

# Impact of Offset Policy on India's Military Industrial Capability

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*India's offset policy in 2005 envisaged direct purchase of products and services, Joint venture, FDI, etc. So far, 12 Offset contracts have been concluded for \$2 B. The study shows that most of it is far low end products and services repair and overhaul facilities, training, and simulators. However, expected inflow in terms of long term investments, FDI have not materialized.*

*The major reasons seem to be low FDI cap of 26 per cent and non-inclusion of technology transfer in its scope. The paper strongly suggests the need for increasing FDI limit upto 50 per cent so that major foreign arms producers find profitable to invest in defence production sector. Besides, critical areas of technology like weapons, sensors, detectors and propulsions and design and development capability should be targeted. Strong Government support and a single point empowered defence offset agency will facilitate the process of optimizing the offset opportunity of \$25 b during 12th Plan.*

## Introduction

India is the world's second largest importer of arms and tenth in terms of military expenditure<sup>1</sup> with a self-reliance index of around 30 per cent. The Kelkar Committee (2005) had recommended that India must "leverage its buying power and use offset arrangements to expand the domestic defence industrial base through foreign investments and technology transfer."<sup>2</sup>

Apropos these recommendations the Indian ministry of defence introduced offset provisions in its Defence Procurement Procedure 2005 (DPP-2005)<sup>3</sup> for capital acquisition schemes exceeding estimated an cost of Rs. 300 crores by including in its scope direct purchase of goods and services, joint venture (JV) and co-production arrangements, foreign direct investment (FDI) inflow, the setting up of manufacture repair & overhaul (MRO) facilities, boosting export etc.

The DPPs of 2006, 2008, 2009 included provision for credit banking, delineated the defence products and dispensed with the licencing requirement of the MOD and provided level playing field to the private sector. Interestingly the offset policy excluded technology transfer from its ambit.

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DPP-2011 marked a substantial departure from the earlier stipulation of direct offsets by including dual use civil aerospace products and homeland security items. It has also made a definitive policy statement for progressive indigenisation in critical areas the provision of a level playing field for the private sector in shipbuilding. This was soon followed up with first ever Defence Production Policy which set out a road map for indigenisation and research and development (R&D) synergy between the public sector, the Defence Research and Development Organisation (DRDO), the private sector and academia.<sup>4</sup>

This paper examines impact of offset policy from 2005-2010 on the indigenous defence industry capability and self-reliance. It highlights how the offset realisation of around \$2 billion during this period has mainly served to promote sub contractorisation of low-end products and services, MRO facilities, training and soft skills and has not ushered in the expected inflow of FDI, JVs and long term partnerships for the design, development and production of high end products with global OEMs.

This calls for a review of our FDI policy, include technology transfer in priority areas as part of our offset policy, upscale investment in R&D by all stakeholders, and ensure a synergy between design, development, production agencies. Along with this there is need for replacing the existing Defence Offset Facilitation Agency (DOFA) by a technically equipped empowered body to oversee offset implementation and realisation

### **Self Reliance**

A review committee headed by Dr. Abdul Kalam, the then scientific advisor (SA) to the defence minister, had in October 1993 set a goal for enhancing the indigenous content in the defence inventory from 30 per cent in 1995 to a possible 70 per cent by 2005.<sup>5</sup> The committee had identified the future systems required as per Table 1 below to bridge the capability gap and improve the self reliance index which was defined as the ratio of indigenous systems procurement cost to total system procurement cost of the year.

