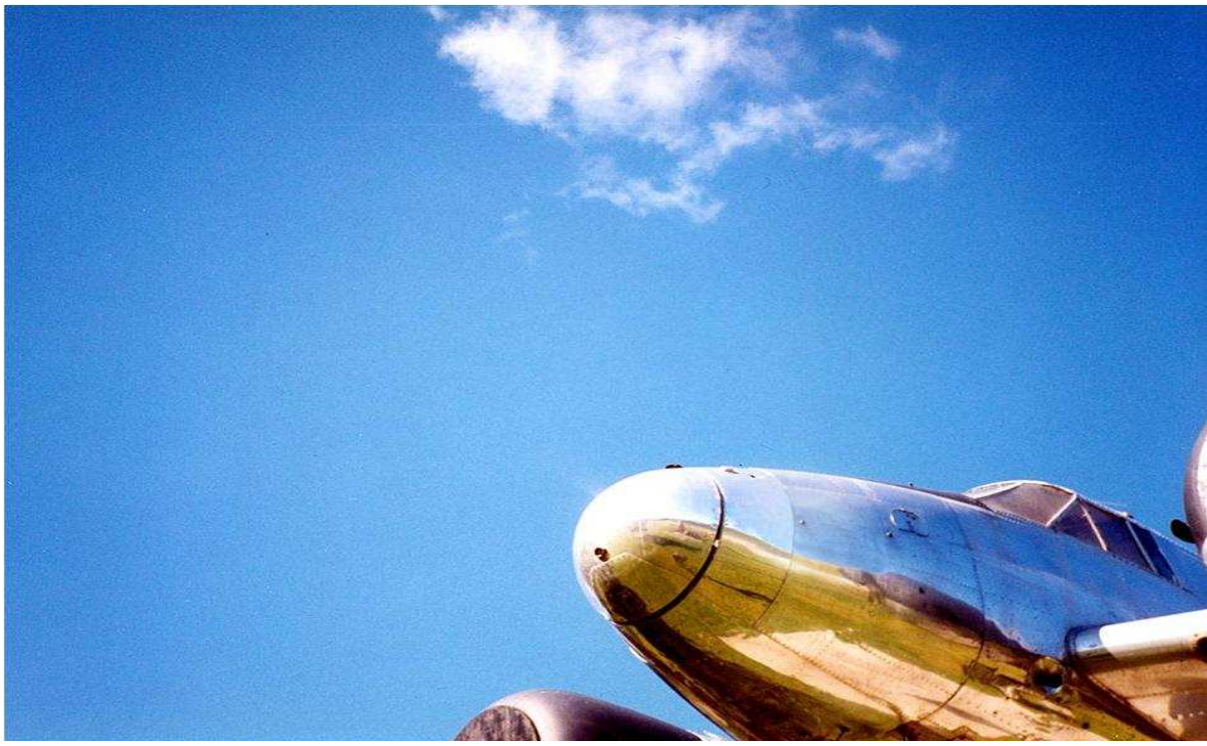
Deloitte.



Global Aerospace Market Outlook and Forecast

October, 2010
AIAC Phase 3 Report

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3 Glossary of terms

Acronym	Definition
A&AP	Aircraft and aircraft parts
A&D	Aerospace and defence
ACAR	European Council for Aeronautics Research
ACARE	Advisory Council for Aeronautics Research in Europe
AeGT	Aerospace Innovation and Growth Team
AFK	Average freight kilometres
AIAC	Aerospace Industries Association of Canada
ASEAN	Association of Southeast Asian Nations
ASK	Available seat kilometres
ATP	Airline transport professionals
AviChina	Aviation Industry of China
BE-LF	Break-even load factor
BMD	Ballistic missile defence
BMBF	Federal Ministry of Education and Research
BMWI	Federal Ministry of Economics and Technology
CAGR	Compound annual growth-rate
CAP	Combat air patrol
CARAD	Aeronautics Research and Technology Demonstration
CAS	Civil aerospace sector
CDDP	Canadian Department of Defence Production
CEO	Chief executive officer
COMAC	Commercial Aircraft Corporation of China, Ltd.
CORAC	Council for Civil Aeronautics Research
CR&D	Collaborative Research and Development Grant
Deloitte	Deloitte & Touche LLP
DoD	United States Department of Defense
E&EP	Engines and engine parts
EADS	European Aeronautic Defense and Space Company
EBIT	Earnings before interest and taxes
EDB	Economic Development Board
Embraer	Ministry of Empresa Brasileira de Aeronautica
EU	European Union
FAA	Federal Aviation Administration
FFS	Full flight simulator
FTD	Flight training devices
FTK	Freight tonne kilometre
FY	Fiscal year
GARDN	Green aerospace research and development network
GDP	Gross domestic product
GEO	Geosynchronous-earth orbit
HMMWV	High mobility multipurpose wheeled vehicles
IADF	International Aircraft Development Fund
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

Acronym	Definition
IMF	International Monetary Fund
IRB	Industrial and Regional Benefits Policy
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
JSF	Joint Strike Fighter
LCC	Low cost carriers
LEO	Low-earth orbit
LuFo	Aeronautical Research Program
M&A	Mergers & acquisitions
MA&D	Military aerospace and defence
MAS	Military aerospace sector
MEO	Medium-earth orbit
MOU	Memorandum of understanding
MRO	Maintenance, repair, and overhaul
MTOW	Maximum take-off weight
NPV	Net present value
NRC	National Research Council
O&M	Operations and maintenance
OAAN	Open Aviation Agreement Negotiations
OEM	Original equipment manufacturer
ONERA	The French Aerospace Lab
PAA	Phased adaptive approach
PPE	Property, plant, and equipment
PPP	Purchase price parity
QDR	Quadrennial Defence Review
R&BA	Regional & business aircraft
R&D	Research & development
RDT&E	Research development, test and evaluation
RJ	Regional jets
RPK	Revenue passenger kilometre
SADI	Strategic aerospace and defence initiative
SIPRI	Stockholm International Peace Research Institute
SME	Subject matter expert or Small to medium sized enterprise
SRA	Strategic Research Agenda
Space	Space sub-sector
STA	Singapore Technologies Aerospace
T&S	Training and simulation
ToT	Transfer of technology
UAC	United Aircraft Corporation
UAV	Unmanned aerial vehicles
UK	United Kingdom
US	United States
USCYBERCOM	United States Cyber Command
WLF	Weight load factor
WMD	Weapons of mass destruction
WTO	World Trade Organization
YD	Yamoussoukro Decision
YoY	Year-over-year

4 Introduction

All currency figures are in nominal US Dollars ("USD") unless specified.

Deloitte & Touche LLP ("Deloitte") was retained by the Aerospace Industries Association of Canada ("AIAC") to assist in analyzing the contribution of the Canadian aerospace industry to the Canadian economy. This analysis consists of three related but distinct phases and corresponding reports:

- Phase 1: provides a synopsis of the Canadian aerospace industry based on a statistical analysis of the 2009 AIAC annual membership survey ("the AIAC Survey"). This report also includes a discussion of the membership's outlook for the sector.
- Phase 2: evaluates the contribution of the aerospace industry to the Canadian economy by quantifying the direct, indirect, and associated impacts of the aerospace industry on measures such as expenditure and investment, employment, and gross domestic product ("GDP"). This report uses macroeconomic and sectoral data, including the AIAC Survey results from Phase 1, to parameterize Deloitte's input-output model and generate numerical results. To further highlight the different ways in which the socioeconomic impacts of the aerospace industry can be felt in the broader economy, this report also presents four case studies drawn from specific development programs in the aerospace industry.
- The Phase 3: report contains four primary components:
  - **Market outlook**: A market outlook which gives a brief overview of the global and domestic aerospace market. The market outlook primarily focuses on the trends that will shape the civil and military aerospace market going forward. Future trends are the focus of discussion because they will directly affect Canada's global competiveness in the global aerospace industry. Significantly more importance is placed on the civil aerospace sector because of the importance of this sector to the domestic aerospace industry. National security concerns create significant barriers to entry within the military aerospace sector and therefore limit the opportunities offered by the sector to Canadian companies. The vast majority of the outlook is also focused on the global, as opposed to the domestic, aerospace market. The reason for this global focus is twofold: first, the Canadian industry is geared heavily towards exports and is therefore dependent on global market conditions; and second, the Canadian industry is analyzed in-depth as part of the Phase 1 and Phase 2 reports.
  - **Comparative analysis**: The comparative analysis briefly outlines some of Canada's global competitors in the aerospace sector. The importance of the aerospace sector to the Canadian economy is also introduced. A report card is developed to evaluate the Canadian economy relative to global competitors based on a set of quantitative and qualitative metrics.
  - **Market forecast**: Global aerospace market revenues, segmented by sector, sub-sector, and region, are forecasted from 2010 to 2020. The implications of this forecast for the Canadian economy are highlighted and the forecast is used to analyze which sub-sectors and regions are of strategic importance to the Canadian aerospace industry. A net-present-value ("NPV") model is also used to estimate the total impact of aerospace revenues generated over the ten year forecast. For example, the total value to the Canadian economy in 2010 dollars if Canada were to capture an extra 5% of the global CAS by 2020.
  - **Policy scenarios**: The global forecast is used to examine the implications of the market forecast on the domestic aerospace industry. The effects of the forecasted aerospace market on employment, research and development investment, and trade with emerging markets are examined.

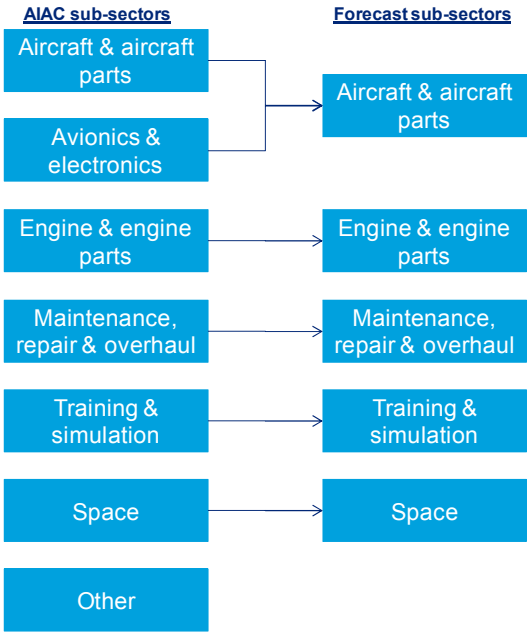
4.1 Industry definition

The civil aerospace sector ("CAS") and the military aerospace sector ("MAS") are defined and segmented into the following sub-sectors:

1. Aircraft & aircraft part manufacturers ("A&AP") (including avionics and electronics)
2. Engine & engine part manufacturers ("E&EP")
3. Maintenance, repair, and overhaul ("MRO")
4. Space ("Space")
    a) Satellite and space vehicle manufacturing, including guided missiles for the MAS
    b) Launch service providers for the CAS only
5. Training & Simulation ("T&S")

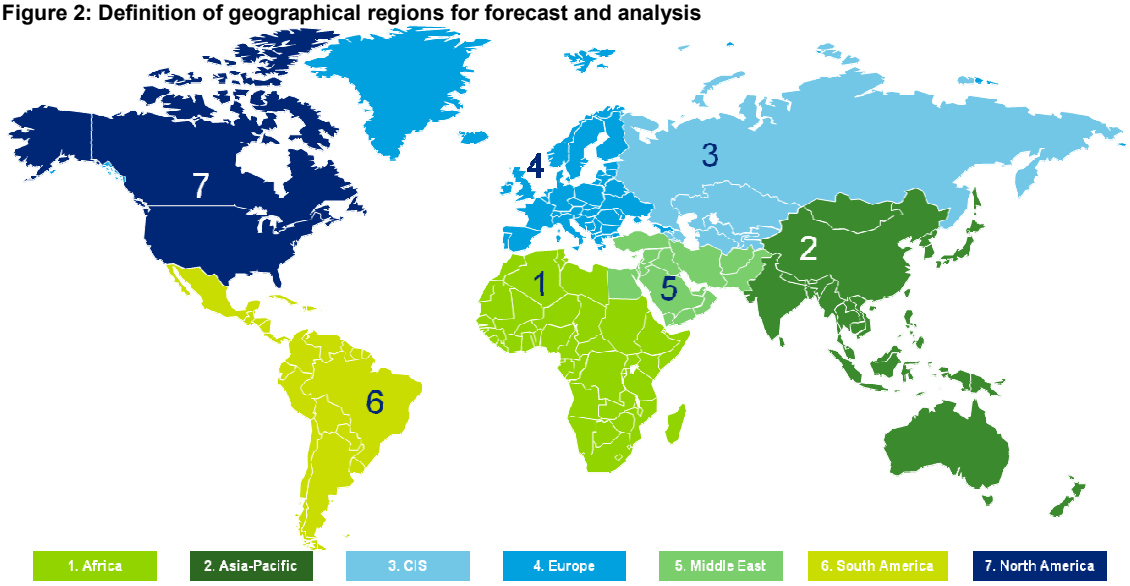
Figure 1 shows the correspondence between sub-sectors in the AIAC Survey and the industry definitions used. The "Other" category is not included because of difficulties strictly defining its constituents.

Figure 1: Correspondence between AIAC Survey sub-sectors and forecast sub-sectors



Seven distinct geographical regions were defined. These regions represent the most granular regional definition that is consistent throughout the third-party data sources.

Figure 2: Definition of geographical regions for forecast and analysis



4.1.1 Civil

The CAS is defined as those activities or services directly related to aviation and provided to four primary groups of end-users:

1. Airlines;
2. Freight & shipping companies;
3. Private individuals and businesses; and
4. Public sector customers for non-military uses.

Further, the main types of civil aircraft included in the market definition are:

- **Commercial aircraft**:
  - Wide-body aircraft (also called “twin-aisle or “large” aircraft depending on seat capacity): large airliners with two passenger aisles and a typical capacity of 200–600 passengers. This type of aircraft is used for the commercial transport of passengers and cargo.
  - Narrow-body aircraft (also called “single-aisle” aircraft): airliners with fuselage aircraft cabin and a single aisle. Narrow-body aircraft typically have a capacity of 100–200 passengers.
- **Regional aircraft**:
  - Regional jet: a large single-aisle short-haul regional aircraft powered by a turbofan. Regional jets typically have a capacity of 70–100 passengers.
  - Regional turboprop: a short-haul aircraft powered by a turboprop engine with a single-aisle. Regional turboprops typically have less than 100 seats.

  Business jet:
  - Smaller jet aircraft designed for transporting groups of business people.
- **Rotorcraft**:
  - An aircraft (e.g., helicopter) whose lift is derived principally from rotating airfoils.[1] Rotorcrafts are typically used in niche applications where space for landing and takeoff is at a premium.

[1] Merriam-Webster dictionary.

For the CAS, the Space sub-sector includes revenue generated by launch services. For example, revenue generated by private sector companies who launch satellites into orbit.

4.1.2 Military

The MAS is defined to include those activities or services directly related to aviation or space provided to public sector customers for military purposes. Many sources define the MAS as a component of the more general military aerospace and defence ("MA&D") sector; the MA&D sector includes defence spending that is not related to aviation or space (e.g., spending on tanks and other land-based military vehicles). Certain figures may speak to the larger MA&D sector.

The Space sub-sector of the MAS includes the manufacturing of missiles that can change their flight path ("guided missiles") and launch vehicles. Launch revenues are not included within the Space sub-sector because of data availability.

4.2 Global market

The global aerospace industry generated revenues of approximately $382 billion in 2009. Of this revenue, the global MAS accounts for approximately 54% while the CAS constitutes the remaining 46%.[2] With the continued focus on the rising threat of global terrorism, the MAS is steadily growing and remains a lucrative market for existing players due to the high barriers to entry. In contrast, the CAS is beginning to see an improvement in passenger traffic as the developed countries begin to emerge from the recent financial crisis.

Five years of aggressive growth in the aerospace industry was brought to an abrupt end in 2008 with the onset of the financial crisis, resulting in flat sales globally for the industry in 2009. In 2009, the global aerospace industry grew sales at a mere 1.3% and earnings were down 15.3% relative to 2008.[3] Industry profitability remained flat or negative in the sector, due to large program related write-offs, asset impairments or regulatory fines at a few of the large firms.

The global aerospace market is highly concentrated among major aircraft OEMs. For example, four major players dominate the global aerospace and defence ("A&D") market:

- EADS produces 8.7% of global A&D revenue;
- Boeing produces 8.5%;
- Lockheed Martin Corporation produces 5.9%; and
- Northrop Grumman Corporation 4.9%.

4.3 Canadian market

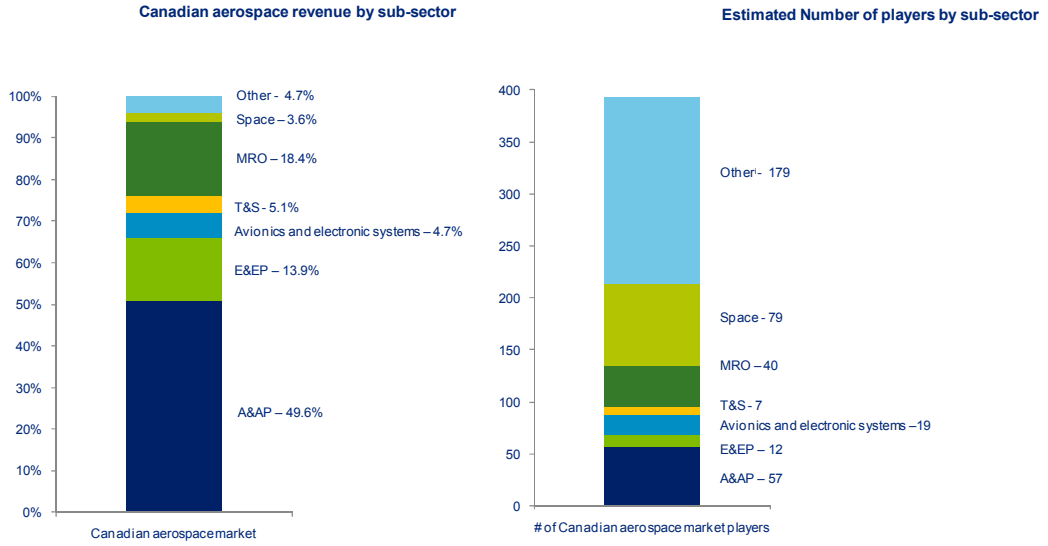
The Canadian aerospace industry generated approximately C$22.2 billion in revenue in 2009.[4] The Canadian aerospace market is largely driven by the A&AP sub-sector. The importance of the A&AP sub-sector is demonstrated by the proportion of revenue generated by the segment with 15% of the total market players generating 50% of overall Canadian aerospace revenues. The remaining market players control 50% of the market with 40 MRO companies and 12 E&EP companies generating 19% and 14% of revenues respectively. Within avionics and electrical systems, T&S, space and the "other" sub-sector, there are 322 players. Figure 3 outlines the current state of the industry in terms of the size of each market segment and the number of players within each segment.

[2] Deloitte analysis.

[3] Deloitte Development LLC, "2009 Global Aerospace and Defence Industry Performance Wrap Up", May 11 2010.

[4] AIAC, "Canadian Aerospace Industry, Performance 2008", June 2009.

Figure 3: Canadian aerospace revenue by segment breakdown[5]



[I]The "Other" category includes all other areas (including business/consulting services). Many companies are represented in more than one category.

The Canadian aerospace industry is largely export based. According to figures from the AIAC, the Canadian aerospace sector generated 78% of its revenues from foreign markets, and 22% from domestic markets in 2009. The US and Europe are the largest customers with a 57% and 27% share of exports respectively.[6] Domestically, aerospace sales are highly concentrated in Ontario (23% of domestic sales) and Quebec (52% of domestic sales).[7] According to the Conference Board of Canada, the largest aerospace companies in Canada are:

Table 1: Canadian aerospace market leaders[8]

Rank	Canadian company	Aerospace industry revenues (USD million)	Percent of total (%)[i]
1	Bombardier Aerospace	9,024	55.6
2	Pratt & Whitney Canada	2,880	17.8
3	CAE Inc.	1,596	9.8
4	Boeing Canada Inc.	660	4.1
5	Vector Aerospace Corp.	543	3.3
6	Boeing Canada Inc.	540	3.3
7	Textron Canada Ltd.	377	2.3
8	Heroux-Devtek Inc.	324	2.0
9	Northstar Aerospace Inc.	212	1.3
10	Avcorp Industries, Inc.	66	0.4

[I] Percent of totals based upon revenues reported in table1 and not total industry revenues.

[5] Source (sub-sector market share): AIAC, "Canadian Aerospace Industry, Survey, June 2009. Source (numbers of players): Based on companies with physical locations in Canada who are listed with AERO-Canada as of June 2010.

[6] AIAC, "Canadian Aerospace Industry, Performance 2008", June 2009.

[7] Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry Outlook: Spring 2010", 2010.

[8] Source: Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry Outlook: Spring 2010", 2010. Converted from CAD to USD using the exchange rate as of 31 December 2009.

5 Civil aerospace sector

5.1 Current market overview

5.1.1 Canada

The domestic CAS generates a larger share of revenue, relative to the MAS, than is seen in the global aerospace industry. In 2009, the CAS generated approximately C$16 billion in revenue or approximately 83% of Canada's total aerospace revenues.[9] Canada is also a major player globally and was responsible for generating approximately 7% of global CAS manufacturing revenue in 2009.[10] The Canadian CAS is primarily driven by exports to the US and Europe.[11]

Canada's aerospace industry was significantly impacted by the global recession because of Canada's heavy reliance on regional and business aircraft. Canada's aerospace sector experienced 4,000 layoffs from pre-recession peak to the 2009 market bottom; during the same time, production volumes declined by 10%. Average weekly wages also experienced a double digit decline as companies reduced hours in place of layoffs because of foreseen labour shortages as the economy recovers.[12] According to the Conference Board of Canada, robust recovery in the industry is not expected until 2011 and it will take until 2013 for full recovery. [13]

5.1.2 Global market

The CAS accounted for approximately 46%, or $176 billion, of global aerospace revenues in 2009. Of the $176 billion in 2009 revenues, approximately $146 billion was attributable to manufacturing which saw a year-over-year ("YoY") decrease of 4% relative to FY 2008. Preliminary projections show global CAS revenue, excluding Space, growing at 1.1% YoY in 2010.

The majority of CAS manufacturing revenues are generated by primary aircraft manufacturers (59%) followed by E&EP (22.5%), and aircraft part and equipment manufacturers (18.5%). The average profit margin of civil aerospace industry manufacturers remained robust in 2009, at 9.5%, but down from double digit levels experienced in the 2000s. In 2009, manufacturing was still concentrated in the developed world, with regions such as North America controlling 48.5% of revenue and Europe controlling 43.0% of revenue. However, a shift in the industry is underway towards low-cost high Gross Domestic Product ("GDP") Asia-Pacific and Latin America. In 2009, 78.5% of the civil aerospace industry manufacturing revenue came from the world's 500 major airlines, followed by freight at 10%, and other end-users at 11.5%.[14]

Broadly speaking, the CAS is seeing positive signals as the recession recedes. For example, many of the major drivers of profitability in the CAS have shown signs of improvement. Airline revenues, revenue passenger kilometres ("RPK"), freight tonne kilometres ("FTK"), and global GDP have begun to recover after significant declines during the global recession. This improvement was highlighted by the April 2010

[9] Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[10] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

[11] AIAC, "Canadian Aerospace Industry Survey Results", July 2009.

[12] Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[13] Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[14] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

report from Scotiabank's Global Economic Research Group which stated that airline capacity had increased by 28%, passenger traffic by 6%, and freight traffic by 3% on a YoY basis.[15]

Confidence among airlines is also beginning to increase; a survey of airlines revealed that 80% and 71% saw improvements in passenger and cargo demand respectively in the three months trailing April 2010.[16] A major challenge for the CAS is that the airlines continue to face low profit margins with registered losses of approximately $16 billion in 2009 and $10 billion in 2008.[17] In June 2010, the International Air Transport Association ("IATA") revised their profit projections for 2010 and estimated that the global airlines will post $2.5 billion in net profit. However, this remains below the $13 billion of net profit that the industry realized prior to the financial crisis.[18]

5.1.3 CAS market leaders

IBISWorld reports that nine companies control over 95% of global CAS manufacturing revenue. The top nine global CAS companies, in terms of revenue, are given below:

Table 2: Global CAS manufacturing market leaders[19]

Rank	Global company	Country	CAS manufacturing revenues (USD million)	Percent of total (%)
1	EADS	Netherlands	43,764	34.4
2	The Boeing Company	US	29,897	23.5
3	United Technologies Corp.	US	11,195	8.8
4	General Electric Company	US	9,414	7.4
5	Bombardier Inc.	Canada	7,761	6.1
6	Rolls-Royce plc	UK	6,997	5.5
7	Embraer	Brazil	4,834	3.8
8	Honeywell	US	4,834	3.8
9	Textron Inc.	US	4,325	3.4
10	Other	-	4,198	3.3

Note: Revenue figures are calculated from the market share data provided by IBISWorld and are therefore an approximation.

5.1.4 Airline performance

As previously noted, the performance of the CAS industry is highly correlated to the performance of airlines because they are the major consumer of aerospace products and services.

Revenue for the airlines had been on the rise during the first decade of the 2000s, with a compound annual growth-rate ("CAGR") of 9% between 2001 and 2008. However, airline revenues declined by 15% in 2009 due to the financial crisis. Current forecasts estimates show airline revenues rebounding in 2010, back to pre-crisis 2007 levels.

[15] Scotiabank, "Global Economic Research Industry Tends – Aerospace", April 20 2010.

[16] IATA, "Economics Briefing", April 2010.

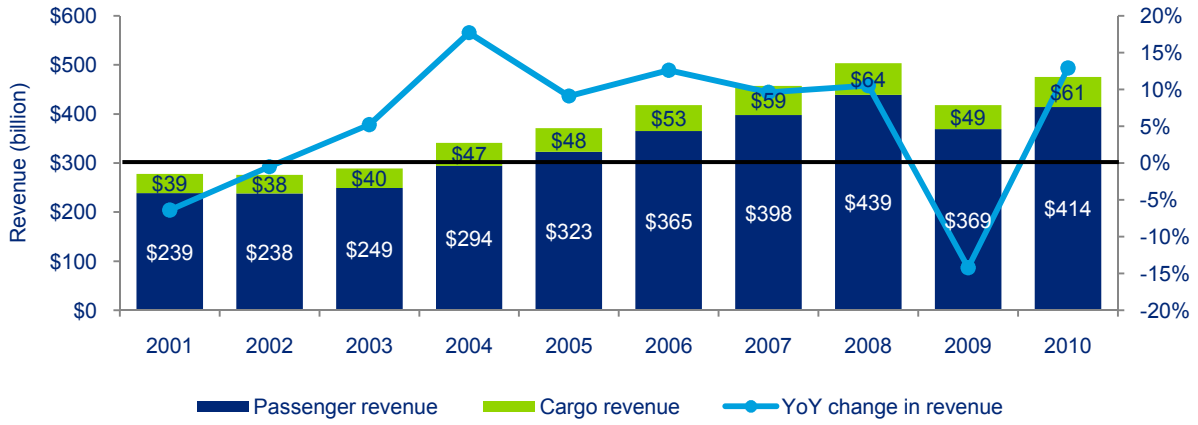
[17] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[18] Aviation Week and Space Technology, "Airline Profitability on the Horizon." June 11, 2010.

[19] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

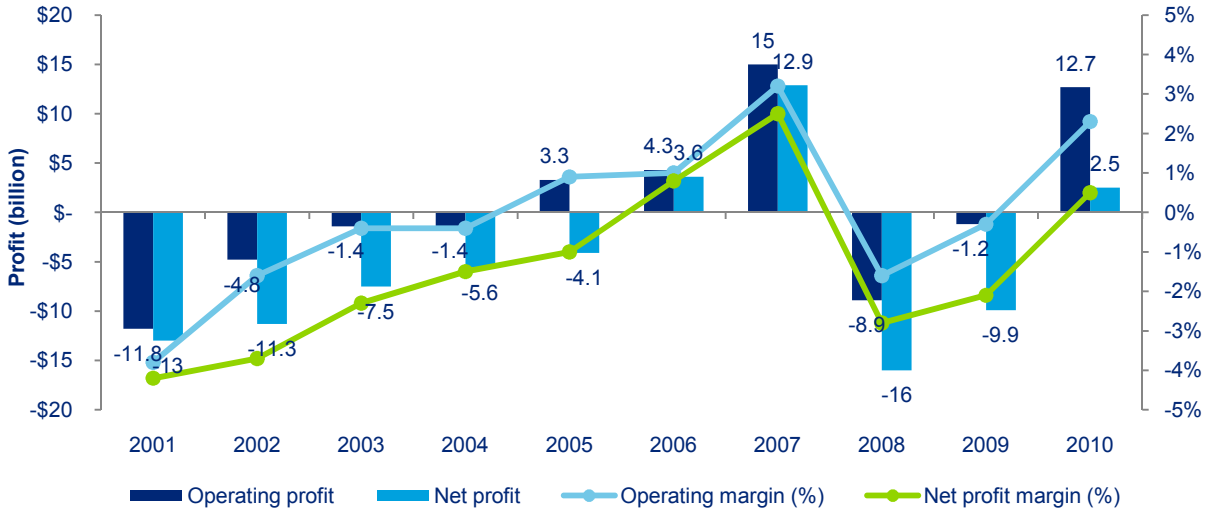
Airline revenues have been dominated by revenue from passenger traffic with freight traffic accounting for a stable 14% to 16% or airline revenues. Therefore, airline performance remains tied to passenger volumes.

Figure 4: Airline revenue[20]



The revenue growth experienced from 2001 to 2008 did not translate into net profit for the airline industry. The airline industry has only been profitable in two of the last ten years (2006 and 2007). Two-thousand and seven was a strong year for airlines with the industry netting over $10 billion in net profit. The strong performance in 2007 was linked to the alignment of multiple factors, including strong passenger and freight volumes, strong per-unit prices, and low fuel costs. Projections by the IATA show airlines achieving positive growth in 2010, driven by growth in Asia-Pacific and Latin America coupled with a rebound in North America. Europe is expected to lag behind other regions in 2010, partly due to air-traffic disruptions related to the Icelandic (Eyjafjallajökull) ash cloud of early 2010.

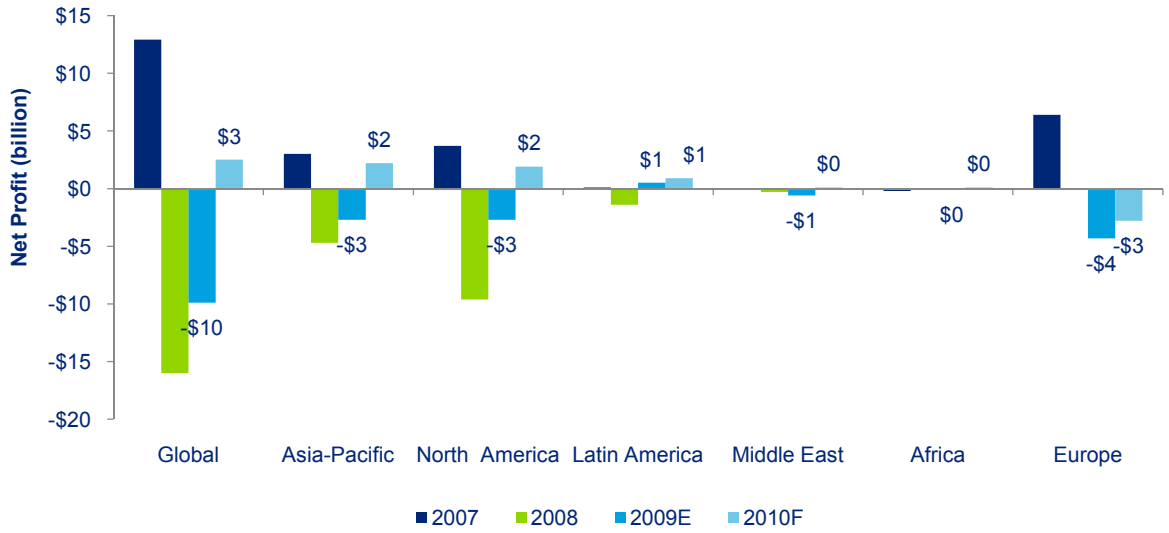
Figure 5: Airline profit[21]



[20] IATA, "Financial Forecast", June 2010.

