

The Changing Face of the Aerospace & Defense Industry

A review of key segments and emerging trends



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Contents

Introduction	3
<hr/>	
Industry Overview	4
Industry Growth Drivers	5
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Market Segment Analysis	8
Large Commercial Aircraft (LCA) Segment	8
Regional Aircraft Segment	10
Business Jets Segment	12
Helicopter Market	14
Global Defense Market	15
<hr/>	
Aerospace Supply Chain Analysis	17
Supply Chain Analysis	17
Key Components of the Aerospace Supply Chain	18
Aircraft Engines	18
Avionics	18
Global Maintenance, Repair and Overhaul (MRO)	19
<hr/>	
Future Trends	20
Increasing Usage of Composites	20
Optimized Usage of Turboprops and Jets	20
Alternate Fuels	20
Globalization	21
<hr/>	
Conclusion	22

Introduction

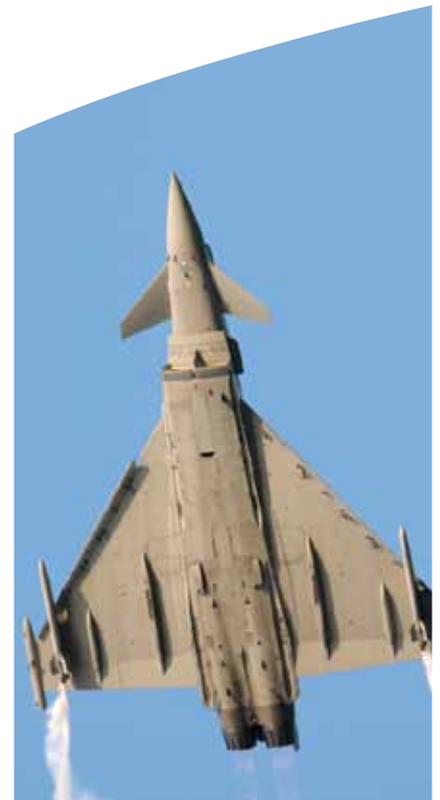
The global Aerospace & Defense industry has experienced transformation in the past 18 months. Following a decline in orders and backlogs in 2008 and 2009 aircraft manufacturers are seeing phenomenal growth in 2011. This strong recovery is being driven by the commercial aviation segment as global passenger traffic increased sharply by 8% to 10% year-on-year. Also contributing to the industry's growth are the overall improvement of the global economy, the emergence of low-cost carriers, and increasing demand for aircraft from the developing economies of China and India.

The two primary players have already raised their production plans: Airbus increased the A320 rate to 36 per month by the end of 2010 and expected to reach the figure of 40 per month in the first quarter of 2012. Boeing is ramping up its production rate of the 737 to 38 per month by 2013, and there have been reports of it going higher.

However, despite the optimism, fuel prices remain a major concern still hampering the recovery and with the potential to affect industry growth. The International Air Transport Association (IATA) has reduced its forecast for airline industry profits (net post-tax) in 2011 from US\$9.1 billion to US\$8.6 billion due to the recent surge in oil and jet kerosene prices.

In terms of regions, weak domestic markets are affecting the European airlines, although business travel and outbound freight look positive. Asia Pacific, Latin American and African airlines are benefiting from the strong economic growth and are experiencing significant gains in traffic. For manufacturers, Asia Pacific is the largest source of order backlog.

This Capgemini research study assesses the global Aerospace & Defense industry and identifies both the challenges and opportunities the market presents for manufacturers. The report examines five key industry segments: Large Commercial Aircraft, Regional Aircraft, Business Jets, Helicopter and Defense. In addition, it provides an analysis of the aerospace supply chain. Also contained in the report are key market observations, substantiated by relevant market sizing and forecast figures, and an overview of future trends and recommendations, which are designed to inform and inspire manufacturers as they develop their go-to-market strategies.



Industry Overview

The Aerospace & Defense (A&D) industry is comprised of manufacturers from civil and military aerospace and defense procurements. The defense procurements segment comprises revenues earned from defense electronics and military aerospace; whereas the civil aerospace segment includes revenues earned from civilian planes (but excludes military aircraft and related items). Globally, the A&D industry recorded total revenues of US\$771 billion in 2010 and registered year-on-year growth of 4.8% from US\$744 billion in 2009. Defense occupied the largest share of the spending pie with 71.8% at US\$660.8 billion in 2009.

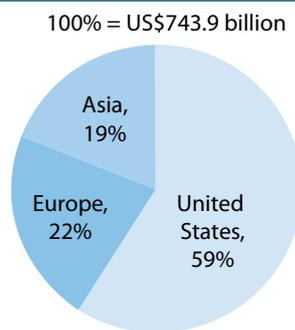
Globally the A&D industry has been forecasted to record an accelerated

growth with an anticipated CAGR of 5.3% for the period 2009 to 2014, reaching a market value of US\$1,190.5 billion. This growth rate is expected to be driven by the Commercial segment due to a more positive economic outlook, rising income levels and the booming Commercial Aviation segment. However, the demand outlook from Defense will be under pressure as many defense programs are experiencing budget cuts.

A&D companies will also continue to face the challenges of improving productivity and responding to ever-increasing government regulations. The United States is, by far, the world's largest Aerospace & Defense market, with revenues close to US\$543 billion. The U.S. market is followed by the European market with an estimated share of about 27%. Even though Asia falls behind the U.S. and the European markets it is considered to be the fastest-growing market for A&D products.

Boeing and Airbus continue to dominate the Large Commercial Aircraft market space while Embraer and Bombardier dominate the smaller aircraft segments, which include Regional and Business Jets.

Figure 1: A&D Market Size Values by Region, 2009



Source – Datamonitor

Figure 2 : Aerospace & Defense – Market Size and Forecast



Source – Datamonitor

http://www.datamonitor.com/store/Product/aerospace_defense_global_industry_guide_2010?productid=4949A252-DDED-4B3F-9F88-B9B3DC27A1F6 2010

Industry Growth Drivers

Economic Growth: The demand for aircraft is related to air travel, which in turn is linked to the increasing wealth, increasing per capita income and positive Gross Domestic Product (GDP) outlook. An increase in air travel has occurred in the developing economies like India and China; both of these countries signify robust optimism for the Aviation segment. Other factors leading to Civil Aviation growth include international trade and globalization. The global economy has also shown gradual signs of recovery from the economic recession. As seen in Figure 3, IMF predicts that the recovery is likely to continue and global GDP is expected to grow between 4.4% and 4.6% until 2015.

An analysis by Boeing spanning the last 50 years revealed that the best indicator for measuring the performance of the Aviation segment is the world Gross Domestic Product (GDP). The Boeing study further found that the downturns experienced by the Airline industry typically match the worldwide economic slumps. Given the present economic situation it is clear that the Airline industry will continue to recover

in the near future with increasing demand from developing economies like India and China, which will offset the relative slowdown in demand from mature economies like North America and Europe.

Environmental Concerns Fueling the Replacement Aircraft Market:

The environment has become a primary focus for any industry, particularly with the increased awareness resulting from the Copenhagen Climate Conference 2009. The implications for the Aviation segment are significant, with engine and airframe manufacturers along with airline operators in the limelight to reduce their carbon footprints.

Despite the fact that carbon dioxide emissions by aircraft account for only 2% of total global emissions, the Aviation segment is gradually taking steps towards carbon-neutral growth. The airlines are committed to improving average fuel efficiency by 1.5% per annum until 2020. Beyond 2020, carbon dioxide emissions from the Aviation segment are expected to stabilize and then decline despite the anticipated increase in traffic; achieving these targets will lead to a

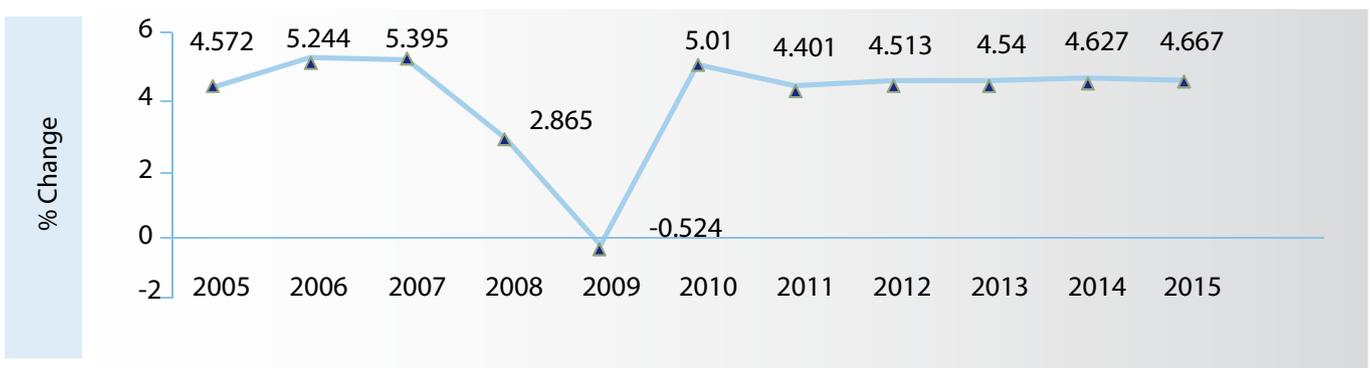
carbon-neutral Aviation industry in the future. However, progress towards that can only be achieved by replacing older aircraft with new, efficient aircraft fleets, infrastructure, operational improvements as well as appropriate economic levers. The increase in environmental awareness and regulations will have a positive effect on demand for new, efficient aircraft in the future.