**Table-I: Future Systems Required**

<ul style="list-style-type: none"> <li>• Automated Air Defence System</li> <li>• Satellite Based Navigation System</li> <li>• Air &amp; Space Based Early Warning System</li> <li>• C4 I System</li> <li>• Under Water Sensors &amp; weapons</li> <li>• Medium &amp; Long Range Guided Missile System with Launching from Multiple Platforms</li> <li>• Unmanned Air Vehicles,</li> <li>• Stealth Air Craft</li> <li>• Air Borne EW (Electronic Warfare) System, (ECM &amp; ECCM) (Electronic Counter Measure)</li> <li>• Very small Aperture Terminals for Satellite Communication GPS (Global Positioning System) Receiver</li> </ul>
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Despite the fairly impressive indigenous capability of our DPSUs & OFs and DRDO the self reliance quotient has not moved beyond 30 per cent, since then as would be seen from the gaps in critical technology in propulsion, weapons and sensors.

**Table II: Critical Technology**

1	Gas Turbine Engine	Single Crystal
		Special Coating
		FADEC
2	Missile	Uncooled FPA seekers
3	Aeronautics	Smart Aerostructures
		Stealth Technology
4	Material	Nano Material, Carbon Fibres
5	Naval Systems	Super Cavitating Technology
6	Sensors	AESA, Radar, RLG, INGPS
7	Communication	Software Defined Radio
8	Avionics	Gen III, II Tubes
9	Surveillance	UAVs, Satellites

*Source: Author's data based on information obtained from DRDO, Bharat Electronics Limited (BEL) and Hindustan Aeronautics Ltd.*

In the aerospace sector the predominant reliance on licenced manufacturing without taking adequate steps to bolster indigenous design and development capability is a major reason <sup>6</sup> for the vertical disjunction between design, development and production agencies<sup>7</sup> and the lack of accountability has only complicated matters. Tony Saich rightly observes that the major organisational problem with India's S&T system has been the lack of linkage across vertical structure; particularly between research & production sectors.<sup>8</sup>

The parliamentary standing committee on defence has expressed serious concern over this and has called for bolstering private public partnership in production and R&D.<sup>9</sup> The Defence Expenditure Review Committee (2009) also recommended the drawing up of a self reliance road map for attaining the goal of 70 per cent indigenisation in a 15 - 20 year time frame.

Our dependence on imports for aerograde material used for the fuselage of fighters and for high quality steel required for frigates, submarines and aircraft carrier, is around 90 per cent.

### Offset Contracts (2005-2010)

The broad details of the 12 acquisition programmes & offset contracts concluded with foreign companies is given in Table 3 below.

**Table-III: OFFSET CASES: CONTRACTS FINALISED (2005 - 2010)**

Sr. No.	Acquisition Programme	Foreign Companies	Contract Value (In Cr.)	Offset Contract (In Cr.)
1	Medium Power Radar	IAI ELTA Israel	810	243
2	Upgrade of Mig-29 Aircrafts for IAF	ROE, Russia	3856	1233
3	Fourth Fleet Tanker	Fincantieri, Italy	800	240
4	Long Range Maritime Recce Anti Submarine warfare Aircraft	Boeing, USA	10684	3205
5	HAROP UAVs	IAI, Israel	720	220
6	Medium Lift Helicopters	RosoboronExport, Russia	4950	1485
7	C-130 J Aircraft	Lockheed Martin, USA	3666	1100
8	EO/ IR Pods - Jaguar upgrade	RAFAEL, France	350	159
9	Fourth Fleet Tanker - under option clause	Fincantieri, Italy	800	240
10	Low Level Transportable Radar (LLTR)	M/s Thales, France	570	171
11	VVIP Helicopters	M/s Agusta Westland UK	4227	1268
12	UAV	M/s IAI	1265	379
	Total		32698	9943

Source: Defence Offset Facilitation Agency (DOFA), Ministry of Defence, Government of India

#### The highlights of offset contracts:

- Steady increase from \$ 48.6 million in 2007 to \$519.5 million in 2008, \$974 million in 2009 to around \$ 700 million in 2010.
- The aerospace sector accounts for 65 per cent and the balance is used by the navy.