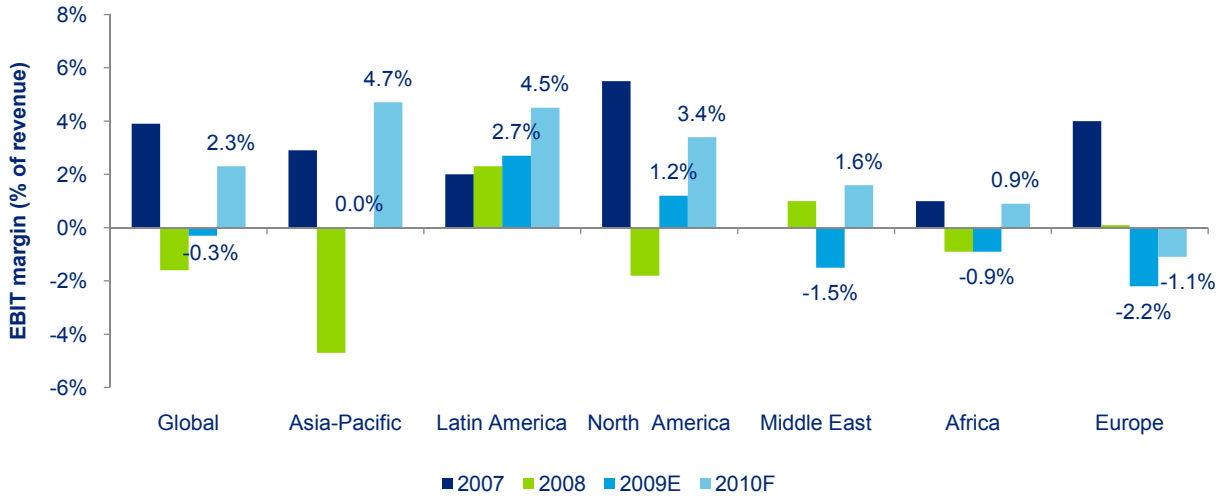
[21] IATA, "Financial Forecast", June 2010.

Figure 6: Airline net profit by region[22]



Airline EBIT margins are also forecasted to be positive in 2010, again due to strength in Asia-Pacific and North America with additional support provided by the Middle East.

Figure 7: Airline EBIT margin by region[23]



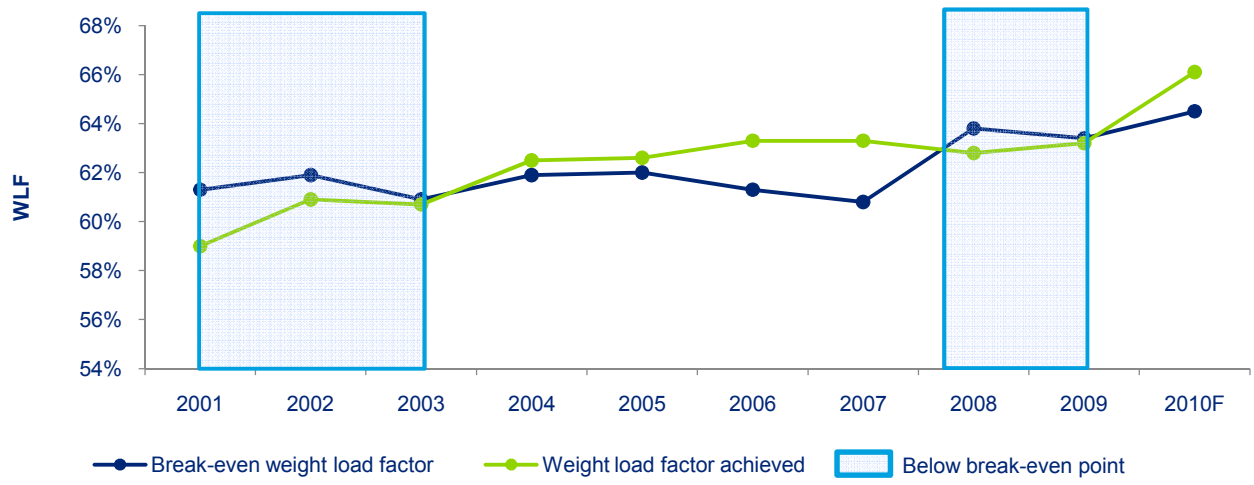
The profitability of the airline industry can be examined by comparing the ratio of used aircraft capacity to available capacity, termed the weight load factor ("WLF"). A load factor is the amount of weight carried by an aircraft divided by the aircraft's weight. A break-even WLF in this context is the WLF that is required, on average, for the airline industry to net out at zero bottom-line profit.

There are two ways to generate revenue from the point of view of the WLF, one can lower the WLF required to achieve profitability or one can increase the WLF that is achieved. The profitability of the airlines in 2008 and 2009 was achieved by the latter as break-even WLF remained relatively constant from 2001 through 2008. However, break-even WLF factors have begun to increase since 2007 primarily due to rising non-fuel costs and this will put pressure on airline profitability.

[22] IATA, "Financial Forecast", June 2010.

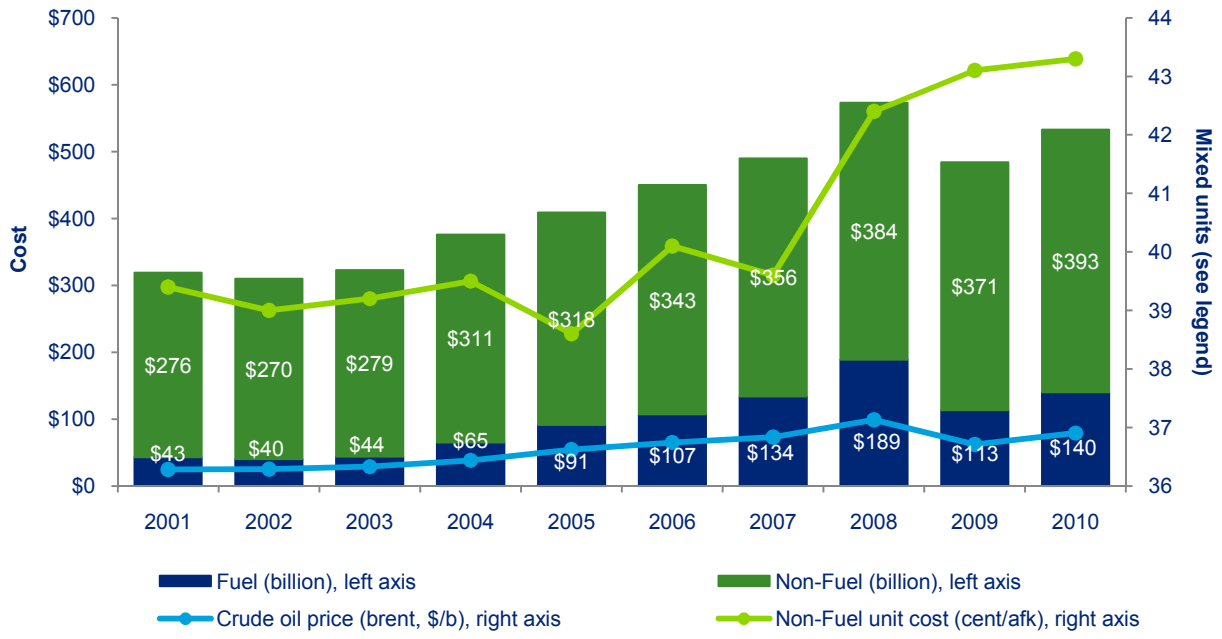
[23] IATA, "Financial Forecast", June 2010.

Figure 8: Airline WLF performance[24]



Fuel costs have played a significant role in driving movements in the WLF and profitability of the airlines over the last decade. Despite this, the vast majority of costs are still non-fuel and per-unit non-fuel costs have increased dramatically since 2007. As seen in Figure 9, per-unit fuel prices decreased in 2008 and 2009 while per-unit non-fuel costs increased. Airline profitability will be impacted if per-unit fuel costs begin to increase as forecasted without a reduction in per-unit non-fuel costs.

Figure 9: Airline cost structure[25]



Note: IATA uses Brent Crude oil spot prices when evaluating airline fuel prices.

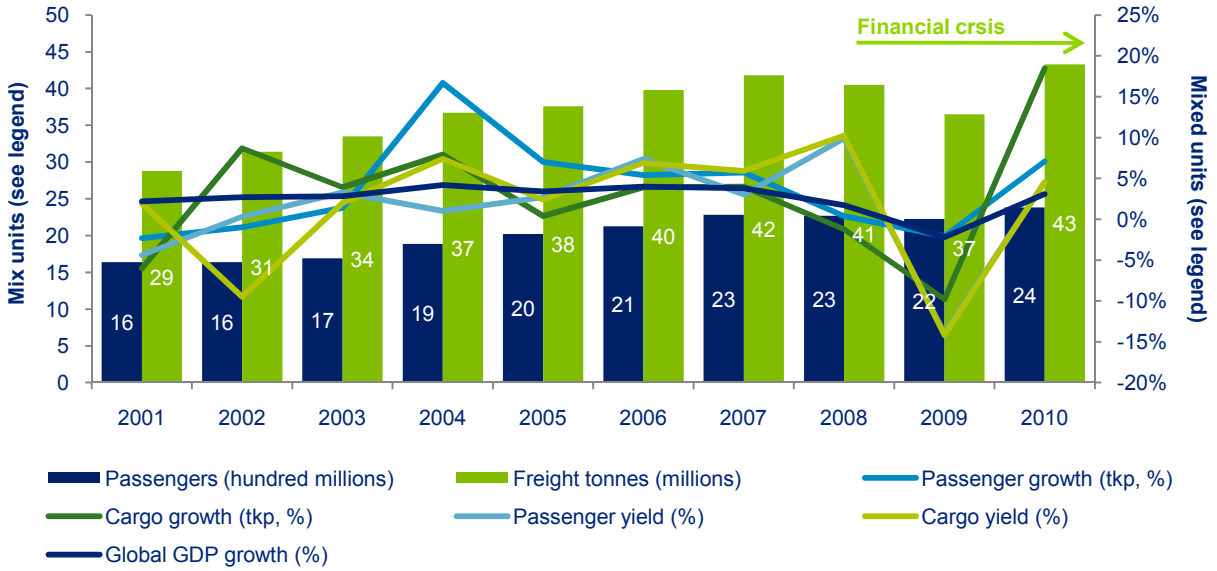
Tied closely to patterns in revenue are patterns in traffic volume. Growth in passenger and freight volumes from 2001 to 2008 was in line with the growth seen in airline revenue. Similarly, the downturn in revenue in 2009 follows the downturn in traffic volumes. In 2009 the drop in passenger and cargo yields (the amount of revenue per revenue mile) was sharper than the drop in volumes. On the passenger side, the drop in yields is likely due to a drop in premiums paid by customers. Air traffic volumes and yields are

[24] IATA, "Financial Forecast", June 2010.

[25] IATA, "Financial Forecast", June 2010.

themselves correlated to global economic growth. This correlation is most clearly demonstrated during the global economic growth in 2004 and downturn in 2009.

Figure 10: Airline passenger & freight traffic performance[26]



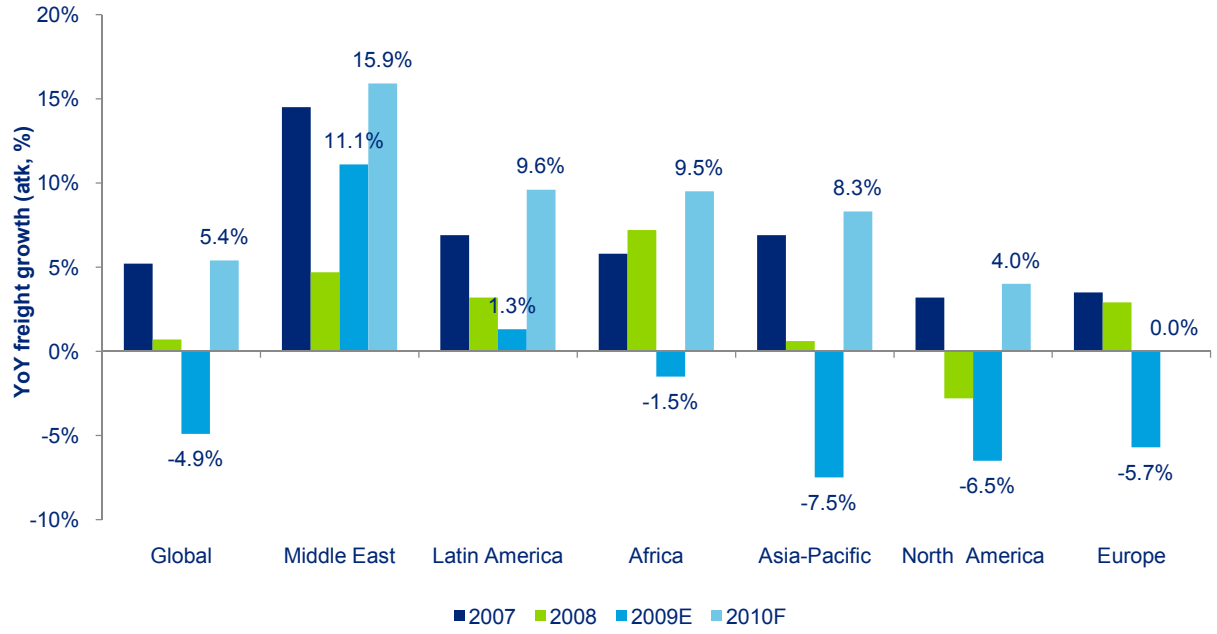
On a regional basis, passenger growth for 2010 is expected to be highest in the Middle East (19.5%), Asia-Pacific (16.2%), and Latin America (13.9%) with North America (8.2%) and Europe (2.9%) lagging behind. The Middle East also ranks number one in expected 2010 freight volume growth at 17%. Latin America and Africa rank ahead of Asia-Pacific in freight growth for 2010. North America is expected to see modest growth in freight volumes in 2010.

Figure 11: YoY airline passenger growth by region[27]

[26] IATA, "Financial Forecast", June 2010.

[27] IATA, "Financial Forecast", June 2010.

Figure 12: YoY airline freight growth by region[28]



5.1.5 Sub-sectors

The majority of global CAS revenue is derived from the A&AP and MRO sub-sectors. The breakdown of CAS revenue by sub-sector is shown in Table 3 and is discussed in depth within "Appendix I".

Table 3: CAS sub-sector revenue in 2009 and 2008

Sub-sector	2009 Revenue (2010 dollars, USD billion)
A&AP	98
E&EP	28
MRO	36
T&S	1
Space	13
Total	**176**

5.2 Key industry trends

The future of the global and Canadian CAS will be defined by the critical issues and challenges facing the sector over the next ten years. Deloitte has identified the following key trends facing the CAS:

- Positive long-term growth as economies emerge from the recent financial crisis;
- Recovering airline profitability moving forward;
- Active fleet renewal and expansion;
- New aircraft models;
- Increased usage of green technologies;
- Increases in MRO activity as companies shift to new geographies;
- Emerging markets becoming competitors and sources of passenger growth;

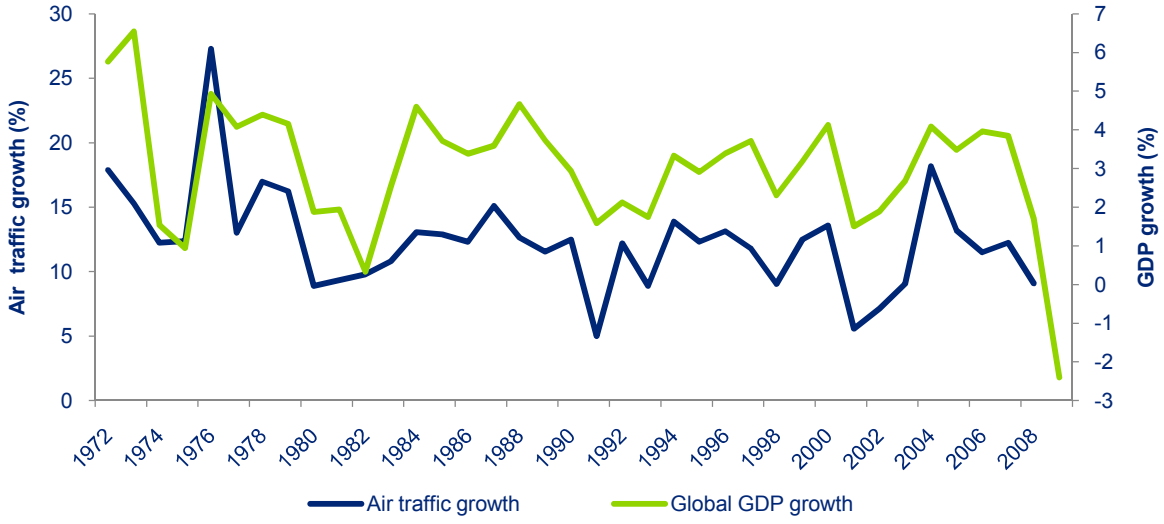
[28] IATA, "Financial Forecast", June 2010.

- Long-term pilot and workforce shortages;
- Regulatory shifts as economies emerge from the financial crisis; and
- Increased private sector demand for satellite and launch services.

5.2.1 Long-term economic growth

Passenger air travel is highly correlated with GDP as shown in Figure 13. According to Airbus estimates, a 1% rise in a country's GDP translates into an increase in air travel demand of 1% in developed countries and 2.5% in developing countries.[29] Given this high correlation, trends in regional and global economic growth are critical to understanding the future of the CAS.

Figure 13: Correlation between air traffic growth and GDP growth[30]

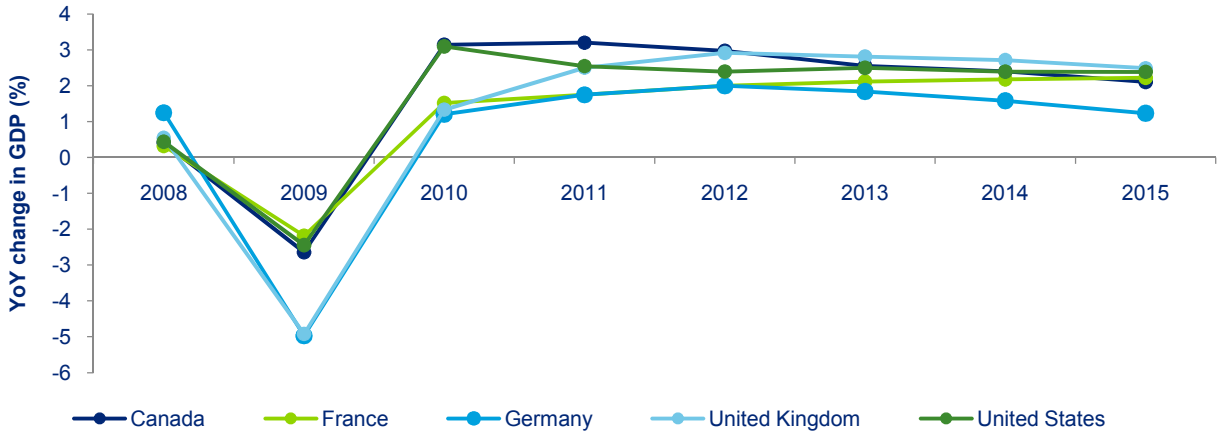


Despite the slow economic recovery following the financial crisis, the long-term forecast for the CAS is for a robust recovery due to increasing air travel and expected long-term growth in global GDP. The International Monetary Fund ("IMF") expects global GDP to increase by 4.6% in 2010 and 4.3% in 2011. As Figure 14 below demonstrates, advanced economy GDPs are expected to rebound in 2010 and remain relatively flat from 2010 to 2015.

[29] Airbus, "2009-2028 Global Forecast", 2009.

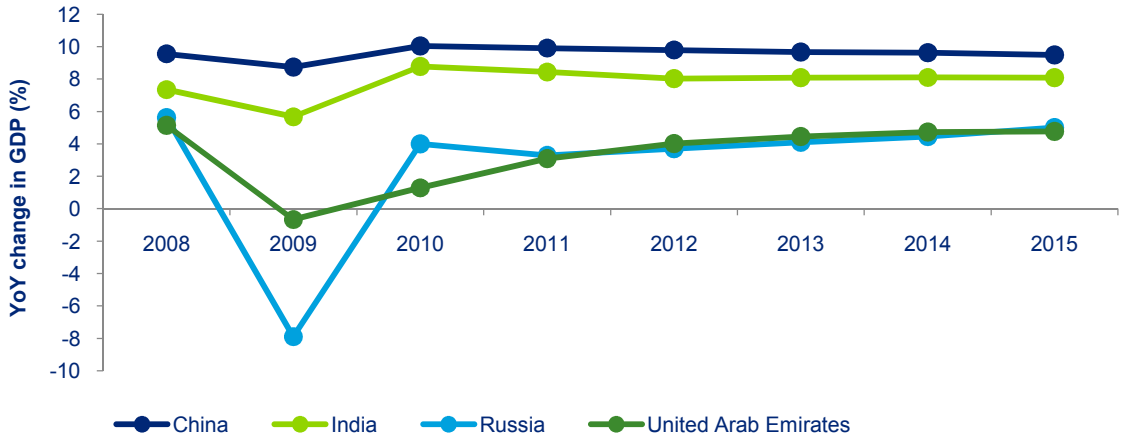
[30] Source: IATA, "Financial Forecast", June 2010; IMF, "World Economic Outlook Update: Restoring Confidence without Harming Recovery", July 2010.

Figure 14: Yearly GDP changes for major OECD countries[31]



The developing Asia-Pacific economies are expected to rebound in 2010 and grow at a rate of 9.2% in 2010 and 8.5% in 2011.[32] Figure 15 shows a breakdown of the percent change in GDP in emerging markets for 2008 to 2015. When comparing Figure 15 to Figure 14, emerging markets - specifically Asia-Pacific and the Middle East - will outperform the OECD countries in terms of GDP growth.

Figure 15: Yearly GDP changes for emerging markets[33]



China and India are expected to continue driving growth in the CAS. According to Bombardier, from 2008 to 2028, China's economy is expected to lead economic growth in both the Asia-Pacific market and the global market with a GDP growth-rate of 7.5%. Bombardier also forecasts India as a secondary source of growth with a GDP growth-rate of 6.3%.[34]

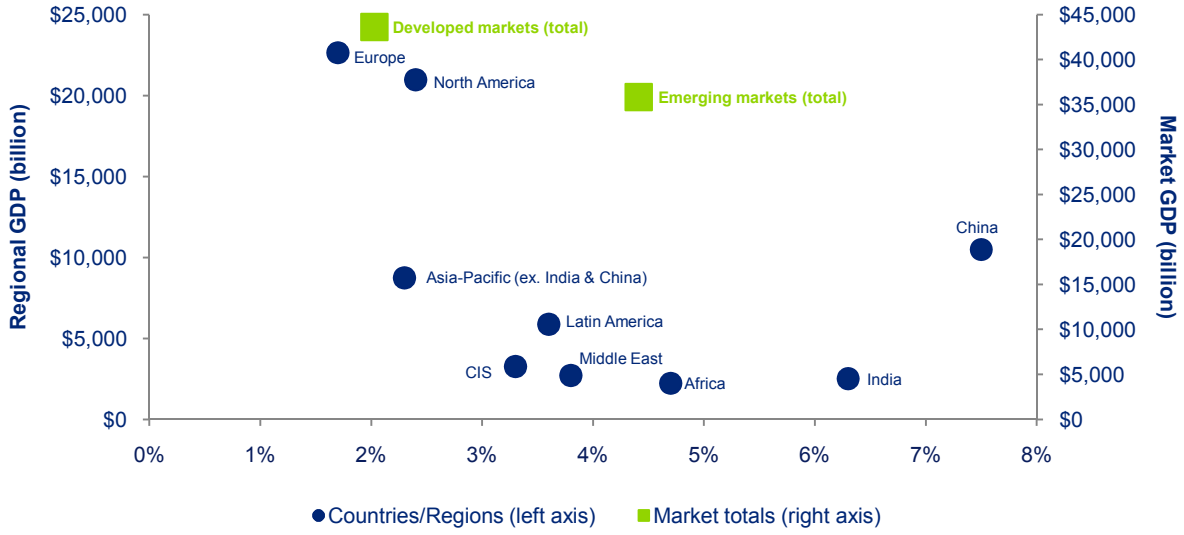
[31] Source: IMF, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in July 2010.

[32] IMF, "World Economic Outlook Update: Restoring Confidence without Harming Recovery", July 2010.

[33] Source: IMF, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in July 2010.

[34] Bombardier, "2009-2028 Market Forecast", 2009.

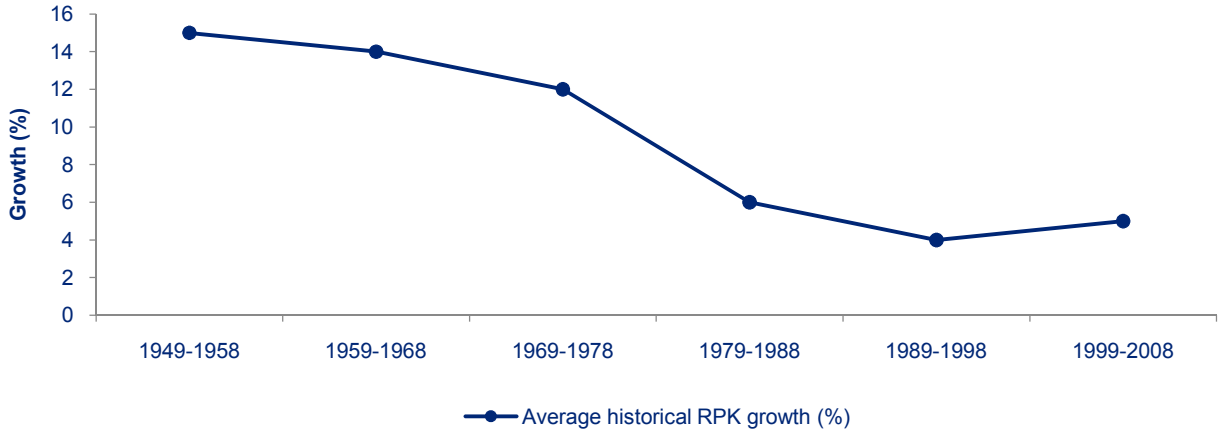
Figure 16: GDP distribution and growth-rates for selected countries and regions[35]



In addition to the rebounding economies, the IATA reports that international air passenger and cargo traffic is now approaching pre-recession levels. The financial markets have improved significantly and as a result access to capital has increased.[36]

Airline RPK is an important measure because of its high correlation with commercial aircraft deliveries. RPK has consistently increased at 5% per year for the last 10 years and OEMs are forecasting global RPK growth to remain at approximately 5% from 2010 to 2028. Over the long-term, however, RPK growth-rates have decreased significantly.

Figure 17: Historical trend in RPK growth[37]

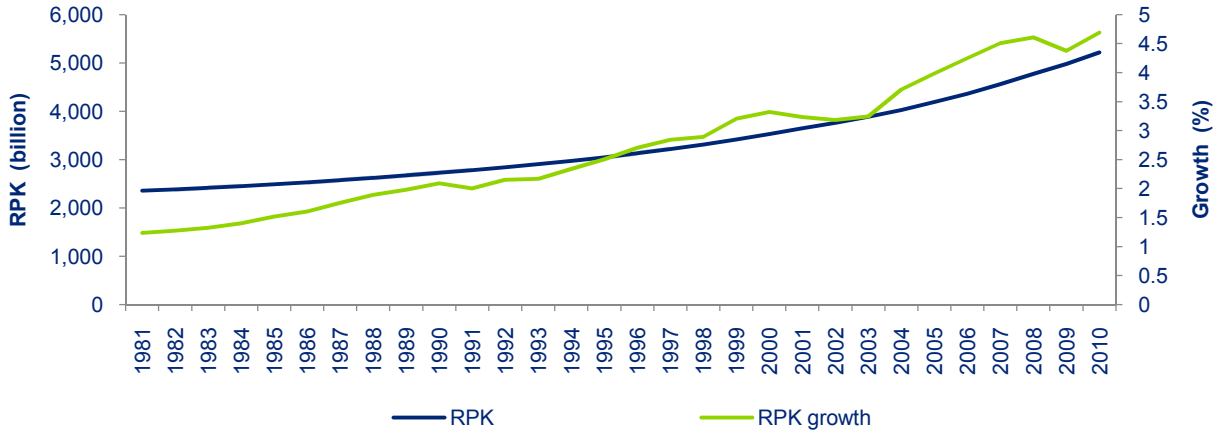


[35] Source: IHS Global Insight; Bombardier, "2009-2028 Market Forecast", 2009; International Monetary Fund, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in August 2010.

[36] IMF, "World Economic Outlook Update: Restoring Confidence without Harming Recovery". July 2010.

[37] Source: Rolls-Royce, "2009-2028 Market Outlook",2009.

Figure 18: Recent trends in RPK growth[38]



In addressing the airline industries anticipated recovery from the global financial crisis, IATA Economics has identified short-term drivers of the recovery in RPK levels:

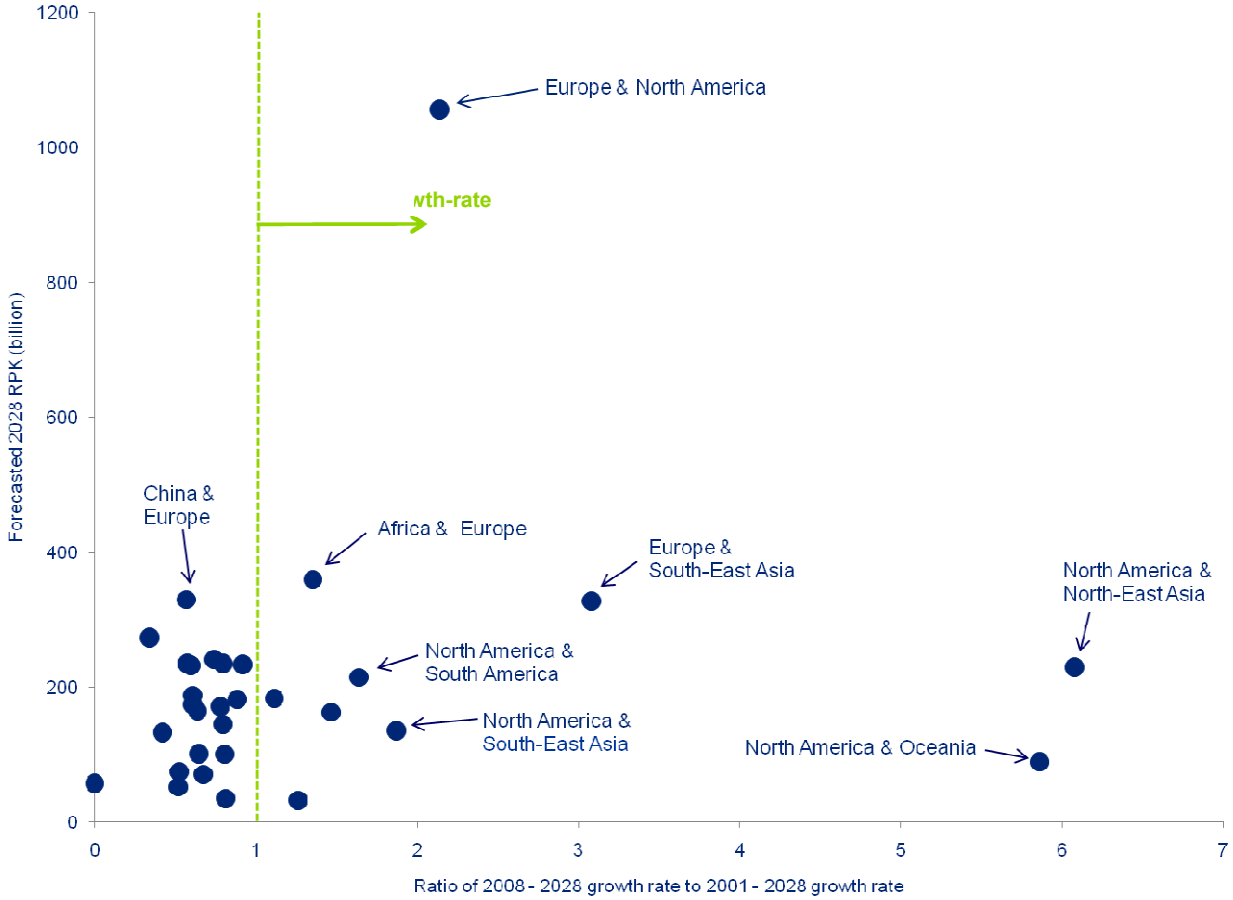
- Airlines are bringing capacity back into international air travel and air freight markets, but still at a rate below demand growth. In March 2010, passenger capacity was up 2%, compared to travel expansion of over 10%. Freight capacity was up over 5% compared to a rise in demand of 28%;
- Airline schedules announced for 2010 point to a 5% increase over 2009. This number may be adjusted higher given underutilized long-haul capacity and the 1,400 planned aircraft deliveries in 2010; and
- Recovering average seat fares in developed markets.[39]

The stable forecasts of 5% global RPK growth mask significant disparities in regional RPK growth. For example, the majority of regions are forecast to have declines in RPK growth-rates for both inter-region and intra-region travel. In terms of intra-region travel, the largest increase in growth-rate between 2008 and 2028 is expected to be for travel between North America and North-East Asia, and North America and Oceania. However, in terms of absolute values, the largest RPK in 2028 is expected to remain between Europe and North America. Notably, the RPK growth-rate between China and Europe is expected to decline between 2008 and 2028.

