Aerospace & Defence Industry

Confederation of Indian Industry

Changing Dynamics*

India's Aerospace Industry

*connectedthinking

PricewaterhouseCoopers

Contents

Foreword

The Indian aerospace industry, both military and civil, stands uniquely poised today, on the threshold of catapulting itself into the global arena. Due to the overwhelming support and involvement of the government in the demand and supply of defence and civil aerospace products, the industry has set itself on the firm path towards a transformational change.

The process of transformation has begun and there are encouraging signs of the aerospace industry emerging as a major factor in our increasing self-reliance as well as the export-oriented sector, with the potential and capacity to provide world-class opportunities for established firms in the global market. At the same time, the domestic capability is being significantly enhanced, through extensive tie-ups, joint ventures and technology transfers. Fundamental strength in the Indian Industry already exists, in the form of a large number of Small and Medium sized Enterprises (SMEs), which in the past have been suppliers at the sub-component and component level, for aerospace DPSUs, HAL, DRDO, ISRO etc. These companies are gradually transforming themselves into major players in this sector, modernizing with cutting edge technologies to become suppliers for global aerospace companies vying to outsource products and components from India.

This report is an attempt on the part of CII to analyse the global opportunities in the area of Aerospace vis-à-vis current Indian capabilities. I believe this report would enable Indian companies to understand the emerging business opportunities in the area of Aerospace and the foreign OEMs to understand the Indian capabilities for making investments in India in this sector.

I would like to thank our Knowledge Partner – PricewaterhouseCoopers India for their support towards bringing out this report.

Atul Kirloskar

Chairman

National Committee on Defence
Confederation of Indian Industry

Preface

We are pleased to present the PricewaterhouseCoopers-CII report on “Changing Dynamics – Indian Aerospace Industry” for release at the AERO India 2009, Bangalore organised by the Ministry of Defence and CII. The Aerospace&Defence industry is important to India’s strategic and economic interests and is characterized by high growth potential. Recognizing this, the Defence Ministry has announced further liberalization of the Offset Policy. A Civil Offset Policy is also in the pipeline. These Offset policies combined with India’s competitive advantage in low cost high skill manufacturing will create opportunities and challenges for both domestic and foreign companies in this sector.

This report aims to capture the perspectives, key developments and drivers in the Global and Indian aerospace sector, the challenges and the opportunities the sector offers for India being considered as a critical base and destination in the value chain for aerospace manufacturing and the rendering of MRO services. The report also considers the issues and concerns of foreign and local players in the field and offers some suggestions for policy changes and actions by industry for the sector to grow.

The current global meltdown makes it difficult to make projections of the impact of the unfolding economic scenario on the sector. The next 18 to 24 months are expected to be a very difficult period for the global economy and fraught with uncertainity. The Indian economy is also likely to feel the impact of the global flowdown. However, keeping in mind that this is a capital intensive and cyclical industry with long lags between investment decisions and their implementation, we have endeavored to present a holistic and long term view of the opportunities and growth areas available in the Indian context. In this regard, we have undertaken primary and secondary research, including a survey as well as individual meetings with industry leaders. We are grateful to key players and leaders in the sector, including manufacturers, service providers, Government agencies and companies who have provided us with their insight and understanding of the industry. We would also thank CII for giving us an opportunity to present the perspectives and opportunities for the sector in India and for their help in conducting the survey.

We believe that the slowdown presents an opportunity to invest & build infrastructure in this strategic sector. We trust this report would provide an insight to existing and prospective investors with regard to opportunities in India in aerospace manufacturing and MRO sector.

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Executive Summary

While activity in the Indian aerospace industry is primarily driven by Government/ Public Sector Units, the potential opportunities (public and private), in the “design to build” lifecycle are tremendous. India’s engineering workforce, its rapidly developing engineering services/R&D expertise and its geo-position in South East Asia, position it as a potential global hub for both manufacturing and MRO.

Drivers of the Global Aerospace Industry

PricewaterhouseCoopers' internal report Globalisation in Aerospace and Defence (January 2008) indicates that the global aerospace market was estimated at USD97 billion in 2007. This includes both commercial and defence aircraft requirements and does not take into account MRO expenditure made by airlines. Growth in the civil and military aviation sectors is the main drivers of the global aerospace industry. Long term projections and estimates by industry experts project growth in both sectors. The civil sector will expand as a result of increased travel in emerging market economies and the defence sector as a result of a heightened focus on military expenditure, given the global war on terrorism. The collapse of the US housing market and the ensuing financial crisis has caused an unprecedented global economic slowdown. In the current economic climate, it would be difficult to make long-term projections. However, it is widely acknowledged that the aviation sector is cyclical. In addition, considering that air travel has become an integral way of life in a highly globalised world and that the aerospace industry is an important component of countries' economies, experts believe that the market will strengthen once the global economy recovers.

The aerospace market supports industries such as Research and Development (R&D), manufacturing, operations, maintenance, and support for the military and civilian sectors. In this report, we focus on two of these: manufacturing and maintenance, since we believe these are the areas in which India has competitive advantages.

Aircraft maintenance includes complex activities, typically referred to as Maintenance, Repair and Overhaul (MRO).

Global Aerospace Manufacturing

According to PricewaterhouseCoopers research, the global aerospace market is dominated by US/EU based companies. Most of the leading companies are involved in the manufacture of commercial or defence aircraft.

- Manufacturing—The aerospace value chain is characterized by a long project life cycle spanning R&D, engineering design, manufacturing, assembly and aftermarket (spare parts and service). Intensive technical and safety requirements mandate significant investments in R&D and quality control by players in the aerospace industry. Aerospace OEMs are restructuring supply chains to address increases in raw material prices, a weakening US dollar, increasing demand from Asia and rising lead times.

- MRO—Aircraft maintenance includes complex activities, typically referred to as MRO. Maintenance is a major cost component of operating aircrafts and significantly affects the overall life cycle cost. In fact, maintenance costs incurred for a typical aircraft can exceed its initial procurement cost. On average, the aerospace industry spends more annually on MRO than on manufacturing or development. The MRO sector is typically divided into four major segments: airframe and modification, engine maintenance, line maintenance and component maintenance.

Indian Aerospace Industry

The Indian aerospace industry is one of the fastest-growing aerospace markets in the world with an expanding consumer base comprising airlines, businesses and High Net Worth Individuals. The rapid growth of this industry has attracted major global aerospace companies to India. All segments in the aerospace industry, including civil and military aviation and space, are showing a significant level of growth.

- India as a Manufacturing Destination—There are several factors driving growth in manufacturing in India's aerospace industry. These include both macro and micro factors - strong economic growth that has resulted in rapidly growing domestic aircraft demand, the liberalization of civil aviation policies, offset requirements, a strong domestic manufacturing base, cost advantages, a well-educated talent pool, the ability to leverage IT competitiveness and a liberal Special Economic Zones law that provides attractive fiscal benefits for developers and manufacturers. The challenges include access to technology, funding, poor availability and high cost of raw material and certification processes.
- India as a MRO Destination—As a support service to the aviation industry, the sector will grow with the industry. Additionally, the globalization of MRO services, manpower cost competitiveness, the availability of talent, locational advantages and the presence of specialist capabilities combine to make India a potential global/regional MRO hub. India's MRO segment is estimated to grow at 10 percent and reach USD1.17 billion by 2010 and USD2.6 billion by 2020. The main challenge in positioning India as an MRO hub comes from the indirect tax structure, specifically customs duties and service tax.

Tax and Policy Framework

India has a federal tax structure whereby both the Central and the State Governments impose a range of taxes. The Central Government levies income taxes on both corporate and individual incomes as well as indirect taxes such as customs duties, central excise and service tax. The State Government imposes other indirect taxes such as Value Added Tax (VAT) and the like.

The complex and multi-tiered tax structure in India makes domestic manufacturing uncompetitive in a range of situations. This is equally true of the defence sector where imported supplies of defence goods to MoD are subject to a lower incidence of taxes than locally supplied goods. The civil aerospace industry is similarly disadvantaged. There are tax incentives available for R&D and for economic activity in Special Economic Zones (SEZs) but these are limited and not broad-based enough to provide meaningful relief. Particular mention needs to be made of the indirect taxes on aircraft servicing in India. Customs duties, service tax and VAT all affect such activities and unless a significant overhaul of the present indirect tax regime is carried out, MRO activities in India will really not expand as they are capable of doing. This challenge needs to be addressed quickly.

On the whole, the Government encourages private investment in both the civil and defence aerospace sector with the goal of encouraging technology transfers and achieving indigenization. The Indian Government has significantly liberalized the civil aviation sector. It welcomes domestic private participation in manufacturing and R&D in the aerospace sector with 100 percent Foreign Direct Investment (FDI) allowed on the automatic route in most areas, the exceptions being air traffic services. The defence sector has more restrictions: while 100 percent domestic private investment is allowed, subject to licensing, in the manufacture of defence equipment, there is a cap of 26 percenton FDI (which is also subject to licensing requirements, and there are other restrictions as well).

Way Forward

In capital intensive sectors like Aerospace&Defence, Governments and industry bodies assume a crucial role in supporting the industry and encouraging the development of a critical mass of capabilities, technologies and suppliers

- Support from Government—The Indian Government has embarked upon several measures to develop and promote the aerospace sector. There remain areas, such as the licensing and SEZ policies, where there needs to be greater clarity in policy as well as easing and rationalizing some procedures.
- Support from Industry Bodies—Industry bodies in general have a crucial role in the creation and sustainability of an environment conducive to industry growth. Their role as mediators between the industry, Government and other stakeholders becomes even more important in the case of an emerging industry like aerospace. These bodies need to make integrated and focused efforts to develop a strong foundation for industry development.
- Regulations and Taxes—India's tax framework needs rationalisation and sector-specific incentives. Focused benefits similar to those that have been extended to other service sectors, such as IT and IT enabled services (ITeS), should also be extended to the MRO sector. These could include service tax exemption and custom duty rationalization, both within and outside an SEZ environment. The indirect tax structure actually works against domestic manufacturers as compared to foreign vendors as mentioned above in tax and regulatory framework. Its effect is to provide incentives for only sub-system and component manufacturing in India, with final assembly and supply being carried out outside the country. Thus, to support and catalyze growth in the Indian industry, the Government should rationalize taxes and provide incentives to companies in the aerospace and defence sector.

The India Opportunity

India is poised to become a large commercial and defense aircraft market. With rising passenger traffic and increasing military and defense expenditures, the demand for aircrafts is expected to increase. Boeing expects a demand of between 900 to 1,000 commercial aircraft worth USD100 billion approximately in the next 20 years. This also suggests that a significant portion of business opportunity could accrue to India, due to the associated offsets.

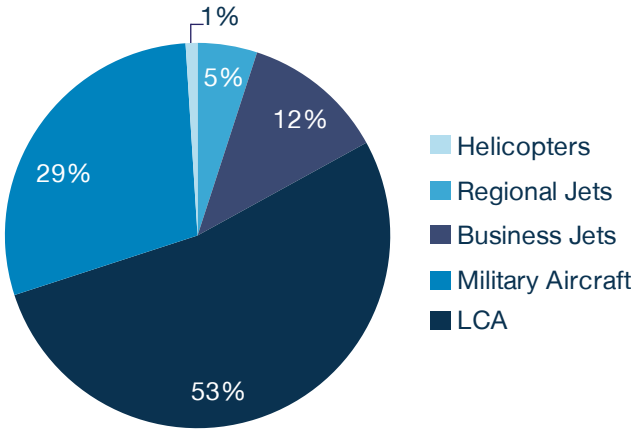
The defense offset policy has been under implementation and a formal civil offset policy is also expected to follow shortly. The total spending in the next 5 years is expected to be between USD25 billion (assuming uniform demand) for commercial aircrafts and USD100 billion as defense expenditure. Out of the defense expenditure, approximately 15-20 percent (USD15-20 billion) is expected to be spent on military aircrafts. Assuming an offset of 30 percent for the civil sector too, the total offset opportunity for the aerospace sector is valued to be at least USD10-15 billion. As Indian manufacturing capabilities mature over the years, it is expected to capture a large share of this opportunity.

Drivers of the Global Aerospace Industry

Growth of the civil and military aviation sectors is the main drivers of the global aerospace industry.

PricewaterhouseCoopers' internal report on Globalisation in Aerospace and Defence indicated that the global aerospace market was estimated at USD97 billion in 2007 including both commercial and defence aircraft requirements and that this was expected to increase. This did not include the MRO expenditure made by airlines.

Global Aerospace Market, 2007 (USD 96.6 billion)



Source: PricewaterhouseCoopers research

The key drivers of the global aerospace industry are the civil and military aviation sectors. It has been observed that:

- With increasing military budgets in most countries, orders for military aircrafts have been on the rise.
- The market share of business jets and helicopters is steadily increasing in emerging economies despite the temporary slowdown in US orders due to the recession.
- The market for regional jets would increase in emerging economies and this segment is expected to witness the entry of new businesses.

Air travel is correlated with wealth, rising incomes and global GDP growth. Increased air travel has been noticed in the emerging market economies of India, China and the Middle East, which present robust promise for the civil aviation sector. India and the Middle East are regulated and may need to ease norms in order to promote industry development. Other factors leading to civil aviation growth include international trade, globalization, declining airfares, additional travel routes and increased flight availability.

The global economy is today on the brink of a major slowdown as the key economies of the USA, Europe and Japan slide into recession.

IMF GDP Growth Projections (Y-O-Y percent)		
Country/Region	2008	2009
US	1.4	-0.7
Euro Area	1.2	-0.5
UK	0.8	-1.3
Japan	0.5	-0.2
China	9.7	8.5
India	7.8	6.3

IMF World Economic Outlook November 2008 (Update)

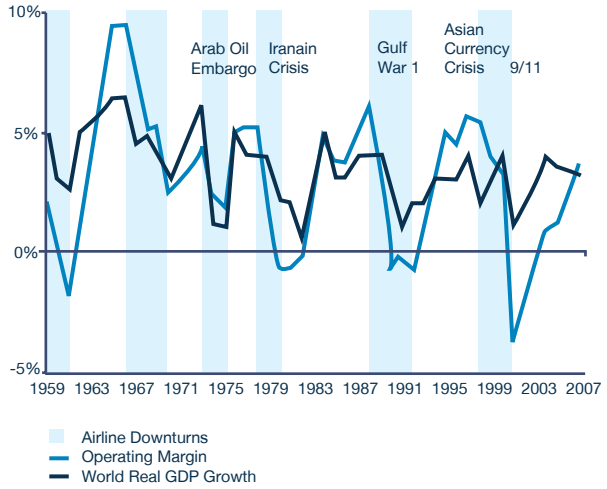
The IMF predicts that this scenario is likely to continue in 2009 (see table below).

Some aerospace analysts expect that the global financial crisis would lead to a decline in aerospace services and that a consolidation in the industry would lead to the dominance of a few, large airlines.

The International Air Transport Association (IATA) has said that global losses for the aerospace industry are likely to continue in 2009. Media articles quoted IATA Director General Giovanni Bisignani as saying, “Recession is by far the biggest threat facing the airline industry. It is more concerning [than high oil prices] because it is the first truly global recession the airline industry has faced. Never will we have seen revenues go down so dramatically.” Airline revenues in 2009 will decline by USD36 billion year-over-year to USD500 billion, according to IATA.

Analysis by Boeing that spans over 50 years reveals that the best indicator of aviation industry performance is world Gross Domestic Product (GDP). The Boeing study shows that airline downturns typically coincide with worldwide economic slumps; conversely, airline operating margins improve as world GDP recovers. This can be seen from the graph below.

Correlation Between the Airline Industry and World Gross Domestic Product Growth



Source: Boeing Research, March 2007

Other issues confronting the global civil aviation sector include:

- High levels of competition within various sectors (for example, low cost carriers)
- Cost cutting (eg., reducing amenities on commercial flights, such as in-flight meals and other services, selling meals instead of providing them, etc.)
- A focus on innovation and manufacturing performance
- Capacity reductions
- Regional delays, cancellations or reductions in new aircraft spend
- Fluctuating aviation fuel prices
- Demographic changes and availability of alternative travel modes.

Given the present state of the world economy and of the industry, it is difficult to make long-term projections. However, industry experts believe that the market will rebound with the reversal of the current economic cycle.In particular:

- The IMF predicts a gradual recovery in global GDP growth early 2010.
- The International Civil Aviation Organization (ICAO) expects the industry to recover by 2011.
- Growth from the emerging markets, most notably India and China (i.e. the two major economies exhibiting positive growth during the current global recessionary phase), is likely to drive demand for air transportation in the Asia-Pacific region. Boeing research notes that Asia, in particular India and China, which accounted for 5 percent of world GDP and operated 5 percent of the global commercial airplane fleet in 1970, had grown to 17 percent of world GDP. According to growth projections, the region is expected to represent a quarter of global GDP by 2012 and to operate 24 percent of the world’s commercial fleet.
- The impact of the current global recession is likely to be moderated by a decline in crude oil prices. These have fallen by nearly 75 percent since touching a

record high of USD145 per barrel in July 2008, mitigating the damage to the airline industry's profits and providing scope for price adjustments to make travel more economical.

- Increased military expenditure by governments, given the global war on terrorism, the desire to protect national borders and the goal of strengthening current defence capabilities will provide a strong demand side pull.

In the next section, we outline the various segments of the aviation industry to establish how each could contribute to the recovery of the overall industry.

Civil Aviation - Segment overview

Civil aviation comprises four main segments: commercial airplanes, business jets, air cargo, and helicopters. An overview of these segments is presented below.