- Level playing field concerns have been turned on their head as the Indian private industry accounts for 70 per cent of these contracts.
- The DPSUs viz. HAL and BEL and Tatas and L&T from the private sector are major players.
- The SMEs and IT companies also have a fairly handsome share.
- There is no positive impact on exports.
- In terms of FDI inflow for infrastructure, production and R&D, the impact is minimal.
- Only one case of credit banking has been approved so far.

**Major Beneficiaries**

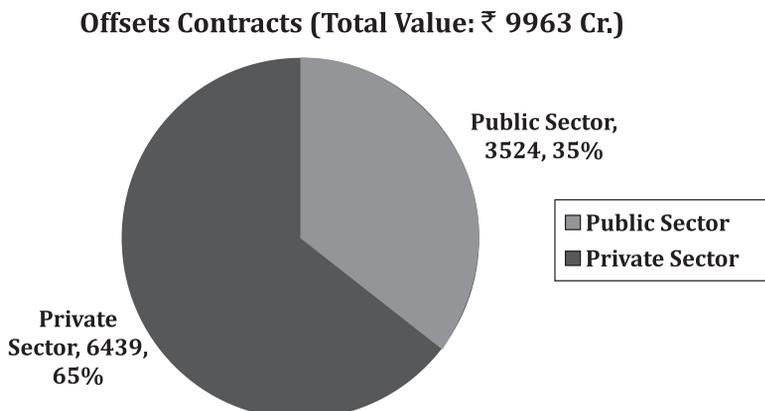
The major beneficiaries of the offset arrangements in the public and private sector are as under in Table 4.

**Table-IV: Beneficiaries of Offset Contracts**

Entity	No. of contracts	Value (Rs in Cr)
HAL	6	1928
BEL	6	1576
TATA	4	1466
L & T	7	771
ALPHA DESIGN	2	575
M & M	1	984
HCL	1	235
WIPRO	1	216

A pie chart showing an overview of contracts amongst private and public players is given below:

**Figure-I: Distribution of Offset Contracts between Public and Private Sectors**



**Major Areas of Offset Realisation**

The major areas of offset realisation are (a) Sub contractorisation (58 per cent) involving supply of fuselage, cabins, radome, tail cone, data link, & other products (b) Engineering projects, project management, (c) Overhaul and repair facilities (16 per cent) (d) Various types of training facilities, simulators and (e) ground handling/support equipments.

**Table-V: Per cent Share in Offsets**

Manufactured final assembly	58per cent
Simulators, Training Centre	18per cent
MRO	16per cent
GHE/GSE (Ground Handling & Support)	8per cent

Source: Defence Offset Facilitation Agency, Ministry of Defence

**Impact of Offsets**

***Aerospace Sector***

The Aerospace sector is historically the prime beneficiary of offsets as most countries source their fighter aircrafts like F5, F15, F16 and F18 from the US with varying degrees of offset obligations.

The US accounts for nearly 60 per cent of the global arms production which was around \$471 billion during 2008.<sup>10</sup> Of the 100 major global arms producing companies, aerospace products account for nearly 80 per cent.

In India the aerospace sector is a near monopoly of HAL. Though a formal offset policy had been promulgated in 2005, HAL has been beneficiary of technology transfers for quite some time through licence arrangements. The impact of such offsets in major TOTs transferred by Russia for MIG 21(1960s- 70s), MIG 27, MIG 29 and SU30(1996) has enabled HAL to achieve a high level of technology capability in manufacturing combat aircraft and engines.<sup>11</sup> The TOT arrangement, however, has not led to a defence industrial capability for supplying advanced weapons system that would be comparable with Western equipments. Nor has the technology gap closed.<sup>12</sup>The types of work realised through offset arrangement in HAL are as under:

**Table-VI: Types of Offsets in Aerospace Sector**

1. Build to Print	32 %
2. Design to Build	21 %
3. MRO Facilities	27 %
4. Software Packages	12 %
5. Design Packages	8 %

Source: Hindustan Aeronautics Ltd (HAL)

HAL has not graduated from building designs provided by licensor due to the inherent limitation of its design and development (D&D) capability.