[38] Source: IATA, "Financial Forecast", June 2010.

[39] IATA, "Premium traffic monitor", April 2010.

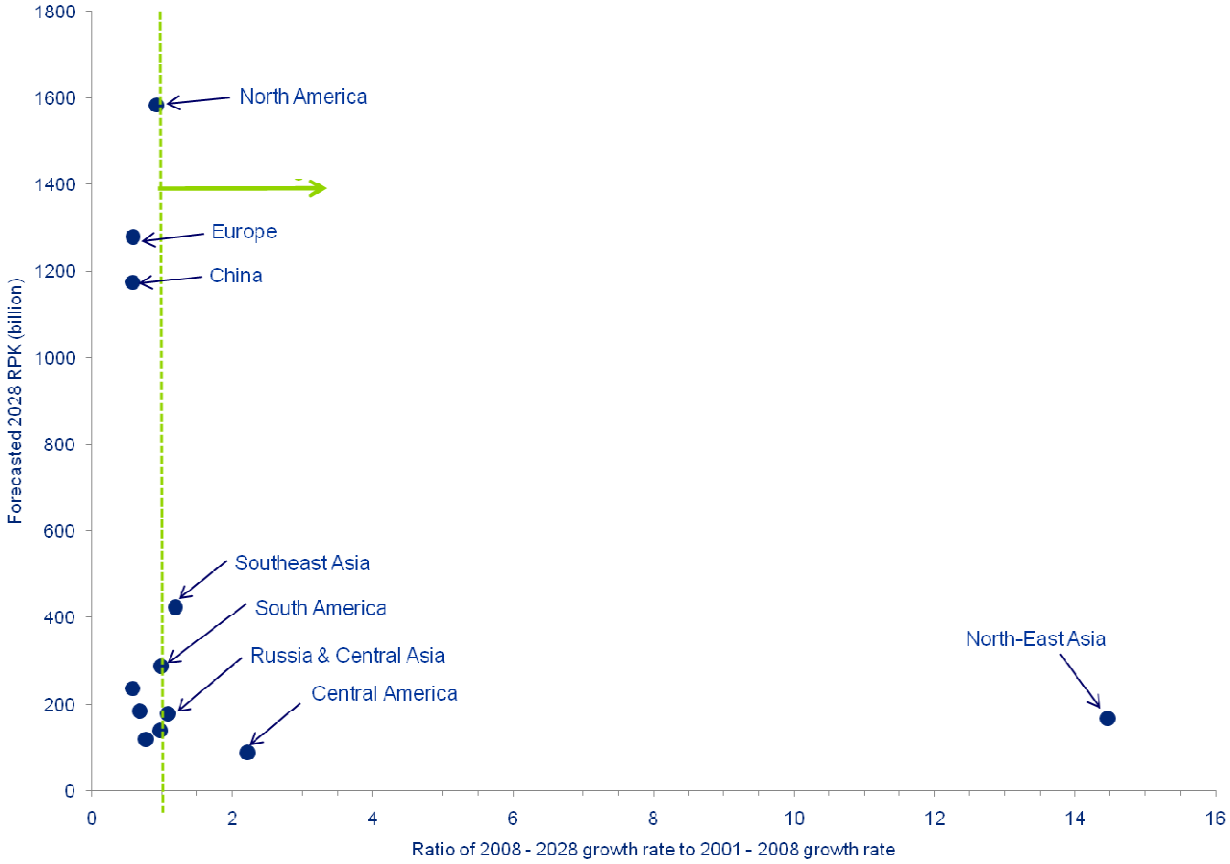
Figure 19: Geographical trends in inter-region RPK growth[40]



The largest increase in RPK growth for intra-regional travel is expected in North-East Asia. China, however, is expected to experience a slowdown in RPK growth between 2008 and 2028. Other regions that are forecast to experience an increase in inter-region RPK growth-rates are South America, Central America, Russia and Central Asia, and Southeast Asia. The top three countries in terms of absolute RPK volume are forecast to remain North America, Europe, and China in 2028 despite declining RPK growth-rates.

[40] Source: Boeing, "Current Market Outlook 2010-2029", 2010.

Figure 20: Geographical trends in intra-region RPK growth[41]



5.2.2 Airline profitability

In June 2010, IATA surveyed airline chief executive officers ("CEOs") to gauge how they felt about future profitability. In the past three of IATA's quarterly surveys, airline CEOs have stated that they were more confident about financial performance improving over the next year.[42]

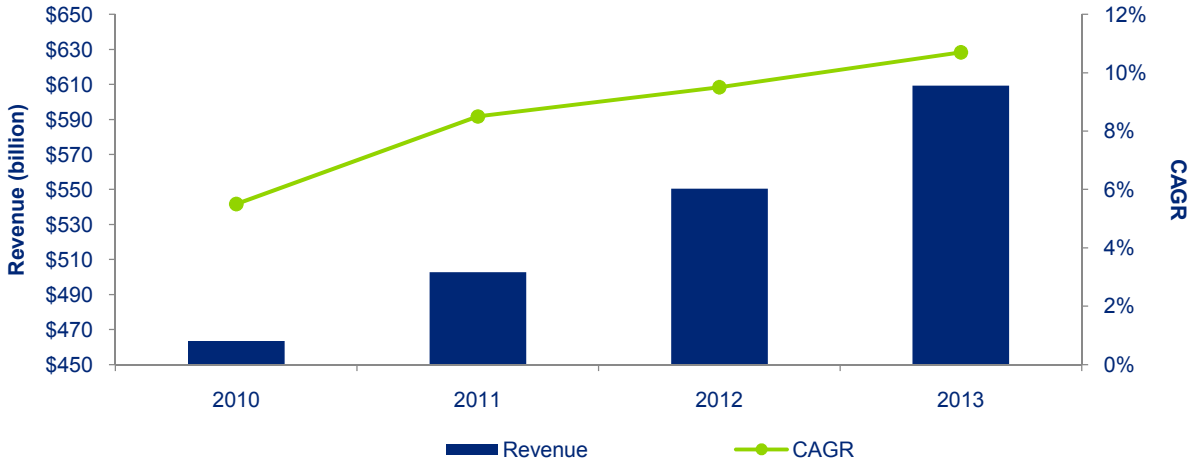
Longer term, third-party forecasts show growth in global airline revenues. Datamonitor anticipates global airline revenue to grow at a 10% CAGR from 2010 to 2013.[43]

[41] Source:Boeing, "Current Market Outlook 2010-2029", 2010.

[42] IATA, "Back to profits in 2010 but not in all regions: Risks Remain". June 2010.

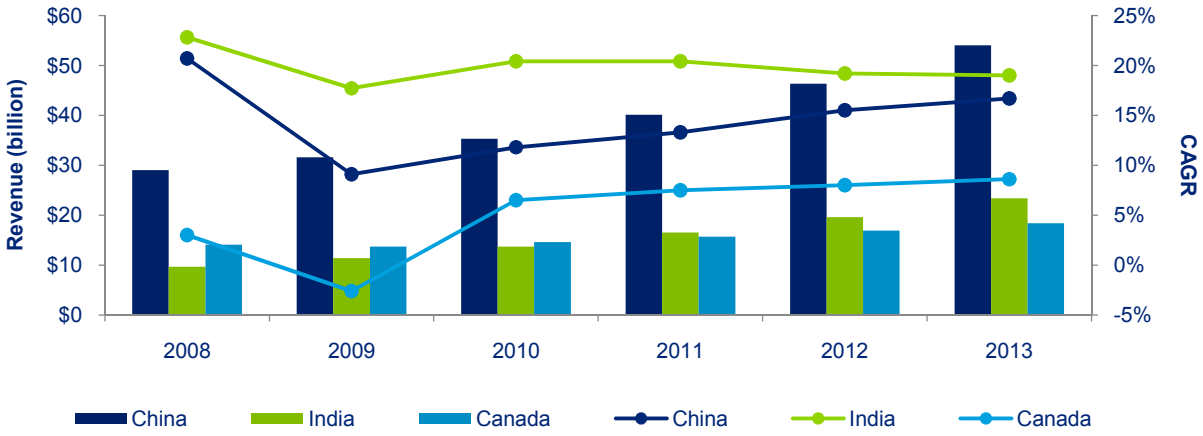
[43] Source: Datamonitor, "Global Airlines: Industry Profile", December 2009.

Figure 21: Forecast of global airline revenue through 2013[44]



Much of airline growth will be driven by emerging markets. For example, the three year CAGR of airline revenue in India and China is expected to exceed 15% between 2010 and 2013. By comparison, Canada's average revenue CAGR is expected to be below the global average at 8%.

Figure 22: Forecasts of selected airline revenue through 2013 for selected geographies[45]

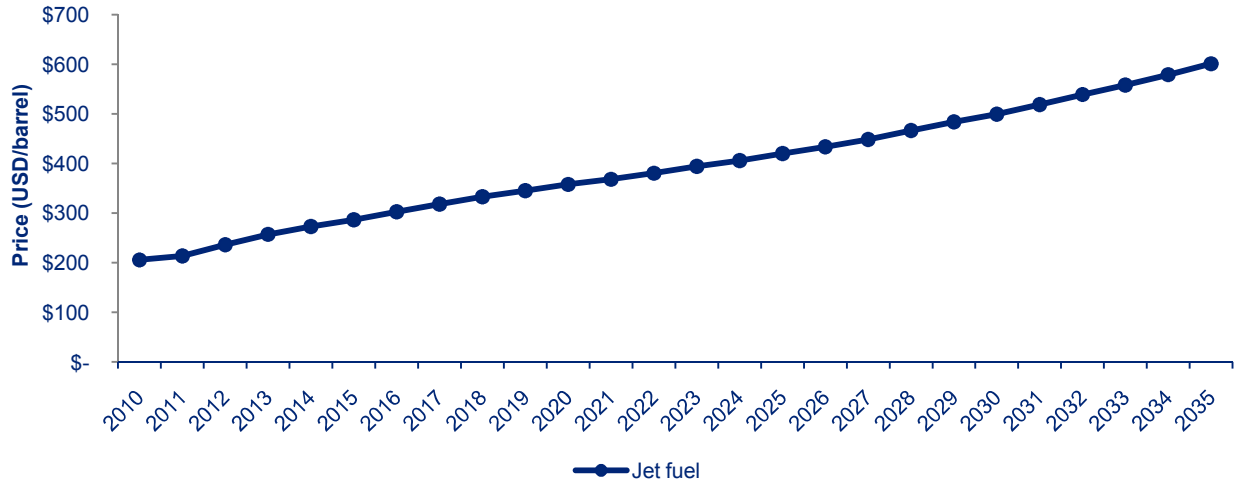


Revenue growth alone may not lead to a profitable industry. One major risk is a further increase in airline costs. Airlines are experiencing significant increases in both fuel and non-fuel costs over the last decade. Non-fuel costs jumped dramatically in 2007. Fuel prices are projected to increase well into the future, forcing airlines to search for more fuel efficient aircrafts and aggressive fuel hedging strategies.

[44] Source: Datamonitor, "Global Airlines: Industry Profile", December 2009.

[45] Source: Datamonitor, "Global Airlines: Industry Profile", December 2009.

Figure 23: Forecast for global jet fuel prices through 2034[46]



Airlines are already taking action to deal with increases in costs, including:

1. Increasing per-aircraft productivity by choosing aircrafts that align seat capacity to seat demand;
2. Increasing the use of larger capacity aircraft for high traffic routes;
3. Increasing the use of the 32 network cities for long-haul flights. Airbus expects 400 new routes to be added to the three major long-haul traffic flows (between: Europe/Africa/Middle East, Americas, and Asia-Pacific) between 2009 and 2028; and[47]
4. Short-term reductions in fleet size to better match capacity with traffic demand.[48]

It is anticipated that these initiatives will remain areas of focus for airlines.

Efficiency has been an area of focus among airlines and efficiency improvements are evident in the airline industry's break-even WLF. Historically, the WLF achieved by the airline industry has been increasing faster than the break-even WLF. As the gap between break-even WLF and WLF achieved increases, the airlines profit margins may become more resilient to economic shocks. One source of the strong trend in break-even WLF could be the continuing rise of low cost carriers ("LCC"). By 2028, LCCs are expected to fly 41% of total routes versus to 19% in 2008.[49]

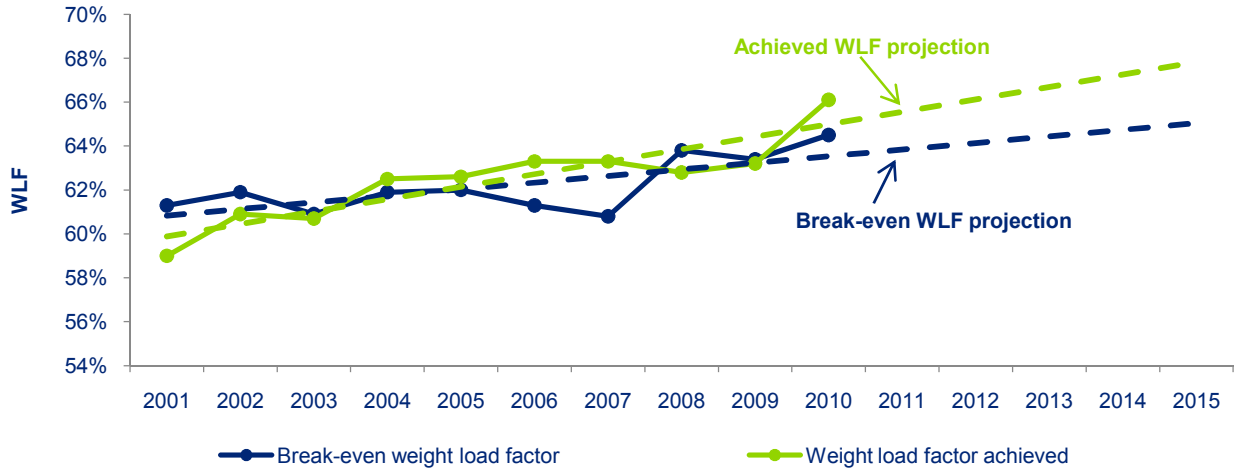
[46] Source: EIA, "Energy Price Outlook", 2010.

[47] Airbus, "2009-2028 Global Forecast", 2009.

[48] Rolls-Royce, "Market Outlook", 2009.

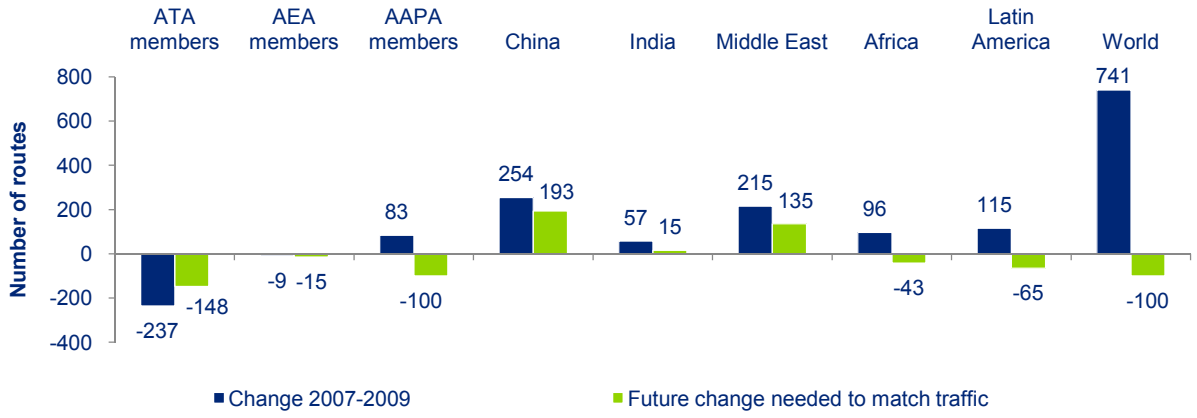
[49] Airbus, "2009-2028 Global Forecast".

Figure 24: Projected trends in airline WLFs[50]



In the short-term, Figure 25 shows that significant route rebalancing still needs to take place to match traffic demand. Rolls-Royce predicts that a net of 100 routes will need to be canceled at the global level to bring supply back in line with demand.

Figure 25: Excess airline capacity by geographical region[51]



ATA = Air Transport Association; AEA = Association of European Airlines; AAPA = Association of Asia Pacific Airlines.

5.2.3 Fleet renewal and expansion

A positive trend for the CAS is the age of commercial airline fleets. The US commercial airline fleet is the world's oldest with an average age of 14.5 years compared to an average aircraft life-span of 20-25 years.[52] Replacing of aging aircraft has been partially offset by a shift amongst the major airlines towards aircraft refurbishment as illustrated by the 10% jump in revenue from the refurbishment industry in 2009.[53]

[50] Source: IATA, "Financial Forecast", June 2010.

[51] Source: Rolls-Royce, "Market Outlook", 2009.

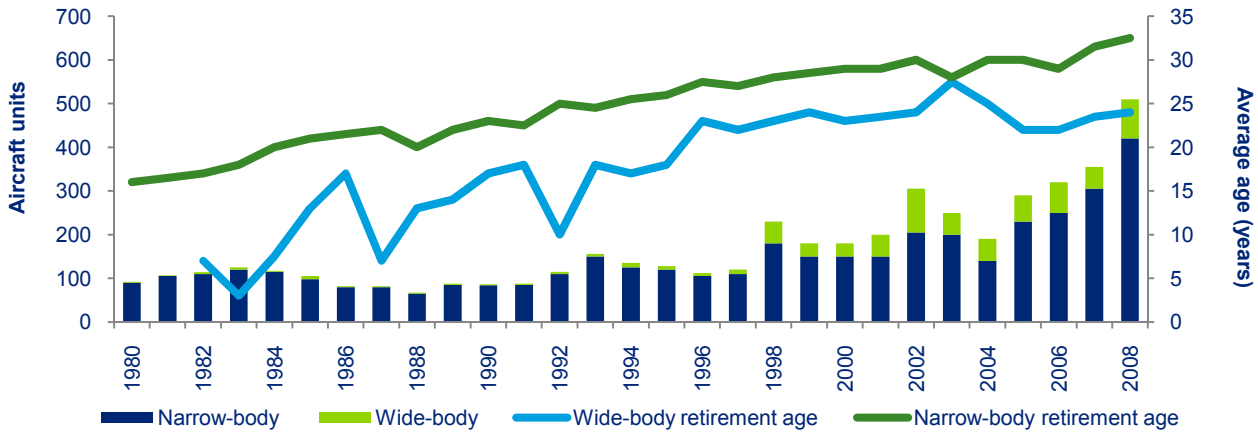
[52] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[53] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

Canadian order volumes remained weak in 2009, with the industry booking only C$150 million in net new orders between January and November. New orders in Canada have since recovered to a more normal level of C$4.3 billion between December 2009 and March 2010. According to the Conference Board of Canada, average industry backlogs increased favorably from 14.3 to 15.6 months between December 2009 and March 2010.[54] Boeing and Airbus netted 142 and 271 new orders respectively in 2009[55]. Boeing's net new order data shows an average of 772 yearly net new orders between 2003 and 2008 and order backlogs remain strong with Boeing and Airbus having a combined order back-log of 8,500 aircraft - representing seven years of production activity for each company. Despite the recent recovery, historical data shows that additional new order reductions may occur because changes in large commercial aircraft production historically lags economic changes by up to three years.[56]

Airlines have not had the capital budgets required to refresh their aging fleets. According to Rolls-Royce, the average aircraft retirement age has increased continuously since 1980 and the current retirement age of both narrow-body (single-aisle) and wide-body (twin-aisle) aircraft exceeds 20 years. This increase in average fleet age is expensive for operators due to increased maintenance costs and inefficient fuel consumption. Airlines may, therefore, be forced to increase retirements and aircraft purchases in the short- to medium-term. Rolls-Royce estimates that by 2020, three times more twin-aisle aircraft will be retired than were retired in 2010. The number of single-aisle retirements in 2020 will be comparable to 2010 levels because of a peak in retirements in 2016.[57]

Figure 26: Historical trend in aircraft retirement age[58]



[54] Conference Board of Canada Canada, "Aerospace Product Manufacturing Industry Outlook", Spring 2010.

[55] Scotiabank, "Global Economic Research Industry Tends – Aerospace", April 20 2010.

[56] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[57] Rolls-Royce, "Market Outlook", 2009.

[58] Source: Rolls-Royce, "Market Outlook", 2009.

Figure 27: Forecasted aircraft retirement schedule[59]

5.2.4 Shifts in aircraft mix

Table 4 shows that there are currently 18,890 aircraft in service. Projections by Boeing put global aircraft fleet growth at 3.5% over the next 20 years to meet passenger and freight traffic demand. Boeing estimates that this fleet growth will translate into 30,900 new aircrafts worth $3.6 trillion. [60]

The relative contribution of various types of aircraft to new deliveries will differ from the current fleet mix as airlines adjust to meet tomorrow's requirements. Boeing has identified the future aircraft mix that it believes will be demanded by airlines:

- Single-aisle aircrafts will account for 69% of new aircraft and 47% of new revenues;
- The twin-aisle market (including Boeing 787 and 777) will account for a smaller 23% of new aircraft and constitute 45% of delivery revenues;
- An increased focus among airlines towards "right-fitting" aircrafts by matching aircraft seat capacity to route traffic levels. In particular, this will constitute a shift towards larger single-aisle (narrow-body) aircraft for regional flights; and
- A continued increase in average seat capacity (see Figure 28).[61]

Additional trends from Boeing, by aircraft type, are summarized in Table 4.

[59] Source: Rolls-Royce, "Market Outlook", 2009.

[60] Boeing "Current Market Outlook 2010-2029", 2010.

[61] Boeing "Current Market Outlook 2010-2029", 2010.

Table 4: Forecast for Aircraft entering service between 2010 and 2029[62]

Aircraft type	2010	2029	CAGR (%)	Market drivers
Large	800	960	0.96	• Anticipated flat growth over the long term; and • Marginal growth will be driven by the freighter market.
Twin Aisle	3,500	8,260	4.62	• Replacement of aging twin-aisle fleets with the Boeing 787 and 777.
Single Aisle	11,580	25,000	4.13	• Grow in passenger air travel in Asia; • The rise of intraregional air travel in emerging markets such as China and India; and • Growth and expansion of the LCC model.
Regional Jets ("RJ")	3,010	2,080	-1.93	• Movement to RJs with larger seat counts due to increased fuel costs and operating costs to gain efficiencies; and • Smaller RJs will be replaced with larger RJs and small single-aisle aircrafts for short haul routes.
Total	**18,890**	**36,300**	**3.50%**	

It is important to remember that no clear consensus exists among OEM aircraft forecasts. This is mainly due to the methodology and assumptions involved, such as:

- Differing definition of seat classes among market forecasts (including assumptions about seat pitch); and
- Different perspectives within the forecasts on overall growth, replacement cycles, aircraft lifespan, passenger growth, and trends in average aircraft size.

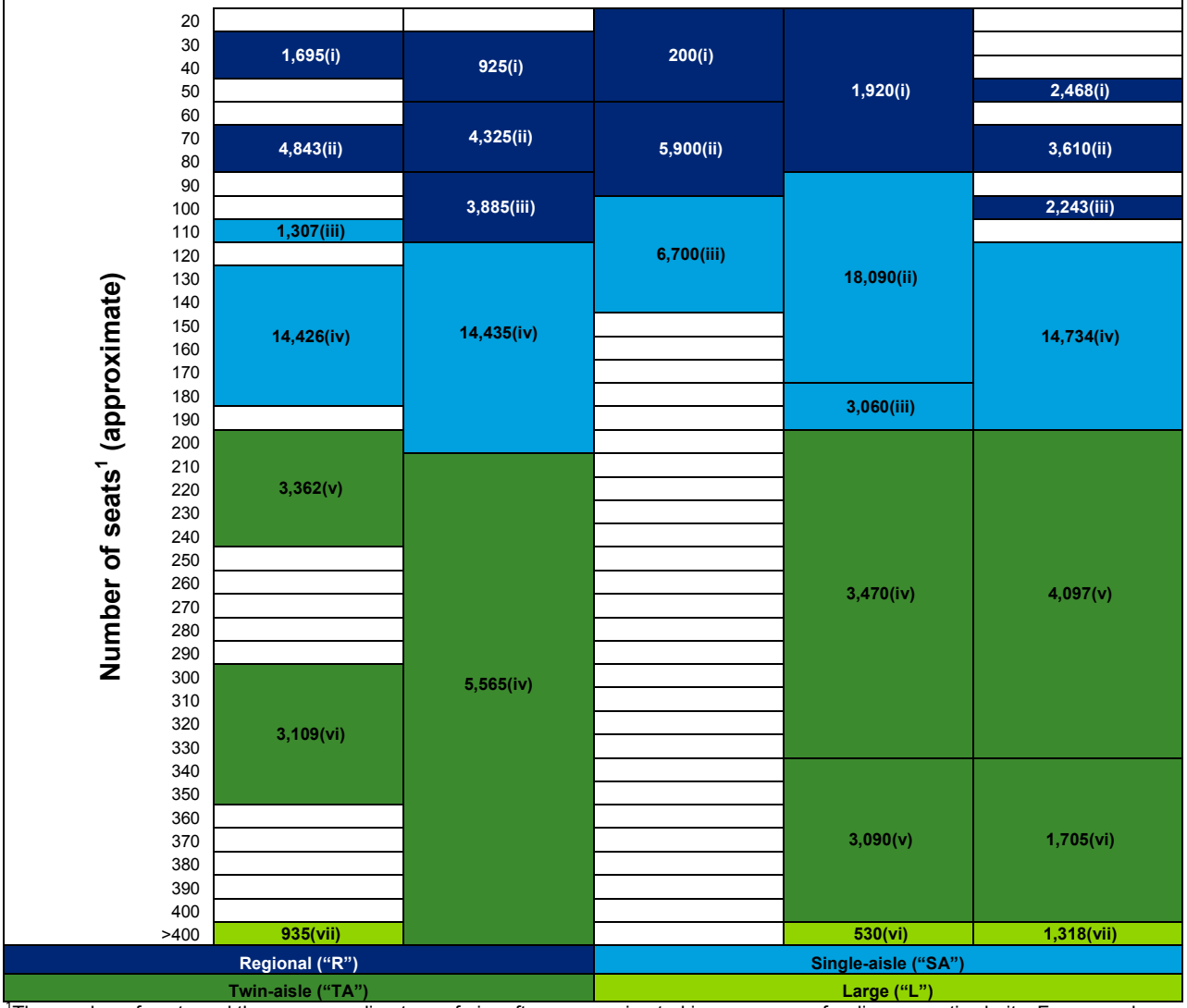
Below are highlights of the various OEM forecasts (see Table 5 for a full summary):

1. The vast majority of deliveries are expected in the 90 to 200 seat category. This corresponds to large single-aisle (narrow-body) aircraft for regional flights and "right-sized" single-aisle aircraft for network flights;
2. Forecasts for deliveries of small regional jets of less than 60 seats are highly variable between forecasts, ranging from 200 to over 2,000; and
3. A high level of variability is also seen among the larger aircraft category (greater than 400 seats). Airbus' forecast puts the number at nearly double that of the other aircraft and engine OEMs.

[62] Boeing "Current Market Outlook 2010-2029", 2010.

Table 5: Summary of delivery forecasts from major aircraft and engine OEMs[63]

Forecast	Rolls-Royce	Embraer	Bombardier	Boeing	Airbus
Forecast years	2009-2028	2010-2029	2010-2029	2010-2029	2009-2028
Includes freight aircraft	No	No	Yes	No	Yes
Seat classifications	30-50R(i) 70-0R(ii) 110SA(iii) 130-180SA(iv) 200-250TA(v) 200-350TA(vi) >400L(vii)	30-60R(i) 61-90R(ii) 91-120R(iii) 121-210SA(iv) >210TA/L(v)	20-59R(i) 60-99R(ii) 100-149R(iii)	Regional(i) 90-175SA(ii) >175SA(iii) 200-340TA(iv) 340-400TA(v) >400L(vi)	50R(i) 70/85R(ii) 100R(iii) 125/210SA(iv) 200-340TA(v) 340-400TA(vi) Very large aircraft(vii)



[1]The number of seats and the corresponding type of aircraft are approximated in some cases for diagrammatic clarity. For example, the figure shows Boeing's greater than 175 seat single-aisle aircraft forecast as covering the 175-200 seat range when this may not be the case.

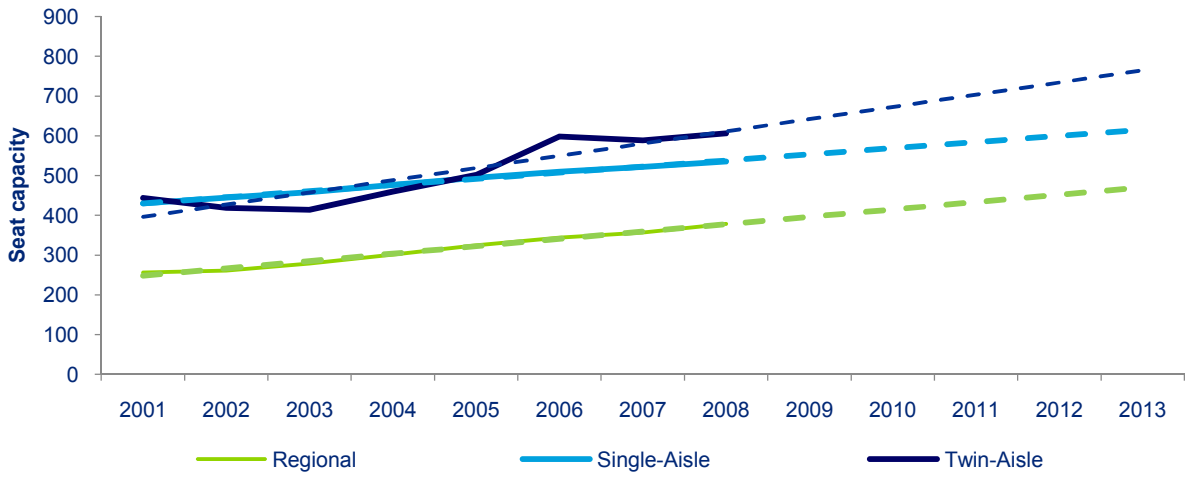
[63] Source: 2009 and 2010 market forecasts by Airbus, Rolls-Royce, Boeing, Bombardier, and Embraer.

Some of the main drivers behind the trends shown in Table 5 are:[64]

- **Regional aircraft**: At the low end of seat capacity, a move to more fuel efficient turboprops for short-haul and niche flights. For longer flights, a move to larger regional jets for increased operating efficiency, higher seat capacity, and an ability to accommodate two class configurations;
- **Single-aisle aircraft:** An overall increase in size as airlines try to increase capacity without moving to wide body models. Airlines are also moving to single class configurations that allow for additional capacity;
- **Twin-aisle aircraft:** Primarily driven by replacement schedules. Additional demand also resulting from increases in pan-pacific flights and mature Asia-Pacific routes of over 2,000 nautical miles; a distance typically serviced by wide-body aircraft; and
- **Large aircraft:** Trends for this aircraft type are driven by two factors. First, the existing 114 airports which handle 72% of air traffic volume are capacity constrained and their ability to handle a larger number of aircraft is limited. A way to increase capacity in a constrained environment is to move to larger aircrafts with greater seat capacities. This capacity constraint is further exacerbated by a second factor which is demand by new air passengers coming from Asia-Pacific and the Middle East. Approximately 30% of the constrained airports are located in Asia-Pacific or the Middle East.

Increases in seat capacity are generally predicted from historical trend lines as shown in Figure 28. Rolls-Royce built a 0.4% annual increase in seat capacity into their forecasting models for 2010-2028.[65]

Figure 28: Historical and projected trend in aircraft seat capacity[66]



[64] Market outlooks and forecasts from Bombardier, Embraer, Boeing, Airbus, & Rolls-Royce from 2009 and 2010.