Commercial Airplanes

According to Boeing's report entitled Current Market Outlook 2008-2027, the commercial airplane market is expected to represent USD3.2 trillion by 2027 with the Asia-Pacific market accounting for almost 37 percent of this. Boeing predicts that Asia-Pacific will be the largest air transport market with 45 percent of air travel being to, from or within the region. Overall, the commercial airplane market will grow at a rate of 3.2 percent with the air cargo segment growing faster than passenger traffic. The fastest growing economies will lead the change to a more geographically balanced market.

Demand by Region— Future Market Value and Airplane Deliveries		
Region	USDB	Airplanes
Asia Pacific	1190	9160
North America	740	8550
Europe	740	6900
Middle East	260	1580
Latin America	140	1700
CIS	70	950
Africa	60	560
Total	USD3.2T	29,400

Source: Current Market Outlook 2008 2027,Boeing

Market Growth Rates (CAGR) from 2007-2027	
World economy (GDP)	3.2%
Number of airplanes in service	3.2%
Number of passengers	4.0%
Airline traffic	5.0%
Cargo traffic	5.8%

Source: Current Market Outlook 2008-2027, Boeing

World Demand for Air Transport Fleet, 2016	
Air Transport Fleet	27,000

Source: AeroStrategy

Business Jets

Despite global economic conditions, the manufacture of business jets is likely to witness only a marginal decline due to long lead times in production and a large backlog of orders. Forecast International's study titled The Market for Business Jet Aircraft expects that annual business jet production will reach 1,400 units in 2008 and exceed 1,600 units in 2009. The study projects that the annual production of business jets will decline for three years dropping to 1,515 units by 2012. Growth is expected to resume in 2013, with yearly production exceeding 1,700 units by 2017. Forecast International projects that 15,936 business jets worth USD223 billion will be produced from 2008 to 2017. This total includes 5,600 Very Light Jets.

Air Cargo

The growth of air cargo is closely linked to GDP growth. Other growth drivers include export promotion, new trade relationships, deregulation, open sky agreements and express logistics business growth. Factors that can impede this segment's growth include trade barriers, oil and fuel prices, terrorist attacks, surface competition and industry relocation.

The current slowdown in the U.S. economy led to a decline in the global air freight movement. According to the 2008 OAG Global Air Freight Forecast, once the world economy rebounds, the international air freight market is expected to grow at an average annual rate of 6.1 percent till 2017. The report also predicts that rapid growth is likely to occur in the Middle East and in Africa. China's growth rate will be third behind these two, and the trade lane between China and North America will be the largest global market for air freight.

Helicopters

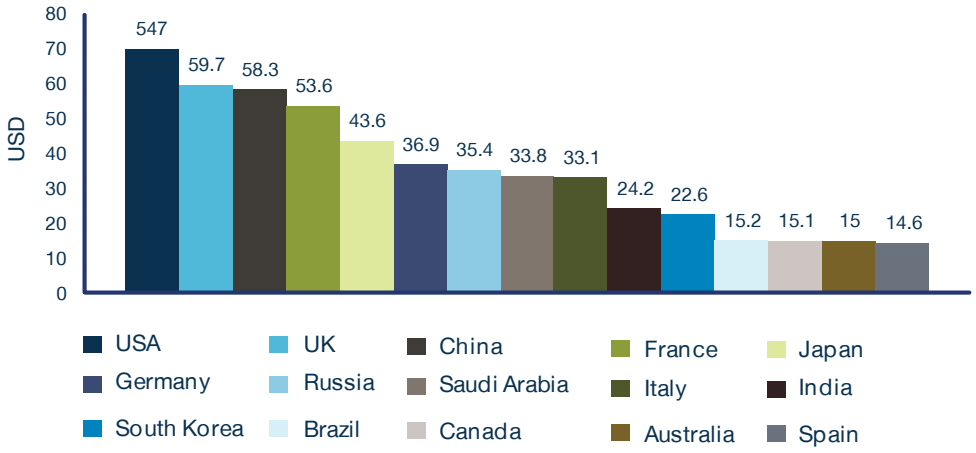
Due to increasing demand, global sales of helicopters are increasing. Honeywell's Turbine-Powered Civil Helicopter Purchase Outlook projects deliveries of approximately 4,450 new civil use helicopters during 2008 to 2012, driven by strong demand for light single and intermediate twin-engine models offering newer technology. Corporate, emergency medical services and law enforcement helicopters combined are expected to account for over 65 percent of all new civil rotorcraft sales during the five-year forecast period.

Military Aviation—Worldwide military expenditure will increase due to the global war on terrorism and an increased focus on the protection of national borders.

According to a white paper by Petter Stålenheim, Catalina Perdomo and Elisabeth Sköns and research from Stockholm International Peace Research Institute (SIPRI)—

- Since 2001, US military spending increased by 59 percent in real terms, due mostly to spending on military operations in Afghanistan and Iraq, and also to increases in the base defence budget.
- World military expenditure in 2007 was an estimated USD1339 billion, a real-term increase of 6.0 percent since 2006.
- From 1998 to 2007, world military spending increased by 45 percent in real terms.
- Military spending in 2007 was 2.5 percent of world Gross Domestic Product (GDP) and USD202 per capita.
- The top five countries with the highest military expenditure in 2007, according to market exchange rate terms and purchasing power parity terms, were the US, the UK, China, France and Japan. India was in tenth place with a military budget of USD24.2 billion.
- India's military expenditure, which accounts for 80 percent of South Asia's total, increased by 3 percent in real terms in 2007. The average annual growth rate from 1998 to 2007 was 6 percent.

Military Expenditure - Countrywise



(Source: The 15 Major Spender Countries in 2007, SIPRI 2008)

The global war against terrorism and security considerations will continue to drive increases in military expenditure. However, it remains to be seen how defence spending in the US will be affected by a change in leadership.

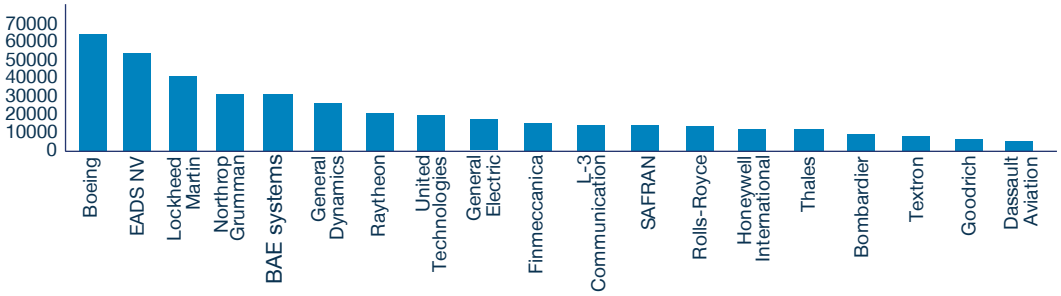
The Global Aerospace Industry

The aerospace industry is an important source of employment, generates robust revenues and is an important contributor to Governments' exchequers. In most industrialized countries, the aerospace industry is a cooperation of public and private industries with Governments being the largest investors and customers.

Key Players

Most of the leading players are involved in the manufacture of commercial and defence aircraft. In addition to the civil industry, large countries like the US are their major customers. For example, the Department of Defence (DoD) and the National Aeronautics and Space Administration (NASA) are the two largest consumers of aerospace technology in the USA. Similarly, the European Space Agency is a major customer for companies operating in the European Union. The FY 07 revenues, and brief descriptions, of select leading global businesses are presented below.

Leading Aerospace Players



FY-07 Revenues (Source: Company Websites, PwC Research)

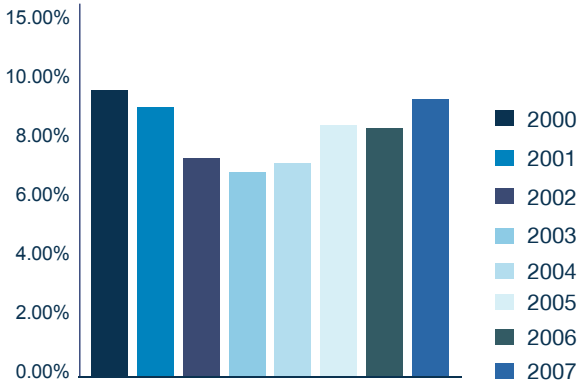
Selected Major Aerospace Players			
Companies	Country	2007 Revenue (USD mn)	Description
Boeing	USA	65, 466	Boeing designs and manufactures rotorcraft, electronic and defence systems, missiles, satellites, launch vehicles and advanced information and communication systems. As a service provider to NASA, Boeing operates the Space Shuttle and International Space Station. The company also provides military and commercial airline support services
EADS	Netherlands	54, 202	The company has five major segments: • Airbus • Military Transport Aircraft • Eurocopter • Defence and Security • Astrium
Lockheed Martin	USA	41,862	Lockheed Martin focuses on research, design, development, manufacture, integration and projection of advanced technology systems, products and services. Major business areas are Aeronautics, Electronic Systems, Information Systems and Global Services Space Systems.
Northrop Grumman	USA	32, 018	Northrop Grumman provides products, services, and integrated solutions in information and services, aerospace, electronics, and shipbuilding. Northrop Grumman participates in defence and commercial technology programs in the U.S. and in other countries.
BAE Systems	UK	31, 444	BAE Systems is a global defence and aerospace company delivering a range of products and services for air, land and naval forces. The company also offers services in advanced electronics, information technology and customer support. Its main lines of businesses are: Electronics, Intelligence & Support, Land & Armaments, and Programmes & Support, etc.

Source: Company Websites, PwC Research

The annual Top 100 survey by Flight International, in association with PricewaterhouseCoopers, revealed —

- The world's largest 100 manufacturers grew their business in 2007; revenues increased by 13 percent and profits by 26 percent (after restatements and including acquisitions).
- Average operating margins of almost 9.5 percent in 2007 were the highest since the previous peak in 2000, just before the World Trade Center attacks. By 2003, operating margins had decreased to 6.9 percent.
- The reasons for expanding order books include the high demand experienced by OEMs for widebody and narrowbody airlines.
- Capacity issues, difficulties in hiring skilled staff and challenges in adding production facilities are major constraints.

Average Operating Margin of Top 100 A&D Companies



Source: PricewaterhouseCoopers (Flight International, August 12 to 18, 2008)

Engines (Civil and Military)				
Sector Rank	Company	Division	Sales(USD million)	
			2007	2006
1	General Electric	Aircraft Engines (excl Smiths est)	15,429	13,017
2	United Technologies	Engines (Pratt & Whitney)	12,129	11,112
3	Rolls-Royce	Civil Aerospace and Defence	10,711	9,832
4	Snecma	Propulsion (Air & Space)	7,601	5,930
5	Honeywell International	Aerospace (estimates)	5,290	5,006
6	MTU		3,563	3,059
7	IHI	Aero-Engines & Space Operations	2,696	2,504
8	Avio	Aeroengines	1,697	1,376
9	Volvo	Aero	1,131	1,116
10	ITP		611	551

Source: PricewaterhouseCoopers, Flight International (August 12 to 18, 2008)

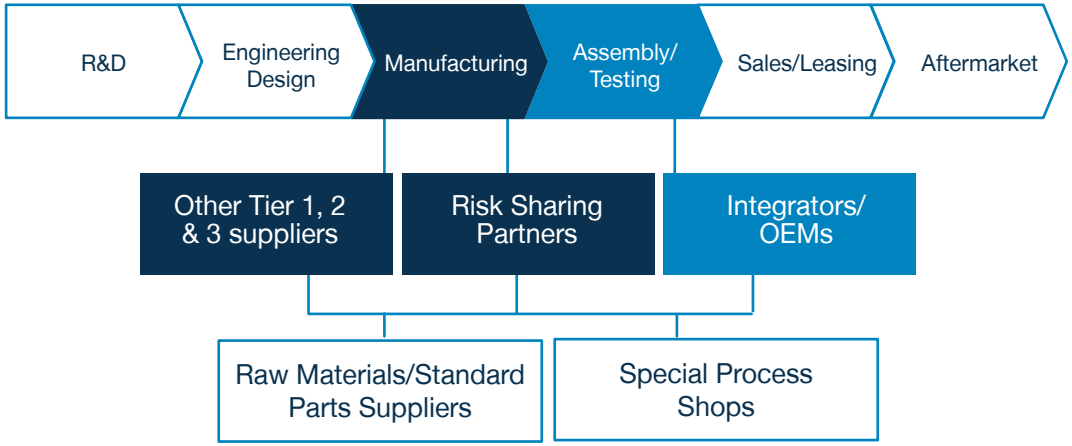
Top Defence Contractors, 2008		
Rank	Company	Sales (USD million)
1	Lockheed Martin	38, 513
2	Boeing	32, 080
3	BAE Systems	29, 800
4	Northrop Grumman	24, 597
5	General Dynamics	21, 520
6	Raytheon	19, 800
7	EADS	12, 239
8	L-3 Communications	11, 239
9	Finmeccanica	10, 601
10	United Technologies	8, 761

Source: www.defencesnews.com

Sales of Commercial Aircraft			
Sector Rank	Company	Sales(USD million)	
		2007	2006
1	Boeing	33,386	28,465
2	Airbus (excl ATR)	32,684	29,876
3	Bombardier	9,713	8,296
4	Cessna	5,000	4,156
5	Gulfstream	4,828	4,116
6	Embraer	4,215	2,935
7	Hawker Beechcraft	3,464	3,095
8	Dassault Aviation	2,577	2,045
9	ATR	1,100	700

Source: PricewaterhouseCoopers, Flight International (August 12 to 18, 2008)

The Aerospace Manufacturing Value Chain



The Aerospace Manufacturing Value Chain—The capital-intensive aerospace manufacturing industry is characterized by a high focus on technology.

The aerospace value chain is complex and is characterized by a long project life cycle spanning R&D, engineering design, manufacturing, assembly and aftermarket (spare parts and service), as shown here:

Intensive technical and safety requirements necessitate significant investments in R&D and quality control by companies in the aerospace industry. In the past, R&D investments were made by large manufacturers in the US and Europe and they consequently acquired significant industry expertise and proprietary technologies.

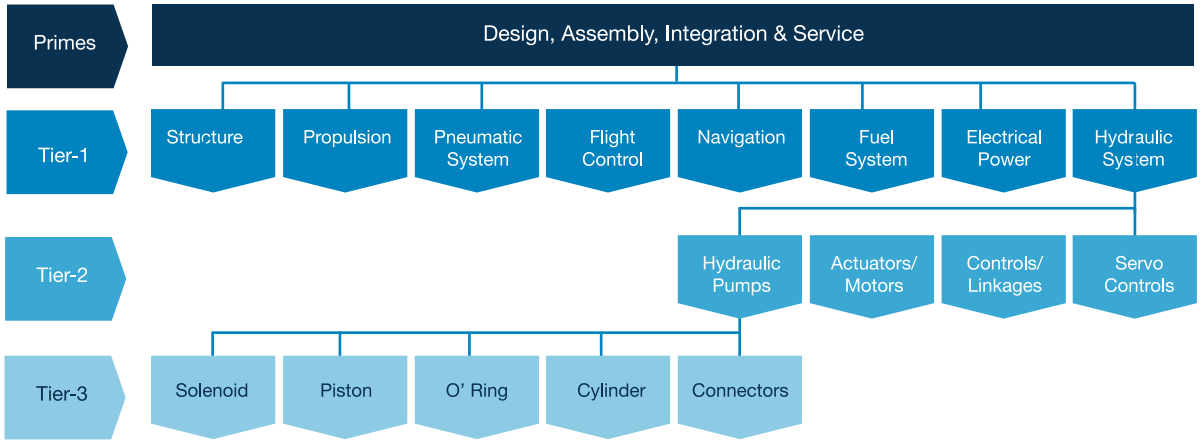
Aerospace&Defence OEMs are moving from vertically-integrated manufacturing to design and systems integration.

The manufacturing and assembly function is a critical component of the value chain and has high entry barriers in terms of both cost and technology. In the past, OEMs followed a vertically integrated manufacturing approach with participation at each level of the design, development and manufacturing process.

This industry structure has changed into a tier-based system of suppliers participating at each stage, as explained below.

- The prime integrators, such as Boeing and Airbus, retain complete control of the programme including design, selection of suppliers, detailed development and manufacturing of critical equipments and final assembly. These integrators may also be responsible for servicing the assembled aircraft.
- Tier-1 vendors maintain responsibility for providing equipment and systems to the primes. This includes design, assembly, services and the assumption of technical and financial risk.
- Tier-2 vendors manufacture and develop the required parts according to the specifications provided by OEMs and Tier-1 vendors. Tier-2 vendors' product portfolios may also include the provision of aftermarket components and services.
- Tier-3 vendors are responsible for the supply of basic products and components to vendors that are higher up the hierarchical order.

The chart below illustrates the role of different participants for a commercial aerospace program.



Source: PricewaterhouseCoopers' Globalisation in Aerospace and Defence (30 January 2008)

The aftermarket industry involves the maintenance and upgrading required for an airplane, after it leaves the factory. Manufacturers of aftermarket components are either OEMs or third-party vendors supplying reverse engineered PMA parts. Aftermarket is a large market in the aerospace industry requiring a wide range of parts of different qualities and prices.

Transformation of the Aerospace Supply Chain— Increasing outsourcing to low cost manufacturing locations.