### ***Subcontractorisation***

Sub contractorisation constitutes the major area of offset realisation. This is not surprising as India is a cost efficient destination for outsourcing. According to a study by the Boston Consulting Group India's vast domestic market and relatively low cost work force with advanced technical skills will make it a manufacturing powerhouse within the next 5 to 10 years.

However, discerning observers and critics aver that such outsourcing arrangements perhaps would have come without offset stipulation. The UK experience suggests that only 25 per cent to 50 per cent of total offset is genuinely new business. There is also dilution, as items like air conditioners, a part of troop comfort; equipment items like simulators; and training in quality of offsets which should have been part of supply contracts are being included as part of offsets.

### ***MRO Capability***

The offset contracts for Mig 29 upgrade and VVIP helicopters, would provide this benefit. In case of the 'Globemaster' contract, HAL is likely to benefit in terms of ROH (repair overhaul) facilities through offset.

Presently the US and Europe contribute more than 60 per cent of global MRO market. Singapore is also an emerging MRO hub. Substantial amount is spent by organisations on MRO rather than on acquisition. This should be a thrust area for a partnership between HAL and the private sector with global companies.

### ***Credit Banking***

A provision of banking credit with a sunset and sunrise clause of two years was introduced in DPP 2009. Of the eight proposals received only one has been approved so far in respect of M/s. Eurocopter.<sup>13</sup>

There has been unusual prevarication by the MOD in the finalising of such banking arrangements. This has understandably embittered foreign OEMs as they look for an expeditious approval process.<sup>14</sup>

There is also a perception that the policy makers are unnecessarily intransigent on the banking period which can have a flexibility of 5-7 years.

**Exports**

It would be seen that, except for BEL, there has been no impact of offset on the promotion of exports. A rank correlation between arms exports and the defence industrial base during 1980-2006 for the EDA (European Defence Agency) countries reveals a significant rank correlation (+0.76)<sup>15</sup> showing that size of DIB (Defence Industrial Base) was positively associated with arms exports and countries like Israel who have invested significantly in R&D have benefited handsomely from global exports as under:

**Technology Transfer**

The present policy does not consider TOT to be a part of offsets. But India has had defence offsets and counter trade arrangements through licence arrangements since 1960s for building tanks, missiles, submarines and aircrafts. However, it has failed to create advanced weapons, propulsion sensor systems that can be

**Table-VII: TREND OF EXPORTS**

Entity	2008-09	2009-10 (In Crores)
HAL	421	204.6
BEL	84	108.8
BEML	248	156.2
OFB	46	11.5
TOTAL	799	481.1

*Source: Ministry of Defence, Government of India, Annual Report 2009 and 2010-11*

competitive with Western equipment. The technology gap has not closed as critical technology and up grades are denied.

**Lessons & Major Policy Issues**

As the foregoing would show Offsets have essentially led to sub contractorisation of low end products and services, setting up simulator, training facilities, project management, depot maintenance facility, GHE/GSE(Ground Handling Equipment and Ground Support Equipment). However, in terms of Foreign Direct Investment

**Table-VIII: Global Defence Exports of Select Countries**

Country	Exports (\$ Billion)
USA	6.8
Russia	4.48
France	1.85
Germany	2.47
UK	1.02
China	0.87
Israel	0.76
India	0.10

Source: SIPRI Year Book 2010

in production and R&D, JV arrangement and exports the response so far has been rather lukewarm from the foreign OEMs. The existing FDI cap of 26 per cent and non-inclusion of technology transfer in scope of offset are being bandied out as major deferents to long terms investment arrangements.

### **FDI Cap in Defence**

The DIPP (Department of Industrial Policy & Promotion) had circulated an approach paper rooting for a more than 74 per cent FDI cap in defence production to offer significant incentives to foreign companies for transferring leading technology.<sup>16</sup> Available at [http://dipp.nic.in/Discussion papers 17th May 2010.doc](http://dipp.nic.in/Discussion%20papers%2017th%20May%202010.doc).