Focus on Fuel-Efficient Aircraft:

The global economic recovery has boosted demand for oil across the world, creating further pressure on energy prices. Additionally, the recent political turmoil in the Middle East and North Africa has also added to the surge in prices. Even if the political risk is reduced, the anticipated economic growth will continue to justify the revisions in oil price forecasts for this year.

According to the International Air Transport Association (IATA), jet kerosene prices have doubled since their low point in early 2009, reaching US\$113 a barrel in early 2011. With these costs representing around a quarter of total operating costs this price rise has added some 25% to unit costs.

Figure 3: Global GDP Growth



Source- <http://www.imf.org/external/ns/cs.aspx?id=28>

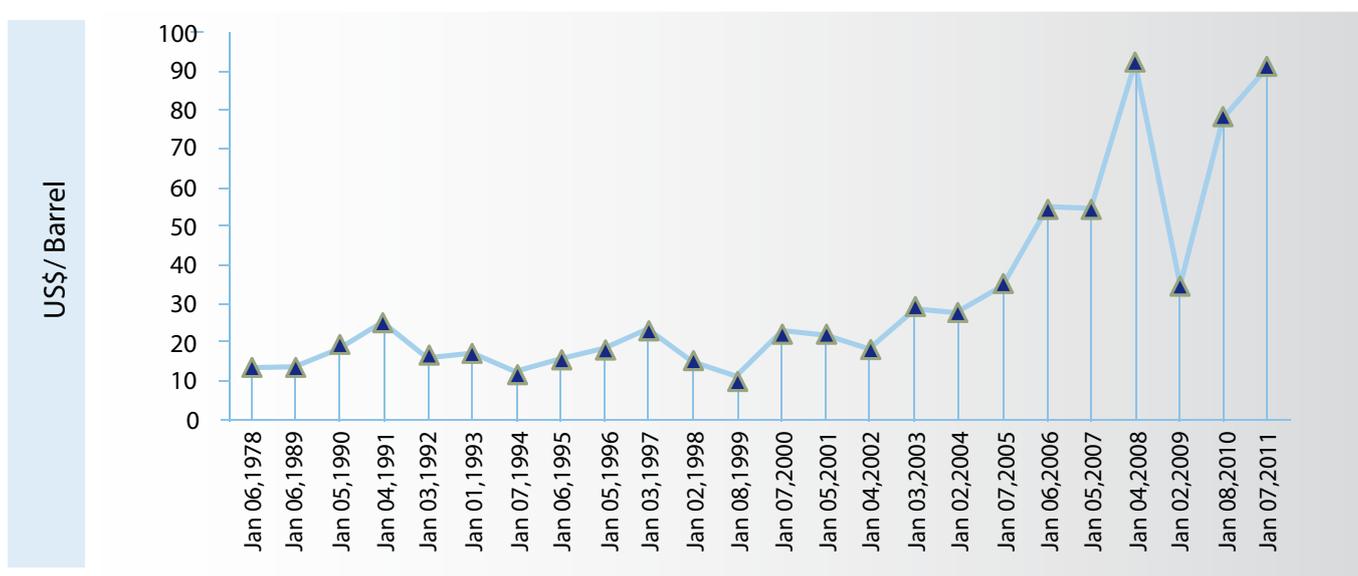
Over the same period the average return fare, excluding fuel surcharges, has risen by 20%. To date the airlines have been able to manage the impact of the increasing input costs by adding surcharges, which in effect offset their increase in revenue over the same period. However, in the long run, aviation companies will be forced to undertake premature retirement of aircraft and will explore more fuel-efficient options. This will create a growth opportunity for aerospace manufacturers in both the short and medium term.

Capacity for Network Expansion: Airlines are highly dependent on the strength of their network to register revenues. Therefore, they are constantly making efforts to ensure that their routes maintain an acceptable return for their investment. With this in mind, airlines are often strengthening their networks through the addition and deletion of routes as well as strong code share relationships.

However, with heavy traffic growth in developing regions, airlines are exploring options to add capacity in these new routes. Recently IndiGo, an India-based airline, launched eight new direct flights from Lucknow to Mumbai, Delhi and Bangalore. This route expansion followed the induction of the new Airbus A320 into its fleet.

Continual Growth of Low-Cost Carriers (LCCs) in Developing Economies: The low-cost carriers have proved to be strong, particularly in the developing economies of Asia and Latin America during the 2008-2009 economic downturn. Double-digit growth has been the norm for these carriers over the last couple of years in the Asia Pacific region. The highest growth in particular was in the short-haul market around Southeast Asia, India and Australia. In India, a country the size of Southeast Asia, low-cost carriers SpiceJet and IndiGo continue to grow as they replace the likes of Air India, Jet

Figure 4: Oil Prices – Tracked Week by Week



Source – EIA, Website
http://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm

Airways and Kingfisher Airlines. Even big fish like Jet and Kingfisher converted 70% of their domestic operations to the low-cost model in the past couple of years.

Despite LCCs opting for predominantly wide-body aircraft, Boeing and Airbus both forecasted that the demand for single-aisle aircraft in the region is expected to accelerate in the coming years. Boeing and Airbus also predicted that the companies will require approximately 5,200 new airliners in the 100 to 210 seat category, such as the best-selling A320 family. This increase in demand will be driven primarily by the growth in fleet size of the LCCs along with the opening of new secondary short-haul routes, especially in China, India and Southeast Asia.

In 2010 low-cost carriers like IndiGo, SpiceJet and JetLite ordered 46 new aircraft, which are to be delivered by 2014.



Figure 5: Historical Distribution of US Domestic Seat Share

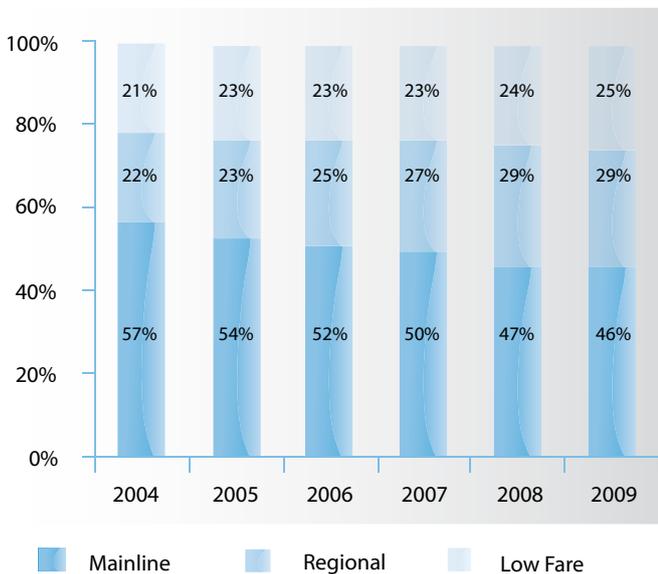
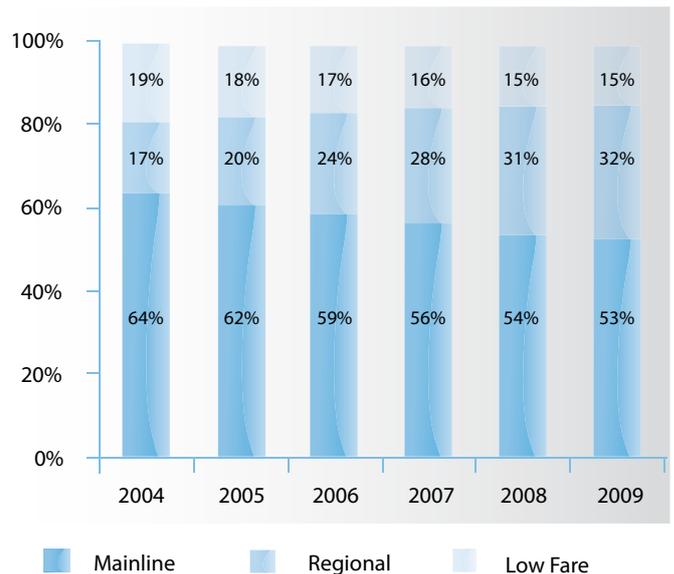


Figure 6: Historical Distribution of EU Domestic Seat Share



Source – OAG Aviation Solutions & Bombardier Commercial Aircraft Market Forecast, 2010–2029, Page 8
http://www.bombardier.com/files/en/supporting_docs/BCA_2010_Market_Forecast.pdf

Market Segment Analysis

The A&D industry can be segmented into Large Commercial Aircraft, Regional Aircraft, Business Jets and Helicopter. However, with changing industry dynamics these segments are gradually blending into one another. The following section includes detailed descriptions of these segments in order to provide a view of the future outlook for the A&D industry as a whole.