A second change that the industry is witnessing is that aerospace OEMs are restructuring supply chains to address increases in raw material prices, changing global and economic conditions, increasing demand from Asia and rising lead times. This has led the OEMs to:

- Work with low cost manufacturers in emerging markets in India China & Brazil
- Maintain a supplier base that is spread around the world
- Share the risk of development with the suppliers

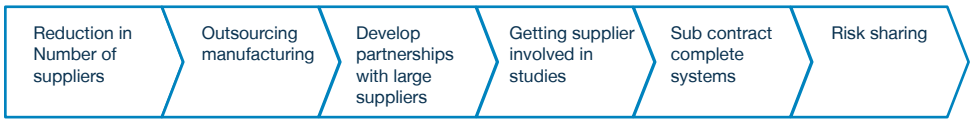
In deciding whether or not to outsource, aerospace majors evaluate several criteria. These include—

- Expertise—Supplier expertise to reduce costs and improve quality
- Growth—To be accelerated through buying capabilities rather than building internal capabilities
- Scale—Leverage supplier scale to reduce airline costs
- Labour costs—Access suppliers that face lower labour rates
- Investments—Leverage supplier investments in hardware and expertise to reduce airline investments

Primes have also started developing relationships with large Tier-1 suppliers whom they can trust. OEMs expect these suppliers to embark upon the same long-term relationships with their suppliers from lower tiers. These relationships are critical since larger and more complex programmes require very large investments in terms of capital and skills in the initial development stage. Typically, the same suppliers act as partners with primes from conceptual research to the detailed development of parts.

As primes develop strong relationships with their core group of Tier 1 suppliers, they begin to hand over responsibility for complete systems, including the management of sub-suppliers. For example, Kawasaki Heavy Industries has been made responsible for the forward fuselage on the Boeing 787. This chain of command enables primes to push costs and associated risks down the supply chain.

The primes have furthermore moved to a system where the suppliers are expected to share the risks of design and development. Investment by the suppliers in years 0 to 2 of an overall cycle of four years is a common practice observed in the industry. In case of A380, it is estimated that 30 percent of the development costs have been borne on a risk sharing basis. The diagram below illustrates these dynamics.



Source: PwC Research

The Global MRO Sector—Maintenance costs are a major cost component of operating aircrafts and significantly impact the overall life cycle cost.

Aircraft maintenance includes complex activities, typically referred to as MRO. On an average, the aerospace industry spends more annually on MRO than on manufacturing or development activities.

The timeframes for maintenance procedures are based on several factors, such as the hours the aircraft flies, the number of take-offs and landings, the age of the aircraft, etc. Given the labour intensive nature of MRO, several leading MRO companies, OEMs and international airlines have outsourced heavy maintenance work.

While regular checks are mandated primarily for safety reasons, they also lead to:

- Reducing maintenance costs
- Identifying performance gaps
- Improving turnaround
- Increasing aircraft utilization
- Improving efficiencies
- Enhancing reliability
- Ensuring operational integrity

The MRO sector is typically divided into four major segments which include—

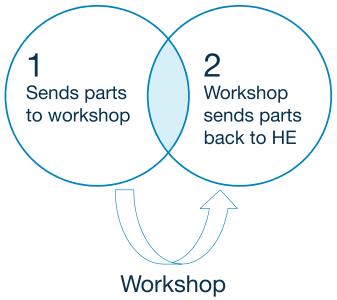
- Airframe heavy and modification
- Engine maintenance
- Line maintenance
- Component maintenance

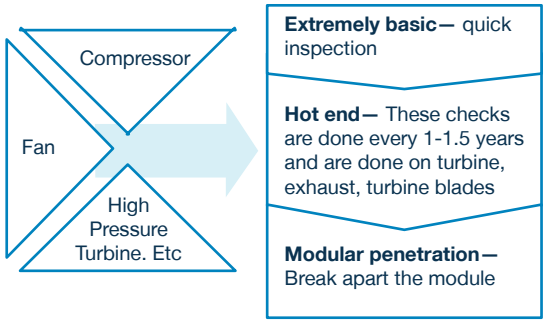
Prior to any check, a series of other items such as planning, design, documentation management, inventory management, sourcing and production planning need to occur.

Airframe	Engine	Component
Stage 1: Line maintenance—Line engineer (LE) checks aircraft and clears what is possible (except for non-critical flight items). The LE works on a smaller list of items. LE is a certified mechanic who has license from local governing authority and through the airline employer. LE is licensed to work on A (Airframe), C (Combustion), E (Electrical), I (Instrumentation) and/or R (Radio). A and B checks are typically performed here.	• Engine has its own value chain and is broken into modular parts • Each module can then be spilt into further parts	• Comprised of several components • Each component has its own value chain, based on complexity

Proceed to Stage 2 for MRO activities which LE cannot fulfill

Stage Two: Heavy maintenance—These activities range from removing select components to stripping the aircraft. Work is completed by the hangar engineer (HE). The HE has more in-depth expertise than the LE. The HE is a licensed engineer and can send parts to workshops for specialists to work on them. Once received from the workshop, the HE puts them back in the aircraft. C and D checks are typically performed here.





- Seats
- Carpets
- Oxygen
- Wheels
- Landing gear
- Flight entertainment systems
- Etc

Heavy Maintenance which encompasses structural modifications, landing gear repair, engine changes and regular calendar checks, is expected to grow from USD9 billion to over USD13 billion by 2017. More than 65 percent of the cost of heavy maintenance is labor. The use of composites in new aircraft frames could help reduce the costs of heavy maintenance.

Engine Maintenance includes dismantling, inspecting, assembling and testing aircraft engines and is the largest MRO segment. Engine maintenance comprises 35 percent of maintenance expenditure, and is expected to increase from USD17 billion to over USD26 billion by 2017. More than 60 percent of the cost of engine maintenance is materials, with labor accounting for 22 percent.

Line Maintenance is very labor-intensive and corrects problems with the aircraft. Issues can vary from minor and major aircraft checks and repairs. While only 15 percent of line maintenance is currently outsourced, the service has the potential to grow.

Component Maintenance is forecast to grow from USD8 billion today to over USD11 billion by 2017. Approximately 70 percent of component maintenance is currently outsourced.

While approximately 70 percent of the MRO market is based in North America and Western Europe, there is a possibility of a shift towards the emerging market economies in the Asia Pacific region. Over the next 20 years, almost 40 percent of air traffic will be to, from or within the Asia Pacific region. The most significant MRO growth will be witnessed in Asia.

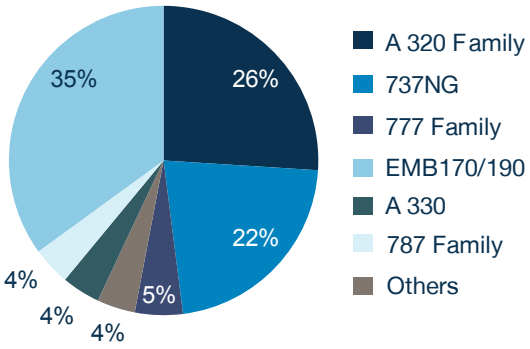
Global spending on MRO services for air transport aircraft amounted to USD46 billion in 2007, according to AeroStrategy. The air transport MRO market is expected to reach USD61 billion by 2017, representing a CAGR of 3.1 percent from 2007.

AeroStrategy expects that growth in the global demand for MRO services will be driven by growth in the air transport fleet. This is projected to grow to 28,000 aircraft by 2017. The fleet is mostly made up of two types of aircraft, the A320 and B737 families; these account for 48 percent of the fleet.

Fleet Growth—2007 to 2017		
2007	Installed Base	18,935
2017	Future Orders	6,130
	Firm Orders	7,310
	Parked Fleet	200
	Installed Base	28,000

Source: AeroStrategy

2017 Air Transport Fleet(28,000)



Source: MRO--The Next Decade (2008), AeroStrategy

One study estimates that MRO outsourcing will increase from 52 percent in 2006 to nearly 65 percent by 2016. Some interesting trends are emerging with increasing MRO outsourcing:

- The formation of non-traditional vendor partnerships to outsource non-core processes—Several third-party vendors are providing maintenance outsourcing services that remove from aircraft carriers activities that were once undertaken by internal staff.
- The development of cost-cutting applications—Close partnerships are developing between manufacturers and end-users. The exchange of information and resources enables them to pursue common goals, such as reducing costs, increasing efficiency and extending product life. These partnerships, in addition to reducing costs, open communication channels, increase customer satisfaction, improve product development and enhance service delivery.
- The focus on innovation—MRO customers are increasingly demanding that MRO players provide them with speed, quality, cost savings and reliability. This focus on cost, value of services and innovation will only intensify given the rise in the number of MRO players and the consequent increased competition.

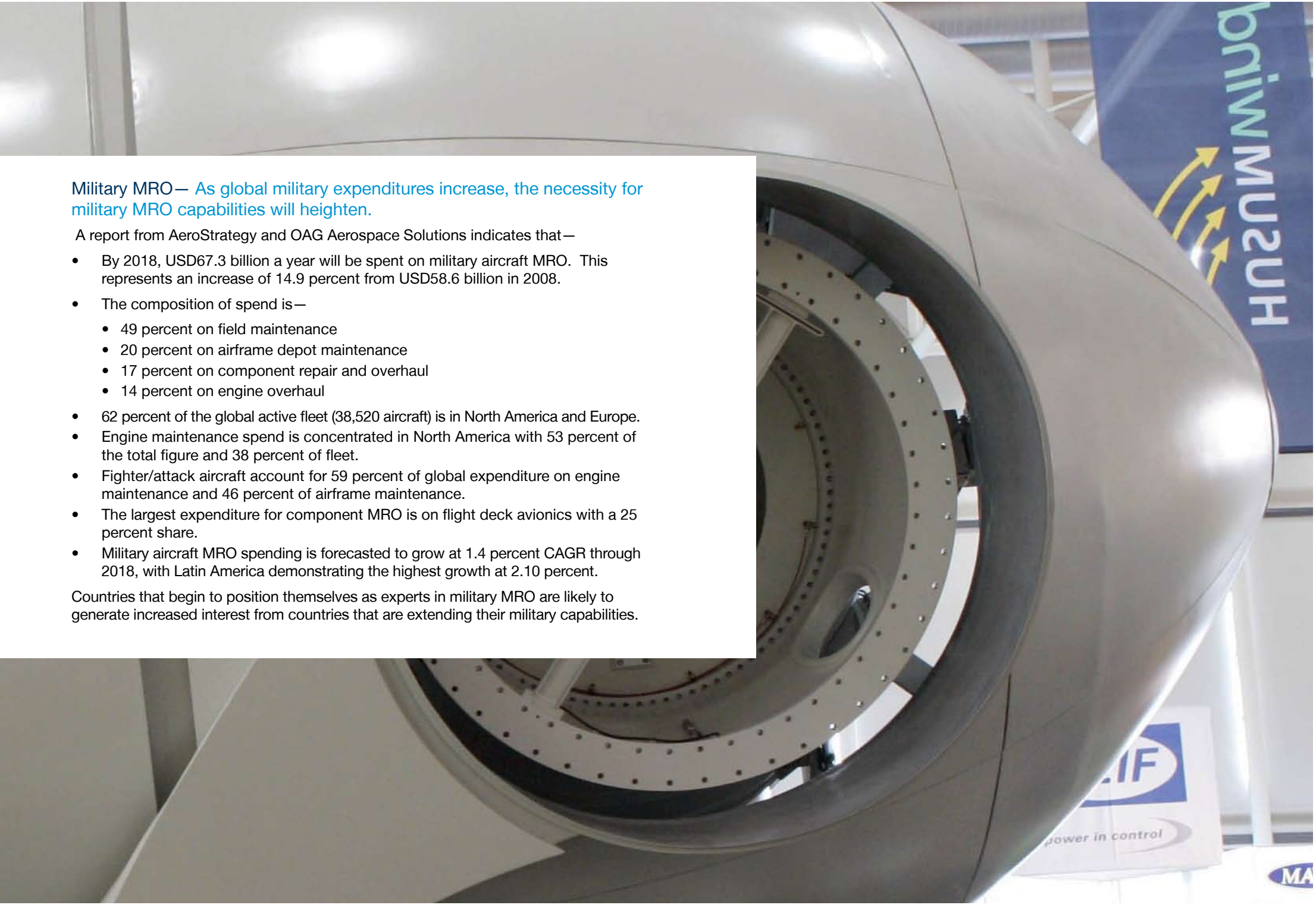
Other findings/projections from the AeroStrategy report include:

Commercial MRO Market by Region, 2006-2016

- Total MRO spend in 2006 was USD40.8 billion.
  - North America is the largest market, accounting for 39 percent or USD15.4 billion
  - Western and Eastern Europe account for 28 percent of spending
  - Asia—Asia Pacific, China and India combined—represent 22 percent or USD9.3 billion the overall market
- The Middle East will have the fastest MRO growth; the most substantive growth will be in Asia (an increase of USD5.6 billion).
- The Middle East, Latin America and Asia will grow by CAGRs of 8.9 percent, 6.4 percent and 4.9 percent respectivley.

Air Transport MRO Spend by Segment, 2006-2016

- Engine and component maintenance are estimated to have the highest CAGRs at 4.5 percent and 4.0 percent respectively.



Military MRO— As global military expenditures increase, the necessity for military MRO capabilities will heighten.

A report from AeroStrategy and OAG Aerospace Solutions indicates that—

- By 2018, USD67.3 billion a year will be spent on military aircraft MRO. This represents an increase of 14.9 percent from USD58.6 billion in 2008.
- The composition of spend is—
  - 49 percent on field maintenance
  - 20 percent on airframe depot maintenance
  - 17 percent on component repair and overhaul
  - 14 percent on engine overhaul
- 62 percent of the global active fleet (38,520 aircraft) is in North America and Europe.
- Engine maintenance spend is concentrated in North America with 53 percent of the total figure and 38 percent of fleet.
- Fighter/attack aircraft account for 59 percent of global expenditure on engine maintenance and 46 percent of airframe maintenance.
- The largest expenditure for component MRO is on flight deck avionics with a 25 percent share.
- Military aircraft MRO spending is forecasted to grow at 1.4 percent CAGR through 2018, with Latin America demonstrating the highest growth at 2.10 percent.

Countries that begin to position themselves as experts in military MRO are likely to generate increased interest from countries that are extending their military capabilities.

India’s Aerospace Industry

The Indian aerospace industry is one of the fastest-growing aerospace markets in the world with airlines, corporates and HNIs placing orders for an increased number of aircraft.

Historical Perspective—The Indian aerospace industry has historically been dominated by large Public Sector Units (PSUs).

The figure below illustrates the key milestones in the development of the Indian aerospace sector.

- The first aircraft company, Hindustan Aircraft Limited, was established in 1940 by Seth Walchand Hirachand. This company later merged with Aeronautics India Limited and Aircraft Manufacturing Depot, Kanpur to form India's largest aerospace major, Hindustan Aeronautics Limited (HAL). HAL is a prominent Government controlled entity and maintains 19 production units and 9 R&D centers in seven locations. HAL has been involved in several R&D programs for both defence and civil aviation and has assumed a significant role in India's space programs.
- In 1942, the Indian Institute of Science (IISc), India's premier centre for research and postgraduate education in science and engineering, offered a two-year Post Graduate course in Aeronautical Engineering.
- In 1948, the Aeronautical Society of India was established to integrate engineers, professionals and industrialists towards a common goal of furthering the growth of the aerospace sector in India.
- In 1958, Defence Research & Development Organization was formed with the merging of the former Technical Development Establishment (of the Indian Army) and the Directorate of Technical Development & Production and the Defence Science Organization. Today, the organization has a network of over 50 laboratories which are engaged in developing defence technologies covering disciplines like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, and special materials.
- In 1959, National Aerospace Laboratories (NAL), Bangalore was formed as a constituent institution under the Council of Scientific and Industrial Research of India (the premier industrial R&D organization in India constituted in 1942). It followed a decade of remarkable consolidation, facility build-up and created R&D divisions in diverse areas of aeronautics. By the mid-1970's, NAL was a major player in Indian aeronautics and one of CSIR's best-managed national laboratories. With the approval of India's Light Combat Aircraft (LCA) project in 1983, NAL strengthened its presence as a major player in the Indian aerospace industry. India's space programme also attained a significant level of maturity during this decade.

India—At-A-Glance

Burgeoning Economic Growth

- 9% GDP growth in 2007-08
- USD1 trillion economy—4th largest (PPP)
- USD25 billion FDI in 2007-08

Enviable Demographics

- 500 million under 25 years—Youngest nation
- 250 million strong and growing middle class
- 71 million joining workforce by 2010
- 882 million—Working age population in 2020
- 4th largest in terms of number of billionaires
- Established education system and prevalence of English language

Dynamic Democracy

- Government Type—Federal Republic
- Indian Union—28 states, 7 Union Territories
- Smooth transition of Government

Prior to 2001, the aerospace and defence industries were exclusively reserved for PSUs. Consequently, these PSUs have grown tremendously by developing and acquiring new technologies and entering into the manufacture of indigenous aircraft.

Over the years, these PSUs have also helped a number of industries (large and small) to acquire technologies, technical and managerial processes, better quality standards, infrastructure and facilities, networking etc. This has helped the industry enhance its capabilities through exposure to flexible and modern manufacturing methods while simultaneously reducing the tolerance for cost and time overruns. In addition, several private sector groups such as Tata's, Larsen and Toubro, Mahindra and Mahindra, Kirloskar's and a large number of smaller companies have been supplying limited parts and equipment to the armed forces and the PSUs.