[65] Rolls-Royce, "Market Outlook", 2009.

[66] Source: Airbus, "2009-2028 Global Forecast", 2009.

5.2.5 Introduction of aircraft models

Tied closely to the previous trend of fleet renewals is the number of new aircraft models scheduled for first delivery between the summer of 2010 and 2020. A summary of upcoming models is given in Table 6.

Table 6: New aircraft models through 2020[67]

Model	OEM	Seat capacity	Range (km)	Engine	Orders	First Delivery
ARJ21	COMAC	78-105	3,700	GE CF3-10A	237	Q4 2010
SuperJet 100	Sukhai	75-95	-	PowerJet SaM146	264	Q4 2010
787-8/9	Boeing	210-290	15,750	GE Genx-1B	787	Q1 2011
Cseries	Bombardier	100-149	5,500	PW 1500G	90	2013
A350XWB-800/900/10000	Airbus	450-550	15,400	RR Trent XWB	528	2013
MRJ	Mitsubishi	70-96	3,300	PW1217G	65	2014
YPX	Kawasaki	100-150	4,300	-	-	2015
C919	COMAC	168-190	4,100	LEAP-X1C	-	2016
MS-21	Irkut	150-212	5,500	Avidivigatel PD-14	146	2016
NSR	Airbus	150-180	-	-	-	2018
737RS	Boeing	100-200	-	-	-	2020

Seat capacity, delivery dates, and range are approximate values. Range will correspond to the maximum range published if more than one number is given. Missing data is due to a lack of data availability or to a situation in which a design decision has not yet been made; for example, the engine choice for the YPX has not been finalized. COMAC stands for the "Commercial Aircraft Corporation of China".

The majority of new models have a seat capacity of 100-200. This highlights that this seat category will be highly competitive in the future. This is especially relevant for Canada because the under-200 seat range is one of Bombardier's core competencies. Only two models have a seat capacity over 200, the Boeing 787 and the Airbus A350XWB. These two models constitute 62% of total orders (based on available data) and have more orders than all other future aircraft models surveyed combined.

A further analysis was done on the announced suppliers for the Boeing 787 and Airbus 350XWB. The Tables below give a ranking by the number of suppliers for each platform. Note that this analysis should be viewed as qualitative in nature because the list of suppliers used is not exhaustive. Also, many of the suppliers are multinationals and the analysis geographically places suppliers based on where their parent company is incorporated instead of where the actual manufacturing activity takes place. Additional manufacturing capacity may be located in Canada and not accurately reflected in the supplier list.

[67] Source: Company webpage(s) and publically available press releases.

Table 7: Ranking of countries based on announced Boeing 787 suppliers

Country	Boeing 787 rank[68]
US	1
Japan	2 (tie)
UK	2 (tie)
France	2 (tie)
Germany	3 (tie)
Sweden	3 (tie)
Canada	3 (tie)
Italy	4 (tie)
Korea	4 (tie)

A tie corresponds to the two countries having the same number of suppliers in the analysis.

Table 8: Ranking of countries based on publically announced Airbus 350XWB suppliers

Country	Airbus 350WXB rank[69]
US	1
Germany	2
France	3
UK	4
Spain	5
Canada	6
Japan	7
Sweden	8
Netherlands	9

At a minimum, this data hints that Canadian companies may not be playing a visible role in these two important future platforms from Boeing and Airbus.

5.2.6 Green technologies

A growing public awareness of the environment is forcing the aerospace industry to design more environmentally friendly aircrafts. Bombardier stated in their 2009 market forecast that by 2020 aircraft NO_x emission and noise levels will be reduced by 80% and 50% respectively over today's values.[70]

One way this is being accomplished is by using more composite materials in aircraft design. Composites improve efficiency and aircraft performance by reducing airframe weight with the additional benefit of reducing operating costs.[71] Based on historical data, composites will constitute approximately 50% of new Airbus aircraft designs by 2020.

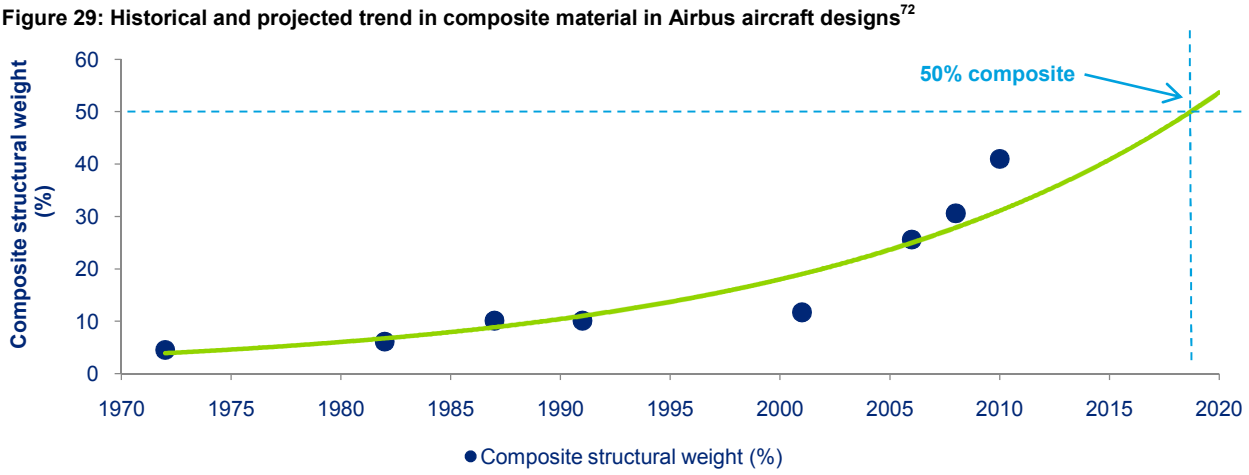
[68] The list published by Boeing is for major tier one and two suppliers and is, therefore, not exhaustive. The geography is defined by the location in which the part is manufactured.

[69] The source data is published by a third-party. The region is defined by the location of the operating subsidiary as defined by OneSource.

[70] Bombardier, "Market Forecast 2009-2028",2009.

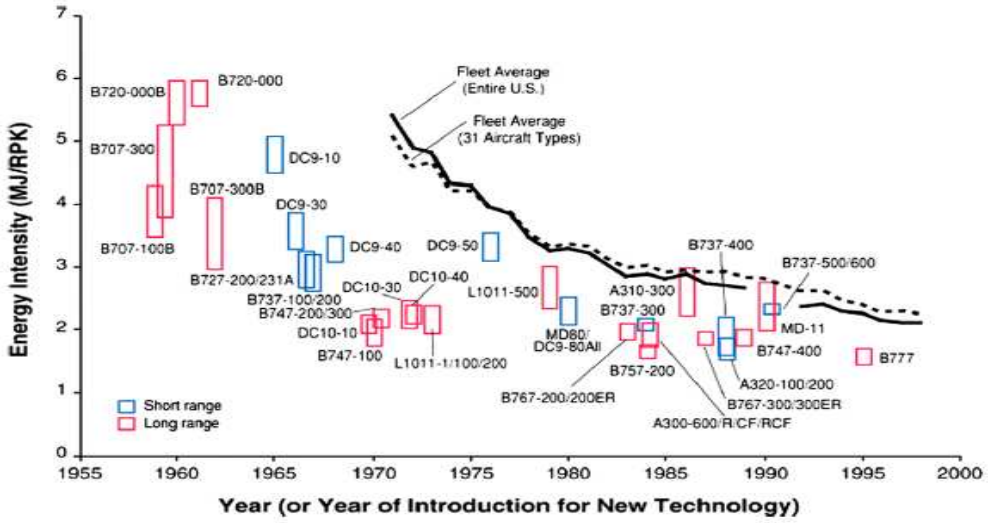
[71] Adam Quitler, "Composites in Aerospace Applications" [HIS Whitepaper].

Figure 29: Historical and projected trend in composite material in Airbus aircraft designs[72]



Third-party analysis confirms that the long-term trend in aircraft design is towards more efficiency. However, the rate of increase in efficiency has been steadily declining - likely due to maturing technologies.

Figure 30: Historical trend in aircraft energy intensity for the US commercial aircraft fleet[73]



Coupled to this increased technology intensity is an increase in research and development ("R&D") spending. Boeing's R&D has increased on average by 25% YoY since 2000.[74] Many companies have begun to outsource R&D to developing markets, such as India, to manage capital expenditures and R&D costs.[75]

Despite increases in aircraft efficiency, the International Panel on Climate Change ("IPCC") forecasts rising aircraft CO_2 emissions well into the future. Therefore, the push to efficiency will continue to pick up

[72] Source: KTH Engineering Sciences, "Cost/Weight Optimization of Aircraft Structures", 2008 KTH Engineering Sciences, "Cost/Weight Optimization of Aircraft Structures", 2008.

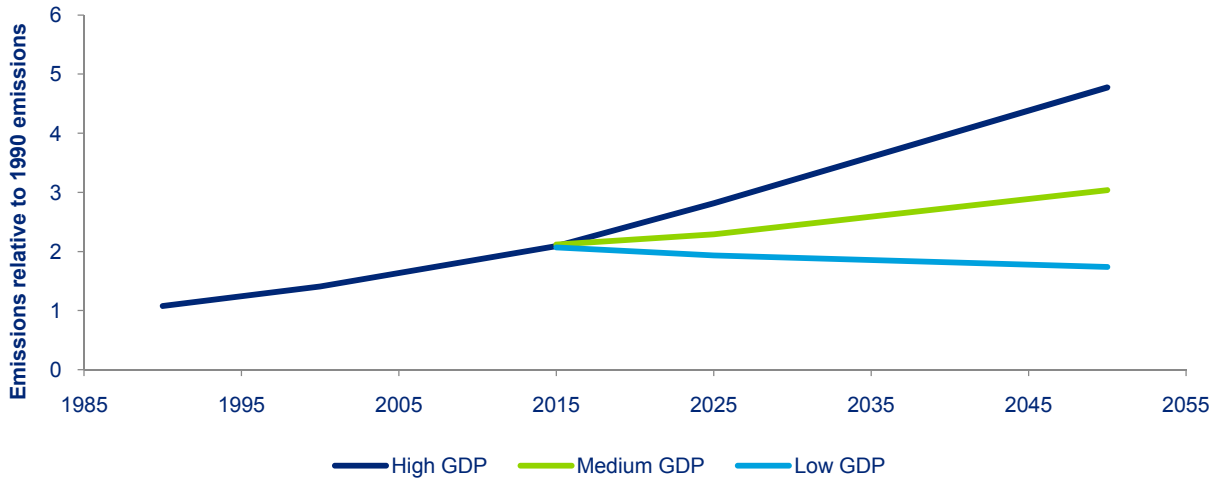
[73] Source: Joosung J. Lee et. al., "Historical and future trends in aircraft performance, cost, and emissions", 2005.

[74] Teal Group, "The Last Healthy Part of the World Economy, presentation, May 2010.

[75] Deloitte subject matter expert, internal communication, 2010.

pace as global policy becomes more restrictive around CO_2 emissions. A key driver will be the EU emission trading scheme which plans to include aviation greenhouse gas emissions by 2012.[76]

Figure 31: Forecast of global aircraft emissions for various GDP scenarios[77]



To help spur the move to green technologies, governments are investing heavily in the aerospace industry and setting specific and ambitious targets. The Advisory Council in Aeronautics Research in Europe's ("ACARE") "Clean Skys" program has set targets of a 50% reduction in CO_2 emissions, 80% reduction in NO_x emissions, and 50% reductions in external noise by 2020. As of 2008, the industry-led Clean Skys program had funding of approximately $2.4 billion.[78]

An important question related to fuel efficiency standards is whether the tightening requirements can be met solely through better designs by the aircraft OEMs. Leaders in the industry have stated that engine design, rather than aircraft design, is the most critical component in meeting the tightening fuel efficiency standards. Airbus has spent over $7 billion developing an A320 replacement and initial tests have only shown marginal performance improvements; optimistic estimates from preliminary tests show fuel consumption, cost reduction, and emission reductions of 4%, 3%, and 5% respectively. Similar results have come out of preliminary work by Boeing on a 737 replacement. Third-party estimates state that next generation aircraft from Boeing and Airbus will only yield 9-10% efficiency improvements over comparable existing models when flown using existing engine technologies.[79] Therefore, much of the efficiency ground may need to be made up in engine design. A summary of some of the key next generation technology being explored by the major engine OEMs is given below:

- **Pratt & Whitney**: Is developing a geared turbofan engine, termed the PW1000G, which reportedly improves fuel efficiency by 10% to 15% while also yielding substantial noise reductions.[80]
- **General Electric**: Is developing a new dual rotor high-bypass turbofan called the GEnx for medium-capacity long-range aircraft. General Electric is reporting that the GEnx will improve fuel efficiency by 15% over comparable existing models.[81]
- **CFM International**: Is developing a high-bypass turbofan named LEAP-X as part of a joint venture with GE and Seneca. CFM claims an increase in fuel efficiency of 16%, reductions in CO_2 emissions of 16%, and reductions in NO_x emissions by 50-60%.[82]

[76] James E McCarthy, "Aviation and Climate Change" (CRS Report R400900).

[77] Source: IPCC, "Aviation and the Global Atmosphere: A Special Report on Climate Change", Cambridge University Press, 2009.

[78] NRC, "Canadian Aerospace Technology Roadmap", 27 Novemeber 2010.

[79] Guy Norris, "The 737 Story: Smoke and mirrors obscure 737 and Airbus A320 replacement studies", published by Flight International, February 7nd 2006.

[80] Pratt & Whiney, "PurePower 100G – Overview", from corporate webpage, 2010.

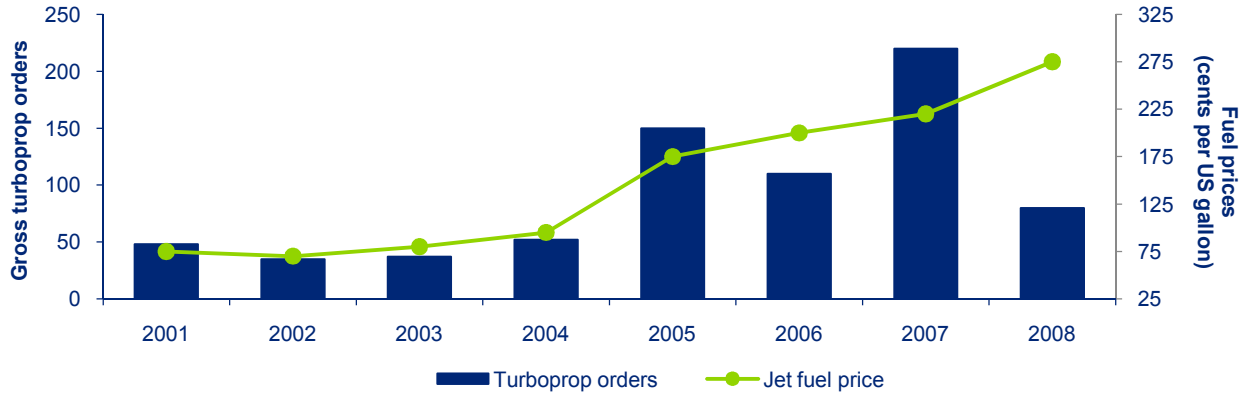
[81] GE, "The GEnx Aviation Family", from corporate webpage, August 2010.

[82] CFM International, "State of the Art", from corporate webpage, August 2010.

- **Rolls-Royce**: Is expanding on the Trent line of high bypass turbofan engines for large commercial aircraft, including the Trent XWB which will power the new Airbus 350XWB. Rolls-Royce has also discussed the development of a new small open-rotor engine aimed specifically at the re-engined aircraft market.[83]

Turboprop usage on short-haul (i.e., less than 800 km) flights may increase due to a move to more fuel efficient technologies. As shown below, turboprop orders are positively correlated to fuel prices.

Figure 32: Turboprop orders are positively correlated to fuel prices[84]



Between 2010 and 2029, Embraer forecasts that 32% of aircraft deliveries in the 30-120 seat range will be turboprops and Bombardier forecasts that 39% of aircraft deliveries in the 20-99 seat range will be turboprops.[85,86]

5.2.7 MRO investment

MRO activity is likely to increase in the short- to medium-term. Over 50% of airlines say that they have under-invested in MRO activity and expect significant investment increases in the future.[87] Further, Oliver Wyman identified the following key trends in the MRO market:

- MRO spend is expected to increase, at just over 6% annually over the next five years;
- Outsourcing of new MRO activities, while still widely popular, has peaked;
- Work is shifting to low-cost labour regions as airlines seek deeper cost reductions, limited primarily by the availability of skilled mechanics and technical resources in these regions;
- Airlines are pursuing the next level of savings, raising demand for maintenance program, reliability, and material solutions to complement the repair work outsourced;
- To drive further cost reductions, airlines are looking to develop sophisticated materials management solutions, reduce investments in inventory, and improve airline operations and reliability;
- To manage diverse, geographically dispersed supply chains, airlines are expanding the size and sophistication of their supplier management functions;
- MRO providers are expanding their geographic reach and capabilities in a bid to become regional and global full-service providers. This expansion is being fueled by acquisitions, with great interest among private equity and other outside (non-strategic) investors; and
- To increase their competitiveness, providers are increasing their investments in technology and already have realized substantial improvements.[88]

[83] Lori Ranson, "Rolls-Royce outlines view of next-generation engines", published by Flight International, March 18th 2010.

[84] Source: Bombardier, "2009-2028 Market Forecast", 2009.

[85] Bombardier, "Market Outlook 2010-2029",2010.

[86] Embraer, "Market Outlook 2010-2029",2010.

[87] Oliver Wyman, "MRO survey", 2009.

[88] Oliver Wyman, "MRO survey", 2009.

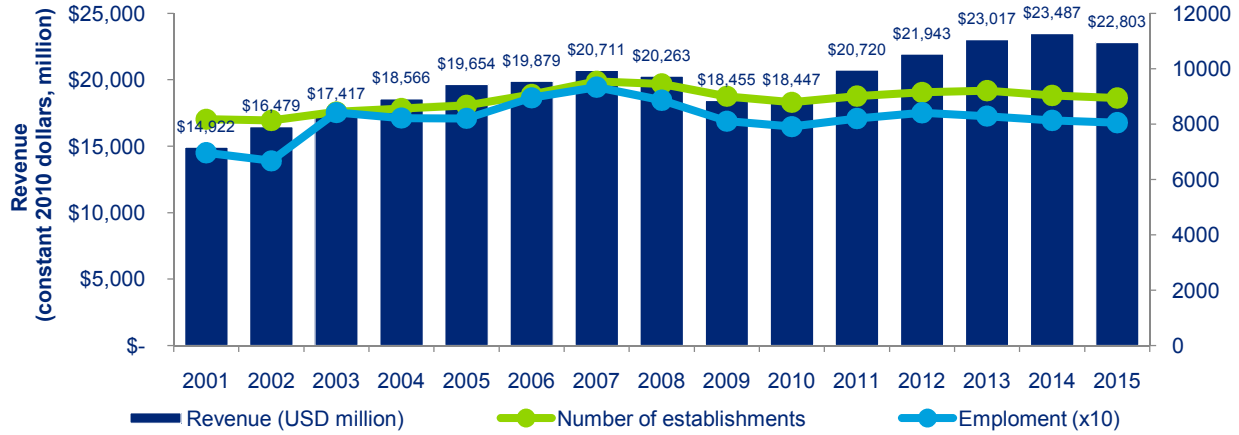
Airlines are increasingly refusing to maintain inventories of parts and are pushing this role onto airframe and primary component OEMs. In practice, this means that suppliers will need to increase their capacity for asset management over historical norms. Also, part pooling agreements are becoming increasingly popular among airlines to reduce part inventories and part pooling agreements account for over 50% of parts in Europe.[89]

The airline industry is also shifting towards broader and longer-term service agreements. Under these types of agreements, the airline pays the MRO provider based on the number of hours the aircraft is flown and in turn, the MRO provider assumes all liability for maintenance. An example of the trend towards broader service offerings is Boeing's GoldCare offering which is a complete life-cycle management program targeted to 787 customers.[90]

There is no consensus among third-party sources on the future of MRO outsourcing. However, the move to outsourcing labour-intensive MRO will likely continue due to wage disparities between developing markets and developed markets. In developing markets MRO labour costs are approximately $45 to $55 per hour compared with $90 to $100 per hour in developed markets.[91] Additionally, MRO activity will be easier to outsource to low-cost centres as major network hubs develop in Asia-Pacific and Latin America.

Data on the US MRO market shows industry revenue increasing at a CAGR of 5% between 2010 and 2015. However, growth in employment and the number of establishments are forecast to remain flat during the same time period. It may be reasonable to assume a trend in the Canadian market that is similar to the trend seen in the United States.

Figure 33: Historical trend and future forecast of US MRO industry[92]



The regional forecast of MRO activity by Oliver Wyman shows capital intensive MRO activity in the US will remain strong through to 2013 with labour intensive MRO activity shifting to cheaper markets (e.g., Latin American countries, including Mexico). Note that the geographical MRO trends follow closely with trends is geographical RPK distributions discussed previously.

[89] WedBush, "Industrial Growth: Aerospace", April 26 2010.

[90] WedBush, "Industrial Growth: Aerospace", April 26 2010.

[91] WedBush, "Industrial Growth: Aerospace", April 26 2010.

[92] Source: IBISWorld, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

Table 9: 2008 - 2013 change in MRO airline fulfillment by geography[93]

Region	Engines (5 year CAGR, %)	Airframes (5 year CAGR, %)	Components (5 year CAGR, %)
North America	14.3	-18.5	-15.8
Europe	-17.1	-6.7	-16.7
Asia-Pacific	13.3	11.1	35.3
Middle East	14.3	10.0	22.2
Latin America	0.0	80.0	33.3

A negative number corresponds to a projected decrease of MRO fulfillment in that geography. A positive number corresponds to a projected increase of MRO fulfillment in that geography.

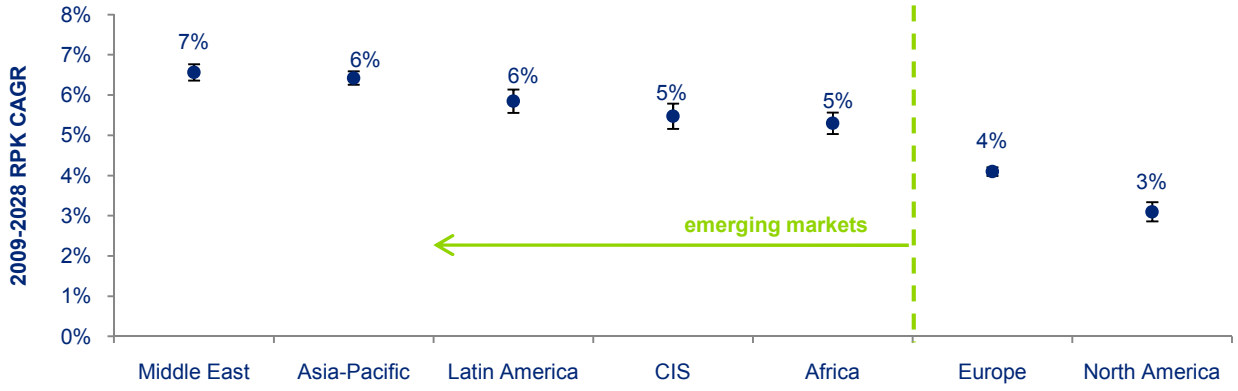
5.2.8 Emerging markets

There are two major trends with respect to emerging markets. The first is the high levels of passenger growth and the second is the maturing of state sponsored aircraft OEMs, especially in the regional and narrow-body product categories.

Companies in Russia and China are launching aircrafts that are government subsidized and this raises long-term questions about how accessible these markets will be to Canadian suppliers. The Chinese government launched COMAC in May 2008 with the expressed purpose of producing commercial aircrafts. The first model under design is the C919, a 156-seat narrow-body aircraft designed to compete against the Boeing 737 and Airbus A320. First delivery is scheduled for no later than 2016 and is claimed to cost 10% less than comparable models. In Russia, UAC has stated that they want to achieve a 10% share of the world civil aviation market and a 50% share of the domestic Russian market by 2025.[94] To accomplish this, UAC's subsidiary Sukohoi is launching a 75- and 95-seat regional jet called the SuperJet 100 set for delivery by the end of 2010. As of 2009, Sukohoi claimed to have 122 orders for the SuperJet 100. The SuperJet 100 is being marketed as a less expensive alternative to competing models from Embraer and Bombardier.[95]

In terms of passenger volumes, aggregate forecasts from OEMs unanimously forecast the highest rates of RPK growth in emerging markets. Europe and North America rank last place in terms of RPK growth over the next 20 years.

Figure 34: RPK growth dominated by emerging markets[96]



[93] Oliver Wyman, "MRO survey", 2009.

[94] United Aircraft Corporation, "Strategy/Plans for Development", accessed from corporate webpage in July 2010.

[95] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[96] Source: RPK growth-rates are the average of forecasts from Boeing, Airbus, Embraer, Bombardier, and Rolls-Royce

5.2.9 Labour issues

One of the largest issues that the CAS faces is pilot and workforce shortages.

The demand for commercial airline pilots is a function of the size and utilization of the commercial airline fleets around the world. It is expected that the US will experience a pilot shortage as soon as year-end 2010. The following factors have continued to fuel the labour shortage:

- The growing demand for pilots due to the increased passenger activity in China, India, and the Middle East;
- The "stop-loss" programs instituted by the US military. The US military implemented a program to prevent military pilots from leaving the service and developed incentive programs to retain experienced pilots. This is resulting in fewer military pilots leaving for jobs with airlines;
- The financial crisis led to a temporary softening of pilot demand however, that was short-lived, and future demand for pilots will remain strong. Globally the need for pilots will continue to grow as economies continue to steadily recover and as airlines continue to grow through fleet expansion;
- Declining salaries and benefits; and
- High training costs.

As of 2009, the average age of a US pilot for commercial aircrafts was approximately 44 years old, and the average age of a pilot in air transport was approximately 49 years old.[97] The pilot population is aging and they are not being replaced, leading to a future crisis in the commercial aerospace industry. The IATA estimates that there are approximately 54,000 pilots working for major airlines, approximately 19,000 regional airline pilots, and approximately 2,500 pilots available for hire in the US in 2010. It is estimated by aviation experts that 42,090 pilots will be required in the next 10 years due to retirements and industry growth. The shortage will directly impact commercial airlines business and the managing of their flight schedules: a US airline had to cancel 4% of its flights because no flight crew was available.[98] Regional airlines will be most impacted by the pilot shortage. According to the Journal of Aviation Management and Education, the demand for pilots by major carriers has forced regional carriers to reduce their hiring minimums to all time lows; in some cases cutting the required flight hours for multi-engine aircraft from 1,000 to 500 and from 350 to 40 for single-engine aircraft. The decline in hours has raised a great deal of concern around safety and pilot experience.[99] To address the pilot shortage and safety concerns, the US Congress introduced a bill in 2009 that enacted new training regulations.

Figure 35 outlines the growing demand by US carriers for pilots. According to the Journal of Aviation Management and Education, the demand for pilots will reach approximately 125,411 by 2028 while the supply is forecasted to be only 80,983.[100] Interestingly, this forecast assumes that there will be no major changes to the training standards. It is estimated that by 2028, the cumulative shortfall of pilots will be 44,000 or 35% of total demand and the only way to close this gap will be to increase the number of people who attend pilot training.

To deal with the pilot shortage, the Bush administration signed "The Fair Treatment for Experienced Pilots Act" in 2007 that allows pilots to fly until the age of 65. This Act, however, is not expected to have a significant long-term impact on the supply of pilots because of seniority systems, salary issues, medical requirements, and alternative job opportunities.[101]

[97] IATA, "Average Age by Active Pilots by Category", 2009.

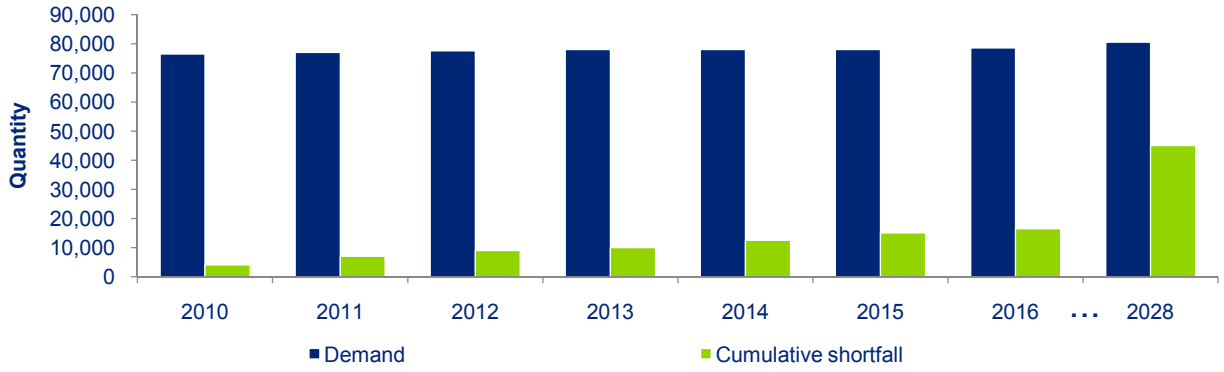
[98] CBC, "Global pilot shortage a looming crisis in Canada." November 2007; and The Aviation Paper, "NTSB: There will be a pilot shortage soon", May 2010.

[99] Journal of Aviation Management and Education. "International supply and demand for US trained commercial airline pilots", 2009.

[100] Journal of Aviation Management and Education. "International supply and demand for US trained commercial airline pilots", 2009.

[101] Journal of Aviation Management and Education. "International supply and demand for US trained commercial airline pilots", 2009.

Figure 35: Estimated supply and demand for US ATP pilots by US carriers[102]



Estimations are based on the percentage of pilots employed by the US carriers.

The labour shortage does not end with the anticipated shortage of commercial pilots - the value chain of the aerospace industry is also at risk.

The looming skilled labour shortage is one of the largest issues facing the global aerospace industry. The aging baby boomer generation means an increased number of the industry's workforce will be eligible for retirement in the coming years. Nearly 6% of the US aerospace industry workforce retired in 2008 and according to Aviation Week, retirement eligibility will increase from 13% in 2009 to more than 20% in 2013 in the US.[103] To add to the complexity of labour shortages, the aerospace industry specifically requires above average education and specific skills. As a result, the challenge facing the industry will be to look to developing countries and recruit immigrant workers or set up specific programs within the post-secondary educational system to attract students to enter the aerospace industry. A short-term strategy that the majority of aerospace companies are using is to aggressively manage employee retention.

According to the International Civil Aviation Organization ("ICAO"), not only will airlines have to add thousands of new aircrafts to their fleet, but they will also need to ensure they have the labour to maintain the fleet. It is anticipated that by 2026, 480,000 new technicians will be required to maintain these aircrafts.[104]

Aerospace companies were careful in managing their workforce through the financial crisis. According to Aviation Week's 2009 Workforce Study, the US Aerospace industry cut 30,000 jobs as of June 1, 2009 or 4.5% of their total workforce. Companies were also very careful to use other means, such as salary freezes, furloughs, temporary shutdowns and other cost cutting measures to avoid mass layoffs.[105] Actions taken by the industry to ensure they are staffing the right talent and replacing the retired baby boomers include:

- A shift towards focusing on universities and colleges. Northrop Grumman Aerospace Systems stated that more than 40% of its operation hires will be recent college graduates;
- Internships are key in managing through the economic downturn; however, smaller aerospace organizations were forced to bring on fewer interns and in some instances had to cancel internships to manage costs;
- Aerospace companies have increased the use of contract workers from 5% to 7% over the last five years to deal with volatile demand. As demand ramps up, companies are converting these contract workers into full-time employees;
- Rockwell Collins has been continually investing in tools and systems to support their employees in professional and work development despite the financial crisis; and

[102] Source: FAA, "Aerospace Forecast Fiscal Years 2010-2030", Forecast 2009.

[103] Aviation Week, "Aviation Week 2009 Workforce Study", July 20, 2009.

[104] ICAO, "ICAO addresses shortage of skilled aviation professionals", March 2010.

[105] Aviation Week, "Aviation Week 2009 Workforce Study", July 20, 2009.

- Gulfstream, one of the hardest hit companies by the downturn, preserved some jobs by reducing work hours at service centers to adjust to fewer customer flight hours. [106]

5.2.10 Regulations

Some of the major trends in regulations are given below. In general, air transportation (demand) is becoming more liberalized while aerospace manufacturing (supply) follows the opposite trend with increasing protectionism.