While the CII, FICCI are generally guarded and recommend an increase to 49 per cent, the foreign OEMs are understandably vociferous and recommend at least 50 per cent so that it makes economic sense in terms of return on investment. Dr. Kelkar and Deepak Parekh recommend an FDI higher than 49 per cent if it brings in critical technology.<sup>17</sup> Air Commodore Jasjit Singh is in favour of increasing FDI to 49 per cent.<sup>18</sup>

Countries like China witnessed a substantial increase in FDI inflow from \$5.8 billion in 1990 to \$67.3 billion in 2007 because of liberal FDI norms. A case in point is their JV with Embraer where 51 per cent FDI was allowed.<sup>19</sup> Dr. Arvind Virmani argued before the FDI group (2000-2004) in the Planning Commission that 100 per cent FDI in high technology defence equipment is preferable to being perpetually dependent on imports for the same items.<sup>20</sup> Dr. Kaushik Basu, Chief economic Advisor strongly recommends higher FDI for bringing in niche technology.

Malaysia varied its FDI between 30-70 per cent depending on the quality of technology coming in. They insisted on technology transfer of manufacturing skills in high end subsystems, making Malaysia a manufacturing hub for pylon and landing gear.<sup>21</sup>

The JV with Russia for the Brahmos cruise missiles with 50:50 FDI participation (\$300 million) is considered a useful model.<sup>22</sup> Today it has successfully delivered its product, has an order book of \$4 billion which is likely to swell to \$12 billion soon.

India has come to be recognised as an economic and technological powerhouse in the making. Manufacturing now accounts for above 27 per cent of India's GDP, contributes 53 per cent of total exports, 79 per cent of FDI and employs 11 per cent of the workforce.<sup>23</sup> Sectors like telecom with an FDI limit of 74 per cent have been receiving significant FDI inflows (around \$25 billion)<sup>24</sup> in the recent past despite the global financial crisis. Therefore, there is a strong case for increasing the FDI to at least 50 per cent.

### **Technology Transfer:**

There is a strong case for including technology transfers for identified key technologies and applying suitable multipliers.

Prof. Brauer, a recognised expert, is of the view that just because India is a big buyer of defence equipment does not guarantee that counterpart countries will transfer relevant technology. Even if transferred, it can become obsolete by the time it is installed and absorbed.<sup>25</sup>

Dr. Kalam, the father of the IGMDP (Integrated Guided Missile Development Programme) programme feels that TOT in the past to DPSUs/OFs only provided some manufacturing capabilities but not key technologies.<sup>26</sup> However, Admiral Sureesh Mehta, the ex-chief of naval staff was of the view<sup>27</sup> that TOT should be a stepping stone to leapfrog and develop indigenous manufacturing technology capability than when transferred. Successful technology needs a defined underlay and buyers must have the capacity or knowledge base to absorb superior knowledge smoothly. Know why must be insisted & no restrictive conditions accepted. NR Mohanty, ex CMD, HAL is also of the view that HAL succeeded in getting high end technologies because of dealing with foreign suppliers with firmness.<sup>28</sup> Key technologies like single crystal blade for turbines were passed on by Russia and successfully absorbed making the engine factory at Koraput an important destination for getting engine components machined by reputed engine houses like Pratt & Whitney.

Some economists suggest that obtaining technology through offsets is more efficient than direct purchase, while DGIDSA feels that buying TOT is a better option.<sup>29</sup> When TOT is part of a large contract, the risk is shifted to the vendor who will have a greater incentive to transfer technology successfully. Dr. Vivek Lall, VP. Boeing is of the view that the 'Buy & Make' policy is adequate for platform related technologies. However, technology based offset projects share IPR (Intellectual Property Rights) (tools, processes, s/w, equipment, data etc.) and are designed to assist, industry, R&D institutions and universities.