In 2001, the Government allowed 100 percent domestic private investment in the defence sector upon obtaining an Industrial Licence (IL) and FDI of up to 26 percent with conditions. Allowing private investment has begun to attract a number of Indian companies into the sector.

The introduction of the defence offset policy in 2006 and significant liberalization in 2008 has provided significant opportunities for Indian companies entering the sector. New players are entering the industry and are aggressively building capabilities to make them attractive partners for the primes and Tier-1 suppliers. Foreign companies are also showing interest in establishing their presence in India.

The Indian aerospace industry is one of the fastest-growing aerospace markets in the world with HNIs, corporates and airlines placing orders for an increased number of aircraft.

The rapid growth of this industry has attracted global aerospace majors to India. All segments within aerospace are showing tremendous growth, including civil aviation, military aviation and Space research:

- Civil aviation— In 2007 and 2008, India assumed the ninth position in the world's civil aviation market, an increase from twelfth place in 2006. India's air passenger travel has been growing at almost 25 percent a year. According to Government estimates, growth in this sector will outpace the global average until 2025.
- Military aviation—Secondary research indicates that India will spend about USD35 billion on military aviation over the next 20 years because most of its existing fleet needs to be replaced. The Indian Army has projected a figure of 500 helicopters and is in the process of finalizing the purchase of 197 helicopters.
- Space—India is one of the six countries in the world that undertakes Space launches. The Indian Space Research Organization (ISRO) under the Department of Space, Government of India, implements the Indian space programme involving the development and operation of satellites, launch vehicles and ground systems, for carrying out research and applications related to communications, remote sensing, meteorology and space sciences. India's 2008–09 budget allocated a 16 percent increase in science spending from the previous year. The 2008–09 budget also includes an increase in funds for manned space missions. The total science budget is over USD6 billion, compared with the previous year's budget of USD5 billion.

Massive investments in all areas of the sector need to be made for India to actualise its potential. The Ministry of Civil Aviation had announced that the Indian aerospace industry needs investment of between USD200 to 300 billion over 2009-2034. The Ministry has pledged its support toward the growth of the aerospace industry through regulatory support and infrastructure development.

The Government recognizes the need to begin creating, modernizing and upgrading Indian airports. Over the next five years, the Airports Authority of India (AAI) has planned a USD3.07 billion investment towards this endeavor.

In terms of the availability of aircraft, Boeing estimates that India needs 856 airplanes, worth USD72.6 billion in the next 20 years, to meet air travel demand.

Software constitutes an integral and increasingly important component of aerospace applications. Given India's IT and software strengths, the country is developing into an aerospace-IT hub. The Government of India's offset programme is also expected to allow new opportunities for IT vendors since for every defence contract worth INR300 crore or more, foreign vendors will need to source components or systems from Indian companies through joint ventures or direct purchase of a minimum of 30 percent of the deal value.

Selected trends emerging in Indian aerospace include—

- An increase in private owned airlines plus increase in HNI, Corporate Jets, helicopters
- Increased outsourcing/manufacturing activities occurring in India
- The Government's easing of regulatory norms that would further increase the pace of activity in Indian aerospace
- An increased defence acquisition programme over the next 10 years

To expedite expansion in Indian aerospace, State Governments have also taken several initiatives—

- The Tamil Nadu Government plans to establish an aero park for global aerospace and aeronautics industry in the areas of design, manufacture and maintenance of aircrafts. The park will be similar to those in Dubai, China and Singapore.
- The Andhra Pradesh Government unveiled plans for two aerospace and precision engineering Special Economic Zones (SEZ) in the state. The Tata Group and 50 local industries propose to establish their units in first of the two SEZ.
- The Karnataka Government has not taken any initiatives so far. Currently, only private sector SEZ has been set up by Quest Global in Belgaum. Bangalore International Airport Ltd. (BIAL) is also coming up with an Aerospace SEZ (1000 acres) near Bangalore but without any Goverment support.

Indian Aviation—High rates of growth, increased market liberalization, regulatory approval for airport privatization, and travel into and within India are driving the civil aviation sector.

The Indian aviation industry is one of the fastest growing civil aviation industries in the world. With the liberalization of the Indian aerospace sector, the industry has evolved from a predominantly Government-owned industry to one with a growing number of privately owned airlines, low-cost carriers and international carriers that have increased flight routes to and from India. Private airlines account for 75 percent share of the domestic aerospace market. 2007 was a landmark year for India's civil aviation sector—

- Passengers carried by domestic airlines increased by 27.9 percent (to 64.9 million passengers) in the first three quarters of 2007, against 50.74 million in the same period last year.
- Overall aircraft movements increased by 23.3 percent during April-December 2007 to 2008, as compared to the same period in 2006 to 2007.
- International and domestic movements increased by 14.8 percent and 25.4 percent respectively. At the same time, overall passenger traffic increased by 25 percent, while the freight traffic increased by 11 percent.

However, Indian Aviation has been impacted by the unpredicted global financial/ economic situation and almost all companies made huge losses in 2008. International Air Transport Association (IATA) reported that the global crisis and the high oil prices and declining traffic has hit India hard and growth has slowed from 33 percent in 2007 to 7.5 percent for the first six months of 2008. The months of July and August of 2008 have recorded a negative growth rate and the total losses for 2008 are around USD1.5 billion.

Some important issues affecting participants in India's aviation sector include—

- High aerospace turbine fuel (ATF) prices-India is one of the most expensive places in the world to buy aerospace turbine fuel. Excise duties, throughput fees charged by airport operators and state taxes of up to 30 percent for domestic flights result in a cost structure that cannot support a competitive industry. According to market estimates, ATF contributes to over 40 percent of airlines' operating costs. As a consequence, high ATF prices not only reduce profitability but increase fares that impacts fares and consequently traffic.

However, the Government has recently reduced ATF prices significantly in the past two months.

- Shortage of trained pilots - IATA had projected that the industry will need 17,000 new pilots annually, in order to meet industry growth and to replace pilots who retire. However, the present slowdown has affected the demand for pilots and December 2008 media reports suggest that several cadet pilots have not been absorbed and that airlines have reneged on their placement agreements. While the present slump has dramatically reduced the demand supply gap, as the industry recovers, this shortage will again reappear.
- Further regulatory easing and improvements in infrastructure - FDI in transport and passenger airlines continues to be restricted and given the poor profitability of the domestic carriers, there is need for the Government to review this policy. Physical and technological infrastructure, such as ATC, and airside facilities at airports, continue to remain key areas that need attention.

However, taking a long term view that accounts for India's present and projected GDP growth, market analysts remain optimistic about the Indian civil aviation sector. A tremendous growth opportunity exists—

- India's flight penetration, at 0.2 per capita, is lower than the 2.2 in the US and 1.2 in China.
- There are only 40 busy airports serving a population of more than a billion.
- The Investment Commission of India projects that passenger traffic will grow at a CAGR of over 15 percent in the next 5 years.
    - The Vision 2020 statement announced by the Ministry of Civil Aerospace envisages creating infrastructure to handle 280 million passengers by 2020.
    - Investment opportunities of USD110 billion envisaged up to 2020 with USD80 billion in new aircraft and USD30 billion in development of airport infrastructure.
    - Associated areas, such as MRO, offer high investment potential.
    - Air cargo traffic to grow at over 11.4 percent per annum over the next 5 years to exceed 2.8 million tonnes by 2010.

India as a Manufacturing Destination

India's Value Proposition as a Manufacturing Hub—The Indian aerospace industry is positioned favorably in the global arena with attractive demand and supply side drivers to support it.

India is rapidly building capabilities to emerge as a preferred destination for manufacturing of aerospace components. The resurgent manufacturing sector is making its presence felt abroad by adopting international quality standards and better efficiency and manufacturing facilities. India has skills and competencies in areas like engineering to production and build to print. These capabilities have been recognized and harnessed by foreign companies outsourcing manufacturing work to India. In the future, a potential opportunity exists in demonstrating India's expertise in the process beginning right from initial design and ending with the final manufacture; this is where India's real and sustainable advantage exists. This is because the systems and components require frequent design changes to suit the performance requirements of different countries, and India, with its huge pool of engineering resources, provides the convenience of providing the required manufacturing services at one location. India already has "Build to Specifications" capabilities in space and missile systems but for aircrafts, only large and well established companies like NAL can boast of this competence.

Significant demand and supply side drivers for manufacturing exist in India. According to the survey conducted by PricewaterhouseCoopers and CII for this report ('the survey'), when asked to rank the growth drivers for the Indian aerospace industry, respondents indicated the following (1=Highest, 5= Lowest):

Top Five Growth Drivers for the Indian Aerospace Industry	
1	High domestic demand
2	Offset policy
3	Cost advantages
4	Talent base
5	Leveraging IT competitiveness

Domestic Aircraft Demand

As discussed earlier, the demand for aircrafts, especially in Asia, is expected to grow as the world economy recovers from the present slump. According to estimates by leading aircraft manufacturers, India will continue to be the fastest growing country in terms of air travel for the next 20 years. Foreign aircraft manufacturers view India's demand potential as an opportunity to outsource manufacturing work, partly due to offset requirements, and also to derive cost benefits. In addition, respondents to the survey indicated that the local demand for aircrafts was a major driver for aerospace growth in India.

Offset Requirements

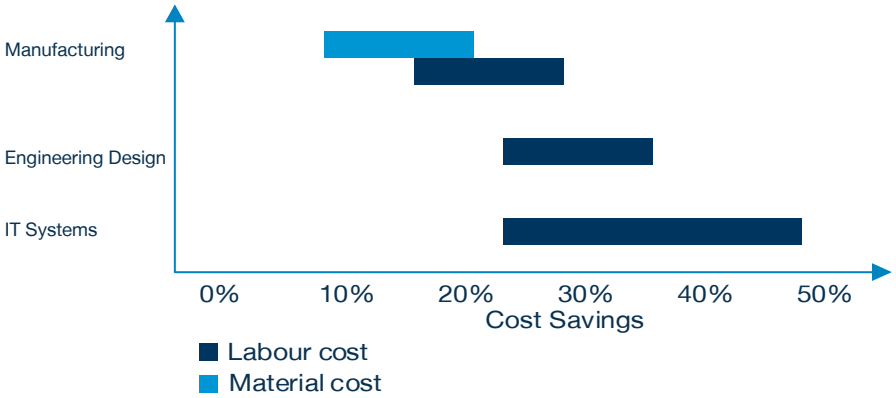
The Government in its national defence offset policy requires a minimum 30 percent plough back of foreign outflows from defence procurement into the Indian defence industry. This policy allows foreign vendors to choose their Indian offset partner, private or public. As indicated earlier, the combined offsets could translate into an opportunity of between USD40 to 50 billion for the Indian market over the next 20 years. For example, the purchase of 126 medium multi-role combat aircrafts by the Indian Air Force will result in a potential offset opportunity in excess of USD5 billion. Though a formal civil offset policy is still being developed, players like Air India have already taken a lead in this direction by entering into an agreement with Boeing with a 50 percent offset obligation (allowing indirect offsets also). These policies will create an opportunity for Indian manufacturers to enter the high tech arena of aerospace manufacturing with its stringent requirements for safety, quality control and precision.

Cost Advantages

India offers cost advantages that vary in magnitude across the value chain. Respondents to the survey indicated that the savings are highest for IT and systems implementation activities in the value chain. Cost savings could range between 15 to 25 percent in manufacturing, depending on the type of component. These savings

are expected in labour intensive processes with import of raw materials. In fact, in some cases local sourcing of raw materials / parts can increase the cost savings by an additional 10 to 20 percent.

Range of Cost Savings



Source: Industry interviews, PricewaterhouseCoopers analysis

Talent Pool

Global aerospace majors are facing an acute shortage of engineering talent. India has a large talent pool of English-speaking engineering graduates: approximately 500,000 engineers graduate each year. Respondents to our survey reaffirmed the fact that India ranks highly in terms of large number of trained English-speaking professionals available when compared to other low cost countries.

India also has a relatively well-established domestic industry which has created a large talent pool with relevant skills and experience in the aerospace industry.

Leveraging IT competitiveness

Indian IT firms have developed best practice processes for quality, project management, and organizational maturity. Many of these practices can be transferred to the aerospace industry which can, in turn, leverage these mature processes to bring improvements into the project lifecycle, covering core R&D services, design and development, verification and validation, development of tools, reverse engineering and maintenance services.

Trends

Research & Development—Indian R&D capabilities are progressively being recognized since large aerospace majors are forming partnerships with academia/industry and establishing captive R&D centers.

India is an attractive destination for R&D due to its inherent advantages of a large number of highly qualified low cost engineers and scientists. Indian aerospace R&D has remained largely in the public domain with Government institutions like HAL, NAL, DRDO, ISRO and CSIR.

The Indian aerospace industry requires large investments in R&D to meet the requirements of armed forces. To boost the investment in the sector, the Government has invited the participation by the private sector and several private and foreign players have expressed interest. The Government is also willing to share the development costs with private players in the defence sector R&D projects by providing them 80 percent of the project funding. This model would ensure active participation of the industry and commitment with assured Minimum Order Quantity (MoQ). Under the tax laws, once certain conditions are complied with, a tax deduction is available of one and one half times of scientific research expenditure incurred by

a company on in-house R&D. The Government is also inviting joint production of defence equipment with a focus on the transfer of technology.

Select foreign companies have established captive R&D centers in India:

- Airbus has been assessing ways to use India for component manufacturing and R&D. It had announced that India will be one of the key centers for design and development of their new A350 aircraft. Airbus Engineering Centre India is the company's high-tech aircraft component manufacturing facility in Bangalore. The facility works on the development of tools to design the aircraft, software for analyzing the stress and strain on airplanes and structural analysis of the aircraft, among other things.
- Snecma, a leading global aerospace company, established its R&D center in India in 2002. This center is engaged in carrying out studies and developing engine components, aircraft equipment and onboard software.

Several foreign and private players that have entered the Indian R&D sphere followed the Public Private Partnership (PPP) model for sharing technology/knowledge and commercializing aerospace manufacturing. Prominent partnerships include:

- In 2008, Boeing had entered into agreements with Indian Institute of Science, Wipro and HCL to develop wireless and other network technologies for aerospace related applications.
- In 2007, Mahindra and Mahindra had signed an agreement for the design and development of a new general aviation aircraft with National Aerospace Laboratories (NAL), CSIR and the Government of India. This is the first public-private JV in the aircraft design sector in India.

The Council of Scientific & Industrial Research (CSIR) is one of the world's largest publicly funded industrial R&D organizations.

- CSIR maintains 38 laboratories in India and its R&D portfolio embraces diverse areas, including Aerospace, Biotechnology, and Chemicals etc.
- National Aerospace Laboratories (NAL), a constituent Institution under CSIR, is a high technology oriented institution concentrating on advanced topics in the aerospace and related disciplines. It is India's only civilian aerospace laboratory and has made significant contributions to a large number of aerospace programmes like aircraft (civil and military), space, engine development, defense and strategic programmes. NAL is an acknowledged centre of excellence in fields like composite structures, high speed wind tunnel testing, aircraft fatigue and aerospace acoustics, failure analysis and accident investigation. It has also successfully executed some innovative research projects in advanced topics like smart materials, parallel processing, advanced flow diagnostics, airport instrumentation etc. NAL has been instrumental in the development of HANSA and SARAS aircrafts.

Engineering Services Outsourcing (ESO) represents India's opportunity to evolve from IT and low-end BPO work to high-end design services.

Global spending on engineering services was USD750 billion in 2004, with aerospace accounting for 8 percent; this could rise to USD1.1 trillion by 2020, according to NASSCOM. The total offshore engineering spend is expected to grow to between USD150 to 225 billion by 2020 and India, with its talent pool and experience in engineering services, could assume 25 percent of this market.

The activities in engineering services that could be outsourced range from concept, detailed design, testing, production and support stages. Some of the activities in these stages include industrial / mechanical/electrical design and analysis, reverse engineering, system engineering, CAD work, embedded software, derivative products, auxiliary functions (piping, cabling, controls), component testing, test equipment design, prototyping, technical manuals, manufacturing engineering, tooling design and build and value/ cost engineering.

Rank	Company
1	Satyam
2	QuEST
3	eServ Perot
4	Ranal
5	Plexion
6	Wipro
7	EASi
8	NeilSoft
9	Eicher
10	Geometric

Source: Top 10 ESO companies in India, Black Book of Outsourcing, 2007

Indian software companies are aggressively trying to increase their share of the ESO market. Our interviews suggested that Indian companies are increasingly being viewed as long-term partners and not as mere suppliers/vendors. This enables Indian players to participate across various phases of the product lifecycle. IT and Engineering majors also play an important role in projects that involve a transfer of technology from the respective foreign counterparts; this has helped in fostering indigenous growth of the sector. This led to the creation of the "virtual manufacturing" sector for aerospace in India where in the engineering and 3D models are tested before manufacturing begins on the shop floor. The business models of these companies have also evolved from simple models to ones that are unique, innovative and that involve the sharing of risk.

Software companies like Wipro, Infosys, Infotech, HCL and Tata Consultancy Services have been active in the aerospace industry for several years. The software engineering services provided by most of these players offer complete solutions ranging from Product Design and Development, Embedded Systems and Avionics to Product Lifecycle Management services. Because of India's IT capabilities, Indian companies are naturally well equipped for Avionics. India's capabilities are ground control stations and operational management systems. IT applications have been developed for flight data management systems, in-flight entertainment, Internet service, power distribution inside the aircraft, software for crew signaling and cabin illumination, Global Positioning System (GPS), etc.