Airline policy ownership

The recent financial crisis has led to a number of the developed countries to retrench into a protectionist mindset. This will directly affect issues such as airline foreign investment and ownership, international trade. The agreement EU-US Open Aviation Agreement Negotiations ("OAAN") is expected to be ratified in November 2010; however, EU member states are still allowed to individually withdraw from the OAAN. It is feared that the UK, the biggest supplier of the OAAN will retrench, and not permit foreign investment into Heathrow.[107]

Airline deregulation

The liberalization of air service rights has continued to gain momentum globally. This is demonstrated by the EU – Canada bilateral agreement that was reached in May 2009 to increase foreign ownership levels and eventually remove cabotage restrictions between economies.

Boeing has outlined the impact of airline deregulation on the aerospace industry:

- China's domestic flight volume has increased nineteen fold since the beginning of airline industry deregulation in the 1990's; and
- Since 1990, Central Europe has increased average seat kilometres ("ASK") from 0.358 billion to 1.8 billion.[108]

In addition to deregulation, countries like China are liberalizing the business environment for the building of business jets. According to Standard & Poor's, Rockwell Collins has anecdotally commented that China has reduced tariffs on business aircraft from 23% to 6%; and approvals of flight plans have been reduced from three to four weeks to a few hours.[109]

Other agreements that are beginning to further market liberalization and access include:

- In 2009, ten members of the Association of Southeast Asian Nations adopted a Multilateral Agreement on Air Services called the ASEAN Multilateral Agreement on Air Services and the ASEAN Multilateral Agreement on the Full Liberalization of Air Freight Services. The purpose of the agreement is to liberalize market access and ownership and control requirements for air carriers in the region. The Agreement is a precursor to an eventual Single Aviation Market arrangement targeted for 2013;[110]
- In preparation for the ASEAN-China Free Trade Agreement in 2010, ASEAN and China agreed to work towards concluding an ASEAN-China Regional Air Services Agreement, covering both air freight and air passenger services to support and facilitate the traffic and movement of passengers and cargo to increase the trade and economy of ASEAN and China; and
- In 1999, a memorandum of understanding was launched called the Yamoussoukro Decision ("YD"). The purpose of the YD is to liberalize the African air transportation market, promote competition, and

[106] Aviation Week, "Aviation Week 2009 Workforce Study", July 20, 2009.

[107] Boeing. "Global Geopolitical Trends and Commercial Aviation", 2009.

[108] Boeing. "Global Geopolitical Trends and Commercial Aviation", 2009.

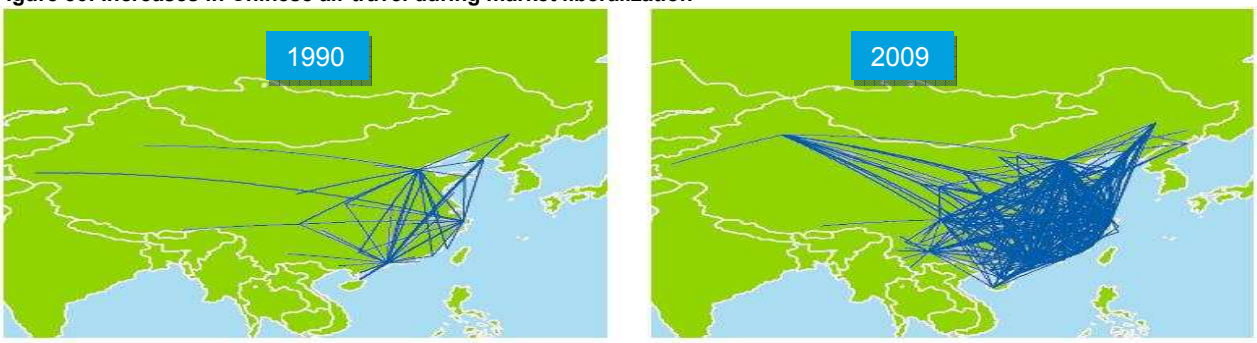
[109] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[110] Ian Thomas et. al., "Developing ASEAN's Single Aviation Market and Regional Air Services Arrangements with Dialogue Partners", accessed from http://www.aseansec.org/aadcp/repsf/docs/07-003-ExecutiveSummary.pdf published in July 2010.

improve operational efficiency. A secondary goal of the YA is to attract private sector capital to the African airline industry. Included in this agreement is freedom for carriers with respect to flight capacity and frequency. Despite being ratified in 1999, the YA is hampered by slow implementation.[111]

Figure 36 and the accompanying table illustrates the impact that deregulation can have on traffic volumes, number of routes, frequencies, and number of airport pairs.

Figure 36: Increases in Chinese air travel during market liberalization[112]



Year	Total ASK (million)	Weekly frequencies	Total airport pairs	Aircraft seats
1990	388	2,088	170	156
2009	6,467 ↑	39,004 ↑	897 ↑	158 ↑

5.2.11 Satellite fleet replacement

The Space sub-sector is small and quickly evolving relative to other CAS sub-sectors. The Space sub-sector is important because of its growth prospects and its resilience to market downturns. In France and Germany, the Space sub-sector was critical in driving revenue growth in the CAS during the financial crisis.[113]

Going forward, the general trends in the Space sub-sector can be summarized as:

- Average manufacturing revenue per satellite has dropped significantly in recent years;
- Expected increase in launch revenues to service the International Space Station ("ISS") because of the cancelation of the space shuttle with no launch vehicle capable of reaching the ISS in the development pipeline;
- A large replacement wave of low-earth orbit ("LEO") satellites is expected from 2012-2015. Significant numbers of geosynchronous-earth orbit ("GEO") satellites will need to be replaced by 2012. The majority of listed elliptical and medium-earth orbit ("MEO") satellites will need to be replaced in 2013-2015;[114]
- The sub-sector is expected to be dominated by civilian customers over the next 20 years and current projections put civil payloads at 77% of total proposed payloads through 2028;[115] and

[111] ICAO/ATAG/WB Development Forum, "Implementation of the Yamoussoukro Decision: Progressing or stalled?" [conference presentation], May 24-26 2006.

[112] Source: Boeing, "Global Geopolitical Trends and Commercial Aviation", 2009.

[113] European Commission, "EU Competitiveness Report", December 2009.

[114] Communication, broadcast, and weather satellites primarily fall under the GEO segment. Low-earth orbit satellites are primarily used for remote sensing and mobile satellite services. Mobile satellite services are satellites that communicate with portable terrestrial terminals (carried on a boat, aircraft, etc.). Elliptical and MEO satellites are typically used for communication purposes when the whole earth needs to be in view of the satellite.

[115] Teal Group, "Teal Mission Model Counts 2,033 Space Payloads through 2028" [online article]. Accessed from https://www.tealgroup.com/index.php?option=com_content&view=article&id=41:teal-mission-model-counts-2033-space-payloads-through-2028&catid=3&Itemid=16 in August 2010.

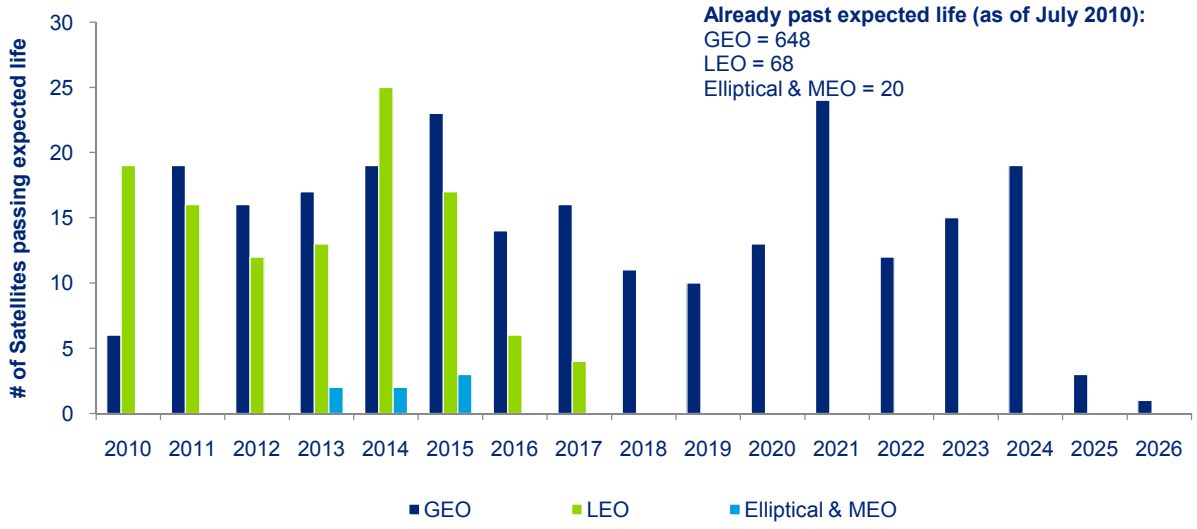
- The number of yearly orders and launches will remain small. Revenues will continue to remain uncertain as the industry matures.

The Teal Group estimates that 1,805 new non-military payloads have been proposed for launch between 2010 and 2029 - although many of these payloads have not received funding. Seventy-seven percent of the proposed payloads have been planned by civil and commercial organizations with military and universities proposing 19% and 4% of total payloads respectively. The Teal Group estimates that the number of civil payloads will increase by 7% for 2010 to 2029. Forecasted growth in civil payloads is in contrast to the drop in share of payloads from 39% in 2005 to 34.5% in 2007.

Of the 1,805 non-military payloads, 9% of them (approximately 200) are planned by the National Aeronautics and Space Administration ("NASA"). Many of NASA's payloads are to service the ISS now that the space shuttle has been retired without a ready successor. Based on Teal Group's research, one-quarter of civil launch payloads are scheduled for the ISS (approximately 215 payloads). Of total forecasted payloads, approximately 62% are for LEO, 23% are for GEO, and the remaining 15% are for MEO, elliptical orbit, or deep space trajectories.[116]

Figure 37 shows the estimated number of satellites being retired, that are currently in use, through 2026. The GEO satellites (communications, broadcasting, and positioning) in service will be retiring at a steady pace through 2024. The majority of the GEO satellites retiring will need to be replaced because of their critical role in terrestrial communication systems. Also, the majority of the LEO fleet will be replaced prior to 2014. Globalstar and Orbcomm LEO mobile communications constellations are expected to need replacement by 2013 and Iridium LEO satellites are expected to need replacement by 2020.[117] The small number of existing Elliptical & MEO satellites will be retiring between 2013 and 2015; however, many of the elliptical & MEO satellite's functions are being replaced by lower cost LEO and GEO satellites.

Figure 37: Number of listed launched satellites passing expected useful life[118]



The sources of demand growth for the Space sub-sector are directly tied to the sources of growth in the satellite servicing sector. The greatest sources of 2009 revenue growth for satellite services was mobile data services (which grew by 18% and now represents two-thirds of mobile satellite service revenue) and

[116] Teal Group, Teal Mission Model Counts 2,033 Space Payloads through 2028" [online article]. Accessed from https://www.tealgroup.com/index.php?option=com_content&view=article&id=41:teal-mission-model-counts-2033-space-payloads-through-2028&catid=3&Itemid=16 in August 2010.

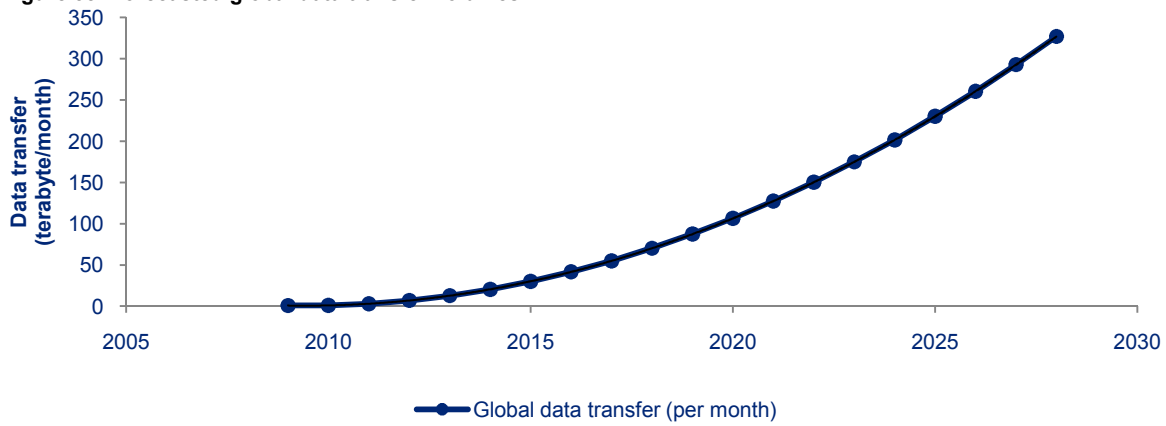
[117] Teal Group, Teal Mission Model Counts 2,033 Space Payloads through 2028", online article: https://www.tealgroup.com/index.php?option=com_content&view=article&id=41:teal-mission-model-counts-2033-space-payloads-through-2028&catid=3&Itemid=16 accessed in August 2010.

[118] Union of Concerned Scientists. "UCS satellite database" [online database]. accessed from http://www.ucsusa.org/nuclear_weapons_and_global_security/space_weapons/technical_issues/ucs-satellite-database.html in July 2010.

HDTV which saw revenue growth of approximately 80% between 2008 and 2009. In contrast, revenues derived from mobile voice services declined by a surprising 23% between 2008 and 2009. Global positioning systems are also forecast as a continued driver of growth.

By 2014, the sum of all forms of video (TV, Video-on-Demand internet video, and peer-to-peer) will exceed 90% of global consumer traffic. In addition, global file sharing traffic is projected to reach 11 Exabyte per month in 2014, representing a 22% CAGR from 2009-2014.[119]

Figure 38**: Forecasted global data transfer volumes**[120]



[119] Cisco, "Internet Traffic to Grow Fourfolds by 2014" [online article], accessed from: http://newsroom.cisco.com/dlls/2010/prod_060210.html published June 16, 2010.

[120] Cisco, "Internet Traffic to Grow Fourfolds by 2014" [online article], accessed from: http://newsroom.cisco.com/dlls/2010/prod_060210.html published June 16, 2010.

6 Military aerospace sector

6.1 Current market overview

According to the AIAC, one quarter of industry revenues are derived from the MAS. The Canadian MAS generated revenues of approximately C$6 billion in 2009 with a focus on exports to the US and Europe.[121] The recently announced F-35 program has the potential to increase the importance of the MAS to the Canadian aerospace industry.

Canadian MAS revenues are correlated to the defence spending of the US, and other G7 nations, because of limited access to emerging military aerospace markets such as China or India. Canada itself spends relatively small amounts on the military. In 2009, Canada military expenditures were $20.5 billion or 1.3% of GDP (0.03% of global GDP) versus 4.3% (1% of global GDP) in the US.[122]

6.1.1 Global market

The MAS accounted for approximately 54%, or $206 billion, of global aerospace revenues in 2009. Of the $206 billion in 2009 revenues, approximately $143 billion was attributable to manufacturing which saw a decrease of 3.3% YoY relative to FY 2008. Preliminary projections show global CAS manufacturing revenues, including Space, growing at 1.3% YoY in 2010. The MAS has experienced steady revenue growth due to a stable base-line commitment by the governments around the world towards military investment. The global MAS is driven by a combination of overall defence spending and the nature of military activity. Governments control the demand in this market through their respective departments of defence and by setting military budgets that are based on strategic and policy considerations.

Global military spending by the 10 largest military spenders has increased by 15.9% over the last nine years. According to the Stockholm International Peace Research Institute ("SIPRI"), the US controlled approximately 43% of global military spend in 2009, followed by China with 6.6%, France with 4.2% and the UK with 3.8%.[123] Collectively, the top five countries constitute 57.6% of global military expenditures. World military expenditures were approximately $1.53 trillion in 2009.[124]

Military spending has been largely exempt from government budget cuts induced by the financial crisis. Two-thirds of the top MA&D spending countries have recently increased military expenditures, largely to boost their economies. In the US, MA&D expenditures were not impacted by the Obama Administration's desire to counteract the recession despite playing a smaller role in the economic stimulus package. The War on Terror, the Iraq War, and a focus on Homeland Security have been the drivers behind the increase in overall military defence spending by the US Department of Defence ("DoD"). Over the last 10 years, US MA&D spending has increased by 235% from $281 billion to $661 billion.[125] As the US deficit deepens, however, MA&D spending is expected to be under increased public scrutiny and the Obama Administration has recently mandated a move in military spending to "70% solutions" that are cheaper with shorter development cycles.

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[121] AIAC, "Canadian Aerospace Industry, Performance 2008", June 2009.

[122] SIPRI, "Military expenditures" [online database], accessed from http://www.sipri.org/databases in June 2010.

[123] SIPRI, "Recent trends in military expenditure", accessed from http://www.sipri.org/research/armaments/milex/resultoutput/trends in May 2010.

[124] SIPRI, "Military expenditures" [online database], accessed from http://www.sipri.org/databases in June 2010.

[125] Center for Arms Control and Non-Proliferation, "US vs. Global Defence Spending", May 21 2010. Numbers are based on 2001 and fiscal 2011 DoD published budgets.

The key MAS customers are the various departments within the military establishments in each country. In the US, these are: the US DoD, the US Air Force, the US Army, the US Navy, and the US Marine Corps. In Europe and the US, current procurement trends show that governments give preference to multiple-award, indefinite-delivery, indefinite quantity omnibus contracts for integrated solutions, following rigorous pre-qualifications. Specific to US law, 50% of the content of US weapon systems must be made domestically. Through the Defence Development Sharing Program, the US DoD and the Canadian Department of Defence Production ("CDDP") collaborate to provide for the defence of both countries. The programs allow Canadian companies to perform R&D for the US armed forces and allows for increased interchangeability between Canadian and US defence equipment. Canada has certain exemptions to the US International Traffic in Arms Regulations ("ITAR").[126]

Emerging markets are becoming prominent sources of military defence spending as their economies grow. From 2000-2009, China increased its military expenditures by 219%, Russia by 103% and India by 68%. The US and UK also increased military expenditure by 211% and 152% respectively over the same nine year period in support of the Iraq and Afghanistan wars.[127]

6.1.2 MAS market leaders

The MAS is dominated by large US based companies. Statistics provided by *Defence News* – a leading publication tracking the global defence market – states that the top 100 contractors generated $399 billion in revenue in 2009 from government military expenditures. This represents a 4% increase from 2008.[128]

The top 10 global MA&D leaders account for $239 billion or approximately 60% of global military expenditure revenues. A highlight of some of the large companies globally is given in Table 10. Canadian companies have a relatively small presence on the global list, with the exception of CAE, a T&S company. In 2009, CAE ranked 77th on the list, with military related revenues of approximately $742 million.

Table 10: Global MAS market leaders[129]

Rank	Company	Country	MAS 2009 revenue (USD million)
1	Lockheed Martin	US	42,026
2	BAE Systems	UK	33,419
3	Boeing	US	31,932
4	Northrop Grumman	US	30,657
5	General Dynamics	US	25,905
6	Raytheon	US	23,139
7	EADS	Netherlands	15,014
8	L-3 Communications	US	13,332
9	Finmeccanica	Italy	13,014
10	United Technologies	US	1,110

[126] First Research, "Aerospace Products and Parts Manufacture" 2010.

[127] SIPRI, "Military expenditures" [online database], accessed from http://www.sipri.org/databases in June 2010. All values expressed in terms of 2008 dollars.

[128] Defence News, "Top 100 for 2009" accessed from http://www.defencenews.com/static/features/top100/charts/rank_2009.php?c=FEA&s=T1C in June 2010.

[129] Defence News, "Top 100 for 2009" accessed from http://www.defencenews.com/static/features/top100/charts/rank_2009.php?c=FEA&s=T1C in June 2010.

6.1.3 Sub-sectors

The breakdown of MAS revenue in 2009, segmented by sub-sector, is given below in Table 11.

Table 11: MAS sub-sector revenue in 2009 and 2008

Sub-sector	2009 Revenue (2010 dollars, USD billion)
A&AP	103
E&EP	23
MRO	62
T&S	1
Space	17
Total	**206**

The A&AP sub-sector is the largest MAS sub-sector and accounted for 50% of industry revenues in 2009. This market sub-sector includes the production of bombers, attacks, fighters, tankers, cargo aircraft, trainers, and rotary aircraft and all associated non-engine parts. The wars in Afghanistan and Iraq have increased the demand for aircraft, especially for unmanned aerial vehicles ("UAV") and transport aircraft. Of the A&AP sub-sector, approximately 17% percent of 2009 revenues are attributable to aircraft parts manufacturing. The military aircraft parts industry is dominated by large A&D conglomerates in a small number of large industrialized countries such as the US, France, and UK. The increased competition from developing countries due to outsourcing has driven down margins and production costs, making for a challenging environment for part manufacturers in developed countries.[130]

The MRO sub-sector is the second largest sub-sector accounting for 30% of industry revenues in 2009. This sub-sector has been buoyed in recent years by the wars in Afghanistan and Iraq due to corresponding increases in wear and tear on rotorcraft and transport aircraft. However, fighter aircraft account for 59% and 46% of engine and airframe MRO respectively and fighters have seen limited use in these wars. Developed countries have cut back on their purchases of expensive next-generation fighters, such as the F-22 Raptor. The MRO sub-sector is also highly concentrated in North America and Europe, which account for approximately 62% of the active military fleet. Approximately 53% of engine MRO activity is located in North America - above the 38% average seen across all types of MRO activity. In 2008, MRO revenue was primarily generated by field maintenance which accounted for 49% of all spending. The remaining spending went to airframe maintenance depot maintenance (20%), component repair and overhaul (17%) and engine overhaul (14%).[131]

The E&EP sub-sector is the third largest sub-sector, generating 11% of industry revenues in 2009. This sub-sector has experienced slight downward pressure due to a move by governments away from overhauling military aircraft, through the replacement of engines, to complete aircraft replacement - the latter being less lucrative for E&EP companies.[132]

Satellites, guided missiles, and space vehicles generated 8% of industry revenues in 2009, making it the fourth-largest sub-sector. In this definition, space includes modern defence systems such as satellites, early warning systems, intelligence gathering (image and signals), space launch vehicles, and navigation and exo-atmospheric interceptors for ballistic missile defence. Prominent countries in the Space sub-sector include the US, Europe, Russia, and China.[133] This industry is highly concentrated in the US, and therefore industry revenues move with changes in DoD spending. Growth in this sub-sector has been driven by increases in missile stockpiles due to the Iraq and Afghanistan wars and the continued development of the US National Missile Defense System. Approximate data from the US shows guided

[130] IBISWorld, "Global Military Aerospace Products Manufacturing", February 2010.

[131] OAG Aviation Solutions, "Global MRO spend on military aviation to increase by 14.9% over the next decade, reports OAG" [press release], December 2008.

[132] IBISWorld, "Global Military Aerospace Products Manufacturing", February 2010.

[133] IBISWorld, "Global Military Aerospace Products Manufacturing", February 2010.

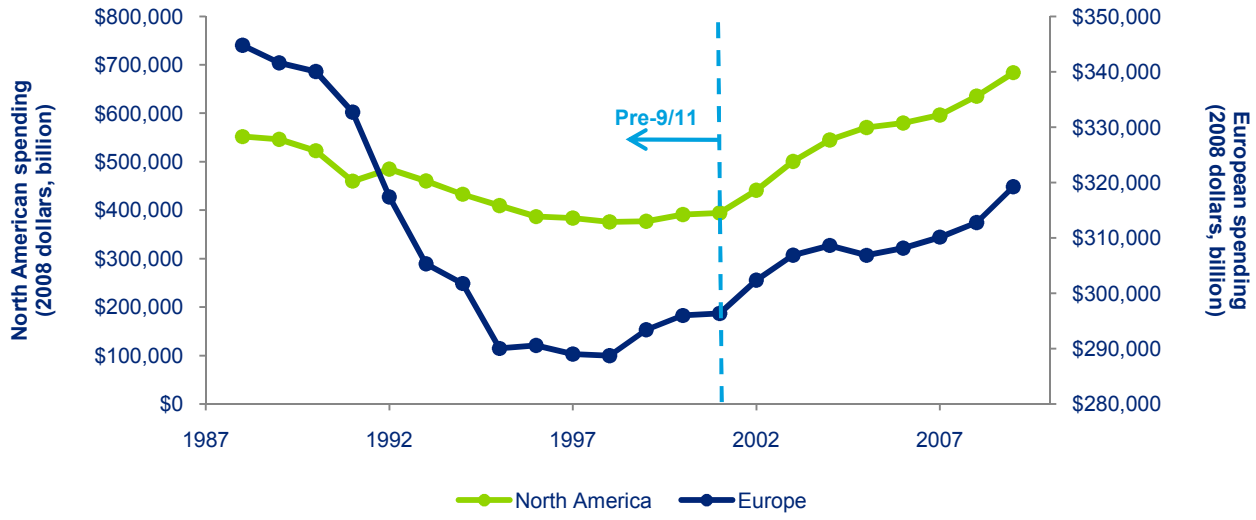
missiles, space vehicles, and parts accounting for approximately 45.5%, 30.9%, and 23.6% of revenues respectively in 2009.[134] Teal Group estimates global delivery of 600,000 missiles, worth $103.7 billion, between 2006 and 2015. However, the importance of the guided-missile product segment will likely decrease as budget deficits hamper military spending and the wars in Iraq and Afghanistan come to an end.[135]

The T&S sub-sector was the smallest in 2009 and generated 2% of revenues. The T&S sub-sector has evolved along with technology and is increasingly shifting to virtual simulation and constructive training. The DoD spent $1.34 billion on T&S sub-sector products and services in FY 2006 with one forecast putting US T&S sub-sector spending at $1.54 billion by 2013.[136]

6.2 Key industry trends

The global financial crisis has forced governments to focus on deficit reduction. Defence budgets in the US and Europe will continue to experience downward pressures as spending shifts to other priorities. Defence spending will eventually begin to fall as developed countries stabilize their economies through tighter fiscal policies. However, the growth in defence spending post-9/11 in developed countries will be difficult to curtail given the size and lobbying influence of the A&D industry.

Figure 39: Military spending in Europe and North America, pre- and post-9/11[137]



Deloitte identified seven key trends that face the MAS specifically, and the MA&D industry more generally, going forward:

- Governments' focus deficit reduction;
- Rebalancing of military forces;
- Growth in Indian and Chinese markets;
- Aging military equipment;
- Increasing merger and acquisition ("M&A") activity;
- Increasing usage of virtual training and simulation; and
- Winding down of combat operations in Iraq and Afghanistan.

[134] Revenues from space vehicles and parts is inflated because it includes some civilian/commercial vehicles.

[135] IBISWorld, "Guided Missile, & Space Vehicle Manufacturing in the US", January 2010.

[136] Frost & Sullivan, "US Military Training and Simulation Market", 2007.

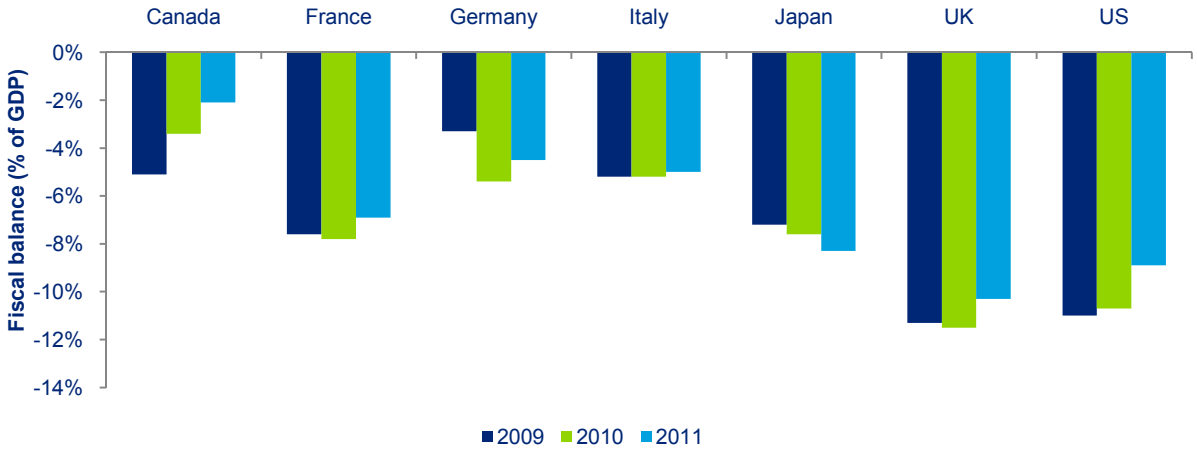
[137] SIPRI, "Military expenditures" [online database], accessed from http://www.sipri.org/databases in June 2010.

6.2.1 Deficit reduction

President Obama published his proposed defence budget for 2011 at $712.1 billion, a 7.2% increase from FY 2009 to FY 2011. However, a significant question exists as to whether such increases in defence spending will remain sustainable given historically high debt levels. According to the Conference Board of Canada, the deficits of other G7 countries will negatively impact the global MA&D market.[138] Both the US and the UK are incurring deficits that exceed 10% of GDP with the Conference Board of Canada asserting that the US federal government is currently taking in two dollars for every three dollars that it spends.

The US government is a major customer for this industry and therefore, an understanding of US deficit spending is crucial to understanding future trends in the global MAS. The US government currently spends 18% of its national budget on military sales and accounts for approximately 46% of global military spending.[139] More broadly, Figure 40 gives a breakdown of the forecasted fiscal balance for the major OECD countries.

Figure 40: Fiscal balance for major OECD countries[140]



Based on the fiscal balances it appears that, with the exception of Canada and Germany, OECD countries will be focused on deficit reductions which can most easily be brought about by spending cuts and/or tax increases.[141] Figure 41 shows the Heritage Foundation's forecast for the US government's MA&D spending from 2010-2019.[142] The Heritage Foundation summed up Obama's focus on the MA&D spending:

> "*Contrary to popular perception, just 17.3%, or less than one-fifth, of federal spending went to national defence in 2009. By historical standards, the federal government's investment in defence is relatively modest, particularly in wartime given that the military is heavily engaged in ongoing operations in Iraq and Afghanistan.*"[143]

[138] Conference Board of Canada, "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[139] Deloitte Development LLC, "2009 Global Aerospace and Defence Industry Performance Wrap Up", May 11 2010.

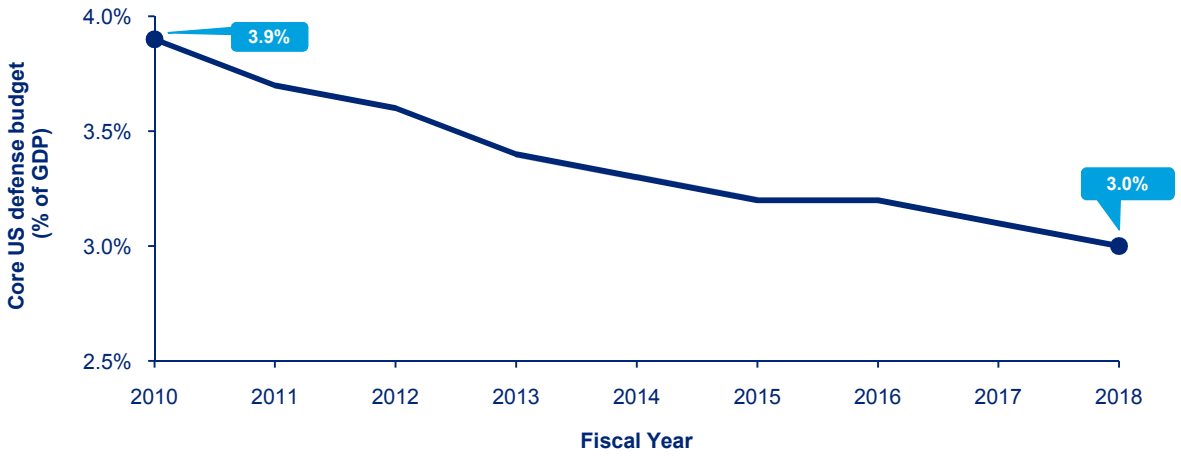
[140] Source: OECD, "Economic Outlook No.87".

[141] Conference Board of Canada. "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[142] Heritage Foundation, "State of the US Military", January 2010.

[143] Heritage Foundation, "State of the US Military", January 2010.