Large Commercial Aircraft (LCA) Segment

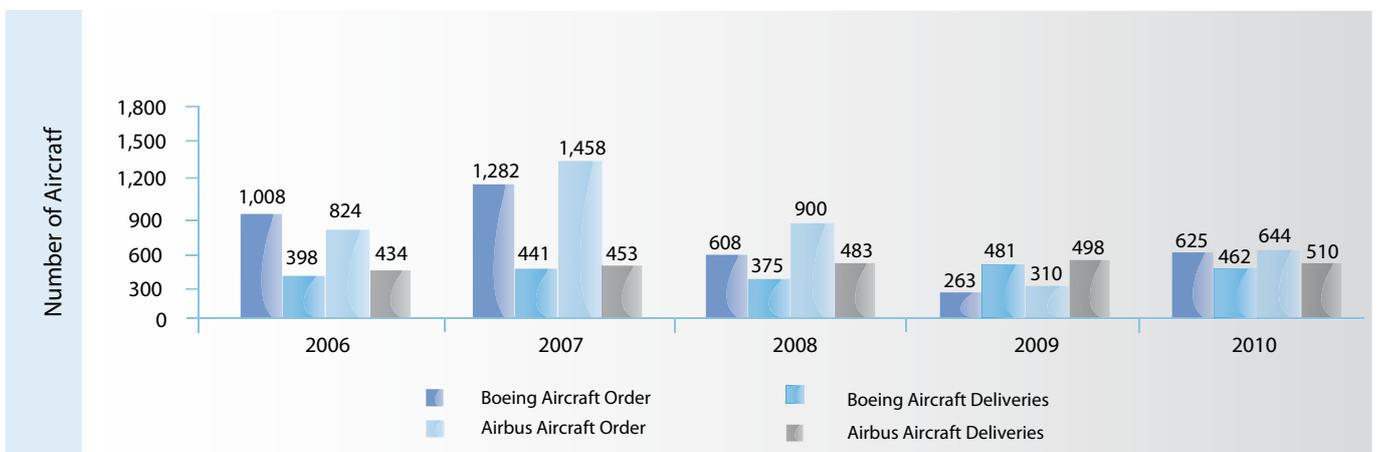
The Aviation industry as a whole is highly sensitive towards the economic situation; this was reflected in the direct effect the economic downturn had on the industry during 2009. It triggered one of the biggest declines in passenger traffic since World War II. However, with the stabilization of the economy, airlines are gradually experiencing relative improvement in the air traffic. Low passenger yields

along with rising fuel costs took a major toll on airline finances during 2009. According to the March 2010 IATA estimate, globally airlines lost approximately US\$9.4 billion in 2009. Albeit even with the recovery, IATA expected the industry to lose US\$2.8 billion in 2010. However, the growth prospects for the global passenger outlook remain at an all-time high for the near future.

Aircraft manufacturers also experienced a sudden drop in orders for new aircraft as a result of the economic downturn. Overall the Aerospace industry generally lags the economic cycle by approximately two years.

However, Aircraft manufacturers were able to manage the slowdown because of geographically balanced backlog of 2005-07. The industry was also able to handle the overall backlog in an efficient way by shifting the delivery

Figure 7: Order and Delivery Trend Analysis – Boeing and Airbus, 2006 - 2010



Note – According to the 2010 company annual reports, Airbus had 310 orders in 2009, down from 900 in 2008, while Boeing's new orders declined to 263 in 2009 from 608 in 2008.

Source – Boeing and Airbus Websites

<http://active.boeing.com/commercial/orders/index.cfm?content=displaystandardreport.cfm&RequestTimeout=500&optReportType=AnnOrd&pageid=m15521>

<http://www.airbus.com/presscentre/corporate-information/key-documents/>

time slots as well as switching deliveries among its customers.

However, with the improved economic outlook, global airline traffic is expected to grow 4.7% on average every year from 2009 to 2028, with the highest gains in Asia Pacific and the Middle East, according to the Airbus Global Market Forecast. Over the next 20 years, Airbus foresees a demand for around 25,850 passenger and freighter aircraft, worth approximately US\$3.2 trillion and Boeing forecasts demand of 28,980 aircraft at US\$3.5 trillion.

This growing demand is expected to be driven by developing economies like India and China, which are expected to witness a surge in air traffic in the near future. Observing the forecasted numbers in Figure 8 and Figure 9 of both Boeing and Airbus, 33% and 34% of this growth is expected to originate from the Asia

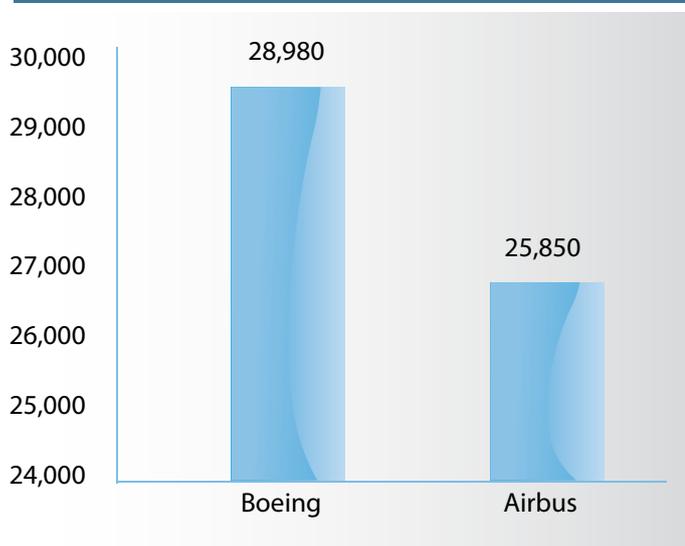
Pacific region, while North America and Europe will contribute 23% each.

In the near future Airbus and Boeing are expected to face increasing competition from manufacturers like Bombardier CSeries, Embraer, Russian MS-21, Sukhoi SuperJet and Comac C919. Though late to arrive, these players have realized the potential economic opportunity that commercial airplanes and related services will represent in the future. This dynamic was reinforced in the forecasts of both Airbus and Boeing. Airbus projected an increasing demand of 16,977 single-aisle aircraft in 2009 while in 2010 it saw a demand for 17,870. Boeing saw a demand for 19,460 single-aisle aircraft in 2009 while in 2010 it was close to 21,150.

In addition, demand for fuel-efficient airplanes will continue to push companies to create designs that will

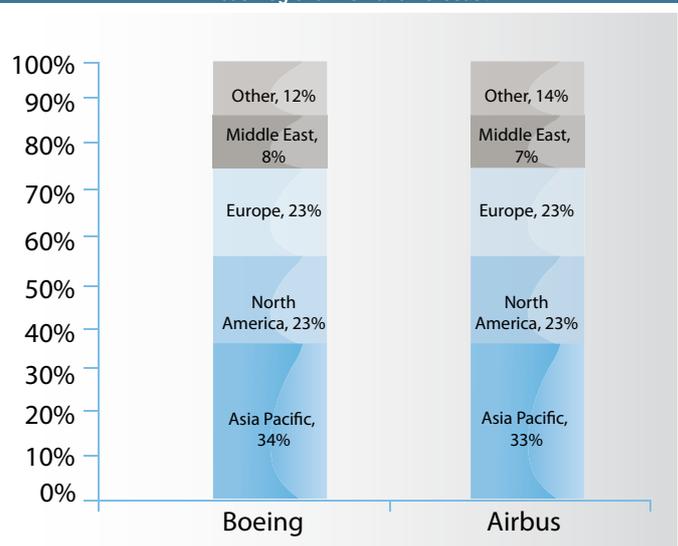
be environmentally progressive in nature and will adhere to North American and European airlines' environmental strategy.

Figure 8: 2010 - 2029, New Airplane Deliveries, Boeing and Airbus Forecast



Source – Boeing and Airbus Global Market Forecast, 2010-2029
<http://www.boeing.com/commercial/cmo/index.html>

Figure 9: 2010 – 2029, New Airplane Deliveries, Boeing and Airbus Regional Demand Forecast



Source – <http://www.airbus.com/presscentre/corporate-information/key-documents/>

Regional Aircraft Segment

Global manufacturing of regional jets is dominated by two manufacturers—Canada’s Bombardier and Brazil’s Embraer. Typically regional jets are considered to be commercial aircraft with fewer than 100 seats. However, this traditional definition has evolved with the changing market dynamics as large regional jet manufacturers are producing jets that are comparable to the smallest aircraft of Boeing and Airbus. The demand for regional jets grew swiftly in the 1990s as airlines used them to fill a niche.