From the foregoing it would be seen that it should be possible to get key technologies and most importantly significantly manufacturing capabilities by technology transfer as an option in offset policy.

### **Indirect Offsets**

Key to the global competitiveness of India's economy lies in building high class infrastructure. In the telecom sector there is a great potential for the manufacture of items like wireless core equipment through technology transfer which are being imported at present. Indirect offsets can infuse much needed FDI into infrastructure sectors where the requirement is assessed at \$1025 billion during 2012 - 2017.<sup>30</sup>

### **National Offset Policy:**

A discussion paper for a national offset policy was circulated in October 2006 by the ministry of commerce. It preferred direct offsets by availing high end technology through TOT and co-production. It also, recommended indirect offsets by way of investment in IT, telecom, bio technology, agricultural research and export promotion. The paper, however, did not find favour other ministries particularly the MOD who perceived such nodal initiatives as being dilatory.

### **Road Ahead**

The primary objective of Indian defence offset is to be self reliant by acquiring key technologies, absorb knowhow through manufacturing, integration, training and maintenance skills, develop know-why in product, technologies, participate in joint development to integrate complex systems, offset upgrades and in the future develop own products and systems.

Governmental support and policy would be critical for achieving self reliance and building defence industry capability. It must cut through the silo mentality, of the quartet of the services, DRDO, DPSUs and private sector by taking up SRI

(Self Reliance Index) improvement as a national mission. There has to be synergy between design and production agency and accountability. Most importantly the commitment of services to indigenisation would be key to the success of design, development and production programmes. EW programmes like Samyukta and Sangraha and Brahmos demonstrate the success of this synergy.

The Brazil government's support for the successful Embrarer programme through technology transfer during (1969-88) by ensuring military R & D funding, technical support and tax breaks for buying the Embrarer's share, and encouraging the setting up of a civil industrial base constitutes an important lesson for India. The Chinese government's support for the indigenisation initiative is also worth emulating.

The fledgling private industry needs to be boosted and the Indian defence industry in general needs to be capability enabled in design, development and production of high technology areas. The SMEs, in particular, need to be nurtured as global integrators in India provide value added training to the local SME supply base. Pre-eminence of countries like US, Russia and France in defence technology is largely attributable to this. This will also boost up defence exports as improved DIB has positive impact on exports.

### **R & D Spending:**

Our weaknesses in core technology areas need to be identified as we seem not to have moved beyond the weaknesses identified by the SRI committee in 1993. Coordinated efforts need to be made to bolster R&D investment by the private sector, public sector and DRDO to at least 10 per cent of their sales. This will facilitate the quicker absorption of high end technology. The military spend on R&D of a few countries would reveal the positive relationship between equipment capability & R&D spending.

Countries like Israel who have focused on high technology (R&D) as part of their offset policy have significantly boosted their exports.

Design and development capability in strategic electronics like microwave components, RLG & accelerometers, FPA and Nano technology, propulsion and weapons (ATGM (Air to Ground Missile) & ATAM (Air to Air Missile), SRSAM (Short Range Surface to Air Missile) will be critical. This will also have excellent potential for dual use (civil) application and boost export. Technology transferred with reasonable depth in these areas must be availed of as part of offsets.

**Table-IX: Defence R&D – Global Trend (\$B)**

Countries	R&D Exp.	R&D Exp as per cent of Total Mil. Exp.
USA	90	14
RUSSIA	7	11.5
FRANCE	6.1	11
UK	4.7	9
INDIA	2.0	6

Joint R&D and joint development initiatives like SR-SAM, MR-SAM, BRAHMOS, FGFA (Fifth Generation Fighter Air Craft) & MRTA (Multi Role Transport Air Craft) need to be pursued assiduously in a mission oriented approach.

Exposure of our designers to major design houses abroad will add value to their design capability in niche areas.