Figure 41: Forecasted reductions in US defence spending[144]



Continued declines in defence as a percent of federal spending are expected. As Tom Captain, Deloitte's Global Aerospace and Defence Sector Leader points out, "an ever-increasing amount of the US government's budget in the last three years have gone to increased military salaries, increases in the operations and maintenance ("O&M") accounts, medical care for the wounded warrior programs, and inflationary pressures. This leaves a small slice of the budget for the research and development and procurement accounts. In particular research development, test and evaluation ("RDT&E") accounted for 5% less of the defence spending in the proposed FY 2011 budget. The reduction in RDT&E spending may reflect the Obama Administration's focus on "70%" equipment solutions that are cheaper with faster development cycles. Table 12 shows a breakdown of the US DoD defence budget. Procurement accounts showed a 7.7% increase in the same FY 2011 budget, mostly from programs of record and not new starts.

Table 12: US defence budget authority for FY 2010 to FY 2011[145]

Department	FY 2010 (USD million)	FY 2011 (USD million)	Change, FY 10 – 11 (%)
Military personnel	139,483	143,524	2.9
O&M	185,121	200,875	8.5
RDT&E	80,098	76,131	-5.0
Procurement	104,799	112,873	7.7
Military construction	21,021	16,924	-19.5
Overseas contingency operations	129,646	159,336	22.9
Other	3,167	2,467	-22.1
Total	**663,335**	**712,130**	**7.4**

The US DoD budget is focused on three areas: rebalancing its military force based on current conflicts and future needs, reforming its procurements and ending underperforming programs, and supporting the US's military force overseas in Iraq and Afghanistan.

6.2.2 Changes in military procurement

The US DoD has allocated $112.9 billion for Procurement and $76.1 billion for RDT&E in FY 2011. Below are a select set of programs that are expected to impact the Canadian MAS. Likely sub-sectors to benefit from each program are given in Table 13:

[144] Heritage Foundation, "State of the US Military", January 2010.

[145] US Department of Defence, "Summary and Explanation of Changes", accessed from http://comptroller.defense.gov/budget2010.html in August 2010.

- **Rotary-Wing Aircraft:** The FY 2010 enacted budget included additional funds to boost Army helicopter pilot training capacity and improve survivability. The FY 2011 request sustains the FY 2010 increase and seeks an additional $65 million to train 1,500 new pilots per year by FY 2012. The FY 2011 request also sustains new acquisition and modernization of helicopters – such as the CH-47, UH-60, LUH, H-1, and V-22 aircraft – worth more than $9.6 billion. The FY 2011 investment request is more than $500 million, or about 6%, above the level provided for in the FY 2010 enacted budget;
- **UAV Combat Air Patrols ("CAPs"):** FY 2011 investment spending will continue the expanded use of UAVs. The request of $2.2 billion supports the plan to increase Predator-Class CAPs from 37 to 65 by FY 2013;
- **Electronic warfare:** The FY 2011 budget request supports procurement of 12 EA-18G aircraft to recapitalize four expeditionary electronic attack squadrons;
- **KC-X Tanker:** The FY 2011 budget includes $864 million in RDT&E for developing a new generation tanker, which remains a very high priority. Initial plans call for procuring 179 commercial-derivative tanker aircraft to replace roughly a third of the current aerial refueling tanker fleet at a projected cost of $35 billion. A draft Request for Proposal was announced in September 2009, with the contract awarding in October or November 2010;
- **Restructure Joint Strike Fighter ("JSF")**: The JSF is a critical tactical air program to ensure continued air dominance over current and future battlefields. The FY 2011 budget request continues implementation of the long-term tactical aircraft acquisition plan and supports continued development and production of three variants of the F-35. Recognizing the need to complete all necessary testing while limiting concurrency, the JSF program has been restructured to add an additional year for development. The base budget requests funding for procurement of 42 aircraft in FY 2011;
- **Next generation bomber:** The FY 2011 request includes funding ($0.2 billion in FY 2011 and $1.7 billion in FY 2011-2015) for the next generation bomber. Near-term efforts include needed studies concerning the design of a future bomber as well as upgrades to existing bombers. To support future decisions, the bomber industrial base will be sustained; and
- **Missile defence:** The FY 2011 budget includes $9.9 billion to support missile defence. The Ballistic Missile Defence ("BMD") review concluded that US missile defences must be adaptive and responsive to advances in technology, and must be proven and cost-effective, and must meet the real threat to the US and its allies. The Phased Adaptive Approach ("PAA") fulfills these requirements with a flexible, scalable response to BMD threats. The recent shift from ground-based interceptors in Europe to a land-based and sea-based Standard Missile-3 system is an example of the PAA.[146]

Table 13: MAS sub-sectors benefiting from DoD spending initiatives

Program	Primary benefiting Sub-sector
Rotary-wing aircraft	A&AP, E&EP, T&S
UAV CAPs	A&AP, E&EP, T&S, Space (guided missiles)
Electronic warfare	A&AP, E&EP, MRO
KC-X Tanker	A&AP, E&EP
JSF	A&AP, E&EP, Space (guided missiles)
Next Generation Bomber	A&AP, E&EP, Space (guided missiles)
Missile defence	Space

The US DoD is also highly focused on developing efficient processes to manage operations. Operation management programs that could impact the Canadian MAS include:

- Through the Weapons System Acquisition Reform Act, the DoD has focused on strict procurement standards with predictable and realistic cost and schedule estimates, and performance outcomes based on mature, demonstrated, technologies.

[146] Defence Professionals, "Obama Proposes $708 Billion Fiscal Year 2011 Defence Budget", Feb 3 2010.

- The DoD is ending unneeded or poorly performing programs. Examples are the C-17 transports and the JSF, EP(X) Navy Intelligence Aircraft, Third Generation Infrared Surveillance, and the Net Enabled Command Capability.

Finally, the DoD budget is addressing support levels for troops in the field. For FY 2011, the DoD has requested $159 billion for overseas contingency operations in Afghanistan and Iraq in addition to:

- $89.4 billion for operating costs linked to the operating tempo of frontline combat and support forces in theatre.
- $21.3 billion for reconstituting equipment - repairing and replacing equipment lost and damaged as a result of ongoing operations - including $2.8 billion to reset equipment redeploying from Iraq and returning to inventory.
- $2.4 billion to ensure greater intelligence, surveillance, and reconnaissance support for US war fighters, including funds for five Enhanced Medium Altitude Reconnaissance Surveillance System aircraft and efforts to address vulnerabilities of unencrypted airborne data links.
- $13.6 billion to train and equip Afghanistan and Iraq Security Forces - $11.6 billion for the training and equipping of Afghan security forces and $2 billion for the training and equipping of Iraqi security forces.
- $1.2 billion on military construction to expand the logistical backbone and operational foundation in Afghanistan. This will enable counter insurgency forces to fight more effectively by increasing operational capability, providing troop housing, replacing expeditionary facilities at the end of their lifecycle, consolidating functions and facilities, and supporting Special Operations forces operating in Afghanistan.[147]

6.2.3 Growth in India and China

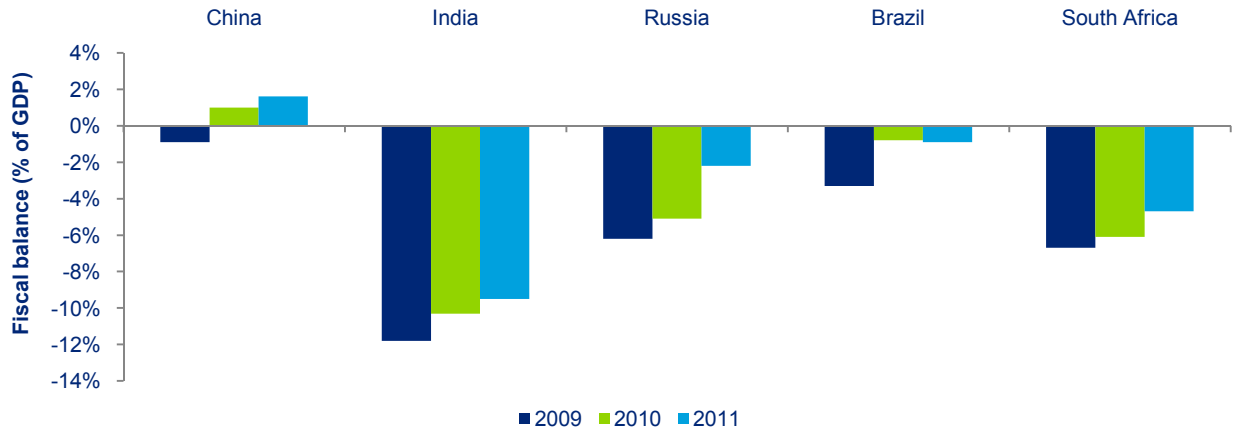
Aerospace manufacturers will continue to search for new markets to grow top-line revenues even as deficits reduce defence spending in traditional markets. Emerging markets are obvious choices for new sources of revenues in order to meet shareholders' price performance expectations. According to IBISWorld, there has been increased inter-nation collaboration with developing countries benefiting from knowledge transfer and cost efficiencies. In addition, China and India are competing for regional influence and are determined to dominate the region in terms of defence spending, despite being significant trading partners. In 2008, trade between the two countries reached $58 billion.[148]

The magnitude and trend of emerging markets fiscal balances, as shown in Figure 42, are generally healthier than those of the OECD nations (Figure 40). Therefore, emerging markets are in a stronger position to grow military spending growing forward.

[147] Defence Professionals, "Obama Proposes $708 Billion Fiscal Year 2011 Defence Budget", Feb 3 2010.

[148] Financial Post, "Global military and defence sector set to grow", February 11 2010.

Figure 42: Fiscal balance of selected non-OECD countries[149]



India

Aerospace companies in the US and Europe are beginning to recognize India as a country of growing strategic importance because it represents an untapped market, and potential engineering and manufacturing partner.

India is becoming one of the largest military spenders in the world, with the third largest defence procurement budget in Asia. According estimations, India was the tenth largest defence spender in 2008 and has seen its defence budget increase by 44% since 1999.[150] Over the next five years, India's MA&D expenditures are expected to grow by $80 billion.[151] It is anticipated that in 2011, $32 billion will be allocated towards national defence, of which, $13 billion will be spent on procurement of new weapon systems and services.[152]

It is estimated that Indian defence procurement will rise to an estimated $42 billion by 2015, including $19.2 billion for capital acquisitions. In total, India is expected to spend nearly $120 billion on military procurement between 2012 and 2017.[153] The table below provides a breakdown of future MA&D budget allocations. Currently, the Indian army makes up approximately 53% of the total budget, with the Indian air force and navy controlling 31% and 16% of the MA&D budget, respectively.

[149] Source: OECD, "Economic Outlook No.87".

[150] Financial Post, "Global military and defence sector set to grow", February 11 2010.

[151] Source: Indian Thirteenth Finance Commission Report, December 2009; Union Budgets and Economic Survey 2003-2011; Deloitte Global Manufacturing Industry Group analysis by service division.

[152] Source: Indian Thirteenth Finance Commission Report, December 2009; Union Budgets and Economic Survey 2003-2011; Deloitte Global Manufacturing Industry Group analysis by service division.

[153] Deloitte Touche Tohmatsu India Private Limited, "Prospects for Global Defence Export Industry in Indian Defence Market", June 16, 2010.

Table 14: Projected Indian defence spending by division[154]

MA&D spend (USD million)	2010	2011	2012	2013	2014	Total 5 year spend
Capital expenditure	13,110	14,421	15,863	17,450	19,195	80,039
Army	6,948	7,643	8,407	9,249	10,173	42,421
Navy	2,098	2,307	2,538	2,792	3,072	12,806
Air Force	4,068	4,471	4,918	5,410	5,950	24,812

India has begun to engage in military and defence joint ventures. Analysts cite the following recent activities as examples of India's desire to ramp up its military capacity: Mahindra & Mahindra's joint venture with BAE corporation to produce mine-resistant all terrain vehicles, Indian engineering and construction firm Larsen & Tourbro building of shipyards for six submarines from Italy's Fincantieri; and France's Thales partnership with state-controlled Hindustan Aeronautic to build fighter jets for the Indian military.[155]

China

China has one of the fastest growing MAS in the world. In 2007, the Chinese military budget increased by 17.8%, in 2008 it increased again by 17.6% and in 2009 by 14.9%. According to the watchdog organization, GlobalSecurity.org, 2010 military expenditures are expected to increase by a reduced 7.5%, reflecting the impact of the financial crisis.[156] Growth in Chinese military expenditures also contracted in FY 2009 due to the Chinese government's desire to slow down the rate of inflation. The Chinese government faced domestic pressure to increase government spending in other areas such as education, social welfare, and infrastructure.

Table 15 shows robust growth of China's military spending through 2025 despite domestic pressures. RAND a not-for-profit think tank, has forecasted Chinese military spending at $403 billion in 2025 with 27% allocated to procurement. This expenditure estimate would put China's military spending at 1.3 times that of the US in 2025. Further, RAND estimates the Chinese government will spend 5% of its GDP on MA&D spending by 2025.

Table 15: RAND projections of Chinese military spending through 2025[157]

Department (2001 dollars, USD billion)	2010	2015	2020	2025
Projection	45.0	207.4	287.3	403.4
Personnel	84.7	111.5	141.0	178.9
Operations and maintenance	22.3	39.6	67.1	113.0
Procurement and R&D	38.0	56.2	79.3	111.4

Values derived from combined market and purchase price parity ("PPP") exchange rates.

Production for China's MAS is done by firms that are not publicly listed. Currently, Aviation Industry of China ("AviChina") is the country's leading maker of both military and civilian aircraft.

[154] Source: Indian Thirteenth Finance Commission Report, December 2009; Union Budgets and Economic Survey 2003-2011; Deloitte Global Manufacturing Industry Group analysis by service division.

[155] Financial Post, "Global military and defence sector set to grow", February 11 2010.

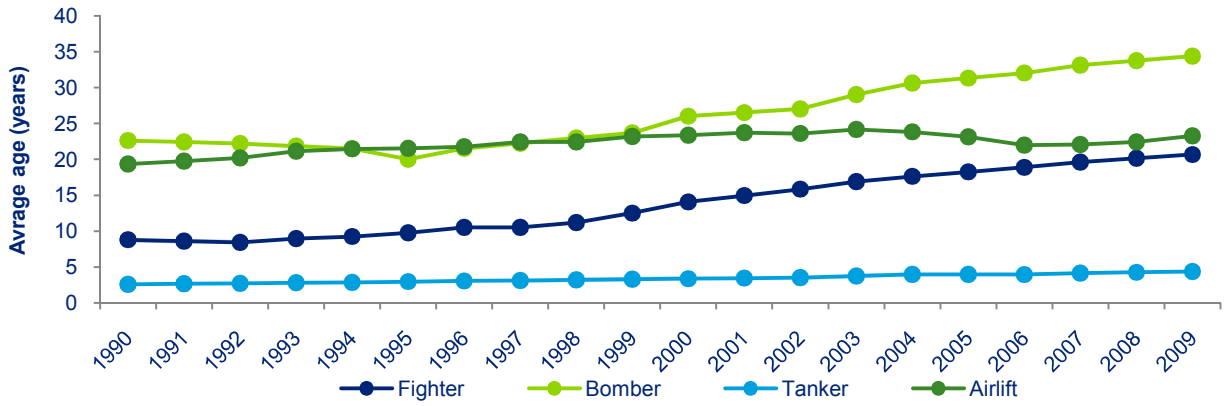
[156] Global Security, "Chinas Defence Budget" [online article], accessed from http://www.globalsecurity.org/military/world/china/budget-table.htm accessed on July 20 2010.

[157] RAND "Modernizing China's Military: Opportunities and Constraints" [online article], access from http://www.rand.org/pubs/monographs/2005/RAND_MG260-1.sum.pdf on July 20 2010.

6.2.4 Aging military equipment

The average age of military aircraft is increasing and aircraft are becoming increasingly expensive to maintain and operate. In 2008, the US Air Force fleet in 2008 was 24 years old. Many transport aircraft and aerial refueling tankers are more than 40 years old – and under current US plans may be 70-80 years old before being retired.[158] The high and growing cost of replacing equipment is forcing governments to spend more resources on MRO.

Figure 43: Average Age of US Military Equipment from 1990-2009[159]



According to the Heritage Foundation, defence modernization, which consists of funding for R&D, and construction of equipment and platforms, comprises about one-third of US defence spending. In 2009, the portion of the US defence budget devoted to modernization was just over 30%, which is low relative to historical norms. By contrast, modernization spending was 44% of the nation's defence budget in 1985.[160] Currently, the majority of major systems used by the US military were designed and built in the 1980s and are in need of replacement.[161] Table 16 gives a breakdown of the average age of the current military platforms:

Table 16: Average age of current military platforms[162]

Platform	Age, as of 2010
Air Force tactical aircraft	Over 20 years
Navy and Marine Corps tactical aircraft	Over 15 years
Army M-113 armoured personnel carriers	Over 27 years
Bradley fighting vehicles	Over 17 years
Ch-47 Chinook helicopters	Nearly 20 years
UH-1 Huey helicopters	35 years
Ticonderoga-class cruisers	Nearly 20 years
P-3C Orion long-range aircraft	Nearly 25 years
B-1 Lancer bomber	Over 20 years
C-5A Galaxy transport aircraft	40 years
KC-135 tankers	44 years

[158] Defence Industry Daily, "Aging Array of American Aircraft Attracting Attention" [online article], accessed from http://www.defenceindustrydaily.com/aging-array-of-american-aircraft-attracting-attention-0901/ on July 22 2010.

[159] Source: Defence Industry Daily, "Aging array of military aircraft attracting attention" [online article], accessed from http://www.defenseindustrydaily.com/aging-array-of-american-aircraft-attracting-attention-0901/ in July 2010.

[160] Heritage Foundation, "State of the US Military", January 2010.

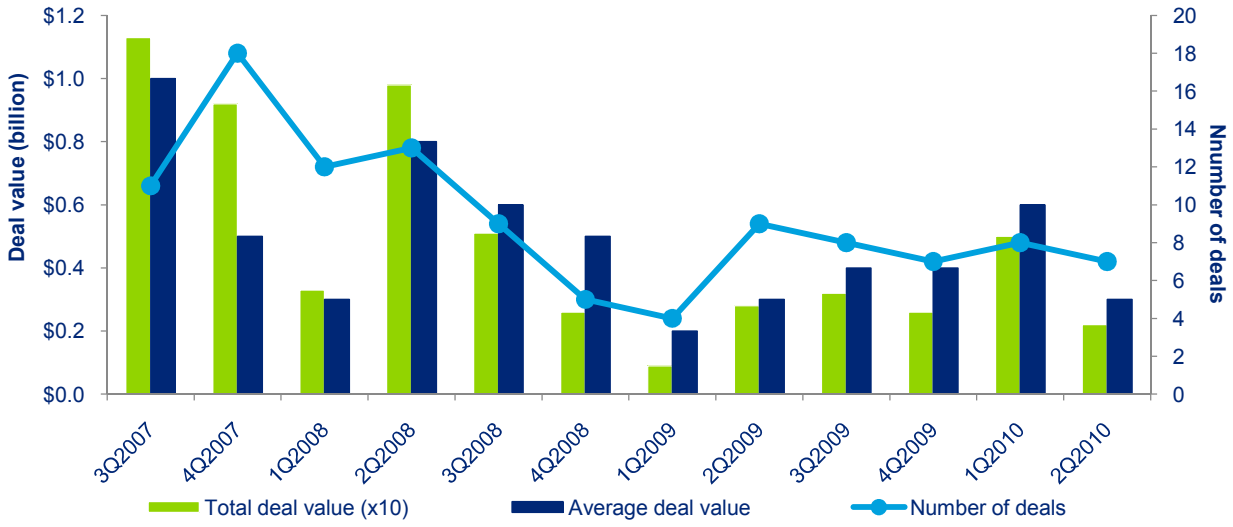
[161] Heritage Foundation, "State of the US Military", January 2010.

[162] Source: Defence Industry Daily, "Aging array of military aircraft attracting attention" [online article], accessed from http://www.defenseindustrydaily.com/aging-array-of-american-aircraft-attracting-attention-0901/ in July 2010.

6.2.5 Mergers and acquisitions activity

Merger and acquisition activity has been accelerating over the last year especially in, but not limited to, the MAS. Larger transactions include the acquisition by Kohlberg Kravis Roberts & Co. Ltd. and General Atlantic Partners of the TASC business unit by Northrop Grumman, the pending sale of DynCorp to Cerberus, the acquisition of VT plc by Babcock International, and the sale of Vought by Carlyle to Triumph Group.[163] Data from the year preceding the second quarter of 2010 shows a sharp rebound in M&A activity from recessionary lows in terms of total value, average value, and deal volume.

Figure 44: A&D M&A activity[164]



Despite the recent increase in activity, Figure 44 shows that M&A activity has yet to recover to pre-recessionary levels. Therefore, the pace of M&A activity may continue to increase moving forward. Two-thousand and nine marked a trough in large M&A deals of greater than $1 billion. There was also a notable decline in M&A activity in the second quarter of 2010; this decline in M&A activity could be a function of firms deferring deals until the February release of the US Quadrennial Defence Review ("QDR"). Approximately 80% of deals in the first half of 2010 came after the February release. The QDR is a legislatively mandated review of the US's military doctrine and strategic objectives and is conducted every four years. The QDR release provided greater clarity to the market and therefore boosted M&A activity.[165] The second quarter also saw an increase in the relative amount of cross-border deals which may signal an increase in the market's appetite for risk.

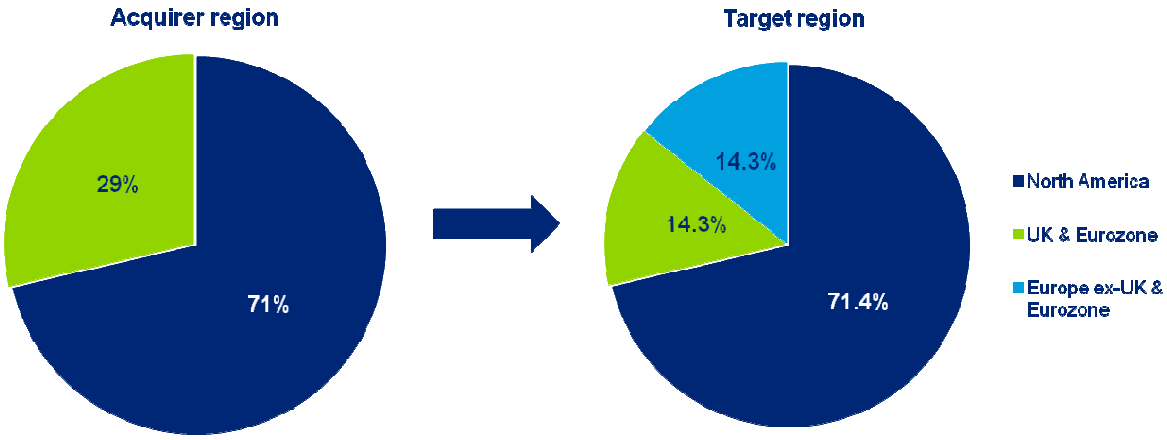
The vast majority of future MAS M&A activity will be driven by two factors. First, by potential buyers with an interest in gaining access to the still lucrative US market. Second, by companies who want to gain access to China, India, and other developing countries with high GDP growth and the associated growth in military spending.[166] It is also anticipated that the larger defence companies will become more aggressive in pursuing smaller specialty companies as traditional sources of defence spending decline. These emerging specialty areas include intelligence, surveillance and reconnaissance, cyber-security, alternative energy, data fusion, and mission operations software development.[167]

The vast majority of M&A deals remain centered in North America, increasing the relevancy of M&A activity to the Canadian MAS. The geographical location of 2010 M&A activity, by target and acquirer, is shown in Figure 45. By comparing the targets and acquirer, it can be inferred that much of non-North

[163] Deloitte Development LLC, "2010 mid-year outlook for the global aerospace and defense sector", 2010.
[164] PriceWaterhouseCooper, "Mission Control, second quarter 2010 A&D industry M&A analysis", 2010.
[165] PriceWaterhouseCooper, "Mission Control, second quarter 2010 A&D industry M&A analysis", 2010.
[166] PriceWaterhouseCooper, "Mission Control, second quarter 2010 A&D industry M&A analysis", 2010.
[167] Deloitte Development LLC, "2010 mid-year outlook for the global aerospace and defense sector", 2010.

American second quarter 2010 M&A activity was related to UK and Eurozone companies acquiring smaller companies located in other parts of Europe.

Figure 45: Regional distribution of M&A activity in second quarter 2010[168]



Going forward, the regional dominancy of North American companies on the buy side of M&A deals may recede. China's desire for a strong aerospace industry will lead to increases in local-market consolidation and vertical integration among domestic players. Deals such as the $85 million March 2010 acquisition of Chengdu CAIC Electronics by AviChina in March 2010 are expected to become more common place. This deal allows AviChina to integrate CAIC's aviation instrument business into AviChina's core business of helicopter and aircraft manufacturing. Emerging market deals, such as the AviChina deal, may signify increasing barriers to entry for Canadian parts suppliers in emerging markets.[169]

6.2.6 Virtual training and simulation

The T&S sub-sector is experiencing growth in virtual simulation and training - particularly in the US. Virtual T&S can be defined as "an environment, with operators feeling that they are operating real equipment in an authentic environment, but are actually operating realistic equipment in virtual environment. A virtual environment is also a computer simulated environment, in which the user trains in a simulator that looks like an actual piece of equipment."[170] This definition also includes software designed for consumer electronics (e.g., Sony Playstation) to be used for military training purposes.

Virtual simulation is an important growth market because of significant cost savings offered over traditional T&S in light of contracting defense budgets. However, the attractiveness of these cost savings are not limited to traditional military powers such as the US; virtual T&S is also attracting new players in the MAS, such as India and China, and Visiongain forecasts that the US share of military T&S will drop from 65% in 2008 to 51% in 2018.[171] Visongain is forecasting the CAGR of global MAS T&S sub-sector revenue at approximately 15% through 2018,[172] as shown in Figure 46.

[168] Deloitte Development LLC, "2010 mid-year outlook for the global aerospace and defense sector", 2010.
[169] Deloitte Development LLC, "2010 mid-year outlook for the global aerospace and defense sector", 2010.
[170] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018", 2008.
[171] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018", 2008.
[172] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018", 2008.

Figure 46: MAS T&S revenue forecast[173]

6.2.7 Ending of the combat missions in Iraq and Afghanistan

The ending of the combat missions in Iraq and Afghanistan is forecast to have a little to no effect on the MAS. A mild impact is forecast because air operations make up a relatively small component of war-related spending due to the land and urban nature of the combat operations. In 2008, for example, only 6% of war related military spending was attributed to air operations.[174] Further, within air operations the vast majority of war-related spending was attributed to O&M which rose by 27% YoY between 2002 and 2008.[175] This increase translates into increased MRO revenue. The aircraft that have seen the most use in Iraq and Afghanistan, such as the Boeing C-17, will need replacement even if the combat missions end.[176]

The MAS does not depend heavily on the Iraq and Afghanistan wars. Under the assumption that the Iraq war has started to wind down, trends in the defense budget over recent years provide a glimpse of how the ending of the wars may affect the MAS. What one sees is that Air Force aircraft procurement dropped by $5 billion between 2008 and 2010 but the Air Force's budget for in-service aircraft modifications increased by $0.9 billion during the same time period. Also, approximately $4.7 billion of the drop in aircraft procurement can be attributed to reductions in the F-22 fighter program that are a function of shifting spending priorities and not operations in Iraq or Afghanistan.[177,178] Finally, a significant military presence is schedule to remain in Iraq and Afghanistan (estimated at 30,000 to 50,000 troops plus support personnel)[179] and this will likely mean the continued use, and therefore demand for, UAVs and support aircrafts.

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[173] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018", 2008.

[174] Congressional Budget Office, "Analysis of the Growth in Funding for Operations in Iraq, Afghanistan, and Elsewhere in the War on Terrorism", February 1st 2008.

[175] Congressional Budget Office, "Analysis of the Growth in Funding for Operations in Iraq, Afghanistan, and Elsewhere in the War on Terrorism", February 1st 2008.

[176] Congressional Research Service, "The Cost of Iraq, Afghanistan, and Other Global War on Terror Operations Since 9/11", page 47 footnote, July 16 2010

[177] The Economist, "The cost of weapons: Defence spending in a time of austerity", August 26 2010.

[178] US Department of Defense, "Department of Defense Budget Fiscal Year 2010" [Procurement Programs], 2009.

[179] The Telegraph, "US troops could stay in Iraq for a decade", accessed from http://www.telegraph.co.uk/news/worldnews/middleeast/iraq/5395691/US-troops-could-stay-in-Iraq-for-a-decade.html in September 2010.

7 Canada's competitiveness

7.1 Introduction

The evaluation of the aerospace industry in other leading nations is critical in understanding the current position of the Canadian aerospace industry globally. Some of the key developed markets in the global aerospace industry are:

- France;
- Germany;
- US;
- UK; and
- Japan.

There is an additional group of nations that are becoming increasingly relevant. It is anticipated that many of these developing nations will be heavily supported by their governments in the hopes of creating a strong domestic aerospace industry. These countries are:

- Brazil;
- China;
- India; and
- Russia.

The countries listed above are chosen based on three criteria:

1. Representative mix of the different types of aerospace markets;
2. Global importance of the country's aerospace industry; and
3. Availability and consistency of relevant industry data.

Canada is compared to these countries based on a number of important aerospace industry metrics:

- **Sales**: 2008 aerospace sales normalized by 2008 nominal GDP;
- **Sales growth**: average growth in sales from 2004 to 2008;
- **R&D intensity**: historical trends in amount of revenue reinvested in R&D;
- **Public R&D investment**: amount of R&D funds that are derived from the public sector;
- **Exports**: percentage of aerospace exports compared to the country's total exports;
- **Employment**: percentage of the country's work force in the aerospace industry;
- **Companies**: number of companies operating in the aerospace industry; and
- **Government programs**: quality of government operated programs in place to support development of future aerospace products.

For each metric and country, a quantitative and/or qualitative score is assigned – resulting in a scorecard showing the relative strengths and weaknesses of the Canadian aerospace industry. See "Appendix III" for details on the data used to construct the aerospace report card.

7.2 The importance of aerospace to the Canadian economy

Canada's aerospace industry plays a critical role in the domestic Canadian economy. Canada's aerospace industry ranks among the top 10 globally by almost every measure. For example, Table 17 lists the top 5 countries in terms of revenues generated from aerospace manufacturing and Table 18 lists the top 5 countries in terms of aerospace employment.

Table 17: Top 5 countries by aerospace manufacturing revenue

Country	Rank based on revenue[180]	Rank based on revenue normalized by GDP[181]
United States	1	3
France	2	1
UK	3	4
Germany	4	5
Canada	5	2

Table 18: Top 5 countries by aerospace employment

Country	Rank based on employment[182]	Rank based on employment normalized by population[183]
United States	1	3
France	2	1
UK	3	4
Germany	4	5
Canada	5	2

Once normalized by GDP, Canada ranks second among the top five countries in terms of aerospace revenue. A similar story is seen in employment once one normalizes by each country's population with Canada also ranking second among the top five countries in terms of aerospace manufacturing employment. This analysis shows that Canada relies more heavily on the aerospace industry for revenue and employment than most other countries.

Research and development spending by the aerospace sector also plays a critical role in the Canadian economy; three aerospace companies - Pratt & Whitney Canada, Bombardier, and CAE - sit on Research Infosource's list of nineteen Canadian companies who spent over $95 million on R&D in 2009. Further, aerospace companies accounted for a tenth of the total R&D spending among the Canadian companies surveyed by Research Infosource.[184]

R&D investments can have significant economic spill-over effects. Consider the following UK case study on R&D spill-over. A collaborative project was undertaken between Airbus, TWI corp. and various levels of government to develop a national composites material network. The project received £20 million in initial funding from the public sector and has been running for four years. As of 2008, the project had produced £100 billion in project work related to aircraft wings for TWI specifically. The project has also been made available to local suppliers and SMEs thereby stimulating much broader economic activity. The work with TWI and the access to the networks that they provided has enabled Airbus to exchange technology and knowledge with other sectors, including wind energy manufacturing and marine transportation manufacturing.[185]

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[180] Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[181] GDP data from: International Monetary Fund, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in August 2010.

[182] Deloitte analysis based on data from global aerospace associations.