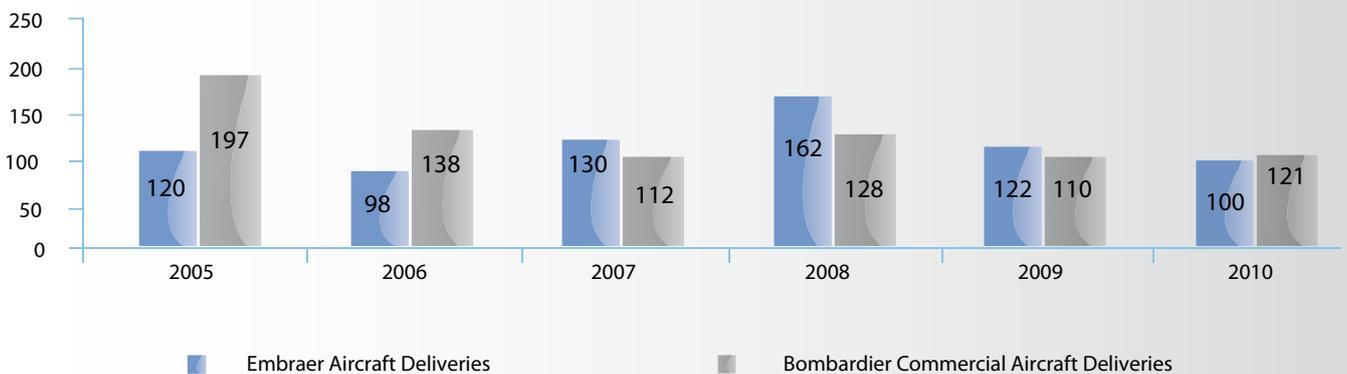
However, due to the recent economic downturn, deliveries of smaller regional aircraft slowed, creating a new regional aircraft segment of 100 to 149 seats. Bombardier (2010 Commercial Aircraft Market Forecast Report) estimates that 12,800 new aircraft worth US\$612 billion are expected to be delivered between 2010 and 2029 in the 20 to 149 seat category. Of these, 2,400 are

estimated to be for turboprops, 3,700 will be in the 20 to 99 seat category, while 6,700 will be in the 100 and 149 seat segments.

In the coming years turboprops are expected to play a crucial role in the regional aircraft market of fewer than 100 seats primarily because regional airlines are facing the stiff challenge of managing rising fuel costs. The low fuel consumption of turboprops, compared with equal size regional jets, provides room for airlines to maintain capacity while reducing fuel bills and effectively curbing their carbon footprint.

Large regional jets having fewer than 100 seats provide opportunities for airlines to fly long routes with optimized seating capacities, while reducing costs without compromising too much on passenger comfort. Bombardier forecasted that the demand for regional jets will outpace turboprops in the near future. Bombardier also forecasted that 61%

Figure 10: Aircraft Delivery Trend Analysis - Embraer and Bombardier



Note – Bombardier Commercial Aircraft is categorized under Regional Aircraft Segment

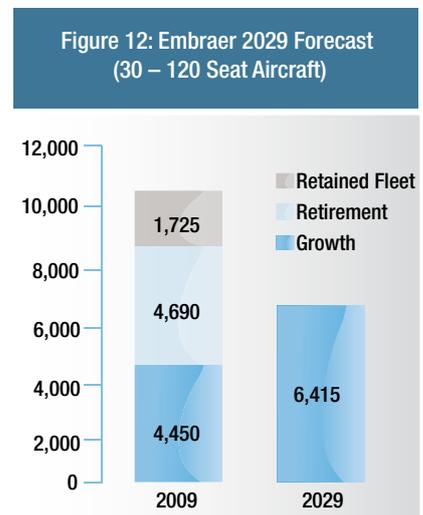
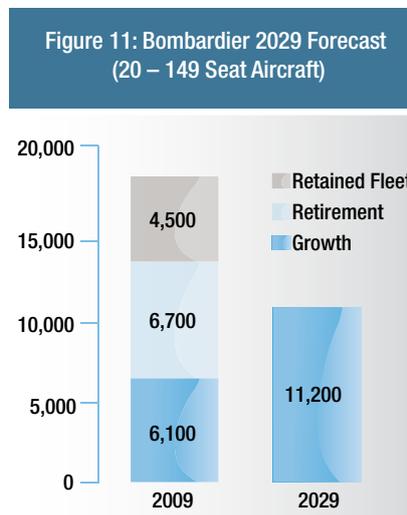
Source – Embraer Website and Bombardier Annual report, 2011, Page 62
http://ri.embraer.com.br/Embraer/Show.aspx?id_canal=BXgITZv8CUwvbKxjJPwpA%3d%3d
<http://www.bombardier.com/en/corporate/investor-relations/financial-results>

of aircraft deliveries having fewer than 100 seats will be for regional jets while the remaining balance will be for turboprops.

An additional opportunity is predicted to arise for the replacement market as the 100 to 149 seat category currently is dominated by an aging fleet of aircraft. Also, many of the aircraft in these segments are derivatives of larger aircraft and not optimally designed to meet the requirement for the 100 to 149 seat category. The added weight and drag produce inefficiencies related to higher fuel burn and more CO₂ emissions

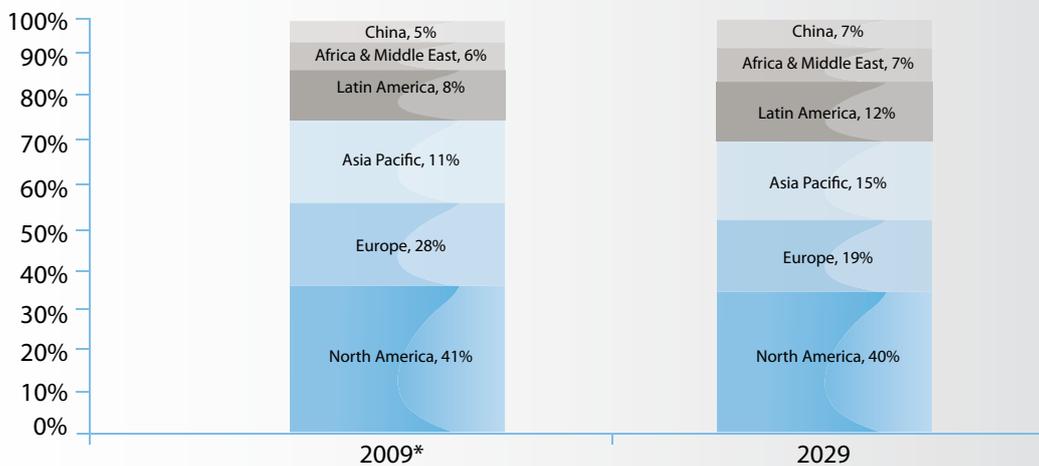
North America and Europe are the two primary markets for regional jets, representing 41% and 28% of the current fleet in the 20 to 149 seat aircraft category, respectively. As seen in Figure 13, Bombardier forecasts that North America will continue to be the largest market in terms of deliveries in the fewer than 150 seat category. By 2029, demand for fewer than 149 seat aircraft from

North America and Europe will decline. However, that will be offset by growing demand from emerging markets. In 2009, Asia Pacific, including India and China, captured 16% of the total market, whereas this figure is forecasted to increase to 22% in 2029 (Figure 13).



Source – Embraer and Bombardier Global Market Forecast, 2010-2029
http://www.bombardier.com/files/en/supporting_docs/BCA_2010_Market_Forecast.pdf
<http://www.embraercommercialjets.com/img/download/248.pdf>

Figure 13: Worldwide Distribution of Regional Airlines Fleet, 2010 - 2029



Note –*Sum does not add to 100% as figures were rounded
 Source – Bombardier Commercial Aircraft Market Forecast, 2010-2029
http://www.bombardier.com/files/en/supporting_docs/BCA_2010_Market_Forecast.pdf

Business Jets Segment

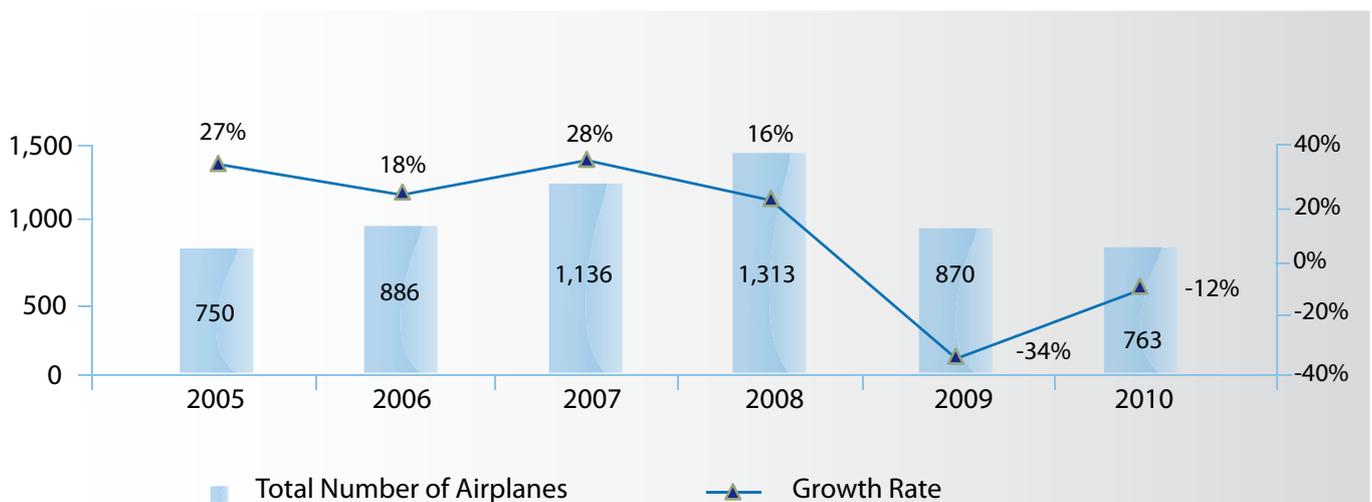
Demand for business jets soared in 2008 as U.S. companies registered record profits and the overall business sentiment was at an all-time high. However, with the collapse of the financial markets, the Business Aviation segment as a whole started facing stiff challenges by the end of 2008. Overall order activities recorded a downfall during the last quarter of 2008. Inventories of pre-owned aircraft increased significantly with residual values taking a hard hit. Moreover, Original Equipment Manufacturers (OEMs) were having a tough time between order cancellations and deferrals. Bombardier estimated that more than 800 net orders were cancelled in 2009 in the Light to Large categories (Bombardier Business Jet Market Forecast). This market situation pushed OEMs to cut their production targets.