Defence Research & Development Organization (DRDO) was established in 1958 and is an eminent defence R&D organization under Ministry of Defence (MoD). Today it is a network of more than 50 laboratories, nearly 800 industry partners (including more than 50 for aeronautics and materials), over 5000 scientists and about 25,000 other scientific, technical and supporting personnel.

DRDO is actively engaged in developing defence technologies and has established an excellent ecosystem with good infrastructure and technology base for defence R&D. It has partnered with both large industries and SMEs in the development of various systems and has more than 100 partner development firms for specialist products.

DRDO has also constituted four research boards - Aeronautics Research and Development Board (AR&DB), Armament Research Board (ARMREB), Naval Research Board (NRB) and Life Sciences Research Board (LSRB) - to nurture and harness talent in academic institutions, R&D Centres and Industries.

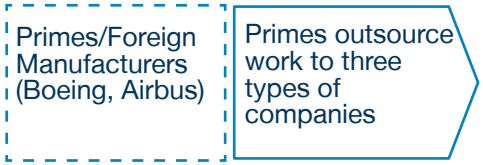
Selected Major Indian IT/ESO Companies	
Companies	**Recent Developments**
Satyam	• Awarded Tier-1 Engineering Supplier Status by EADS • Introduced a unique digital design platform to perform real-time simulations of designs and reduce the time-to-market and cost • Last year, Satyam forged an alliance with Northrop Grumman and signed a multiyear, multi-disciplinary service agreement with Hawker Beechcraft Corporation (HBC) to provide design, CAE, analysis, product lifecycle management and other services
Wipro	• Agreement to work jointly on commercial aerospace projects with Britain's BAE Systems • Entered into an agreement with Boeing to develop wireless and other network technologies for aerospace-related applications (PPP) • Partnered with Lockheed Martin to create demonstration centers showing new capabilities for linking multiple control centers, aircraft and vehicles • Wipro became the largest hydraulics company in India and the second-largest globally after an acquisition in Sweden. It is assessing the possibility of creating new designs for smart landing gears and brakes
TCS	• Partnered with Saab to establish Saab's Aeronautical Design and Development Centre (ADDC) in India • TCS has also been investing in capabilities such as hardware and software testing, additional demonstration labs, innovation centers, embedded avionics systems and high-end design for large aircraft
HCL	• Member of Aerospace Network Research Consortium along with Wipro Technologies, IISc and Boeing • Selected by CIRCOR Aerospace as strategic partner for Engineering and IT • Last year, HCL partnered with SMITHS Aerospace to open a Development Center in Chennai • Entered into a strategic relationship to serve as an extension of Rockwell Collins' engineering centers to deliver high value services such as software, hardware and mechanical engineering for product development.
Quest	• QuEST supports its aerospace customers on global programs related to aero structures, engines, accessories, actuation systems, aircraft interiors and ground support equipment. It also specializes in complete end-to-end solutions for the aerospace industry right from design and analysis to manufacturing • QuEST has been selected as EADS E2S preferred supplier for engineering services, manufacturing capabilities, ability to offer offset fulfillment and Risk Sharing Partnerships. • The firm recently entered into a JV to launch India's first independent processing facility for aerospace manufacturing and has setup a Special Economic Zone (SEZ) in Belgaum.

Source: Company Website, Secondary Research

Foreign players have been active in engineering design either by establishing their own centers or entering into partnerships:

- Honeywell Aerospace, a global provider of integrated avionics, engines, systems and service solutions for aerospace industry, currently maintains a captive design and development center in India and is looking to expand its presence in this area in India.
- In December 2008, Dassault Aviation signed a Memorandum of Understanding with Tata Technologies to make INCAT, a Tata Technologies company, a key offset partner. The company will also partner Dassault Aviation for engineering services in a number of critical domains to support the Indian Air Force MMRCA program, involving significant offset requirements.

Aerospace manufacturing has traditionally not been a stronghold for India due to the absence of a mature supplier base. However, with large private players allocating funds and aggressively building capabilities, India has started its journey to be a worthy contender for manufacturing operations.



- Public Sector Undertakings (e.g., HAL, BEL)
- Private Companies—
  - IT/Engineering Companies (e.g., HCL, Infosys, QuEST)
  - Other Players (e.g., Tata Group, L&T)
- Auto Component Manufacturers (e.g., M&M, TAL)

Traditionally, PSUs like HAL and BEL partnered with domestic vendors for years and as a result, have enjoyed strong relationships. This vendor base however, consists of small to mid-tier suppliers and is small since HAL has been doing most of the work in-house. HAL currently outsources 15 percent of its manufacturing operations to external vendors.

While these vendors may have adequate capabilities, they need not necessarily have the international certifications and the latest technologies required to be suppliers for the aerospace primes.

The US recession and significant margin pressures have forced global OEM and Tier-1 suppliers to undertake major restructuring and cost cutting exercises. Emerging economies could be considered to be able to provide significant cost benefits and hence some defence manufacturing-related work is being increasingly outsourced to these economies. The work even being outsourced for US defence which has typically been kept within the country's local suppliers. India could benefit from this trend with offset obligations acting as a catalyst. Efforts by domestic suppliers to move up the value chain is also encouraging foreign companies to outsource more manufacturing related work, rather than only systems and low value IT assignments.

Select Leading India-Based Aerospace Players	
Hindustan Aeronautics Limited (HAL)	HAL is a Government-controlled entity and has 19 Production Units and nine Research and Design Centers in seven locations in India. It has been ranked 40 in Top 100 aerospace and defence companies by a survey from Flight International and PricewaterhouseCoopers • HAL has manufactured 12 types of aircraft with in-house R & D and 14 under license. It has manufactured over 3550 aircraft, 3600 engines and overhauled over 8150 aircraft and 27300 engines. • The company exports to over 30 countries, demonstrating its high quality and price competitiveness. • Some prominent current projects include Dhruv (Advanced Light Helicopter-ALH), Tejas - Light Combat Aircraft (LCA), Intermediate Jet Trainer (IJT) and various military and civil upgrades. HAL has also played a significant role in India's space programs by participating in the manufacture of structures for Satellite Launch Vehicles. • Recently, it delivered its first advanced jet trainer 'Hawk', which is designed by BAE systems and powered by a single Rolls Royce engine. • Airbus entered into the first manufacturing agreement with HAL in 1998 to make doors for its A320. Primary interviews with HAL reveal that 50 percent of the doors for Airbus are manufactured by HAL.
Bharat Electronics Limited (BEL)	BEL has entered into MoUs with aerospace majors like: • Lockheed Martin, Boeing, EADS & Northrop Grumman for opportunities arising out of offsets • Elisra, Israel, for working on various airborne electronic warfare programmes for the Indian defence • IAI-Malat for working in the field of Unmanned Aerial Vehicles (UAV) • BEL signed a term sheet with Rafael, Israel, which is expected to lead to the formation of a joint venture, for missile electronics and guidance technologies
Dynamatic Aerospace	Dynamatic Aerospace is known for the development of complex aero structures like wing, rear fuselage, ailerons flaps, fins, slats, stabilizers, canards and air brakes. Dynamatic Aerospace closely partners with agencies like Ministry of Defence, Hindustan Aeronautics Limited and other defence establishments on several key projects. It has the largest infrastructure in the Indian private sector for manufacture of exacting Air Frame Structures and Precision Aerospace Components.
Taneja Aerospace & Aviation Limited (TAAL)	TAAL is the only listed company in aerospace manufacturing in India. It manufactures small civilian aircraft, aero-structures and aircraft parts, provides aircraft maintenance services and represents Cessna Aircraft Company, USA, for the sale of its aircraft in India. It is the only private sector company manufacturing entire aircraft in India.

Source: Company website, secondary research

India Plans of Select Global Aerospace Majors	
EADS	Media reports indicate that the European Aeronautic Defence and Space Company (EADS) plans to outsource to India approximately USD5 billion worth of aerospace components, systems and software over the next 10 years. EADS outsources USD126 million worth of aero infrastructure and engine components each year to Indian vendors and expects that number to rise to USD1.3 billion annually by 2020.
Boeing	Boeing expects commercial aircraft orders worth approximately $40 billion in the next 20 years and defence sales of another $10-15 billion over the next ten years from India. Boeing has forged a major partnership worth USD1 billion with HAL in the defence sector. Recently, Boeing started outsourcing work for its new series of Dreamliner jets and F-18 Super Hornet combat aircraft to India. The work involves dealing with sophisticated composite materials for which appropriate technology will be transferred by Boeing. Boeing will also be outsourcing aerospace structures and aviation electronics products to 7 firms in India against its $600 Mn offset requirements for supply of eight P-8I reconnaissance planes to the Indian Navy.
Eurocopter	Many strategic deals have occurred recently in the helicopter sector. Eurocopter is establishing a precision manufacturing facility in India in collaboration with Mach Aero. The facility of Mach Aero in India will be a part of Eurocopter's global supply chain and entails the introduction of the latest technological advancements with regards to helicopters in the Indian market. Eurocopter will assist Mach Aero in developing globally accepted high levels of technology, quality and production rates for public and private players in India. The development of the precision aerospace parts market in India will also provide a global platform for Indian aviation companies to become more competitive.

Source: Secondary research

Indian engineering majors are actively addressing these market opportunities by establishing specialized divisions and new companies. The Indian engineering sector has over five decades of experience in the post independence scenario. Private sector participation and globalization in this sector has led to the emergence of large and mature players who provide services across the manufacturing value chain.

Indian automotive companies are also well-positioned to leverage their strengths towards aerospace. The auto component sector is growing at approximately 20 percent per year and many global OEMs and Tier 1 companies have started sourcing components from India, due to the high quality standards followed by Indian manufacturers.

For instance, India has the largest number Deming Award winning companies outside Japan (11) in the auto component sphere and proven practices such as 5S, TPM, TQM and JIT are used by companies. The companies are also conversant with the multiple automotive standards followed in different parts of the globe.

Several players are planning to enter the aircraft components production. Most are primarily becoming involved with precision engineering, machining, aircraft lighting, manufacture of tyres and transmission components. For example, Tata Automobile Ltd (TAL) entered into an agreement with Boeing to manufacture structural components for their 787 Dreamliner airplane programme.

The auto component majors have indicated several reasons for the entry of these suppliers into the aerospace sector:

- Diversification of product portfolio and de-risking of business
- Skills and manufacturing processes are similar to those required for aircrafts, allowing them to effectively utilize existing capacities and capabilities
- Higher margins in the sector
- Leveraging the benefits of the large quantum of work to come through the offset clause
- Mature processes and structures for New Product Development which can be leveraged

Auto Companies' Forays into the Aerospace Sector	
Mahindra & Mahindra (M&M)	The group has a strong presence in the automotive business and is a market leader in multi-utility vehicles. Some of the group companies which have been active in the aerospace vertical include: • Mahindra Systech, started in 2004 as an automotive component supplier, consists of 3 core divisions: Mahindra Engineering Services (MES), Sourcing Unit and the Manufacturing Unit. MES has been providing design and delivery services to the global automotive, aerospace, and manufacturing industry. The aerospace manufacturing division has been involved in tool design/development and prototyping/manufacturing of jigs & fixtures, metal, composite components and assemblies. In 2006, M&M also acquired an aerospace engineering firm Plexion Technologies. • Mahindra Defence Systems, another recent entrant into the aerospace business, has traditionally been providing solutions for the light combat / armored vehicles for defence forces.

Source: Company Website, Secondary Research

There have been large-scale efforts to design, develop and manufacture indigenous aircrafts in India. Some examples of this are:

	Significant Initiatives	Specifications
Tejas (Light Combat Aircraft)	Tejas has been developed by Aeronautical Development Agency (ADA) with HAL being the principal contractor. The plan envisaged indigenous development of the three most sophisticated systems: the fly-by-wire (FBW) flight control system (FCS), multi-mode pulse-Doppler radar, and afterburning turbofan engine. The LCA programme is currently entering the weapons integration stage and the first lot of aircraft is expected to be inducted into the Indian Air Force (IAF) by 2010.	Capacity: 1 Powerplant: 1× General Electric F404-GE-IN20 turbofan Maximum speed: 1,920+ kmph at 15,000 m Range: 3000 km
Dhruv (Advanced Light Helicopter)	The ALH is a multi-role, multi-mission helicopter in 5.5 ton class, fully designed and developed by HAL. Dhruv is a multi-purpose helicopter which is developed to meet the requirements of the Army, Navy, Air Force and the Coast Guard. Around 80 helicopters have entered service with the Indian armed forces since 2002 and it has also been exported to countries like Nepal, Israel and recently, Equador.	Capacity: 6 and 12 for 2 versions Powerplant: 2x Turbomeca TM 333-2B2 turboshafts of 1,000 shp (746 kW) each Cruise speed: 250 kmph Service ceiling: 4500 m Range: 660 km
SARAS	SARAS, a 14-seater multi-role aircraft designed by NAL, will be the first passenger plane in the Light Transport Aircraft category to be designed and manufactured in the country. It is currently under development and its third prototype is expected to fly by June 2009.	Capacity: 14 passengers Powerplant: 2× Pratt & Whitney Canada PT6A turboprop, 850 shp (634 kW) each Maximum speed: 550 km/h (340 mph) Range: 1940 km (1200 mi) Service ceiling: 7,500 m (24,600 ft)
Regional Transport Aircraft (RTA)	CSIR has approved INR300 crore to design an aeroplane that can carry 90 passengers on short flights. The first prototype would be a 70-seat plane. The new plane will have more composites and embedded Micro-electrical mechanical systems (Mems) to monitor aircraft health and reduce maintenance costs.	Capacity: 70 passengers in 4-abreast seating Range: 600-800 km Cruise speed: 550kmph Service ceiling: 9144 m
HANSA	HANSA is an all composite 2 seater trainer turboprop aircraft totally designed, developed and tested by NAL and certified by Director General of Civil Aviation (DGCA). A new variant, Hansa-4, with a more powerful diesel engine (230 hp) is under production currently.	Capacity: Two, pilot and instructor Powerplant: 1 × Rotax 914 F3, 86 kW (115 hp) Cruising speed: 215 km/h (134 mph) Endurance: 4 hours

Source: Vayu Aerospace Review, HAL/NAL websites, Secondary research

Challenges—India has to overcome certain challenges in its path to emerging as a manufacturing destination for global players.

According to the survey conducted by PricewaterhouseCoopers and CII, when asked to rank the challenges for the Indian aerospace industry, respondents indicated the following (1=Highest, 5= Lowest):

Top Six Challenges for the Indian Aerospace Industry	
1	Access to technology
2	Raw material availability
3	Access to funding
4	Certification processes
5	Skill availability
6	Quality issues

These challenges need to be addressed for India to become a major player in the global aerospace supply chain. The aerospace sector in India is in the early stages of development and most of the domestic demand is being met through imports. In order to reduce dependence on imports, a strategy focusing on building skills and infrastructure would need to be developed. The challenges listed above are discussed below:

Access to Technology

Technology expertise was ranked as the most critical challenge faced by the Indian companies. India needs to keep pace with the increasingly high use of technology across the design lifecycle. Foreign companies are reluctant to transfer cutting edge technologies with limited management control in the Indian entity and in the past, have given licenses for older technologies. In case of Tier-3 suppliers especially, which are generally small family-owned businesses in US and Europe, there is little incentive to transfer know how or invest in local Indian companies.

Raw Material Development Capabilities

There has been a significant shift in the type of raw materials that are being used in airframe structures. The composition of materials used in aircraft manufacturing is migrating towards new advanced materials.

For instance, the material composition for most of the new aircraft have changed from using 80 percent aluminum to approximately 60 percent titanium and composites and only 20 percent aluminum (as a percentage of structural weight). The use of composite materials is rapidly becoming a mainstay since they result in lower maintenance costs, make the aircraft lighter and more fuel efficient. The demand for composites in the aerospace market is expected to grow by more than 10 percent in the next five years. Currently, almost all raw materials are being imported by Indian suppliers. In the field of advanced materials, novel processing and material characterization methodologies are still emerging and will take time before the country becomes self reliant.

Composites—Materials of the Future

The Indian Perspective— While a significant know-how exists in a few national centers of excellence, especially in the aerospace sector, a serious effort is required to boost the penetration and usage of composites through indigenous design capability, product development and testing. To enhance the utilization and application of composites as critical performance material, the Department of Science & Technology (DST), Government of India has been taking several initiatives like:

- Launching a development and commercialization mission on advanced composites
- Establishing a Composite Technology Park in 2002 in Bangalore for design and development of eco-friendly, light-weight and cost- effective composite material for non-aerospace applications.

Building Composite Expertise (Obtained from primary interviews conducted by PricewaterhouseCoopers)

- Some prominent companies who are building expertise in this area include HAL and Tata Advanced Systems
- One IT and engineering design firm stated that the use of composites is an integral component of design and analysis and building capabilities for it soon will be necessary. It has a basic facility which they are trying to augment/improve. They have acquired an autoclave and are also adding a clean room.

Source: Secondary research, Industry Interviews.

Access to Funding

The aerospace business is highly capital intensive. In the initial high growth phase, capital needs to be injected rapidly and continuously to maintain the planned growth rate. Additionally, working capital requirements, market development, brand building and awareness require significant on-going investment and expenditure. Funding access can act as an entry barrier into this space.

Certification Process

Getting international airworthiness certifications for processes and parts has been a challenge for India-based suppliers. It is also a deterrent for OEMs to outsource some of their components to India since the approval for parts made in India can sometimes take too long and become cost inefficient (when their logistics costs are also considered). Countries like Mexico have already entered into a bilateral aviation safety agreement with the FAA allowing manufacturers to inspect and certify components in Mexico, instead of shipping them to the United States for safety checks.

