of indirect offsets is appropriate.
- Offset policy components: These need to be tailored to the offset types. And all these components — contract value, offset requirements, method of valuation, non-fulfillment penalty, and so forth — need to be fair and transparent to ensure that both sides understand and agree on the terms of success.
- Offset governance: This must be designed to control the offset policy components. Additionally, governance should avoid overlaps of roles and responsibilities among the various entities, which can dilute or delay objectives.

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