However, with the gradual recovery of the economy, business jet usage has increased and pre-owned inventory has started declining. According to the General Aviation Manufacturers Association (GAMA) the used business jet inventory in December 2010 was 14.8% of the active fleet, which was 1.5% lower than in December 2009. With recovery visible, the average business jet inventory is still above the historical average.

Credit availability has started to recover, improving the ability of certain operators to finance their business jet purchases. GAMA recorded a drop in worldwide shipments of business jets for the third year - in 2010, 763 units of planes were delivered around the globe, compared with 870 units in 2009, a 12% decline.

However, business jet manufacturers are witnessing gradual improvement in demand, but there is contraction

Figure 14: Worldwide Business Jet Shipments – 2005 - 2010 Analysis - Embraer and Bombardier



in new aircraft prices, which will continue to remain low until the end of 2011. The recovery for business jets usually lags a rebound in the general economy by 18 to 24 months. Gulfstream is making efforts to focus on the large-cabin aircraft market, which has recovered from the economic crisis earlier than the mid-cabin market.

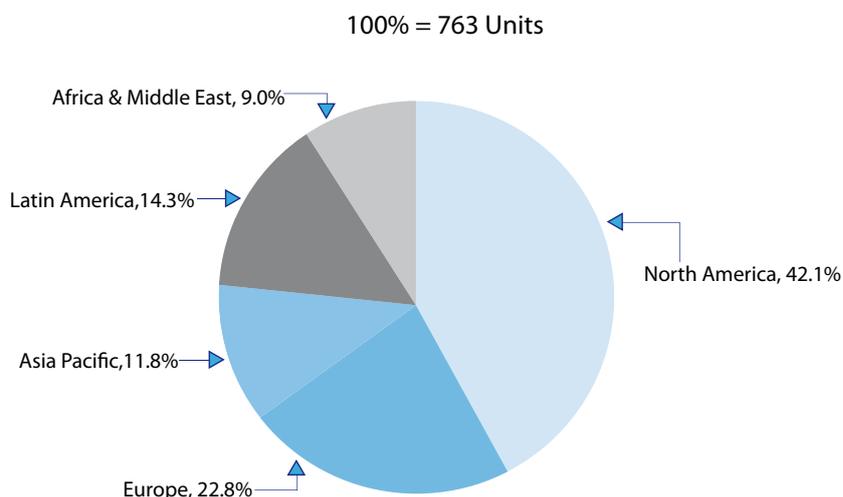
According to GAMA, in 2010, 42.1% of business jet deliveries were to North American customers, compared with 49% in 2009. Europe accounted for 22.8% of the shipments in 2010, Latin America followed with 14.3%, Asia Pacific at 11.8% and the Middle East and Africa with 9.0%.

The worldwide business jets fleet consisted of 14,200 aircraft at the end of 2009 and is forecasted to grow at 3.6% CAGR to an estimated 29,000 aircraft by 2029. Bombardier forecasted that the business jet shipments will increase to 10,500 by 2019 and to 15,500 by 2029. Shipment of 10,500 business jet units is expected to garner revenues worth US\$254 billion until 2019 and US\$407 billion by 2029. Bombardier also predicted delivery to increase to 1,600 business jet units per year.

Further, according to the Bombardier forecasts, North America is estimated to occupy the maximum share of the market with 4,400 units of jets being delivered between 2020 and 2029. Europe will follow with the second-largest business jet delivery of approximately 2,500 units. Asia Pacific will also register significant business jet fleet growth with increasing demand from developing economies like India and China. The Chinese business jet fleet is expected to grow at a CAGR of 20% amounting

to 700 aircraft in 2019. The Indian business jet fleet is expected to grow at a CAGR of 13% over the next couple of years and will account for an estimated 440 aircraft in 2019.

Figure 15: 2010, Business Jet Delivery by region, 2010



Source – 2010 GAMA Statistical Databook & Industry Outlook, Page 16
http://www.gama.aero/files/GAMA_DATABOOK_2011_web.pdf

Figure 16: 10-Year Delivery Outlook – Regional Perspective

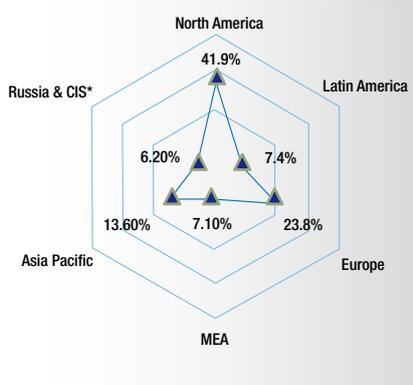
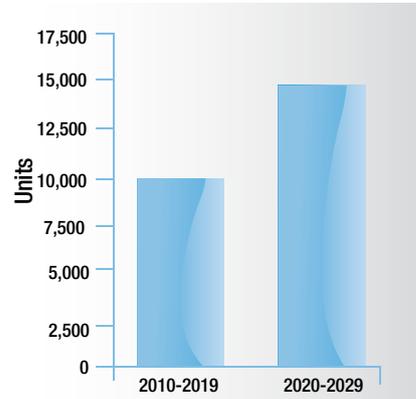


Figure 17: 2010 – Business Jet Industry, 20- Year Delivery Outlook



Note –*CIS = Commonwealth of Independent States
 Source – Bombardier Business Jet Market Forecast, Page 25 & Page 6 respectively
http://www.gama.aero/files/GAMA_DATABOOK_2011_web.pdf

Helicopter Market

The financial crisis had a deep impact on the Helicopter segment, but with the worst of the economic downturn coming to an end, optimism is back for the market. However, in the near future, the enduring credit crunch along with high inventories of used production models will continue to hamper fresh order intake.

According to the projections in Honeywell's 13th Turbine-Powered Civilian Helicopter Purchase Outlook Report, global deliveries of new civilian-use helicopters are expected to increase 5% during the period 2011–2015. Along with the more positive economic outlook, the introduction of new technologies is generating increasing interest among customers.

Helicopter manufacturers are making efforts to introduce safety-enhancing technologies, which include new

ways of monitoring health and usage, enhanced situational awareness tools, workload-reducing automatic flight control systems and maintenance-saving vibration-reduction packages. Manufacturers: such as AgustaWestland are also investing in advanced technologies as product differentiators. A key goal has been to develop technologies for providing jet-like smoothness in helicopters with active vibration control of structural responses.

New civilian helicopter deliveries are expected to reach 4,200 to 4,400 during 2011-2015. The vast majority of the global Civil Helicopter market is highly polarized among three manufacturers: Eurocopter, Bell Helicopter and AgustaWestland.

Observing the geographic segmentation in Figure 18, North America and Europe continue to occupy the largest regional market share for new helicopters, accounting

Figure 18: 5-year Delivery Outlook – Regional Perspective

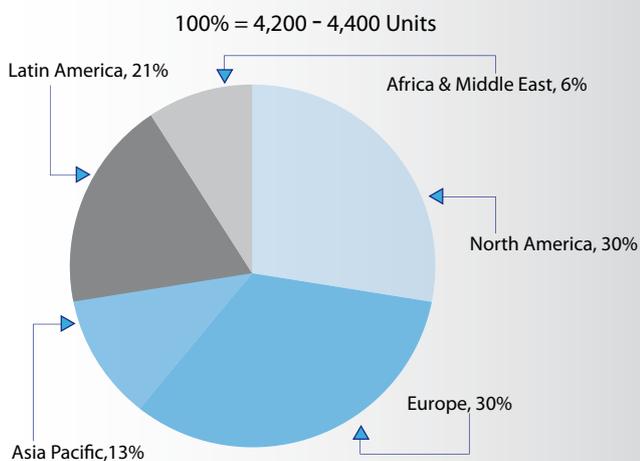
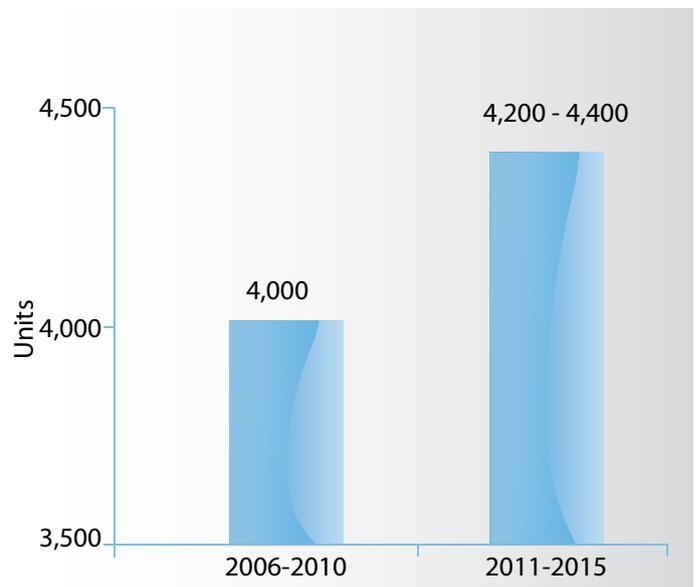


Figure 19: Civilian Helicopter Market Outlook – 2011 - 2015

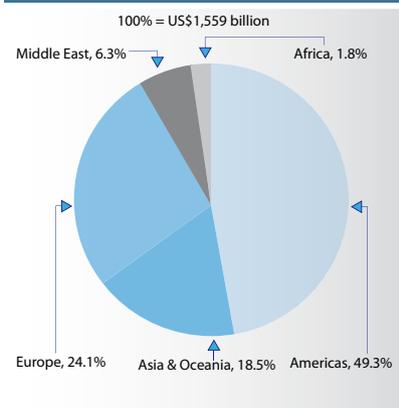


for 60% of planned purchases. However, according to Honeywell, buying plans in 2010 fell 26%, compared with 2009. Asia Pacific, Africa and the Middle East are expected to capture a 19% global share of the five-year market (2011-15) demand.