There have been accreditations and certifications in place for special processes and product quality standards (see the table below); however, the approvals for international airworthiness of parts manufactured by Indian manufacturers still do not occur within the country. Primary research also shows that this is one sphere where Indian companies expect support from the Government through bilateral arrangements with international certification agencies.

NADCAP	NADCAP (National Aerospace and Defence Contractors Accreditation Program) is a global cooperative standards-setting program for aerospace engineering, defence and related industries. Nadcap program gives accreditation for special processes in aerospace and military industry such as heat treatment, chemical processing etc. This accreditation is required and accepted by several leading players like Boeing, GE, Honeywell etc.
AS9100	AS9100 is a widely adopted quality management system standard for the aerospace industry. Most major aerospace manufacturers and suppliers worldwide require compliance and/or registration to AS9100 as a condition of doing business with them

Lack of Skills

While the number of engineering students graduating every year is very large, an issue that arises is their lack of employability. Consequently, companies have to invest significantly to make fresh recruits “industry-ready” with the right kind of skills and training. For instance, extensive training is required to become DERs (Direct Engineering Representatives) for Boeing-related work and Authorized Signatories for Airbus-related work. Both in terms of quality of education and relevance of course, there is much that needs to be done to truly exploit India’s huge demographic advantage.

Quality Issues

Quality assurance and reliability are essential in aerospace technologies due to stringent requirements of weight-to-strength considerations and the need for highly reliable systems. The industry works on a zero defect target. While Indian manufacturing has improved significantly in quality control, a mature supplier base is still developing in India and the inability of smaller suppliers to keep abreast with the rising quality issues could become a problem for the Indian aerospace companies.

India as a MRO Destination

India's Value Proposition as a MRO Hub—India has the potential to be a global/ regional MRO destination due to continued economic growth, liberalization of aerospace policies, globalization of MRO services, its locational advantage and the availability of talent.

According to the article entitled "Technical Articles—Engineering Services for Aerospace MRO," India's MRO segment will grow at 10 percent and reach USD1.17 billion by 2010 and USD2.6 billion by 2020. Respondents in the MRO segment indicated that the MRO segment is growing at 11 percent pre-and post- the current economic situation. It is essential that MRO companies offer a comprehensive portfolio of services and position themselves as long-term strategic partners to operators.

India could become the MRO global hub by capitalizing upon:

- Manpower cost arbitrage—MRO manpower costs in India are lower than the leading industrialized nations. Respondents indicated that MRO manpower costs in India range from USD30 to USD35 per hour. This is almost 60 percent cheaper than in Western Europe or the US but not significantly dissimilar to wage rates in China or Indonesia. There is also a shortage of talent in developed countries; these workforces are ageing and the supply of high quality engineering talent is declining. India has a robust supply of talent, available at relatively cheaper rates.
- Availability of talent—India has a large and able population of engineering graduates who are trained and have suitable technical competence and experience. However, some Indian MRO companies believe that India is experiencing an increasing trend for aerospace engineers choosing to work abroad, some in tax-free zones. Many of these engineers have been poached from India-based carriers. To address this, MRO companies are in the early stages of working with educational institutions to guide graduates towards aerospace and also institute after-graduation employment programmes.
- Locational advantages—Currently, there are no MROs within a five-hour fly zone of India. Indian MRO companies can leverage India's inherent geographic advantage of being between Europe and the Asia Pacific region.
    - Domestic carriers can benefit from having MRO facilities within India's borders. This cuts the cost of sending their aircraft to Dubai or Singapore.
    - International carriers, who have been increasing their flight routes to India, can have their aircraft serviced in India, thereby leveraging cost arbitrage opportunities.
- Untapped opportunity—MRO companies believe that this segment offers significant opportunity since demand for MRO activities/facilities is high. Given the growth of Indian aerospace, it is logical to build a MRO infrastructure to support current and future growth in the sector. In addition, the growth of several low cost carriers in India has increased competitive pressure on the aircraft majors who would prefer to have aircrafts serviced locally to reduce costs and on-ground time.
- Graded development—Each segment requires specific skills, knowledge and regulatory approvals. While there is tremendous potential for India to develop capabilities in all segments, currently airframe is the prime candidate for offshoring to India, especially for airlines with over 30 aircraft, due to its labor intensive nature. As MRO players' competencies grow, line maintenance and component repairs will be the next segments to be offshored. Engine overhaul is likely to be the last segment to be offshored to India after the Indian MRO market has matured.

In addition to developing capability, this sector is characterized by heavy regulatory approvals. The MRO business needs to have regulatory approval from local and international authorities; DGCA (India), FAA (US), EASA (Europe) and JBAA (Japan). Most leasing companies are based in the US, Europe, Japan and the Middle East. MROs need to have certification from the agencies of the country in which the leasing company (from whom the aircraft is leased is based)

Establishing MRO facilities in India will enable operators to achieve faster turnaround times, savings in operating costs and a decline of foreign exchange outflows. Outstanding MRO facilities will also attract work from overseas, which will result in an increase of jobs, a rise in consumption and an overall lift to the economy.

Currently, overhaul of military aircraft in India is almost wholly carried out by Hindustan Aeronautics Ltd. Military units, including the Air Force, Army and Naval Aviation are under increasing pressure to outsource work. Some countries, such as Malaysia and Singapore, which are not facing threats to their borders are open to outsourcing their maintenance operations through the establishment of public-private partnerships.

Experts also see immediate interest from international helicopter operators, who have been allowed to fully own their Indian ventures. Global helicopter operators are in dialogue with Indian companies to establish MRO bases in India. With better equipment, aircraft and training facilities, India will witness the entry of international helicopter operators.

Trends

Increased Investments Planned in India's MRO—Recognizing India's locational and cost advantages, foreign companies are bullish regarding India's potential as an MRO hub and several alliances with local companies have been announced.

A selection of the alliances announced relating to MRO activities, obtained from media articles, is presented below—

- Air Works India Engineering Pvt. Ltd. plans to invest approximately USD120 million over the next three years to establish a maintenance center for planes. According to Fredrik Groth, Chief Executive. "We will need another USD100 million and a strategic partner about a year-and-a-half down the line (from December 2009) as we get into sophisticated engineering." In its second phase, Air Works plans to overhaul engines and parts, such as landing gears.
- European Aeronautic Defence & Space Co NV (EADS) signed a joint venture agreement with the National Aerospace Co. of India Ltd (NACIL), which operates Air India, to build an aircraft MRO center. The value of the joint venture is estimated at USD40 million, over five years. The joint venture will initially maintain and repair airframes of Nacil's Airbus planes and later also offer services to other

airlines, including for non-Airbus aircraft. The MRO facility, to be established in Delhi, will service more than 100 single-aisle and about 10 wide-body planes a year by 2013.

- The Air India-Boeing MRO is a joint venture between Air India and Boeing and a third party whose name is yet to be announced. The project, which was announced in 2006, would commence with an initial investment of USD100 million.
- Indian Airlines has signed an agreement with Airbus and Bangalore-based Jupiter Aerospace to form a MRO joint venture. The joint venture is for MRO and life cycle support of commercial aircraft.
- According to the tripartite term sheet, the MRO venture will begin its activities in Delhi with two A320 hangars with a third hangar being added in due course. The Phase II expansion will cater to wide-body and other aircraft types. By the third year, the joint venture will have facilities to cater to over 200 aircraft of single aisle and wide-body aircraft belonging to various customers from India and abroad.
- Taneja Aerospace & Aviation entered into a MRO facility agreement with Air Works Commercial MRO Services (AWACS). The company will be licensing seven acres of land and upto five hanger spaces on a long term basis. The company hopes to develop its private air field as a MRO and aerospace park.

Select states in India are positioning themselves as MRO locations. For example, Gujarat plans to become a hub for MRO activities.

- Foreign companies have shown interest in investing in the state, which has a locational advantage.
- The State Government hired an agency to prepare a blue print for MRO facilities.
- The Government plans to float a company, Gujarat Airport Infrastructure Company (GAIC) to execute development related to airport and related infrastructure in the state. Proposed developments for airports and MROs will be assessed by GAIC.

Challenges

Tax & Regulatory Environment

- Customs duty is exempt on parts imported for maintenance, repair and overhaul of aircraft subject to specified conditions. In case these conditions are not satisfied, the customs duty would be up to 27 percent on the parts imported.
- Services in the nature of maintenance, repair and overhaul (MRO) are covered under the taxable category of 'management, maintenance or repair services' under service tax legislation. In addition, in terms of the Export of Service Rules, 2005, as amended to date, there are specified parameters (in addition to the location of performance of the activity) which need to be fulfilled for such services to qualify as export of services and hence be not charged to service tax.
- There are presently high rates of indirect taxes which disincentivize MRO activities
  - Imported spares are charged to customs duties up to 27 percent plus Value Added Tax of 4 percent or 12.5 percent on intra State sale thereof and Entry Tax / Octroi in specified States / Municipalities.
  - Servicing an aircraft in India entails a service tax of 12.36 percent. This burden is reduced to the extent of service tax credit admissible to MRO customers.

Participants in India's MRO industry believe that the tax regime needs to change in order to enable India to positioning itself as an MRO hub to the world.

Land Allotment Processes

A challenge for MRO players is the absence or shortage of land at India's major airports. The lack of clarity behind land allotment and its unpredictability are issues that deter potential MRO players. However, with the Government's decision to privatize the Mumbai and Delhi airports, MRO players are confident that there will be more transparency into the land allotment process.

Select India-Based MRO Players	
HAMCO	Hyderabad Aircraft Maintenance Company (HAMCO) is an India-based third-party Aircraft Maintenance Organization for commercial planes. Services offered by HAMCO include Avionics, Electrical Wiring Inspections, Air Frame, Simulator Division and Manufacturing Services. Maintenance Services include A, B, C, and D checks, drop-in / line maintenance and engine changes / Q.E.C. swaps / C-1 & C-2 fan changes / stage III HAMCO offers a range of maintenance services including line level and comprehensive C and D checks, major repairs (such as accident damage, aging and corrosion prevention programs, structural life improvements, implementation of manufacturer recommended maintenance) and providing customized maintenance programs.
GMR Group	GMR Group is one of the fastest growing Bangalore headquartered infrastructure companies with interests in the development of airports, energy, highways and urban infrastructure. The company uses the Public Private Partnership model, and has successfully implemented several infrastructure projects in India. GMR Infrastructure Limited is the infrastructure holding company formed to fund the capital requirements of infrastructure projects in the Group's Energy, Highways and Airport business. It undertakes the development of the infrastructure projects through its various subsidiaries. The Group's other focus area is agri-business with sugar as its main product-line. GMR Industries Limited is the holding company for the Group's Agri-Business. Having proven its credentials as a leading infrastructure conglomerate in India, GMR is expanding its operations globally. It now has presence in the following countries - Nepal, United Kingdom, Netherlands, Philippines, Australia, Mexico and Istanbul, Turkey.
Air Works India Engineering Pvt. Ltd	Established in 1951, Air Works India Engineering Pvt. Ltd. offers general aerospace services. Starting with maintenance and overhaul work on a few Dakota DC-3s, Air Works has since been on a significant growth path, expanding in the areas of General/Business Aviation Maintenance Support, Commercial Aircraft Maintenance and Support and Aircraft Sales and Charter. In November 2007, Air Works attracted two strategic investors to broaden the equity and strategic reach of the Company. The investors include: • Global Technology Investment Group, LLC, a New York based Private Equity firm • Punj Lloyd, a transnational company specializing in the energy and infrastructure sectors, headquartered in Gurgaon, India The company is present in six cities and maintains three lines of service— • Business Aerospace Services including Aircraft Management, FBO and Training • Airline MRO including Airframe, engine, components. • Sales and Non Scheduled Charter Operations including Offshore O&G transportation The company has serviced over 40 different types of aircraft. The company has a 40,000 sq ft hangar for maintenance activities. The company plans to increase its presence in additional cities, such as Kolkata, Hyderabad, Goa and Ahmedabad.
Max Aerospace and Aerospace Limited	Established in 1994, the company provides engineering support for all the major commercial airlines and aircraft operators in India and the Middle East. Its engineering facility in Mumbai supports a range of aircrafts and components. The company also maintains offices in New Delhi, Goa and Bangalore. The company offers the following services— • Avionics • Electrical • Air Frame • Simulator Division • Manufacturing Services

Note—Company overviews for HAL and TAAL profiles are provided in earlier sections. Source: Company Website, Secondary Research


DELTA
KIWI

Tax and Policy Framework

India has a federal set up of tax administration under which the Central Government levies taxes on income, custom duties, central excise, service tax, whereas the State Government levies taxes, like value added tax, works contract tax, etc.

India has a federal set up of tax administration under which the Central Government levies taxes on income, custom duties, central excise, service tax, whereas the State Government levies taxes, like value added tax, works contract tax, etc. These are summarized below:

Corporate Income Tax

- Foreign companies can have business presence in India either through Project/ Branch Office (foreign company) or by forming a subsidiary/joint venture company (domestic company).
- The effective tax rate is 42.23 percent (including surcharge and education cess (S&C)) for foreign companies and 33.99 percent (including S&C) for domestic companies.
- Companies are liable to Minimum Alternate Tax (MAT) at 10 percent (plus S&C) of book profits, whereas tax liability under normal Income tax provisions is lower. MAT credit is allowed against tax liability in subsequent 7 years under normal income tax provisions.
- A domestic company is liable to pay Dividend Distribution Tax (DDT) at 16.995 percent (including S&C) on its dividends. However, dividend income is exempt in the hands of shareholders.
- An additional tax “Fringe Benefit tax” is also levied at 30 percent (plus S&C) on the employer company on value of prescribed fringe benefits including ESOP provided to the employees other than perquisites on which tax is paid/payable by the employee.
- Accelerated depreciation of 40 percent is available for Aeroplanes-Aeroengines.

Tax Holiday

- 100 percent tax holiday is available for 10 years for Special Economic Zone (SEZ) Developers, Co-developers.
- 100 percent tax holiday from profits on exports for five years and 50 percent tax holiday for next 10 years for units set up in a SEZ (during last five years subject to additional conditions).
- Export Oriented Units (EOU) or Electronic Hardware Technology Parks (EHTP) or Software Technology Parks (STP) are eligible for deduction of 100 percent of export profits for 10 years up to 31 March 2010.
- 100 percent tax holiday is available for 10 years on profits of an undertaking which begins manufacturing/producing eligible goods or undertakes substantial expansion from 1 April 2007 and 31 March 2017 in any of the North Eastern States.
- 100 percent tax holiday is available on profits of an undertaking which begins manufacturing/producing eligible goods in the State of Himachal Pradesh or Uttaranchal (up to 31 March 2012) for 5 years and 30 percent thereafter.
- 100 percent tax holiday is available for the profits derived by a new undertaking which develops, maintains and operates any new infrastructure facility such as roads, highway, bridges, airports, ports, etc. The tax holiday is available for 10 consecutive years out of 15 years beginning from the year in which the undertaking or enterprise develops and begins to operate any infrastructure facility.
- 100 percent tax exemption is available on any income of venture capital company or venture capital fund from an investment in venture capital undertaking, which, inter-alia, engaged in developing, maintaining and operating any new infrastructure facility (as mentioned above).

- Scientific Research & Development (R&D): If certain conditions are met, deduction is available of one and one half times of scientific research expenditure incurred by a company on in-house R&D facility where it is engaged in business of bio-technology or in manufacture/production of electronic equipments, computers, telecom equipments, chemicals or other specified articles, like aircraft, helicopters, computer software, etc (up to 31 March 2012). Further, if certain conditions are met, deduction is available of one and one fourth times in respect of payments made for research activities to an approved Indian company having scientific R&D as its main object.
- Royalty/fees for technical services received by a foreign company under an agreement with Government for providing services in or outside India in projects connected with the security of India, is exempt, if such foreign company is notified by Central Government in the Official Gazette. In other cases, in absence of permanent establishment of the foreign company in India, royalty/fees for technical services would be taxable at 10 percent (plus S&C) for agreements entered into after 1 June 2005, subject to fulfillment of certain other conditions.
- Exemption from payment of withholding tax on lease rental incomes on aircrafts and engines earned by a non-resident lessor from an Indian company is currently applicable only for lease agreements which have been signed prior to 31 March 2007 (subject to respective agreements being approved by the Indian Government.

General

- International transactions with associated companies need to be at arm's length price and subject to transfer pricing regulations.
- Tax payer can approach high-powered Authority for Advance ruling to determine income tax aspects of any proposed or current transactions.
- India has entered into comprehensive treaties for avoidance of double taxation with over 70 countries and limited agreements with 18 countries. Tax implications under the domestic laws could be mitigated by resorting to tax treaty.