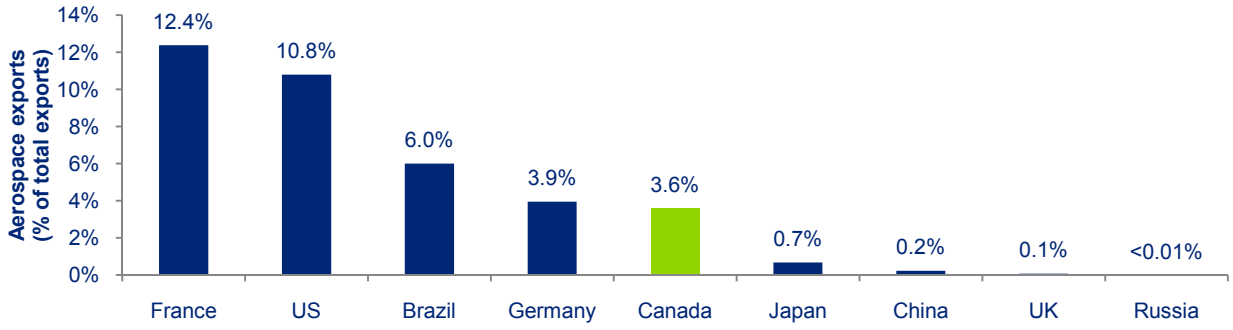
[183] GDP data from: International Monetary Fund, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in August 2010.

[184] Research Infosource, "Canada's Top 100 Corporate R&D Spenders List 2009 Analysis", 2009.

[185] Oxford Economics, "Intermediate Research and Technology Sector on the UK economy", pg 40, 2008.

The aerospace industry generates a significant fraction of Canada's total exports at just under 4% in 2008 (see Figure 47).

Figure 47: Aerospace exports as a percentage of total exports for selected markets[186]



Finally, the importance of Canada's aerospace industry is reflected in Canada's reputation as an aerospace leader in other countries:

> *"Canada's international aerospace reputation and know-how is among the best. Montreal is one of three world class aerospace centers in the world, along with Toulouse (France) and Seattle (United States). Montreal is also one of the few places in the world where an entire aircraft can be assembled within a 30 mile radius."*[187] *– U.S. Dept. of Commerce*

7.3 Overview of aerospace markets

7.3.1 Developed markets

France

The MAS and CAS have progressed steadily in France since World War II. France has been helped significantly by the European production network, which was developed through the coordination of technological advancement programs across Europe.

France's strongest position in the aerospace industry is in aircraft assembly, and manufacturing of fixed-wing aircraft and helicopter parts. In the past decade, France has seen robust growth in production and employment while the proportion of value-added services has declined. The local of Ile-de-France has the largest concentration of aerospace activities and Airbus locates nearly 40% of their workforce in Toulouse.

France's aerospace industry experienced strong economic growth throughout 2008 and achieved the highest percentage of turnover in exports ever due to strength in the CAS. Strong aerospace exports resulted in a record trade balance and employment increases for the industry. Space, in particular, has seen impressive growth as the market for telecommunication satellites continues to grow.

The French government has made commitments to lay the groundwork for future aerospace industry growth by innovating and identifying new technologies that will make domestically produced products more competitive. A key focus is on R&D expansion by incentivizing industry to invest a greater

[186] Data from: United Nations. "Comtrade" [online database]. accessed from http://comtrade.un.org/db/dqQuickQuery.aspx in July 2010.

[187] US Dept. of Commerce. "Canada: U.S. Companies Capture Large Share of Canada's Aerospace Market", 2009.

percentage of industry revenues into R&D. France also committed to increasing government support of both civil and military research.[188]

Germany

Germany became a global leader in the aerospace market during the early 20th century and hosted the first international aerospace exhibition in 1907. However, Germany's aerospace industry was dismantled following World War II and only began to recover in the 1970's. Since the 1970's, the German aerospace industry has developed into a significant player as illustrated by the countries participation in Airbus and Eurocopter. Part of Germany's success can be linked to the significant number of small, technologically advanced, aerospace manufacturing companies.

The German aerospace industry weathered the economic crisis well and experienced growth in 2009 due to strength in the CAS. Although relatively small, the Space sub-sector proved to be driving force in 2009. Space manufacturers benefited from the awarding of new contracts in communications/navigation, earth observation, and the continuation of the Ariane program. The net result was a significant increase in new jobs within the CAS space sub-sector.

Expenditures on R&D grew to record levels in 2009. Germany has stated that research and technology are core competencies for the domestic industry and are therefore in need of constant investment. This need for increases in investment can be seen in the aerospace industry's campaign for the launch of a military aviation technology program. Looking forward, the German industry sees UAVs as an essential platform and plans to promote UAV development by further opening national airspace to UAV aircraft.[189]

United Kingdom

The UK aerospace industry is the largest in Europe and is second globally only to the US. The UK aerospace industry was consolidated during the 1960's and 1970's and firms emerged with drastically improved productivity and financial performance. In the past several years, the export-focused parts of the UK aerospace industry have seen downward pressures on revenues because of the appreciation of the British Pound Sterling relative to the US Dollar and the industry has increased off-shoring as a mechanism to mitigate exchange risk. The main aerospace hub is located in the northwest of the country and is home to the industry's two largest firms: Rolls-Royce and British Aerospace Electronic Systems.

Similar to the France and Germany, the UK aerospace industry weathered the financial crisis well and experienced revenue growth in 2009. This growth was driven by a strong performance in exports from the MAS as a result of the rising demand for defence and security equipment. Over two-thirds of the UK MAS revenues came from exports and this export strength has been built through sustained investment in R&D. For example, the UK government increased public sector R&D investment in 2009, partially offsetting contractions in private sector R&D spending.[190]

Japan

Japan's aerospace industry was historically hampered by a prohibition on producing aircrafts put in place after World War II. In the past Japan's aerospace program has unsuccessfully attempted to re-start the domestic CAS through the production of small turboprop aircraft. In recent years, the industry has found success in the MAS through the production of defence aircraft. The MAS now accounts for more than 50% of aircraft production despite reductions in production volumes due to budget deficits.

Japan has used participation in international programs as a mechanism to acquire technology and skilled labour. Japan entered into a joint aircraft production venture with Boeing that included domestic firms in all phases of production. The Boeing 787 Transport program included Mitsubishi Heavy Industries,

[188] GIFAS, "2008 Results for the French Aerospace Industry", April 2, 2009.

[189] BLDI, "The German Aerospace Industry in 2009", April 22, 2009.

[190] ADS, "2010 UK Aerospace Industry Survey 2010", July 2010.

Kawasaki Heavy Industries, and Fuji Heavy Industries in the production process.[191] These international ventures have had a sizeable impact on the industry, as illustrated by the decrease in exports attributable to capacity utilized by the Boeing project. [192]

United States

The US still possesses the world's leading aerospace industry despite weakening domestic manufacturing. Over the past decade manufacturing capacity in the aerospace industry has not been downsized to the same degree as other domestic industries. Historically, the US aerospace industry has been closely linked to Canada's and has taken advantage of wage differentials. However, supply chain globalization has resulted in emerging nations becoming more lucrative locations for the production of parts and components. The state of California possesses the largest aerospace cluster in the US with other significant aerospace clusters in Texas, Colorado, and the Greater Washington Region.[193]

7.3.2 Emerging markets

Brazil

In 1969, the government of Brazil created the Ministry of Empresa Brasileira de Aeronautica ("Embraer"). Through Embraer, Brazil has become an export-leader in the CAS for regional aircraft and a direct competitor to Canada's Bombardier.

Embraer was significantly impacted by the financial crisis and saw reductions in orders, revenues, and employment. Brazil's aerospace industry is primarily focused on the CAS with the MAS accounting for only 9% of industry revenue. Additionally, the industry is highly reliant on Embraer who is responsible for 89% of total Brazilian aerospace revenues.[194] The industry hopes to stabilize revenues in 2011 through the release of the new executive family jet, Legacy 650, and the Brazilian certification of the Phenom 300.[195]

China

Since the 1970's, China has unsuccessfully tried to create a domestic commercial aircraft producer. Despite historical setbacks, the Chinese aerospace industry is expected to become among the world's largest aircraft manufacturers through COMAC. COMAC may eventually hold a monopoly on the production of jet aircraft of over 70 seats to service what is projected to be the world's second largest aviation market by 2025.[196] The Chinese government is leveraging the appeal of its growing domestic travel market to force foreign aerospace firms into favorable partnership terms - thereby gaining access to the technology of the global market leaders.[197]

India

Due to the Indian government's protectionist policies, foreign aerospace companies have been able to sell and invest in India for less than a decade. The Indian government recently started developing a domestic aerospace sector to accommodate a growing interest in the manufacturing of military aircraft and the rapid growth in domestic air travel. Currently, the Indian aerospace industry is dominated by public sector defence providers, and next steps for the industry include major structural policy changes.

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[191] SJAC, "Aerospace Industry in Japan 2010", 2010.

[192] SJAC, "Aerospace Industry in Japan 2010", 2010.

[193] Source: Conference Board of Canada Canada, "Aerospace Product Manufacturing Industry Outlook", Spring 2010.

[194] AIAB, "Review of Year 2009", July 21, 2010.

[195] AIAB, "Review of Year 2009", July 21, 2010.

[196] Boeing Current Market Outlook, 2008.

[197] European Commission, "EU Competitiveness Report", December 2009.

One such structural change being the application of offset obligations on foreign companies who want to access the Indian market. [198]

Russia

The Soviet Union once produced one quarter of the world's aircrafts. However, Russia's aerospace market declined significantly after the fall of the Soviet Union. The decline in the domestic aerospace industry is attributed to drop in demand from former states, a drastic cut in government funding, and a growing disconnect between the state-owned manufacturers and design bureaus. In response, Russian President Vladimir Putin moved to consolidate the Russian aircraft industry in 2006 under the state-owned joint stock company Obyedinyonnaya Aviasroitelnaya Korporatsiya ("UAC"), with hopes of being one of the world's largest aircraft manufacturers by 2015.[199]

7.4 Government participation in aerospace innovation

Governments have historically played a large role in the aerospace industry relative to other manufacturing industries. One major form of government support is programs that directly increase or aim to foster R&D and innovation. The relationship between R&D intensity is given below:

Table 19: Correlation between R&D intensity and revenues

	R&D intensity ranking	Revenue ranking
Canada	5	5
France	2	2
Germany	1	3
UK	3	4
US	4	1

The variation in revenue and R&D rankings illustrates that the impact of government R&D investment is more nuanced with factors such as the type of investment (i.e., innovation vs. development), timing, and nature of the programs (i.e., government run or industry lead) playing a role in the success of government investment in the aerospace industry.

7.4.1 Canada

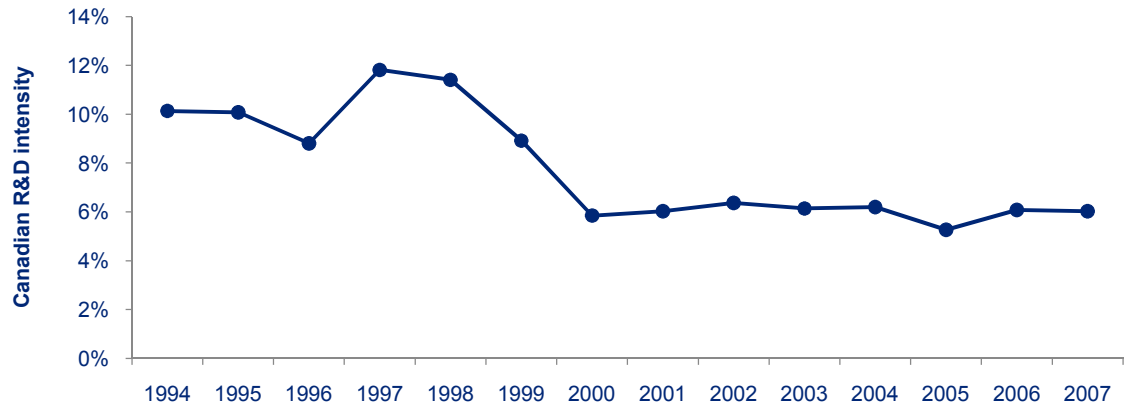
For Canada, increasing investment in R&D and innovation may be critical given the forecasted competition in the regional aircraft market, one of Canada's core competencies. However, in the past 10 to 15 years R&D intensity has actually declined to approximately 6% from the 12% in 1997. [200] R&D intensity in Canada appears counter current to market trends. Research and development spending is likely to increase as markets become increasingly competitive.

[198] European Commission, "EU Competitiveness Report", December 2009.

[199] European Commission, "EU Competitiveness Report", December 2009.

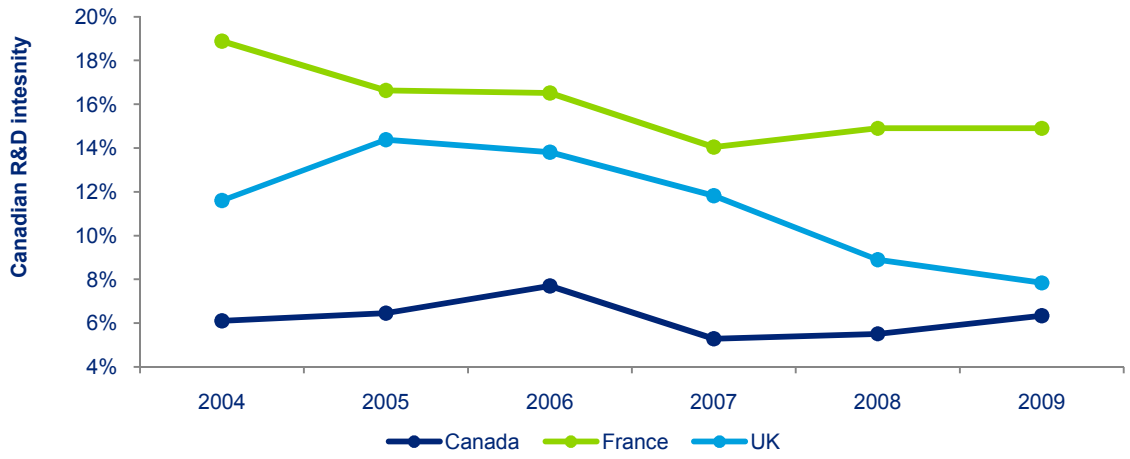
[200] AIAC, "Major Future Platforms", June 2009.

Figure 48: Canada's historical R&D intensity[201]



However, the shorter-term trend in Canadian R&D intensity has been positive. Since 2007, Canadian R&D intensity has been increasing in line with France's R&D intensity and more favourably than the UK's which has declined since 2007.

Figure 49: Canada's historical R&D intensity[202]



Canadian R&D and innovation programs may account a portion of the recent increase in R&D intensity, these programs include:

- **National Research Council ("NRC")**: The NRC's Institute for Aerospace Research employs close to 370 researchers/technicians and receives approximately $26.5 million in innovation funding.
- **Strategic Aerospace Defence Fund ("SADI")**:[203] A federally funded program designed to encourage strategic, innovation driven, R&D investment in the Canadian A&D sector. "The objectives of SADI are to accelerate innovation by A&D companies and foster collaboration between research institutes, universities, colleges, and the private sector."[204] The funding provided is conditionally or non-conditionally repayable and is most often set to cover 30% of eligible costs. Strategic projects are those defined to be: 1) supportive of the next generation of aerospace product; 2) building on Canada's competency with respect to a particular technological platform; 3) enabling of Canadian companies to participate in the supply chain of next generation aircraft platforms; and 4) helping Canada meet its global A&D commitments. As of September 2010, SADI has provided approximately $430 million in funding.

[201] Conference Board of Canada. "Canada's Aerospace Product Manufacturing Industry", Spring 2010.

[202] Source: AIAC (Canada), BDLI (France), and SBAC (UK).

[203] Industry Canada, "SADI R&D program", accessed from http://ito.ic.gc.ca/eic/site/ito-oti.nsf/eng/h_00022.html in August 2010.

[204] Industry Canada, "SADI R&D program", accessed from http://ito.ic.gc.ca/eic/site/ito-oti.nsf/eng/h_00022.html in August 2010.

- **Green Aviation Research and Development Network ("GARDN")**:[205] A primarily private sector funding initiative created to promote the development of environmentally innovative products and services in Canada's aerospace industry. Projects fall into one of seven themes: 1) noise reduction; 2) emission reduction; 3) materials & manufacturing; 4) airport operations; 5) aircraft operations; 6) alternative fuels; and 7) lifecycle management. Like SADI, the GARDN program fosters collaboration between the public and private sectors by bringing together eleven Canadian universities, three major aerospace companies, seven SMEs, the public sector (NRC), and one foreign university. The GARDN program will deliver approximately $21 million in funding between 2009 and 2013.
- **Industrial and Regional Benefits Policy ("IRB")**: [206] The IRB policy provides the framework for defence procurement and acts as a lever to promote industrial and regional development objectives of the federal government. The IRB increases the level of economic activities within advanced technology sectors.

7.4.2 Developed markets

European Union

European advancements in the aerospace industry have lagged behind the US. However, lagging behind the US has made clear the need for a re-design, reorganization, and refitting of EU aerospace R&D systems. The EU has adopted a more strategic approach to the identification of research priorities, new mechanisms for forging a consensus among stakeholders in pursuit of these priorities, and a new form of cross-border collaboration in the application of this research. In essence, the EU has attempted to create a cross-border "knowledge society" with a focus on funding the technological frontiers and investing in the training and education of the workforce required for next generation jobs.[207] Programs such as Clean Skys managed by ACARE demonstrate that the EU is heavily investing in green technology to get ahead of the market's movement in this direction.

France

State investment has been a pre-requisite for France remaining competitive in aerospace OEM manufacturing. France has strengthened its European linkages and spending in order to remain in compliance with European pollution and noise emission targets. For example, the financing budget of the civil aeronautics research was increased to approximately $370 million to help reach European environmental targets. In 2008, a Council for Civil Aeronautics Research ("CORAC") was created to link French and European initiatives, thereby eliminating discrepancies between public and private policy. Objectives set out for the industry include:

- Maintaining a strategic position in the defence industry by independently supplying key military aircraft;
- Developing an industry whose contributions serve to progress the economy as a whole; and
- Remain a centre of reference for the global aerospace industry.[208]

Among the ministerial departments involved in aerospace is the Ministry of Finance, which has a representative on the Board of Director's of companies in which the state holds a significant investment. ONERA, the main research organization of the public sector, had a budget of approximately $270 million in 2008 and is involved in promoting state initiatives by fostering cooperation on R&D projects.[209]

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[205] GARDN, [webpage], accessed from http://www.gardn.org/ in August 2010.

[206] AIAC, "Major Future Platforms", June 2009.

[207] Group of Priorities, "European Aeronautics: A Vision for 2020", January 2001.

[208] European Commission, "EU Competitiveness Report", December 2009.

[209] European Commission, "EU Competitiveness Report", December 2009.

Germany

The German government has been heavily involved in the aerospace industry since the 1970's. Sources of involvement include:

- **Federal Ministry of Education and Research ("BMBF")**: This ministry defines a set of technologies that impact the Germany aerospace industry, including micro-systems, optics, and nano-technology.
- **Federal Ministry of Economics and Technology ("BMWi")**: The BMWi supports specific research within the aerospace industry through a series of programs termed "LuFo". LuFo is managed and organized by the German Aerospace Center. The most recent version of the program, LuFo IV, covers 2009-2013 and provides approximately $382 million in funding.[210] The funding is focused on: 1) air traffic control and the environment (65%); 2) aircraft safety and the air cabin environment (25%); and 3) economic efficiency, value creation and competitiveness (10%).[211]

The Strategic Research Agenda ("SRA"), with 6000 employees and 13 domestic locations, has also supported R&D efforts in technologies that improve flight physics as part of an effort to meet European-wide aerospace goals set by the European Council for Aeronautics Research ("ACAR"). Of crucial importance is the well-developed network of universities and research bodies with expensive research and testing tools that can be leveraged by smaller domestic companies who cannot afford such specialized equipment. National and regional authorities also encourage the organization of the aerospace industry into regional clusters; a notable example being the cluster developed in Hamburg for the production of the Airbus 320.

Japan

Government has played a critical role in the development of the Japanese aerospace industry by facilitating the development of international partnerships. The Boeing 767 Transport program involved collaboration between the private sector and the Ministry of International Trade with half of the development costs covered by the government. In 1991, the government went on to provide a $58 million loan for the Boeing 777. A large portion of financial assistance is delivered by the International Aircraft Development Fund ("IADF"), which is mandated with promoting international collaboration.[212]

United Kingdom

The UK government has significant influence over the UK aerospace industry due to the large amounts of purchases it makes in the MAS. In 2002, the Aerospace Innovation and Growth Team ("AeGT") of the Secretary of State for Industry and Trade was created to bring together relevant industry players to map out a 20-year vision for UK aerospace industry. The goal of this map is to help the UK offer the world's most innovative and productive aerospace industry. New public initiatives of the AeGT include the Technology Strategy Board and a National Aerospace Strategy Group, which have become increasingly important following the phase out of the Civil Aeronautics Research and Technology Demonstration ("CARAD"). Specific industry support is derived from smaller bodies within the Technology Strategy Board's Technology Program, including:

- **Knowledge Transfer Networks**: Established and funded by the government, industry, and academic. These national networks bring together organizations to encourage innovations through knowledge transfer. [213]
- **Collaborative Research and Development Grants ("CR&D")**: Aims to reduce the development risk of companies by covering 25-75% of R&D costs.[214]

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[210] Bundesanzeiger, "Nr. 17", 3 February 2009.

[211] European Commission, "EU Competitiveness Report", December 2009.

[212] SJAC, "Aerospace Industry in Japan 2010", 2010.

[213] House of Commons Trade and Industry Commons, "The UK Aerospace Industry, 15th Report on Session 2004-05", July 19, 2005.

[214] House of Commons Trade and Industry Commons, "The UK Aerospace Industry, 15th Report on Session 2004-05", July 19, 2005.

Only 1% of UK government funding was to civil aeronautics in 2009. However, financial support for manufacturing is improving and the UK government recognizes the important role the aerospace industry plays in overall economic development. The UK has also used investment in the aerospace industry to shape regional economies. For example, a significant amount of launch aid was directed towards Rolls-Royce for four new factories in economically struggling areas of UK. Aerospace companies are also eligible for tax breaks which amounted to $173 million in 2008.[215]

United States

No specific regulatory body oversees the US aerospace industry. Instead, there are several ministries and agencies responsible for particular sectors or sub-sectors. The most important national aerospace institutions are:

- **Federal Aviation Administration ("FAA"):** The FAA regulates civil aviation to promote safety and efficiency. The FAA also provides funding for research projects in conjunction with the aeronautics industry, including: innovations in night vision for navigation, collision warning equipment, and other communication equipment.
- **NASA**: NASA is responsible for access to space, space exploration, and the maintenance of required space infrastructure. [216] NASA's research activity falls within the Aeronautics Research Mission Directorate, which has a 2010 budget of $511.4 million for research in Fundamental Aeronautics, Aviation Safety, Airspace Systems, and Aeronautics Test Programs. NASA's budget has fallen from $650 million in 2009 and is forecast to remain stagnate at $530 million for the medium- to long-term.[217]

Research and Development priorities are unified under a Federal policy despite the lack of a body to direct aerospace policy more generally. After a considerable number of studies and reports, it was determined that a national policy and guidelines for R&D programs was needed in order to avoid widespread duplication of activities and a corresponding inefficiency in fund usage. As such, the National Aeronautics Research and Development Policy implemented initiatives and guidelines to drive federal aeronautics R&D until 2020.

The US aerospace industry also enjoys considerable support from the Export-Import Bank of the United States due to the global nature of the civil aerospace market. For example, Boeing has been provided financial support through $10 million in loan guarantees.[218]

7.4.3 Emerging markets

Brazil

Public sector organizations such as the Brazilian Development Bank and the Ministry for Science and Technology played a critical role in creating Embraer through direct funding, tax breaks, and other forms of support. However, there has been a reduction in direct government funding provided to the Brazilian aerospace industry since the 1994 privatization of Embraer. A federally-owned bank does, however, provide interest rates rebates for loan purchasers of exported Embraer aircrafts. Through such policies, the government has been able to exert influence on Embraer to create a domestic, consolidated, supply chain. It is important to note that these policies have been questioned by Canada and an ensuing WTO investigation found both nations have been guilty of unfair trade practices.[219]

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[215] ADS, "2010 UK Aerospace Industry Survey 2010", July 2010.

[216] NASA, "Aeronautics Research Mission Directorate", accessed from http://www.aeronautics.nasa.gov/about_us.htm in August 2010.

[217] NASA, "New Aeronautics Research Program" [exhibit], July 2009.

[218] European Commission, "EU Competitiveness Report", Page 227, December 2009.

[219] European Commission, "EU Competitiveness Report", December 2009.

China

Growth in airline infrastructure has lagged demand for air transport services, equating to capacity restrictions and a limited ability to service the growing civil aircraft fleet. In response, the Civil Aviation Administration of China announced in 2008 a development plan to build 97 airports at a cost of $62 billion.[220] To support the manufacturing sector, the government sponsored COMAC plans to be produce multiple models of civil aircraft by 2020.

India

Prior to 2001, investment in aerospace and defence was exclusively reserved for the public sector. Since then, India has become one of the largest military spenders in the world and the government has earmarked $32 billion for procurement in FY 2010. In addition to this guaranteed base of defence revenue, defence firms in India enjoy a range of tax exemptions and concessions, and funding from the government for development of R&D and manufacturing capabilities. It is also thought that certain domestic firms are preferentially selected by the government to receive technology and licensed production from overseas sources.[221]

Russia

The government is currently supporting the aerospace industry through $700 million in annual funding as set out in a three-year budget introduced in 2007. However, firms that are not associated with UAC have limited access to these funds. The long-term nature of aerospace investment contrasted with the short-term nature of government funding has resulted in low levels of domestic aircraft production. In response, the Russian government has reduced import taxes on aircraft to allow for an increased supply of foreign aircraft to meet the growing demand among national carriers for an advanced aircraft fleet.[222]

Singapore

Singapore has transformed itself, in a relatively short period of time, into Asia's most important MRO hub and is arguably the aerospace success story of Asia. Singapore boasts more than 30 major MRO facilities, the highest concentration of engine and component MRO capability, and an aerospace industry with annual revenue in excess of $4 billion. Beyond MRO, Singapore plays host to several world-class design and manufacturing operations and in 2007, achieved a major breakthrough when Rolls-Royce selected Seletar Aerospace Parker to host its S$320 million final assembly and test facility for aircraft engines – the first facility of its kind in continental Asia. Singapore has also attracted several leading aerospace firms to establish R&D centers in the city-state. [223]

Several factors underpin Singapore's success, including a flexible workforce, a corrupt-free and transparent government, and a highly respected legal system. Perhaps the most critical success factor is a collaborative planning effort between the government and the industry led by the Economic Development Board ("EDB"); other organizations in the collaboration include the Ministry of Transport, the Work Development Agency, the Aerospace Industry Association of Singapore, and A*STAR - Singapore's lead agency for fostering scientific research. The EDB's approach places a premium on the needs of industry rather than "top down" policies.[224]

The success of Singapore Technologies Aerospace ("STA"), the largest airframe MRO provider in the world, has helped expand Singapore's reputation as an MRO provider. STA's commitment to impeccable quality standards and competitive turnaround time has been the root cause of their established position as a sought-after MRO provider. Many customers fly into Singapore for the sole purpose of maintenance.

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[220] Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[221] Deloitte, "Prospect's for Global Defense Export Market".

[222] Source: European Commission, "EU Competitiveness Report", December 2009; WSJ, "Plane Speaking", March 29, 2010.

[223] Source: Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[224] Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

Future initiatives of STA include new investments in hangar expansion to address the growing shortage of aerospace manpower globally and increased business aviation traffic in Singapore. [225]

7.5 Global aerospace report card

Table 20: Aerospace market report card[226]

	Sales	Sales growth	R&D intensity	Public R&D investment	Exports	Employment	Companies	Government programs
Developed markets								
Canada	A	C	C	C	D ↑	B	B	D
France	A	A	A	C	A ↑	A	B	A
Germany	B	B	A	B	D ↑	D	C	A
Japan	D	-	-	-	D ↓	D	-	C
UK	B	D	C	B	D ↑	D	A	B
US	A	B	C	B	B ↑	B	-	B
Emerging markets								
Brazil	C	-	-	-	C ↑	-	-	D
China	D	-	-	-	D ↓	-	-	C
India	D	-	-	-		-	-	D
Russia	D	-	-	-	D ↑	-	-	B

↓ Indicates the country is a net importer ↑ Indicates the country is a net exporter

Table 21: Scoring criteria for aerospace market report card

	Sales[i]	Sales growth	R&D intensity	Public R&D investment	Exports	Employment	Companies	Government programs
A	>= 0.012	>= 9%	>=15%	>=76%	>=12%	>=0.6%	>=451	Qualitative and based on the degree of government support & industry involvement
B	>= 0.006	6-18.9%	10-14.9%	51-75%	8-11.9%	0.4-0.59%	301-450	
C	>= 0.004	3-5.9%	5-9.9%	26-50%	4-7.9%	0.2-0.39%	151-300	
D	>= 0	0-2.9%	0-4.9%	0-25%	0-3.9%	0-0.19%	0-150	

[i] The cut-off values were set based on normalized sale quartiles internal to the data-set.

Note that many of the criteria examined have a direct impact on one another. For example, sales may be a key driver of employment while R&D investment may be a key driver for sales growth.

The general trend in the report card is Canada performing in line with the US but slightly behind France and Germany. Based on this analysis, Canada is also performing better than all of the emerging markets examined.

[225] Source: Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[226] The rankings range from "A" (strongest) to "D" (weakest). Rankings are derived using a set of qualitative and quantitative measures described in Appendix III .

Canada ranks highly in terms of aerospace sales once GDP is taken into account. Canada outperforms all emerging markets in terms of sales, including Brazil. Only France and the US match Canada in terms of sales. Canada performs more poorly in terms of sales growth, only ranking ahead of the UK.

Canada's sales growth may be a result of weakness in R&D investment in which Canada also ranked poorly. Canada's R&D investment intensity lags behind France and Germany and is in line with the US. As mentioned previously, France and Germany both put a high level of importance on R&D spending in order to maintain their leadership position in the industry. France and Germany also have strong Space sub-sectors and this may be a by-product of their focus on R&D investment. Germany and France rank ahead of Canada in terms of public sector R&D investment. However, Germany ranks ahead of France in public sector R&D investment and this potentially indicates divergent policy strategies to drive R&D investment intensity. Germany may be boosting R&D investment intensity through direct government funding while France achieves R&D investment intensity through initiatives that increase private-sector spending.

Canada has a strong performance in terms of aerospace employees once the population base is taken into account. In terms of employment, Canada is tied with the US and is second only to France. Unlike Germany and the UK, Canada's strong ranking in both employment and sales may indicate that the large labour force is being used effectively by the aerospace industry.

Canada also lags in terms of aerospace exports as a fraction of total exports but is still strong in terms of exports as a percent of aerospace revenues. Canada's low ranking is likely due to the structure of the Canadian economy and is therefore not as important as Canada's low R&D ranking. Most of the countries examined are net exporters, with the exception of those in Asia-Pacific. This highlights a significant source of competitive pressure going forward, as countries attempt to grow their aerospace exports, particularly to the Asia-Pacific region.

Canada earned a D with respect to government programs because of the decline in R&D intensity over the last ten years. Canada is only investing 6% of revenues into R&D in the sector. France and Germany, who both earned a grade of A, are investing in R&D at a rate of approximately 16% of sales. The NRC's Institute for Aerospace Research receives $26.5 million in funding. In comparison, Germany's Federal Ministry of Economics and Technology is offering support of approximately $382 million from 2009 to 2013 for aerospace research. These numbers indicate large disparaties between Canada and best-in-class countries.

8 2010-2020 global aerospace forecast model

8.1 Introduction

This section discusses selected results from the market forecast. It is important to note that the forecasting model includes a greater number of variations than can be discussed in this report. The model settings used to generate the proceeding results are given in "Appendix IV".

The model developed forecasts global aerospace revenues segmented by sector, sub-sector, and region:

1. **Sector**
   a) Global CAS
   b) Global MAS
2. **Sub-sector**
   a) A&AP
   b) E&EP
   c) MRO
   d) T&S
   e) Space[227]
3. **Region**
   a) Africa
   b) Asia-Pacific
   c) CIS
   d) Europe
   e) Latin America
   f) Middle East
   g) North America

The model includes a NPV calculator to determine the size in 2010 ("today") of industry revenues spread over multiple years in the forecast. An incremental NPV corresponds to the 2010 revenues that are equivalent to the revenues forecasted to be generated over forecast from a particular gain in market share for a particular sub-sector (e.g., A&AP sub-sector market share increases by 1%). The NPV calculation is important because it captures all of the benefits derived from the industry over the forecasted time horizon.