Global Defense Market

The global military expenditure slowed considerably and is expected to stay flat in the near future, primarily because of U.S. defense budget cuts. Cancellations along with delays of major weapons programs will have a major impact on any additional defense-related spending across the world. Even then, global defense spending was close to 2% of GDP, with Saudi Arabia, Oman and UAE spending proportionately higher amounts. According to the Stockholm International Peace Research Institute (SIPRI), global military expenditures accelerated in 2010 by 1.3% in

Figure 20: Regional Split of Global Defense Expenditures, 2010



Source – SIPRI Market Forecast
<http://www.sipri.org/databases>

Figure 21: Defense Spending as % of Country GDP

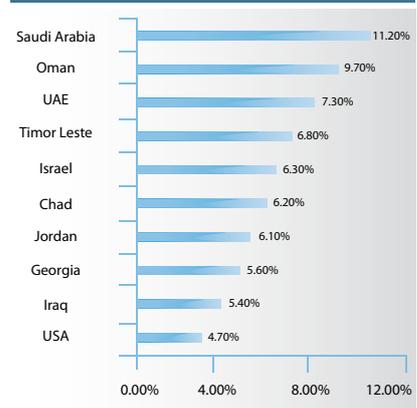
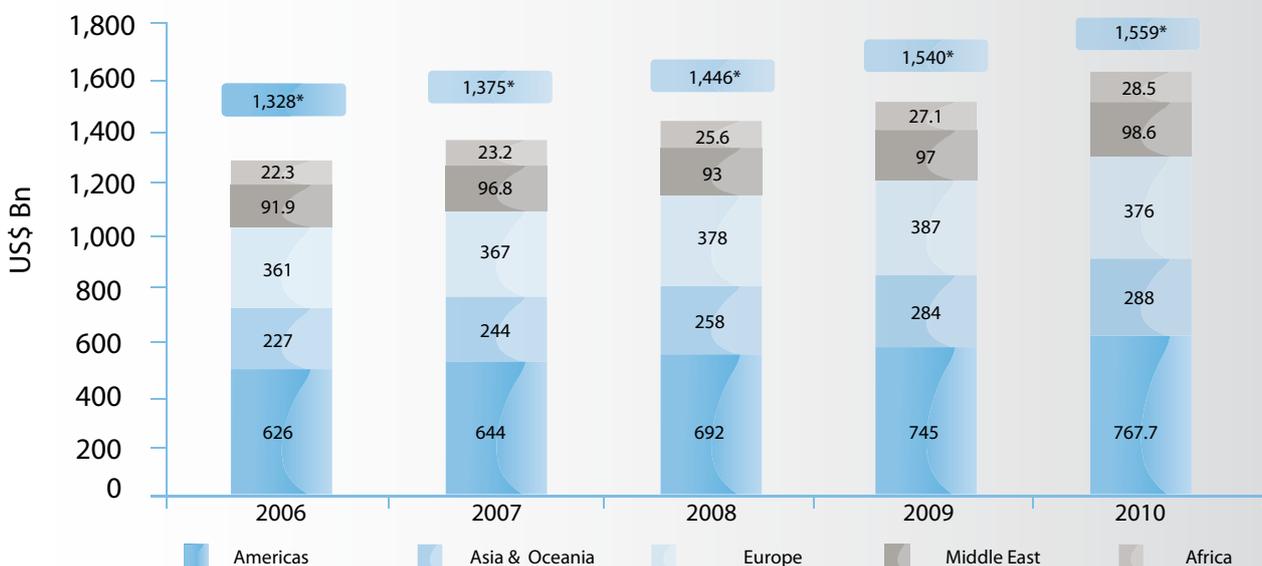


Figure 22: Global Military Expenditures, 2006 - 2010



Source – SIPRI Market Forecast
<http://www.sipri.org/databases>

real terms to reach US\$1.6 trillion, albeit the figure represented the lowest growth rate since 2001 and a remarkable slowdown from the global spending increase of 5.9% in 2009.

The United States decreased its military investments in 2010 but still remained the largest defense spender in the world. U.S. defense spending increased by a mere 2.8% in 2010 amounting to US\$698 billion after registering an average growth of 7.4% from 2001. European military expenditures fell by 2.8% in 2010 due to government efforts to reduce costs to address rising budget deficits. In Asia, defense expenditures grew by only 1.4%, with China leading the way with an estimated US\$119 billion defense expenditure in 2010.

Globally defense contractors are witnessing a gradual shift in spending patterns. Most of the defense procurement appears to have shifted to high-tech intelligence equipment, replacing demand for conventional big guns and heavy armor. As a result, consolidation is becoming evident as

vendors are making efforts to bridge gaps in their product offerings.

Boeing in particular has been active in this space, having acquired Argon ST, a developer of intelligence equipment, and Narus, a real-time network traffic and analytics software supplier. Boeing further strengthened its position in the logistics command and control business areas by acquiring CDM Technologies, a software company specializing in real-time transportation and logistics planning systems for the U.S. military.

Many defense suppliers are also entering into partnerships with competitors to improve their prospects to win major contracts. Boeing and Northrop Grumman entered into a strategic partnership to chase the competitive development and sustainment contract for future work on the Ground-based Midcourse Defense (GMD) system for the U.S. Missile Defense Agency (MDA).

In 2010, defense aircraft sales were boosted by higher demand from international customers. In 2010,

military aircraft sales recorded a sharp 8% growth to reach US\$64.5 billion.

Industry backlogs were stable despite the fact that many contracts were terminated, showing only a modest plunge.

However, in the long run factors like U.S. defense budget cuts, growing instability in the Middle East, piracy in the commercial shipping lanes of Somalia, North Korea's continued long range strike and nuclear arms development will continue to hamper global stability, which in effect will influence the global defense spending.

Figure 23: Global Defense Expenditure

US\$ Billion	31/12/2010	31/12/2009	31/12/2008
EADS Defense	79.7	76.2	70.4
Lockheed Martin	78.2	77.2	80.1
Finmeccanica	65.0	65.0	61.8
Boeing Defense, Space & Security	48.3	46.0	45.2
Northrop Grumman	64.1	69.1	76.4

Source – EADS Registration Document, Page 27; Lockheed Martin Annual Report, 2010, Page 20; Feronica Annual Report, 2010, Page 9; Boeing Annual Report, Page 17; Northrop Grumman, Annual Report 2010, Page 49 & Annual Report 2009, Page 47

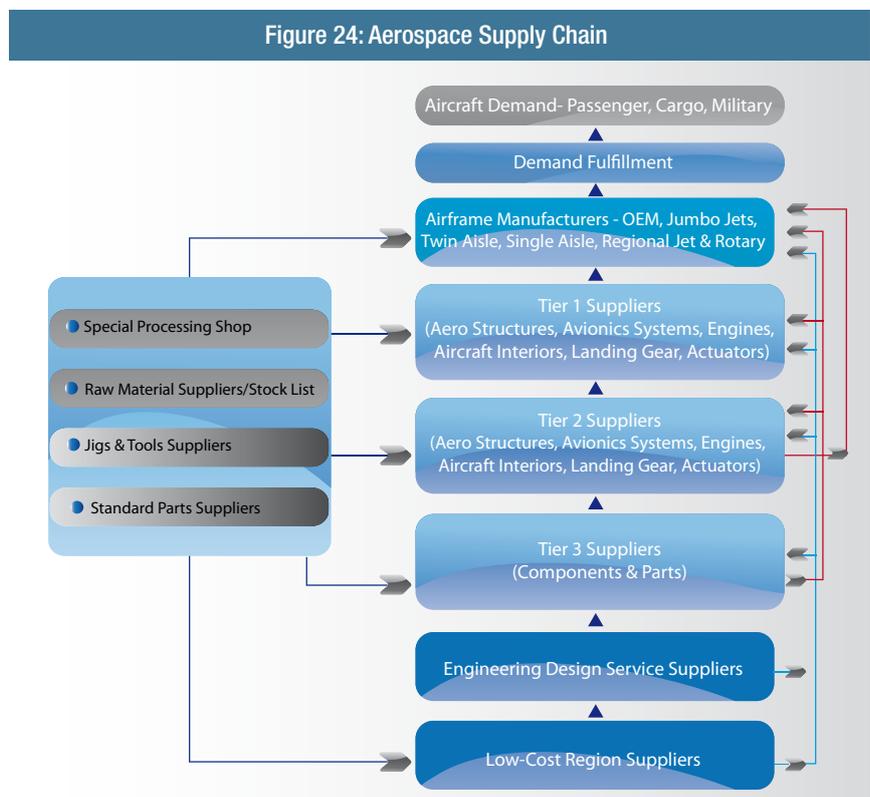
Aerospace Supply Chain Analysis

Supply Chain Analysis

The overall Aerospace supply chain can be classified among OEMs, Tier 1 suppliers, Tier 2 suppliers and Tier 3 suppliers. Traditionally, large aircraft manufacturers, often referred to as OEMs, will specify their needs to the Tier 1 suppliers. OEMs are responsible for overall designing and manufacturing, which are often referred to as the most critical component of the value chain and frequently face entry barriers due to high investment requirements and technological capabilities. Tier 2 suppliers produce aircraft parts

according to the Tier 1 suppliers' specifications. Tier 3 suppliers are responsible for providing basic components required by other vendors that are present higher in the value chain.