There is also a need for better synergy between design, development and production agencies & institutional arrangement to support this.

### **Shipbuilding Sector**

The commercial shipbuilding sector must be included in the scope of offsets as has been done for civil aviation sector. The experiences of China and Korea hold important lessons for India.

### ***Need for Synergy***

National assets in technologies must be made available for defence efforts. This recommendation of Dr Kalam's SRI committee, continues to be relevant.

A better oversight mechanism for inter-sectoral prioritisation, identification of capability gaps and investment in facilities and R&D would optimise offset realisation process. There is a definite need to improve our implementation process.

The self reliance action plan has to be jointly evolved by all wings of MOD and followed up by the DAC (Defence Acquisition Council), the PMO (Prime Minister's Office). A National Task Force on offsets should address the larger policy issues of bolstering national capability by identifying funding requirement for infrastructure and other social sectors without compromising the specific capability requirements of the defence services. *idsa*

Notes:

- 1 Data based on *SIPRI Yearbook 2010: Armaments, Disarmament and International Security*, Oxford: Oxford University Press, 2010.
- 2 Ministry of Defence, *Towards Strengthening Self Reliance in Defence Preparedness*, Kelkar Committee Report, April 2005.
- 3 The capital procurement of the MoD is guided by a document know as Defence Procurement Procedure (DPP), which is revised periodically. The latest document is available at official website of MoD.
- 4 See Ministry of Defence, *Defence Production Policy*, available at <http://mod.nic.in/>
- 5 Report of the "Review Committee to Evolve a Ten Year Plan for Self Reliance in Defence System".
- 6 Singh, Jasjit, *Indian Aircrafts Industry* (New Delhi: Knowledge World, 2011).
- 7 Ibid.
- 8 Saich, Anthony, "Reform of China's Science and Technology Organisational System." *Science and Technology in Post-Mao China*. Ed. D.F. Simon and M. Goldman. Council on East Asian Studies, Harvard University, 1989, 69-88.
- 9 Parliamentary Standing Committee on Defence (2009-2010)
- 10 *SIPRI Yearbook*, p. 254.
- 11 Bhaskaran, A., "Role of Offsets in Indian Defence Procurement Policy", in J Brauer & P Dunne (ed.), *Arms Trade and Economic Development*, London: Routledge, 2004, p. 220.
- 12 Ibid, p. 224.
- 13 Interaction with a Joint Secretary, DOFA, DDP in April 2011.
- 14 E-mail response from Philip Georgoiun, Lockheed Martin (08 May 2011).
- 15 Eriksson - E.A (2007) Study on effects of offsets on Development of European Defence Industry and Market.
- 16 Available at <http://dipp.nic.in/Discussion papers 17th May 2010.doc>.
- 17 Interview with Dr. Kelkar & Deepak Parekh September 03, 2010 and August 31, 2010.
- 18 Yan, Nelie, "China's Search for Indigenous Industrial Development", Ph.D thesis (June 2009).
- 19 Air Commodore Jasjit Singh, see note. 6.
- 20 Email date June 5, 2011.
- 21 Reply from Dr. Kogila Balakrishna, June 05, 2011.
- 22 Email from Dr. APJ Abdul Kalam May 05, 2011.
- 23 Shri J.D. Patil, VP, L&T: Conference on Offsets, July 12, 2011.

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- 24 *Economic Survey - 2010-2011*, Ministry of Finance, Government of India.
- 25 Email Response from J Brauer.
- 26 Interaction with Dr. APJ Abdul Kalam, June 03, 2011.
- 27 Inaugural Address in International Seminar on Defence Finance, New Delhi, June 11, 2011.
- 28 Ex Chairman, HAL, May 13, 2011.
- 29 Interaction with NS Sisodia, Director General, Institute for Defence Studies and Analysis, New Delhi, June 15, 2011.
- 30 *Economic Survey - 2010-2011*, GoI, India.