Indirect Tax

- Customs Duties: Effective customs duty rate on import of goods is 26.85 percent based on peak rate of customs. Exemption from customs duty is available for majority of goods imported in relation to defence subject to fulfilment of prescribed conditions.
- Excise Duty: Effective excise duty rate is 10.3 percent (inclusive of education cess) on manufacturing activity. Exemption from excise duty is available for specified goods imported in relation to specified defence projects. Further, goods supplied against international competitive bidding (ICB) are exempt from excise duty subject to fulfillment of prescribed conditions. The challenge on the ground is to ensure that these benefits actually accrue.
- Value Added Tax (VAT) / Central Sales Tax (CST): While inter-State sales of goods is subject to levy of CST, intra-State sale of goods are subject to levy of VAT. The CST rate is 2 percent if the prescribed statutory form is issued by the purchaser, whereas if no forms are provided, the VAT rate applicable in the originating State of the Seller will be applicable. For most goods, the VAT rate is either 4 percent or 12.5 percent depending on the nature of goods. No general exemptions/ concessions are available on sale of goods to defence. Accordingly, the relevant State VAT legislation should be examined and the possibility of special dispensation if required from State Government can be explored.
- Service Tax: specified services are subject to service tax and the liability to pay service tax is on the service provider. However, for few specified services including imported services, liability to pay service tax shifts on service recipient. Service tax rate is 12.36 percent (inclusive of education cess). At present, there are no specific exemptions available for services rendered to defence related activities, accordingly, the option of minimising the levy of service tax should be explored.
- The States are also authorized to levy other local taxes such as entry tax. Further, local authorities and municipal corporations impose local taxes.

- Research & Development Cess is applicable on import of technology into India by an industrial concern under a foreign collaboration. Presently, Cess is applicable at the rate of 5 percent. However, the Cess paid can be adjusted against service tax liability accruing under certain service categories.
- Indirect tax incentives available to SEZ units for its authorised operations.

India's tax framework, punctuated with federal and state levies under the direct and indirect tax regulations, can catalyze growth in the Indian Aerospace Industry through tax-rate rationalisation and sector-specific tax incentives. Focused benefits should be extended for the MRO sector akin to other service sectors, such as IT, ITES, etc. including service tax exemption, custom duty rationalization, both within and outside an SEZ environment.

A level field must be provided to domestic manufacturers supplying to the Defence sector. A foreign OEM executing a supply contract for the MoD enjoys various tax and duty exemptions for its supplies to the MoD from overseas. An Indian Private Sector defence system manufacturer on the other hand, is subjected to a number of taxes and duties which are to the extent of up to 34% of the total supply amount. The following model illustrates the burden to be faced by an Indian manufacturer while executing a defence supply contract vis-à-vis a foreign vendor who directly exports to MoD:

Particulars	Indian Manufacturer	Foreign Vendor
Customs Duty	Conditional customs duty exemption available on case to case basis.	Foreign vendor exports to MoD. Customs duty exemption is available since imports by MoD.
Excise Duty	No specific excise duty exemption for supply to MoD. Only Unit Project/ Item specific exemption is available.	Excise duty not applicable.
Central Sales Tax (CST)	No exemption. CST payable @ 2% eg. Form C on raw materials/ Sub-components/ Finished Products.	CST not applicable.
Value Added Tax (VAT)	No VAT exemption. VAT is payable @ 12.5% on raw materials/ Sub components/ Finished Products.	VAT not applicable.
Service Tax	Service tax is applicable on input services like payment on Technical Know how / Engineering Services. No exemption.	Service tax not applicable and services availed by foreign vendor from India are exempt as these are treated as export services.

Sources: Company Website, secondary research

In view of the above, it is apparent that the current tax and duty regime makes the Indian manufacturer uncompetitive as the incidence of tax is higher vis-à-vis foreign vendors directly supplying to MoD.

Like defence supplies, the civil aerospace industry too bears numerous taxes and duties. While there are tax incentives available for R&D and Special Economic Zones (SEZs), the indirect tax structure, such as central excise, VAT, service tax still tends to disincentivize final assembly in India. Similarly, servicing an aircraft in India involves a huge tax cost, such as service tax, custom duty, VAT. Thus, there is an urgent need for rationalizing taxes and duties imposed on this sector by the Government.

Foreign Investment Regulations Summary

Civil Aviation and Airports

FDI up to 49 percent is permitted for scheduled air transport services/domestic scheduled passenger airlines under the automatic route. NRI investment is permitted up to 100 percent under the automatic route. However, no direct or indirect equity participation by foreign airlines is allowed.

- For non-scheduled air transport services/non-scheduled airlines, chartered airlines and cargo airlines, FDI up to 74 percent is permitted under the automatic route. NRI investment is permitted up to 100 percent under the automatic route.
- 100 percent FDI permitted under the automatic route for MRO, flying training institutes and technical training institutions.
- FDI up to 74 percent and NRI investment up to 100 percent under the automatic route is permitted for ground handling services subject to regulations in the sector and security clearances.
- FDI up to 100 percent is permitted under the automatic route for helicopter services / sea plane services requiring DGCA approval.
- 100 percent FDI under the automatic route is permitted in setting up of Greenfield airport projects (existing projects would require FIPB approval for FDI beyond 74 percent).

The Indian Government welcomes private participation in manufacturing and R&D in the defence sector with the goal of encouraging technology transfers and setting up production units in the country.

- 100 percent domestic investment is permitted in manufacturing defence equipment, subject to industrial licensing by the Department of Industrial Policy and Promotion (DIPP).
- FDI, including NRI investment, in this sector is permitted up to 26 percent subject to prior approval of the Government and compliance with the licensing requirements and guidelines issued by DIPP.
- The guidelines for production of arms and ammunitions include stipulations that, the management of the Applicant Company/partnership should be in Indian hands i.e. two-thirds of the Board as well as the Chief Executive must be resident Indians. Further, there is a three year lock-in period for transfer of equity from one foreign investor to another foreign investor.

Defence Procurement Policy

- Defence procurement is governed by the DPP. The latest policy on Defence Procurement was released on 1 August 2008 (DPP 2008).

Key Features: Defence Offset Policy

- Effective 1 September 2008
- Mandatory offset requirement of a minimum of 30 percent for procurement of defence equipment in excess of INR3 billion
- Only direct offsets allowed
- Banking of Direct Offset Credits permitted for up to two years
- Transfer of Technology not counted towards offset calculation
- Vendor free to choose Indian offset Partner

- Indian Offset Partner to comply with only licensing requirements/ guidelines issued by DIPP
- Offset obligations to be fulfilled co-terminus within period of main contract
- Offsets can be discharged by any combination of the following methods
  - Direct purchase of, or, executing export orders for defence products and components manufactured by, or services provided by, Indian defence industries
  - Direct foreign investment in Indian defence industries for industrial infrastructure for services, co-development, joint ventures and co-production of defence products
  - Direct foreign investment in Indian organizations engaged in research in defence R & D as certified by Defence Offset Facilitation Agency (DOFA)
  - Discharge of banked offset credits
- Quarterly monitoring of implementation & Penalty for defaults

Key Concerns of OEMs

- End Use Monitoring and Protection of Information Agreements between India and US still not signed – potential deal breakers for US firms
- FDI capped at 26 percent
- IPR Protection
- JV Partner search
- Indirect offsets not permitted
- Technology Transfer not counted for Offset discharge
- Multipliers not allowed
- Banked credits valid for only 2 years

Special Economic Zone (SEZ) Act

India's SEZ Act provides excellent tax incentives to both developers and units that are located in the special economic zone. The SEZ Act provides fiscal benefits to both promoters and investors, enabling India to become a preferred destination for outsourcing manufacturing. The most significant aspect of the policy is that there is no export obligation – rather, units need to be foreign exchange positive over a five year period. Moreover, there is no such requirement for the developer. OEMs can develop a defence SEZ and invite its suppliers to set up units in it. The Government needs to support such an initiative, particularly if existing Indian units are to be encouraged to set up new facilities there, by allowing them full tax benefits. This is essential if the Government is serious about making India a manufacturing hub for the aerospace and defence sector a possible configuration of such an SEZ is illustrated below.

Direct Tax Incentives	Indirect Tax Incentives
• Income tax 100% exemption for 10 out of 15 years for developers and 100% 5 yrs, 50% next 10 yrs for units • DDT exemption (not for units) • MAT exemption (also for units)	• No Customs Duty • No Excise Duty • No Service Tax • No CST • Exemption from Local Taxes and Stamp duty (State specific)

Defence SEZs—Built and Operated Tax-Free

All India SEZ Details

Formal Approvals: 531

Notified: 260

Multi-Product SEZs

Formal Approvals: 23

Notified: 9

IT/ITeS SEZs

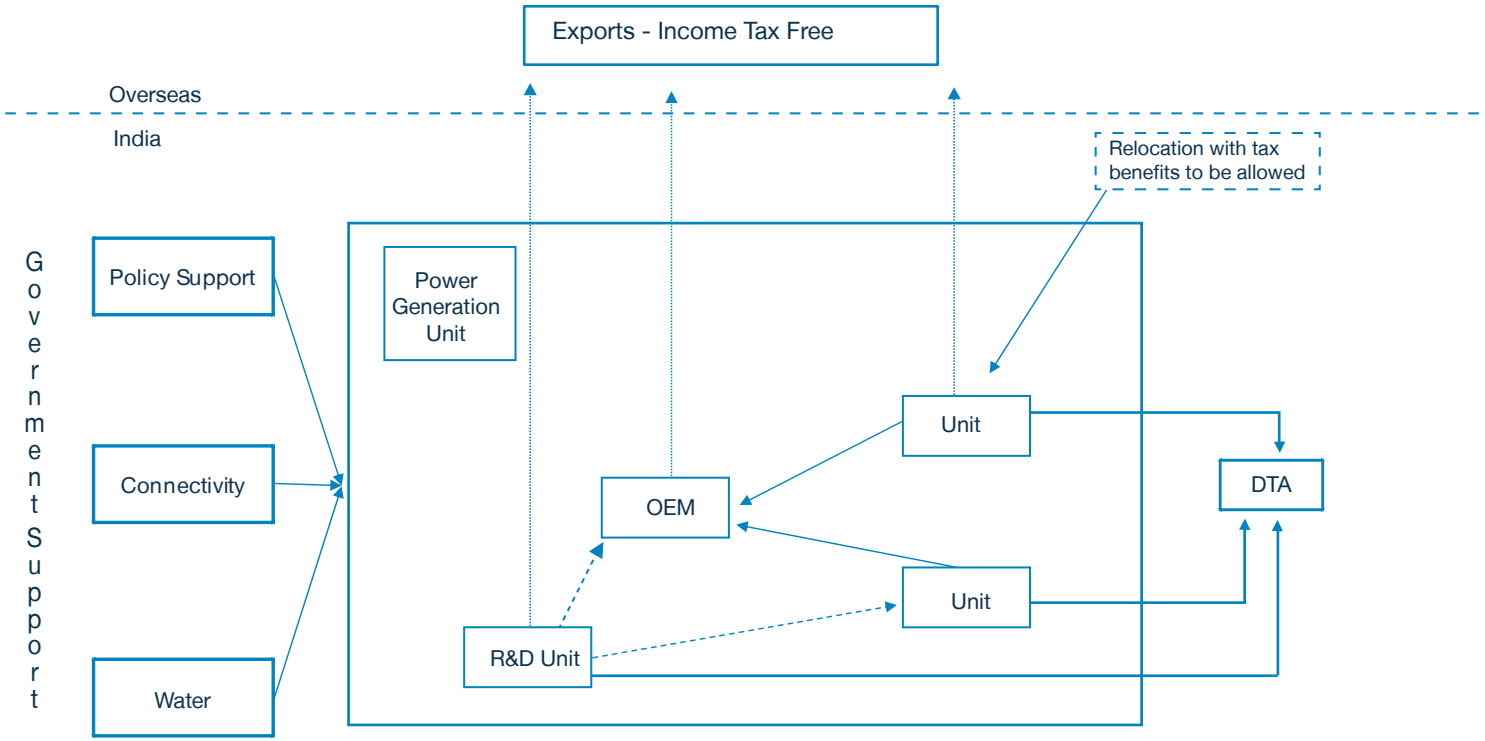
Formal Approvals: 292

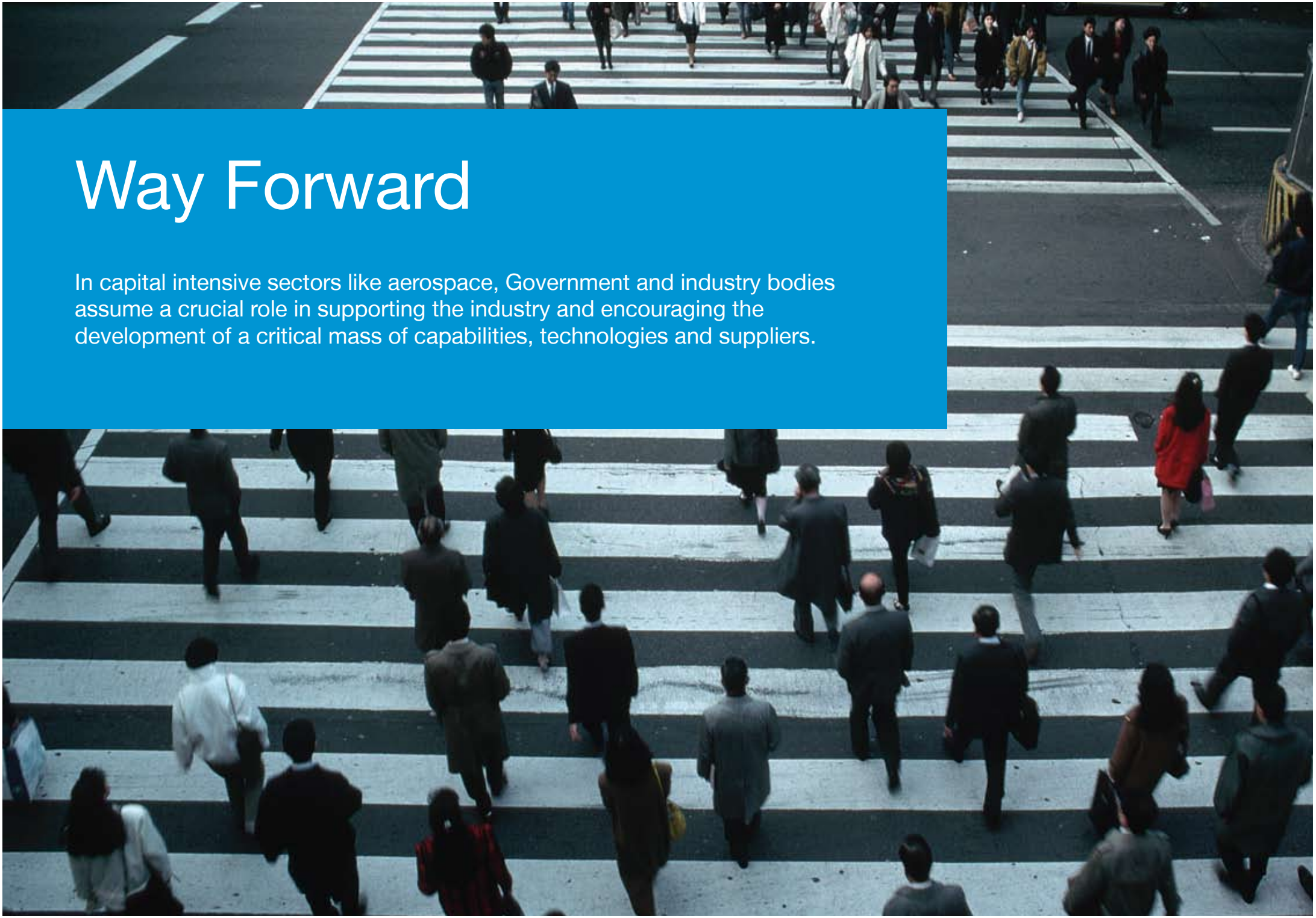
Notified: 155

Aerospace and Precision Engineering SEZ

Formal Approvals: 1

India as A Global/Regional Hub—Aerospace&Defence SEZs





Way Forward

In capital intensive sectors like aerospace, Government and industry bodies assume a crucial role in supporting the industry and encouraging the development of a critical mass of capabilities, technologies and suppliers.

India has proved its mettle in services and manufacturing in a number of sectors not only locally but globally. The rapid strides India has made in IT and IT related services including design and engineering services, the emergence of India as a manufacturing hub for automobiles and automotive components, a number of global acquisitions in diverse industries like steel, aluminum, pharmaceuticals etc clearly demonstrate that India and Indian companies are internationally competitive, can match international quality and service standards and have the appetite, capacity and capability to invest for the long run. The success of India's indigenous Space program is testimony to this capability.

In this context of India's position in the global stage, the Indian aerospace industry is clearly poised for growth. There are number of factors that favour this. Strong local demand in aviation coupled with large defence requirements position India as one of the most significant buyers of aerospace equipment. The same is also true for all related maintenance and repair services. India also has strong competitive advantage by way of availability of a large low cost engineering and skilled talent pool. Additionally, from the MRO perspective, India has geographic advantage. India also has a long history in aerospace R&D, design, engineering and manufacturing through the Government owned entities like HAL, NAL, ISRO, DRDO etc and more recently some private players.

The current global economic slowdown has been a source of concern for more than one reason for the industry. Slowing demand, company bankruptcies, reduced air travel etc. are predicted to continue for some time at least. But, if we see the other side of the coin, this downturn might prove to be a blessing in disguise for the Indian industry especially when considering their plans and ambitions to have a global presence.

Development of manufacturing in aerospace takes considerable time and the current slowdown provides Indian companies the time window to initiate efforts so that they are ready to take advantage as the business cycle turns more positive.

This is therefore a good time for Indian companies with aspirations in aerospace to identify areas of interest based on their core competence, develop partnerships with global players and establish a development programme to commercial production.

Another very good option for larger Indian companies with their eyes on manufacturing is to make foreign acquisitions which are expected to come cheap at this time. This would give them a face abroad to interact and do business with OEMs/Tier1/2 directly while simultaneously harnessing the advantages that India as a manufacturing destination provides. These acquisitions can also serve to fill critical capability gaps.