However, with the changing dynamics in the industry, airframe manufacturers and Tier 1 suppliers are gradually becoming large integrators of airplane production. New strategies adopted by the Aerospace industry to achieve greater efficiency and reduced costs are increasing OEMs' dependence on Tier 1 suppliers. This enhances



Source – Autodesk Whitepaper 'Digital Prototyping for the Aerospace Supply Chain', 2008
http://images.autodesk.com/adsk/files/aerospace_whitepaper_color_us_1_.pdf

risk sharing between suppliers and buyers (OEMs), including suppliers from low-cost regions in the value chain, and increasing transparency into aircraft programs, plans and schedules. Big players like Boeing and Airbus are focusing more on integration and less on internal production capability. These vendors are working towards a business model where they will need to work with fewer Tier 1 suppliers, and decreasing direct interactions with Tier 2 and Tier 3 suppliers.

Another important component of the value chain is the aftermarket industry, often referred to as Maintenance, Repair and Overhaul (MRO), which provides support to the OEMs and airlines through day-to-day maintenance and required upgrades.

Key Components of the Aerospace Supply Chain

Aerospace manufacturing is an extremely complicated process, involving manufacturing of a wide

range of components that vary in terms of specifications and functions. It is estimated that the airframe and engine constitute a quarter of the total aircraft production values while systems and avionics combined account for another quarter of the total value chain. The following section describes the dynamics of major components of the value chain.

Aircraft Engines

The Aircraft Engines segment consists of companies that primarily specialize in manufacturing jet engines. This market is dominated by three companies: General Electric, Rolls-Royce and Pratt & Whitney. Rolls-Royce is the current market leader and is estimated to have about 50% of the new orders in the most lucrative wide-bodied aircraft market, while GE holds about 40% of the new orders.

In this segment intense competition often results in price wars among the players. To avoid such situations, engine manufacturers typically enter into exclusive supplier contracts

with commercial aircraft makers or OEMs. In many instances these manufacturers enter into joint-venture agreements to share high investments required for future engine design and development. In some cases, jet engine manufacturers are willing to sell their products at “no profit no loss” in order to capture future lucrative MRO business, which provides them with incremental income over the years. As a result, companies in this segment tend to have healthy profit margins.

Apart from the large OEMs and the corresponding joint ventures (with a regional emphasis on the U.S.), there are several suppliers in the global aviation engine market including MTU Aero Engines of Germany, Volvo Aero of Sweden, Avio S.p.A. of Italy and ITP Engines of the UK.

Avionics

The Avionics market consists of electronic aircraft systems like fly-by-wire (or even fly-by-light) flight controls, system monitoring, anti-

Figure 25: Global MRO Market, 2005 - 2010

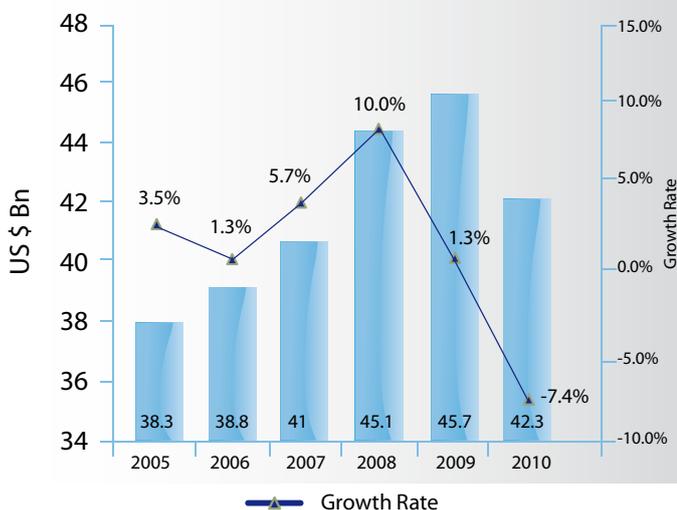
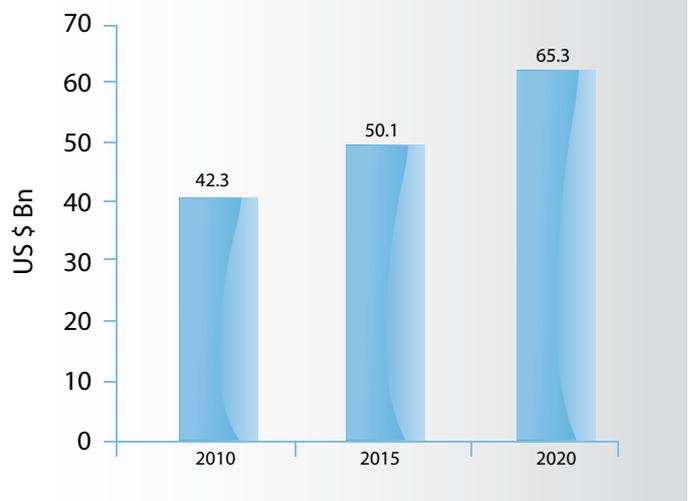


Figure 26: Global MRO Market Forecast, 2010, 2015 - 2020



Source – TeamSAI Consulting, MRO Market Forecast

collision systems and pilot assistant/ interface systems like communication, flight management systems, navigation and weather forecast. After the economic downturn the outlook for the Avionics software market continues to be difficult. However, the market is expected to follow the overall aircraft manufacturing cycle. Key players in this segment include Thales, Honeywell and L3-Communications.

Global Maintenance, Repair and Overhaul (MRO)

Demand for MRO services is primarily driven by airline companies, which use in-house maintenance services or outsource these activities to third-party providers. As noted previously, with the number of aircraft in operation expected to increase across all regions in the future, demand for MRO services is set to grow. Airline operators are also influencing the dynamics of the market through their growing demand for quick turnaround times in order to keep their planes in the air as long as possible. Also,

outsourcing of MRO-related activities is gaining traction as airlines focus on their core business of passenger transport while leaving non-core activities in the hands of specialists.

However, the increasing global airline fleet does not necessarily mean that the MRO market will also record growth at par with the increasing fleet size. Over time the maintenance requirements of aircraft tend to decline as new-generation aircraft that require less maintenance replace the older ones.

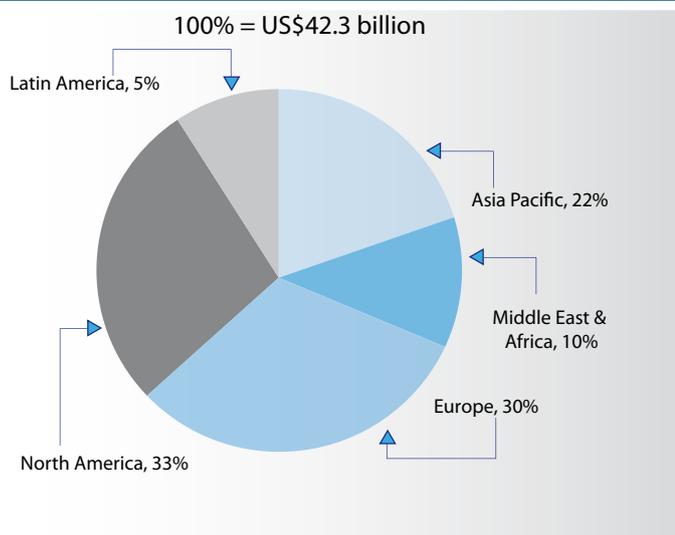
The global MRO market is expected to grow by 3.4% per annum through 2015 and 4.4% through 2020. In terms of value, the MRO market is predicted to reach US\$50.1 billion by 2015. In 2010, global MRO-related expenditures fell by 7.5%, although they have registered growth of 2.1% in 2011.

The greatest share of MRO revenue is derived from engine maintenance activities, which involve a material-

intensive process with labor only accounting for close to 30% of the revenue earned from this segment. Engine manufacturers are increasingly making efforts to raise their share of the engine maintenance market as it is a source of substantial incremental revenue and profit. Components contribute around 23% of the overall MRO market.