Last but not the least, it must be recognized that India's competitive advantage lies in its excellent quality of engineering professionals, especially in design, development and testing. For long term sustainable competitive advantage, it is critical that Indian aerospace industry entrants work on a programme that moves them swiftly from "manufacture to print" to "design to manufacture." This means that while they may start with licensed production with requisite technology transfer, they should graduate to development of upgrades/variants to joint design, development and manufacture.

One significant disadvantage that India faces in the context of aerospace manufacturing is availability of appropriate grade raw materials, whether it is metals like aluminium and titanium or plastics and composites and many others. It is essential that a concerted effort is made to develop these materials locally and till such time this happens, support is available to the industry for import of these materials.

While the individual company level initiatives will be critical and a number of forward looking companies will come forward to invest in aerospace, a more broad based development of the industry will require support from Government and industry bodies. PricewaterhouseCoopers and CII asked respondents about various support measures and their expectations from Government and industry bodies. There have been many interesting and varied findings that can be considered and taken up for implementation with some urgency.

Support from Government—The Indian Government has initiated several measures to develop and promote the interests of the aerospace industry.

It is already encouraging cooperation with countries that are prepared to transfer technology and are interested in co-designing, co-development and co-production, especially of defence products. Respondents to the PricewaterhouseCoopers-CII survey identified the following six measures that the Government needs to take to give a fillip to the sector.

Top Six Support Measures Expected from the Government	
1	Well defined Offset Policy
2	Infrastructure Support
3	Development Funds/ Tax Duties
4	Industry Promotion Events
5	Increasing FDI Limit
6	Soft Credit Lines

Well-Defined Offset Policy

A well defined offset policy is crucial for giving the direction to the nation's aerospace industry. Participants in the survey felt that the current offset policy is not very specific regarding the gamut of products and services covered under it. It should be directed to fill critical gaps in defence capability as opposed to listing generic items. Other issues in the policy include increasing the validity of banking credits and lowering the offset requirement from the present INR300 crore. Getting the policy right for all stakeholders, including foreign firms is very important to yield desirable results.

Infrastructure Support

The expectation for infrastructural support was ranked a close second in the survey. Infrastructure will play a major role in the sector's development considering the industry's robust technology requirements. As India moves into more complex aerospace manufacturing, an ecosystem must be made available for the industry to sustain its advantage and ensure further growth.

The fragmented supplier base needs a common infrastructure to leverage efficiencies. The Government should continue encouraging these hubs which in turn will see many more players entering this industry and making sizeable investments.

Initiatives in Establishing Aerospace Ecosystems in India

1. Aerospace Park, CII, Chennai—The Confederation of Indian Industry (CII) has proposed to establish an aerospace park in Chennai. The proposed park will attract an investment of USD10 billion and will create over 100,000 jobs.
2. SEZ, Quest, Belgaum, Karnataka—QuEST Global is establishing an industry-specific precision engineering SEZ in Belgaum, Karnataka. QuEST Global SEZ has already signed three clients, namely QuEST Global Engineering, QuEST Global Manufacturing and Aerospace Processing India (API) for the SEZ.
3. SEZ, APIIC, Hyderabad—This SEZ will focus on avionics systems repair, precision component fabrication, airframe and engine components, mechanical, electrical and electronic components. A group of approximately 35 companies, under the aegis of Samuha Engineering Industries, will be developing units to supply equipment and services to defence establishments in the country.
4. Lepakshi Aerospace Park, Chilamattur, Anantapur District, Andhra Pradesh— The SEZ will have an integrated ecosystem for research, design, manufacture and maintenance of aircrafts, both civil and defense. The 2,500 acre SEZ, in close proximity to the Bangalore International Airport, has received in-principal approval from the Board of Approvals on 15th January, 2009.
5. SEZ, KIADB, Devanahalli, Karnataka—The Karnataka Industrial Areas Development Board (KIADB) proposal has received in-principle clearance by the Karnataka government for establishing an aerospace SEZ in Devanahalli.
6. SEZ, TAAL, Bangalore—Taneja Aerospace & Aviation Ltd (TAAL) received in-principle approval from the government to set up a SEZ dedicated to aviation in Bangalore.

Source: Secondary research

Development Funds/Tax Incentives

The aerospace industry warrants a priority sector declaration given its strategic and economic importance. The Government could consider development funds, especially in the design and infrastructure requirements of the sector. Further the tax incentives (both direct and indirect) akin to other service sectors, like IT and ITeS, could provide the requisite thrust and the right direction for industry growth.

From an MRO perspective, the import of spares into India is subject to both customs duties and rendition of service is subject to levy of service tax. Participants in India's MRO industry believe that the tax regime should change in order to encourage the opportunity available to India in positioning itself as an MRO hub to the world.

For domestic manufacturers supplying to the defence establishment, the Government may consider an exemption from customs duty, excise duty and service tax on both inputs and outputs. In the alternative, it can consider providing deemed export benefits to such supplies. Though the supplies to the Ministry of Defence can fall under the deemed export category under the current provisions, however there should not be any conditions for such supplies to be treated as deemed exports. Finally, these benefits should be available to both contractors and sub-contractors. Like defence supplies, civil aerospace industry also bears numerous taxes and duties which need to be rationalized

Thus, to support the burgeoning growth in Indian Industry, the Government should rationalize taxes and provide incentives to the companies in aerospace and defence sector.

Industry Promotion Events

The capabilities developed by Indian suppliers need to be promoted and showcased using all available platforms to the international investors, OEMs or bigger suppliers that are interested in coming to India. Proper marketing of Indian skills abroad can ensure that the industry is more visible in the international arena and the development occurs more rapidly.

Increase in FDI Limit

Technology acquisition must be energetically pursued and that requires Government effort. India may not see much of IP and technology transfer until foreign investing companies are allowed to have a larger stake in the JV with Indian counterpart. The current limit of 26 percent for the foreign stake may prove restrictive for the growth of the industry. However, there is also a contrary view that the 26 percent cap should be retained as it provides Indian companies greater leverage in negotiations with foreign partners and more control in the JV.

Soft Credit Lines

By its very nature, this industry demands large upfront investments and a longer gestation period. Since the industry is in its infancy, investors might be wary of investing large sums of money for there are no immediate returns. The availability of soft credit lines will encourage the infusion of capital in this industry by private players.

Support from Industry Associations—Industry bodies also assume a very crucial role in the creation and sustainability of an environment conducive to the growth of industry.

Their role as mediators between the industry, Government and other stakeholders becomes even more important in case of a fledgling industry like aerospace. Integrated and focused efforts are required by these bodies for developing a strong foundation for the development of this industry. A list of expectations from these bodies that came across in the interviews are listed below—

- Synchronized efforts towards industry promotion. Trade shows should be rationalized and well planned. Multiple trade promotions should be avoided since they result in increased expenses for companies.
- Focus equally on promoting small, mid-tier and large companies.
- Create a forum for interaction with foreign buyers and improve awareness among various stakeholders at international level in order to develop Indian industry.
- Given the maturity of PSU/State enterprises in this industry, promote Public Private Partnership (PPP) more aggressively.

- Protect domestic industry's interest in negotiations with foreign buyers. Indian industry needs to be very clear and upfront in terms of its expectations from foreign partners like technology transfer issues, offset discharge methods, local partnerships etc.
- Actively engage with the Indian Aerospace&Defence establishments to create infrastructure for the development of the industry. There is a need to further develop the systems engineering capabilities and building/funding new aerospace programs in the country.
- Work with Government bodies to ensure faster processing of proposals of national importance.
- Support the formulation and implementation of a clear defence and civil offset policy, including methods for fulfillment, clarity on individuals/bodies that are responsible for enforcing offsets etc.
- Create a pool of industry experts who can assist companies for assignments and on matters of complex technical issues.
- Encourage educational institutes to offer more industry oriented courses to ensure availability of the talent pool of fresh graduates.

Appendix One -
Can India Emulate China in the Aerospace Sector?

The fragmented nature of the Indian aerospace sector has been a hindrance in achieving self-reliance in its aerospace capabilities.

The fragmented nature of the Indian aerospace sector means that it has to make further progress before it becomes self-reliant in its aerospace capabilities. China is focused on developing itself into a major aerospace market with huge investments, numerous R&D and manufacturing facilities, a large and well-trained work force and strong Government support. China plans to build capabilities in every area. (China currently has no formal offset policy.) While China did not have access to western technology and design/development capabilities, its technology base was built through robust in-house R&D and reverse engineering of foreign products. The chronology of this was as follows:

- The Chinese military aircraft industry began with the licensed production of MiGs and other aircraft from the former Soviet Union in the late 1950s.
- After developing considerable expertise from technology transfer, China started efforts to produce its own indigenous aircraft.
- It was only later that China built in-house design and development capabilities supported by several laboratories.

Aviation Industry Corporation of China (AVIC) is the major aircraft organization involved in R&D and production of civil and military aircrafts. China also centralized its aerospace activities under one ministry at the Government level; the majority of orders from its Government drove economies of scale and encouraged exports.

India, in comparison, has a more fragmented structure. With so many authorities as stakeholders in the development of this sector, there is no single national aeronautical policy or plan that has emerged to focus on industry's growth and self reliance.

	China	India
Aircraft manufacturing	• China is ahead of India in production of commercial aircraft and also exports to the US. China merged its two largest aircraft makers (Avic-I and Avic-II) to form the Aviation Industry Corp. of China. This body has emerged as a world-class aircraft manufacturer with aviation products including a 150-seat jumbo jet. • China flew its first passenger ARJ21 regional jet in September 2008 and also plans to develop 150 seater mainline jets in the medium term. • China started developing turbo-propelled regional aircraft Modern Ark 700 (MA 700) for the high-end international market.	• India maintains capabilities in designing and manufacturing military aircrafts (by HAL) but has been unable to establish its presence in passenger aircrafts. • Recently, CSIR approved a plan for its Bangalore aerospace lab to design an airplane that can carry 90 passengers on short flights. • NAL is also building the regional transport aircraft. India is expected to launch its first series of regional jets only in 2012 in partnership with Bombardier and Embraer
Assembly	• Airbus assembly plant in China (Airbus Tianjin Final Assembly Company) began operations in September 2008. The new plant is expected to assemble 44 aircraft a year by 2011. • China also jointly assembles the Embraer ERJ-145 regional jet.	• India still does not have a complete assembly line set up by any global OEM though the Government is looking to set up an assembly unit for 25-60 seater turboprop aircraft in collaboration with EADS. • India plans to assemble 108 Medium Multi Role Combat Aircrafts (MMRCA) out of IAF's purchase of 126 planes. • BAE Systems partnered with HAL to produce Hawk which involves assembling 11,000 components sourced by BAE Systems from UK.

Appendix Two -
Selected India-Based Aerospace Bodies

Aerospace-Related Bodies

- Ministry of Defence (MoD)
- Directorate General of Civil Aviation (DGCA)
- Aeronautical Society of India, Hyderabad
- Aeronautical Development Agency (ADA)
- National Aerospace Laboratories (NAL)
- Hindustan Aeronautics Limited (HAL)
- Centre for Military Airworthiness and Certification (CEMILAC)
- Directorate General of Aeronautical Quality Assurance (DGAQA)

Ministry of Defence (MoD)

The Ministry of Defence is comprised of Department of Defence (DOD), Department of Defence Production (DPP) and Department of Defence Research & Development (DD&RD). The main functions of MoD include:

- Obtaining policy directions of the Government on all defence and security related issues and communicating them for implementation to the Services Headquarters, Inter-Services Organisations, Production Establishments and Research and Development Organisations.
- Implementing the Government's policy directions and execution of approved programmes using the allocated resources.

Directorate General of Civil Aviation

The main functions of this body include—

- Granting approval for aircraft maintenance, repair and manufacturing organizations and their continued oversight.
- Promoting indigenous design and manufacture of aircraft and aircraft components by acting as a catalytic agent.
- Examining current and new international and foreign airworthiness design standards and adoption of as per national requirements.
- Assessing the design and suitability of aircraft components and equipment and their approval for use in aircraft. Assessment and approval of the installation of aircraft components and equipment in aircraft.

Aeronautical Society of India (AeSI)

The main objectives of the society are—

- To promote aerospace technologies and industries in India, encourage potential entrepreneurs to establish medium/small scale industries in this sector.
- To provide a forum for interaction of industries and users, R&D institutions, universities etc.
- To participate in and conduct National/International Airshows/Seminars/ Workshops
- To encourage education/research and sponsor institute scholarships/fellowships, etc. in aerospace.
- To collaborate with similar societies, trusts, professional institutions and industries in India and abroad for achieving its objectives.

Aeronautical Development Agency (ADA)

ADA was created for the LCA programme by Ministry of Defence. ADA is involved in activities related to the development of LCA. LCA is built with the state-of-the-art technology design/analysis tools and production facilities supported by capabilities in Indian aircraft design, production and product support.

National Aerospace Laboratories (NAL)

National Aerospace Laboratories (NAL), a constituent Institution under CSIR, is a high technology oriented institution concentrating on advanced topics in the aerospace and related disciplines. It is India's only civilian aerospace laboratory and has made significant contributions to a large number of aerospace programmes like aircraft (civil and military), space, engine development, defense and strategic programmes.

Hindustan Aeronautics Limited (HAL)

Hindustan Aeronautics Limited (HAL) came into existence on 1st October 1964 and is one of the oldest and biggest PSUs in the aerospace domain. It has 19 Production Units and 9 Research and Design Centers in the country. The Company has manufactured 12 types of aircraft with in-house R&D and 14 types under license. HAL has been successful in numerous R & D programs for both defence and civil aviation sectors and has also played a significant role in India's space programs by participating in the manufacture of structures for Satellite Launch Vehicles.

Centre for Military Airworthiness and Certification (CEMILAC)

CEMILAC's main functions are to provide assurance for military aircraft and airborne systems. It is organized into 14 RCMAs (Regional Centre for Military Airworthiness), can cost effectively undertake design validation, certification and type approval, analysis of accidents/incidents, evaluation and extension of life of aircraft and components, and approval of design organizations.

Directorate General of Aeronautical Quality Assurance (DGAQA)

DGAQA was established in 1954 under the name of DTD&P (Air), encompassing R&D activities and the inspection and indigenization of military aeronautical stores. The main functions of this body include:

- Quality Assurance during design development, production. Overhaul and repair of military aircraft/aero-engines and its accessories, air armaments, rockets, missile systems and ground support equipment for military aircraft.
- Technical association with DRDO and other agencies during the process of type approval, lifting and life extension studies of aircraft and its accessories.
- Establishment of indigenous sources for production of aeronautical stores through the Technical Committee (Aeronautical Stores).

Glossary

A&D	Aerospace&Defence
AVIC	Aviation Industry Corporation of China
CAGR	Compound Annual Growth Rate
CSIR	Council of Scientific and Industrial Research
DoD	Department of Defence
EADS	European Aeronautic Defence & Space Company
EDS	Engineering Design Services
ESO	Engineering Services Outsourcing
FAA	Federal Aviation Administration
FDI	Foreign Direct Investment
HAL	Hindustan Aeronautics Limited
HNI	High-Net Worth Individual
IT	Information Technology
MMRCA	Medium Multi Role Combat Aircrafts
MRO	Maintenance, Repair and Overhaul
NAL	National Aerospace Laboratories
OEM	Original Equipment Manufacturer
PPP	Public Private Partnership
PSU	Public Sector Unit
SEZ	Special Economic Zone
PMA	Parts Manufacturer Approval

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About Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes. CII is a non-government, not-for-profit, industry led and industry managed organisation, playing a proactive role in India's development process. Founded over 113 years ago, it is India's premier business association, with a direct membership of over 7500 organisations from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 83,000 companies from around 380 national and regional sectoral associations.

The Confederation of Indian Industry has been actively partnering with the Ministry of Defence, Armed Forces and DRDO in promoting Industry participation in Defence Production. CII Defence Division has been committed to working in the areas of steering policy formulation, defence market development / trade promotion and formulation of international joint ventures / technology transfers.

CII formed the Defence Division in 1993 to catalyse change in the Defence sector by pursuing the Government to liberalise Defence Production and by initiating the process of partnership with the Defence establishments in organising interactive meetings with end users, i.e. the Armed Forces. Realising the importance of harnessing the technologies developed within the country, CII has also been a pioneer in organising interactive sessions with the Defence Research and Development Organisation to enlarge the role of Private sector in Defence R&D. A major partnership with Ministry of Defence has been the organisation of the Defexpo India (Asia's largest Land and Naval Systems exhibition) in 1999, 2002, 2004, 2006 & 2008 and the Aero India exhibition in 2009.

CII Defence Division strives to forge industry initiatives to strengthen the Indian Defence Sector. The objective of this division is to "Establish a strong partnership between Defence Services & Industry and enlarge the role and scope of Indian Industry in Defence Production for mutual benefit and enhance the National Security".

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Our Aerospace and Defence Team

PricewaterhouseCoopers (PwC) has a strong global Aerospace and Defence (A&D) practice that serves most of the leading global companies. To assist our domestic and international client participate in the exciting growth of the Industry in India, we set up the A&D practice in India in 2007. With deep understanding of Government regulations and industry issues, PwC is a one-stop shop for clients and is competent to assist in various aspects of their businesses. Our team consists of professionals with diverse background and experience and is integrated across all lines of service that include regulatory advice and assistance in obtaining approvals, tax and regulatory structuring, advisory services.

To provide the highest possible level of service, we invest the time of our consultants in developing industry expertise. The team maintains strong yet independent relationships with the Government and constantly shares knowledge with players in the industry and Government.

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