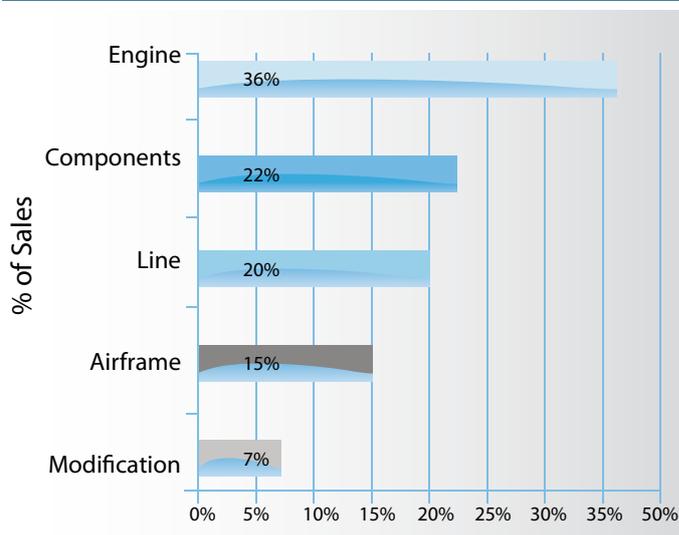
The highest market share within the MRO market is captured by the OEMs. They have an added advantage with technical knowledge of products as they can be readily adapted for maintenance-related activities. Other associated services like airframe, line maintenance and modifications contribute 15%, 21% and 7%, respectively.

Figure 27: Global MRO Market Regional Split, 2010



Source – TeamSAI Consulting, MRO market Forecast

Figure 28: Global Air Transport MRO Market



Source – Aero Strategy/OAG Aviation

Future Trends

The A&D industry has always been known for its innovation capability in achieving extraordinary technical advances and also in allowing individual companies to remain competitive in a rapidly evolving landscape. A few of the innovations, like the Global Positioning System (GPS), Boeing's Joint Direct Attack Munitions (JDAM), the Airbus A380 and SpaceX's Falcon 1, have altered the entire industry in terms of its functioning. Several developing trends have similar potential.

Increasing Usage of Composites

The composite class of materials has the capability to play an important role in the Aerospace industry today and in the future. The key reasons for composite materials' attractiveness to aviation and aerospace applications are their exceptional durability and high stiffness-to-density ratios. Composite material generally consists of relatively strong, stiff fibers in a tough resin matrix. Other composite materials that are often used in aerospace include carbon- and glass-fiber-reinforced plastic (CFRP and GFRP, respectively).

Usage of composite materials is lucrative in aircraft because composites help in reducing the overall weight of the airframe enabling better fuel efficiency. Composites are estimated to enable a 20% saving in terms of weight along with lower production time and improved damage tolerance. Usage of composites in aircraft has gradually increased over the years. The A380 has used 20% to 22% composites by weight along with extensive usage of GLARE (glass-fiber-reinforced aluminum alloy). As

conventional metallic materials and their derivatives continue to evolve to increase performance, there is little doubt that the significant benefits of using composites are yet to be fully exploited. As this understanding develops, composite materials will play an increasingly significant role in aircraft manufacturing.

Optimized Usage of Turboprops and Jets

Aircraft and engine design play a crucial role in determining the airline fleet size for optimizing the networks as well as reducing the fuel bills. Once again airlines have started embracing turboprops as a cost-effective way of serving short-haul markets. Turboprops not only lower fuel burn but often play a tangible role in decreasing emissions. As environmental considerations drive airline and passenger choices, the advantages of turboprops are substantial. The propeller has been used since the earliest days of powered flight; the concept has been refined over the years with significant improvements in turbine efficiency and propeller technology. In the future airlines will make an ongoing effort to maintain the right balance between turboprops and jet numbers to increase their profitability.

Alternate Fuels

The Aerospace industry is exploring the possibilities of alternative fuels to decrease exposure to oil price variations and reduce dependency on crude oil. The fuel crisis in 2008 illustrated the industry's sensitivity to rapidly rising fuel prices. Biofuels are primarily developed from feed stock of one of two key sources, namely,

plants with high sugar content (e.g., corn and sugar cane) and plants that are rich in bio-derived oils (e.g., soybeans, algae). Biofuels produced from plants high in sugar content, including ethanol, are generally referred to as first-generation biofuels and are ill-suited for high-end applications like aviation. On the other hand, second-generation biofuels made up of bio-derived oil can be chemically processed to make high-quality jet fuel and diesel.

Airline companies like Lufthansa, Ryanair and easyJet have already signed a deal with Solena, an American producer of aviation biofuels, marking a step towards an increase in this trend. In January 2010, Qantas also started working with Solena to build a commercial-scale aviation biofuel plant. Solena is also setting up a similar plant in London, which is scheduled to produce biofuel from 2014.

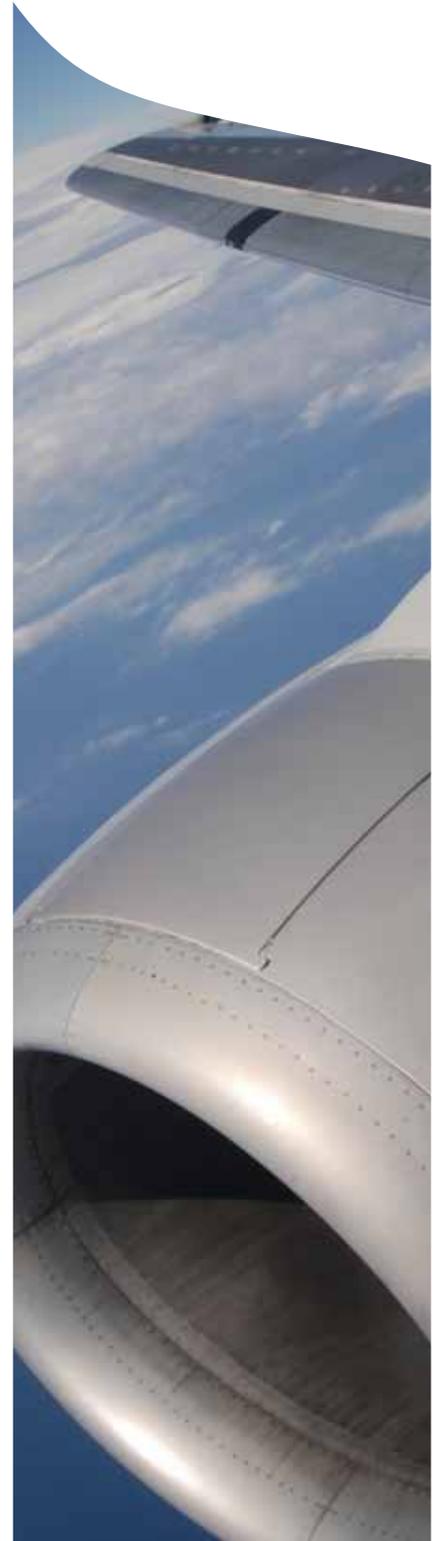
One reason for the sudden popularity of biofuels is the latest technological advancement of deriving biofuels from waste; this has sidelined some of the problems that have hampered production of crop-based varieties of biofuels. Tests have already been conducted successfully by airlines, including Qatar Airways, Continental, United, Air New Zealand, Japan Airlines and Lufthansa.

However, it is expected to take years and more investment in R&D before biofuels can replace the traditional kerosene-based jet fuel mix for extensive usage in civil aviation. According to IATA an investment of US\$10-15 billion will be required

Globalization

Globalization is a growing factor in the A&D industry. With an established international customer base, the sector is well positioned to overcome inherent globalization challenges and derive benefits from the booming commercial markets of Asia Pacific and defense markets in the Middle East and Asia. Additionally, A&D supply chain markets are opening up in India, Brazil, Mexico and Turkey, as well as China for commercial aerospace.

For many A&D companies, their customer base, production, and research and development are already globalized and now their MROs are increasingly becoming global in nature. Besides the U.S. some other countries that are attractive for MRO-related investments are Singapore, China, UAE and Brazil. These investments are changing the overall landscape of the aerospace maintenance infrastructure and will continue to change the dynamics in the near future.



Conclusion

This report makes it clear that the Aerospace & Defense industry faces critical changes and challenges. In this increasingly competitive environment, A&D companies more than ever must excel in key strategic areas by taking the following actions:

Take advantage of new and innovative technologies: In a context where newcomers from developing countries will aggressively launch their products to the market, innovation and new technologies can help traditional players stay ahead of these new competitors.

Reduce development cycles for new programs: With strong pressure to reduce development cycles and the increasing importance of Tier 1 suppliers in product design, OEMs must rethink their concurrent engineering process toward more collaboration, while securing intellectual property. To address these challenges requires a new standard in Product Lifecycle Management that is nothing less than excellence.

Secure the industrial ramp-up of programs: To meet the aggressive production targets of new or existing programs, A&D industrials must optimize their processes toward more integration both internally (from plants to final assembly line) and in the global supply chain (from Tier 1 suppliers to final assembly line).

Grow revenues from the services area: A&D industrials must increasingly make the shift from products towards services in order to create new revenue streams through added-value services in maintenance activities. The best performing companies in the coming years will be

those that have successfully managed their development in the MRO area.

Reduce costs without conceding quality: In most A&D companies cost-reduction programs have been running for a number of years. Yet there are still opportunities for additional reduction via approaches such as Business Process Outsourcing of some business functions like Technical Publications.

This study presents an overview of key industry segments and critical trends. Yet there is much more that can be explored and applied to your own organization. For additional information about how Capgemini can help you address the trends and challenges, please visit our Aerospace & Defense practice website at www.capgemini.com/aerospace-defense





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