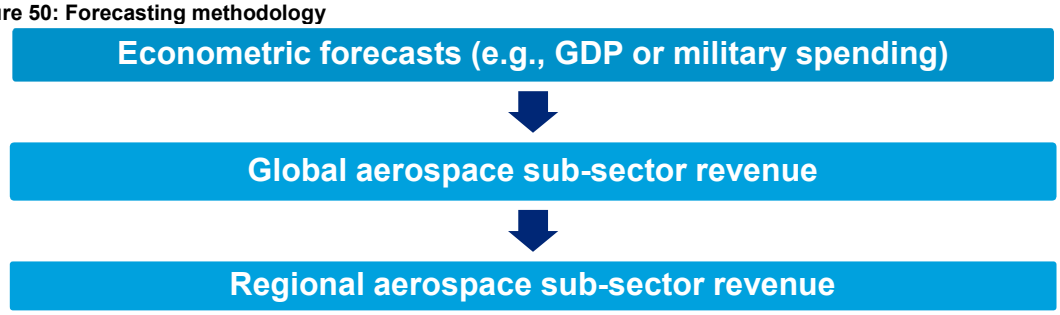
One significant caveat that exists for this model is that Canada's revenue by sub-sector is assumed to be partitioned between regions in the same manner as global sub-sector revenue is partitioned between regions. For example, if Asia-Pacific accounts for 25% of global MRO revenue it is assumed that 25% of Canada's MRO revenue comes from Asia-Pacific. However, MRO is tied to a particular geography and

[227] Space is not sub-divided by region due to a lack of data.

therefore this assumption inflates the revenue Canada derives from Asia-Pacific MRO. Care must be taken when examining Canada-specific revenues segmented by region.

The forecasting methodology differs between the CAS and MAS. However, in both cases the forecast methodology follows a top down, demand side, approach that starts at broad economic factors. The forecasting methodology can be summarized into three steps:

Figure 50: Forecasting methodology



Parts of the model utilize third-party forecasts for certain sub-sectors and the methodology for these third-party forecasts is proprietary and therefore cannot be validated. The CAS model also relies heavily on regional and global GDP forecasts provided by the IMF. Errors inherent in any third-party forecasts or data sources would invalidate the results produced by or derived from the forecasting model.

The results presented use regional RPK forecasts from major OEMs and assumes post-9/11 military spending in the US and Europe. A detailed description of the forecast methodology and assumptions can be found in “Appendix II”.

8.2 Civil aerospace sector forecast

The global CAS is forecast to have revenues of $262 billion in 2020. A breakdown of global CAS revenue by sub-sector and region is given below:

Table 22: Global CAS forecast summary broken down by sub-sector and region

2010 dollars, USD billion	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	CAGR (%)
Aircraft & aircraft parts													
Africa	0.32	0.26	0.29	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.43	0.45	**2**
Asia-Pacific	4.12	3.99	4.42	4.65	4.90	5.14	5.39	5.69	5.99	6.31	6.64	6.98	**4**
CIS	0.48	0.59	0.62	0.63	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.76	**4**
Europe	45.99	44.72	48.00	49.20	50.45	51.77	53.16	54.97	56.88	58.89	61.00	63.22	**3**
Latin America	2.91	3.27	3.66	3.89	4.13	4.36	4.61	4.89	5.17	5.47	5.78	6.10	**6**
Middle East	1.81	1.38	1.54	1.62	1.71	1.80	1.90	2.00	2.11	2.23	2.35	2.47	**2**
North America	42.80	45.47	48.73	49.86	51.06	52.33	53.67	55.43	57.30	59.26	61.32	63.50	**4**
Global	98.44	99.67	107.25	110.16	113.21	116.40	119.74	124.03	128.54	133.28	138.25	143.48	**3**
Engine & engine parts													
Africa	0.13	0.12	0.13	0.14	0.15	0.16	0.17	0.17	0.18	0.18	0.19	0.20	**3**
Asia-Pacific	3.03	3.69	4.16	4.46	4.77	5.09	5.43	5.66	5.89	6.13	6.38	6.63	**6**
CIS	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	**-1**
Europe	8.35	8.75	9.55	9.96	10.39	10.84	11.32	11.58	11.86	12.15	12.46	12.78	**4**
Latin America	0.58	0.41	0.46	0.49	0.53	0.56	0.60	0.62	0.65	0.68	0.70	0.73	**1**
Middle East	0.20	0.24	0.26	0.27	0.28	0.29	0.31	0.31	0.32	0.33	0.33	0.34	**4**
North America	15.85	15.72	17.13	17.83	18.57	19.35	20.18	20.63	21.10	21.60	22.12	22.67	**4**
Global	28.23	29.03	31.81	33.26	34.78	36.39	38.09	39.07	40.09	41.16	42.28	43.44	**4**
Maintenance, repair, & overhaul													
Africa	0.88	0.94	1.00	1.05	1.09	1.14	1.20	1.26	1.31	1.37	1.42	1.48	**5**
Asia-Pacific	9.61	10.40	11.20	11.82	12.45	13.10	14.01	14.80	15.61	16.44	17.28	18.15	**6**
CIS	1.10	1.18	1.26	1.32	1.38	1.44	1.53	1.60	1.67	1.74	1.82	1.89	**5**
Europe	10.07	10.65	11.22	11.58	11.94	12.29	12.85	13.28	13.70	14.11	14.52	14.91	**4**
Latin America	1.70	1.83	1.96	2.06	2.16	2.26	2.40	2.52	2.65	2.77	2.90	3.03	**5**
Middle East	1.79	1.94	2.09	2.21	2.33	2.46	2.63	2.78	2.94	3.10	3.26	3.43	**6**
North America	10.51	11.01	11.49	11.75	11.99	12.22	12.66	12.96	13.24	13.51	13.76	14.00	**3**
Global	35.67	37.95	40.23	41.79	43.34	44.90	47.28	49.20	51.12	53.04	54.96	56.88	**4**
Training & simulation													
Africa	0.03	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.07	**7**
Asia-Pacific	0.35	0.28	0.38	0.42	0.46	0.50	0.55	0.60	0.66	0.72	0.78	0.84	**8**
CIS	0.04	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	**7**
Europe	0.37	0.28	0.38	0.41	0.44	0.47	0.51	0.54	0.58	0.61	0.65	0.69	**6**
Latin America	0.06	0.05	0.07	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.13	0.14	**8**
Middle East	0.07	0.05	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.13	0.15	0.16	**8**
North America	0.38	0.29	0.39	0.42	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	**5**
Global	1.30	1.01	1.36	1.48	1.60	1.73	1.86	2.01	2.15	2.31	2.47	2.64	**7**
Space - Launches & Manufacturing													
Global	11.83	26.42	26.42	26.42	26.42	26.42	26.42	26.42	15.39	15.39	15.39	15.39	

The A&AP is forecast to be the dominant sub-sector based on revenue from 2010 to 2020. However, the T&S market is forecast to grow the fastest with a CAGR of 7%. The performance of the T&S sub-sector is a result of strong aircraft deliveries volumes and global growth in passenger traffic. Growth in MRO is projected to be second highest at approximately 4%. This growth in civil MRO is a result of aging fleets and an increase in MRO activity among airlines to offset historical under-investment.[228] Both A&AP and

[228] Oliver Wyman, "MRO survey", 2009.

E&EP have nearly identical revenue CAGRs at approximately 3% and 4% respectively and this is to be expected given the tight linkage between these manufacturing sub-sectors.

Figure 51: CAS revenue forecast summary by sub-sector

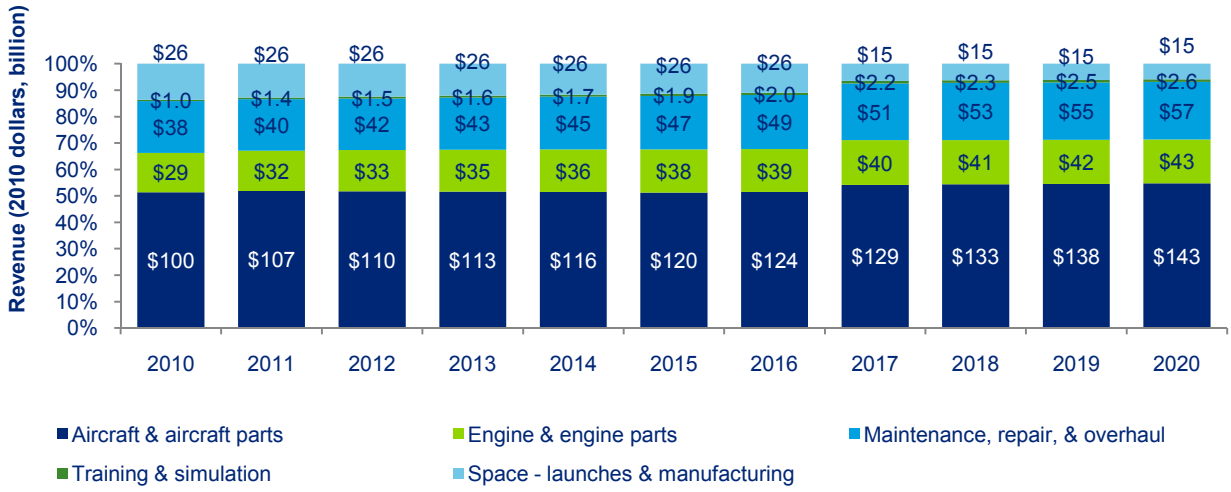


Table 23: CAS sub-sector revenue growth

Sub-sector	2009	2020	CAGR (%)	Share of total 2020 revenue (%)
T&S	1	2	7	1
MRO	36	57	4	22
E&EP	28	43	4	12
A&AP	98	143	3	55
Space	-	-	-	6

Space is not included because the forecast methodology would result in inaccurate values for revenue growth.

With respect to regions, the largest sources of revenue through 2020 will remain North America and Europe. However, North America and Europe also have the lowest CAGR in the forecast at 4% and 3% respectively. The fastest growth in revenue is seen in the two emerging markets, Asia-Pacific and Latin America at 6% and 5% respectively. Africa is forecast to lag behind other emerging markets. In general, regional variations in revenue CAGR are small with a maximum variance of 2%. In the forecast, sub-sector growth-rates are inversely proportional to the amount of revenue generated by the sub-sector and this results in the uniformity observed in regional CAGRs. The largest sub-sectors, which would drive large swings in regional revenue, are growing at the lowest rates.

Table 24: CAS regional revenue growth

Region	2009	2020	CAGR (%)	Share of total 2020 revenue (%)
Asia-Pacific	17	33	6	13
Latin America	5	10	6	4
CIS	2	3	5	1
Middle East	4	7	5	2
Africa	1	2	4	1
North America	69	101	3	42
Europe	65	92	3	38

8.2.1 By sub-sector

Table 25: Changes in regional CAS market share by sub-sector

2010 dollars, USD billion	2009 market share (%)	2020 market share (%)	Delta (%)
Aircraft & aircraft parts			
Africa	0.3	0.3	-0.1
Asia-Pacific	4.2	4.3	0.1
CIS	0.5	0.5	0.0
Europe	46.7	44.8	-1.9
Latin America	3.0	3.7	0.7
Middle East	1.8	1.5	-0.3
North America	43.5	45.0	1.5
Engine & engine parts			
Africa	0.4	0.4	0.0
Asia-Pacific	10.7	13.4	2.6
CIS	0.3	0.2	-0.1
Europe	29.6	30.2	0.6
Latin America	2.1	1.5	-0.6
Middle East	0.7	0.7	0.0
North America	56.2	53.6	-2.5
Maintenance, repair, & overhaul			
Africa	2.5	2.6	0.1
Asia-Pacific	26.9	31.9	5.0
CIS	3.1	3.3	0.2
Europe	28.2	26.2	-2.0
Latin America	4.8	5.3	0.6
Middle East	5.0	6.0	1.0
North America	29.5	24.6	-4.9
Training & simulation			
Africa	2.5	2.6	0.1
Asia-Pacific	26.9	31.9	5.0
CIS	3.1	3.3	0.2
Europe	28.2	26.2	-2.0
Latin America	4.8	5.3	0.6
Middle East	5.0	6.0	1.0
North America	29.5	24.6	-4.9

Delta is calculated as 2020 market share minus 2009 market share and does not take into account exchange rate fluctuations.

For A&AP, the largest CAGR in revenue is seen for Latin America at 6%. However, North America and Europe remain first and second in terms of total revenue; individually, both regions are forecasted to account for almost 45% of global revenue in 2020. Strong growth in A&AP revenue is also forecast for Asia-Pacific and CIS with a CAGR of 4% for both regions.

Engine & engine parts revenue is also forecast to remain dominated, in terms of revenue, by North America and Europe through 2020 with these regions accounting for 54% and 30% of total E&EP revenue respectively. Asia-Pacific, however, is forecasted to have the highest CAGR in E&EP revenue at 6%. Three regions - Europe, North America, and Middle East - have a CAGR of 4% through 2020. The CIS is forecast to experience a negative CAGR of -1% in E&EP revenue through 2020; this negative CAGR is a result of the decreasing CIS E&EP exports seen in the historical data set used to build the forecasting model.

With respect to MRO, the region predicted to generate the most revenue in 2020 is Asia-Pacific with the forecast showing the region generating 32% of global civil MRO revenue in 2020. North America and Europe are expected to also account for a significant portion of MRO revenue at 26% and 25%

respectively. The model predicts that Asia-Pacific will surpass Europe and North America in terms of MRO revenue by 2015. The highest CAGR is expected for Asia-Pacific and the Middle East at 6% followed closely by the CIS and Latin America at 5%.

Similar to MRO, Asia-Pacific is also forecast to overtake North America and Europe in terms of T&S revenue by 2015. By 2020, the forecast has Asia-Pacific generating 32% of T&S revenue compared to approximately 25% for both Europe and North America. Asia-Pacific is also forecast to have the highest CAGR at 8%. North America and Europe are the only regions forecast to have a T&S CAGR smaller than 7%, at 5% and 6% respectively.

8.3 Military aerospace sector forecast

The MAS is forecast to generate revenues of $253 billion in 2020. A segmented breakdown of global MAS revenue segmented by sub-sector and region is given below:

Table 26: Global MAS forecast summary broken down by sub-sector and region

2010 dollars, USD billion	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	CAGR (%)
Aircraft & aircraft parts													
Africa	3.67	3.71	3.84	4.00	4.17	4.35	4.54	4.75	4.96	5.18	5.42	5.67	4
Asia-Pacific	14.75	13.98	14.26	14.65	15.06	15.50	15.95	16.42	16.92	17.43	17.97	18.53	2
CIS	4.45	4.35	4.43	4.54	4.65	4.76	4.87	4.98	5.08	5.19	5.29	5.39	2
Europe	23.27	23.99	23.65	23.48	23.32	23.18	23.05	22.93	22.82	22.72	22.63	22.54	0
Latin America	4.06	3.90	3.93	3.97	4.02	4.07	4.12	4.17	4.22	4.27	4.32	4.37	1
Middle East	2.86	2.64	2.69	2.75	2.81	2.88	2.95	3.03	3.10	3.18	3.27	3.36	1
North America	49.84	53.59	54.86	56.46	58.03	59.59	61.12	62.64	64.15	65.64	67.11	68.58	3
Global	102.90	106.16	107.65	109.85	112.08	114.33	116.61	118.91	121.24	123.61	126.00	128.43	2
Engine & engine parts													
Africa	0.81	0.81	0.84	0.88	0.92	0.96	1.00	1.04	1.09	1.14	1.19	1.24	4
Asia-Pacific	3.25	3.07	3.13	3.22	3.31	3.40	3.50	3.60	3.71	3.83	3.94	4.07	2
CIS	0.98	0.95	0.97	1.00	1.02	1.05	1.07	1.09	1.12	1.14	1.16	1.18	2
Europe	5.13	5.27	5.19	5.15	5.12	5.09	5.06	5.03	5.01	4.99	4.97	4.95	0
Latin America	0.90	0.86	0.86	0.87	0.88	0.89	0.90	0.91	0.93	0.94	0.95	0.96	1
Middle East	0.63	0.58	0.59	0.60	0.62	0.63	0.65	0.66	0.68	0.70	0.72	0.74	1
North America	10.98	11.76	12.04	12.39	12.74	13.08	13.42	13.75	14.08	14.41	14.73	15.05	3
Global	22.68	23.30	23.63	24.11	24.60	25.10	25.60	26.10	26.61	27.13	27.66	28.19	2
Maintenance, repair, & overhaul													
Africa	2.20	2.18	2.26	2.34	2.42	2.51	2.61	2.71	2.81	2.92	3.04	3.16	3
Asia-Pacific	8.82	8.21	8.38	8.55	8.74	8.94	9.14	9.36	9.59	9.83	10.08	10.34	1
CIS	2.66	2.56	2.60	2.65	2.70	2.75	2.79	2.84	2.88	2.92	2.97	3.01	1
Europe	13.91	14.09	13.89	13.71	13.53	13.37	13.22	13.07	12.94	12.81	12.69	12.58	-1
Latin America	2.43	2.29	2.31	2.32	2.33	2.35	2.36	2.38	2.39	2.41	2.42	2.44	0
Middle East	1.71	1.55	1.58	1.60	1.63	1.66	1.69	1.73	1.76	1.80	1.83	1.87	1
North America	29.79	31.49	32.23	32.96	33.67	34.37	35.05	35.72	36.37	37.02	37.65	38.27	2
Global	61.51	62.37	63.25	64.13	65.03	65.94	66.86	67.80	68.75	69.71	70.69	71.68	1
Training & simulation													
Africa	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.09	0.10	0.12	0.14	18
Asia-Pacific	0.09	0.10	0.12	0.14	0.16	0.19	0.22	0.25	0.29	0.33	0.39	0.45	15
CIS	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	15
Europe	0.15	0.17	0.20	0.22	0.25	0.28	0.31	0.35	0.40	0.44	0.49	0.55	13
Latin America	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.11	14
Middle East	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.08	15
North America	0.31	0.39	0.45	0.54	0.62	0.71	0.83	0.95	1.12	1.26	1.45	1.67	16
Global	0.65	0.77	0.89	1.04	1.19	1.37	1.57	1.80	2.11	2.37	2.72	3.12	15
Space & guided missiles													
Global	17.12	17.65	17.90	18.27	18.64	19.01	19.39	19.77	20.16	20.56	20.95	21.36	2

Similar to the CAS, the A&AP sub-sector is forecast to continue to dominate the MAS in terms of revenue (51% of total). Also similar to the CAS, the T&S sub-sector is forecast to experience the fastest revenue growth with a CAGR of 15%. On the military side, the fast growth in T&S is tied to increases in the usage of virtual training devices to offset the rising cost of equipment and consumables.[229] Partially corresponding to robust T&S growth is weak growth in military MRO revenue with a CAGR of 1.4%; low

[229] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018", 2008.

MRO growth fits within the context of increasing military expenditures in the virtual T&S space. Both the E&EP and A&EP sub-sectors are forecasted to experience a relatively small CAGR of 2.

Figure 52: MAS forecast summary by sub-sector

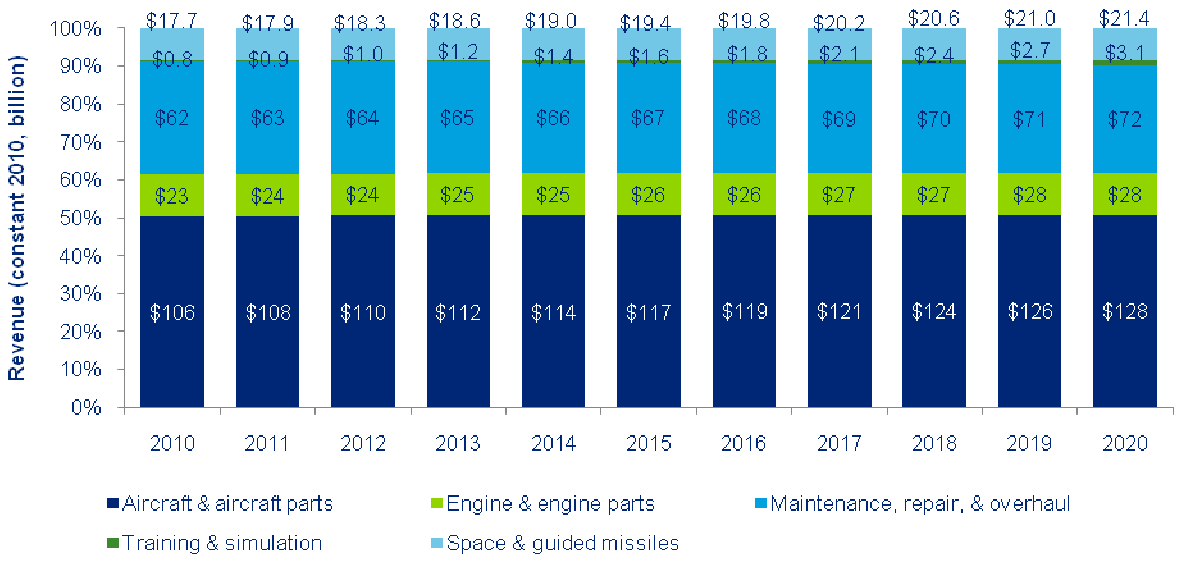


Table 27: MAS revenue growth by sub-sector

Sub-sector	2009	2020	CAGR (%)	Share of total 2020 revenue (%)
Training & Simulation	0.7	3	15	1
Aircraft & aircraft parts	102	128	2	51
Engine & engine parts	23	28	2	11
MRO	62	72	1	28
Space	17	21	2	8

From a regional point of view, the largest increases in MAS revenue are projected for Africa at a CAGR of 4% and North America at a CAGR of 3%. Africa's strong performance needs to be put into context; the region had a very small revenue base in 2009 and a fast ramp-up in military spending within the region in recent years. Asia-Pacific and CIS are also forecast to have relatively strong growth in MAS revenue with a CAGR of 2% for both regions. Europe's MAS is expected to remain flat with a CAGR of 0%. Despite Europe's low CAGR, the region is forecasted to rank second behind North America in terms of 2020 MAS revenue with a 54% and 18% share of global revenue respectively. Asia-Pacific is forecast to rank third in terms of MAS revenue market share at 14%, and is expected to close the gap that exists in MAS revenue between itself and Europe.

Table 28: MAS revenue growth by region

Region	2009	2020	CAGR (%)	Share of total 2020 revenue (%)
Africa	$7	$11	4	4
North America	$99	$135	3	53
Asia-Pacific	$29	$36	2	14
CIS	$9	$11	2	4
Middle East	$6	$7	1	3
Latin America	$8	$9	1	3
Europe	$46	$44	0	18

8.3.1 By sub-sector

Table 29: Changes in regional MAS market share by sub-sector

2010 dollars, USD billion	2009 market share (%)	2020 market share (%)	Delta (%)
Aircraft & aircraft parts			
Africa	3.6	4.4	0.8
Asia-Pacific	14.3	14.4	0.1
CIS	4.3	4.2	-0.1
Europe	22.6	17.6	-5.1
Latin America	3.9	3.4	-0.5
Middle East	2.8	2.6	-0.2
North America	48.4	53.4	5.0
Engine & engine parts			
Africa	3.6	4.4	0.8
Asia-Pacific	14.3	14.4	0.1
CIS	4.3	4.2	-0.1
Europe	22.6	17.6	-5.1
Latin America	3.9	3.4	-0.5
Middle East	2.8	2.6	-0.2
North America	48.4	53.4	5.0
Maintenance, repair, & overhaul			
Africa	3.6	4.4	0.8
Asia-Pacific	14.3	14.4	0.1
CIS	4.3	4.2	-0.1
Europe	22.6	17.6	-5.1
Latin America	3.9	3.4	-0.5
Middle East	2.8	2.6	-0.2
North America	48.4	53.4	5.0
Training & simulation			
Africa	3.6	4.4	0.8
Asia-Pacific	14.3	14.4	0.1
CIS	4.3	4.2	-0.1
Europe	22.6	17.6	-5.1
Latin America	3.9	3.4	-0.5
Middle East	2.8	2.6	-0.2
North America	48.4	53.4	5.0

Delta is calculated as 2020 market share minus 2009 market share and does not take into account exchange rate fluctuations.

In 2020, the majority of A&AP and E&EP revenue is forecast to remain in North America with the region accounting for 51% of global revenue. The CAGR trend for A&AP and E&EP sub-sector revenue is identical to the trend seen for overall MAS revenue with Africa and North America in first and second respectively. Europe is also forecast to have flat revenue CAGR for the A&AP and E&EP sub-sectors.

Unlike the civil MRO sub-sector, the military MRO sub-sector revenue is forecast to remain dominated by North America and Europe account for 53% and 18% of revenue respectively. Asia-Pacific is forecast to be the third highest generator of MRO sub-sector revenue in 2020 at 14%. All regions, with the exception of North America and Africa, are expected to have MRO revenue CAGR of 1% or less. North America and Africa are forecast to have MRO revenue CAGR of 2% and 3% respectively. Again, the strong performance of Africa is due to an extremely small base of 2009 military MRO spending on which to grow.

All regions are forecast to have strong growth in T&S revenue with CAGRs exceeding 13%. It is important to remember, however, that MAS T&S is growing from a relatively small base which can exaggerate growth-rates. The top three regions in terms of T&S sub-sector market share in 2020 are forecast to be North America, Europe, and Asia-Pacific at 44%, 14%, and 12% respectively.

8.3.2 Military spending scenarios

The results presented in this report assume US and European military spending follows the trend observed post-9/11. However, North America and European military spending was substantially different pre-9/11 and it can be argued that spending will follow a pre-9/11 trend line going forward because of budget deficits. This section examines the difference in global MAS revenue if the US and Europe were to follow the pre-9/11 military spending trend.

It was found that assuming pre-9/11 spending had a significant impact on forecasted revenue. For instance, 2020 global revenue is $57 billion below the baseline forecast when using a pre-9/11 spending scenario; this equates to a 22% reduction in revenue. In addition, the impact on North American MAS spending is more severe than at the global level with a decrease in US MAS revenue topping $91 billion in 2020; this is a 73% reduction in revenues relative to the post-9/11 forecast values. Coinciding with a decrease in revenue from the North American and European MAS is a significant increase in MAS revenue attributed to other regions. For instance, Asia-Pacific revenue in 2020 for the pre-9/11 spending scenario is approximately $25 billion above the revenue value produced by the post-9/11 spending scenario; this equates to a 74% increase in revenues relative to the post-9/11 forecast. Europe is negatively impacted to a smaller extent than North America experiencing a 21% reduction in 2020 revenues relative to revenues using post-9/11 spending. The impact on Europe is smaller because military spending changed by a much smaller extent after 9/11.

Table 30: Change in forecasted MAS revenue using pre-9/11 spending scenario

2010 dollars, USD billion	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Global MAS (total)	0.0	-30.0	-33.0	-35.9	-38.9	-41.9	-44.8	-47.8	-50.8	-53.7	-56.7
North America	-42.7	-53.6	-57.9	-62.2	-66.4	-70.5	-74.6	-78.7	-82.7	-86.7	-90.6
Europe	6.2	-0.6	-1.3	-2.0	-2.8	-3.7	-4.6	-5.5	-6.6	-7.6	-8.7
Asia-Pacific	17.9	13.6	14.8	15.9	17.1	18.4	19.6	20.8	22.0	23.3	24.6
Latin America	5.0	3.7	4.0	4.3	4.5	4.7	5.0	5.2	5.4	5.6	5.8
CIS	5.6	4.2	4.6	4.9	5.3	5.6	5.9	6.3	6.6	6.9	7.1
Middle East	3.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4
Africa	4.7	3.7	4.0	4.4	4.8	5.2	5.7	6.1	6.6	7.0	7.5

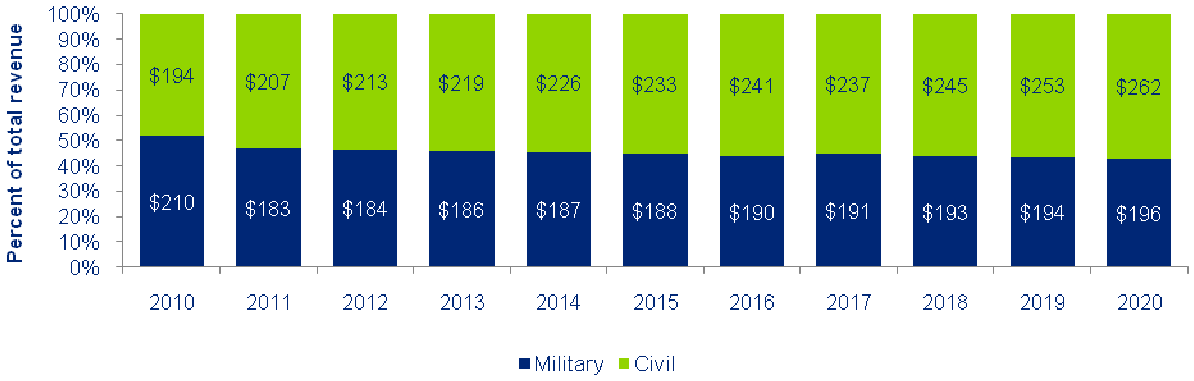
Table 31: Percent reduction in forecasted MAS revenue using pre-9/11 spending scenario

Percent reduction (%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MAS (total)	0	-14	-15	-16	-17	-18	-19	-20	-21	-22	-22
North America	-44	-54	-57	-59	-62	-64	-66	-68	-70	-72	-73
Europe	14	-1	-3	-5	-7	-9	-11	-13	-16	-19	-21
Asia-Pacific	70	53	56	58	61	64	66	68	70	72	74
Latin America	70	53	56	58	61	64	66	68	70	72	74
CIS	70	53	56	58	61	64	66	68	70	72	74
Middle East	70	53	56	58	61	64	66	68	70	72	74
Africa	70	53	56	58	61	64	66	68	70	72	74

Changing the military spending scenario decreased global, North American, and European spending across all sub-sectors and increased revenue from all other regions for all sub-sectors. The A&AP sub-sector sees the largest decrease in revenues across all regions. The largest percent reduction in North American and European revenue) is seen in the MRO and T&S sub-sectors.

Changing the military forecast also impacts the split of revenue between the MAS and CAS. The CAS becomes a more important source of revenue if one assumes a reduction in military spending for North America and Europe. Under a reduced spending assumption, the global CAS would account for approximately 57% of 2020 revenue compared to approximately 51% using post-9/11 spending; representing a 6% shift in revenue share from the global MAS to global CAS.

Figure 53: Forecasted revenue split between CAS and MAS using pre-9/11 spending scenario



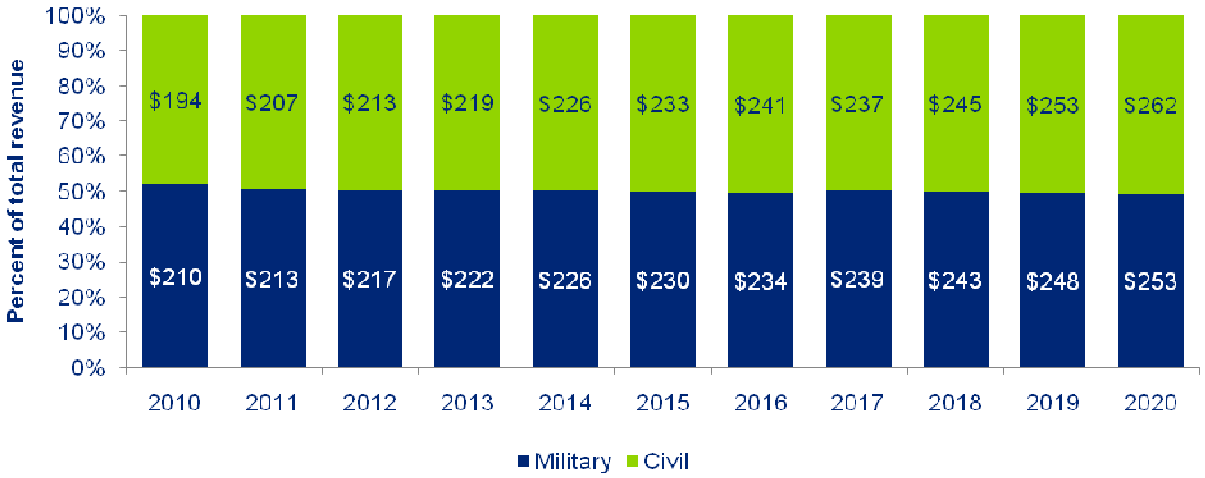
Based on the analysis, the following insights are identified on the affect of military spending assumptions on the aerospace industry:

1. Global MAS revenue is highly dependent on the assumed military spending scenario for the US and Europe;
2. Significant reductions in military spending among developed nations may result in a large market share shift in global MAS revenue towards developing countries;
3. A decreasing trend in military spending will significantly increase the relative importance of the global CAS; and
4. Cuts in military spending by the US and Europe significantly affects all regions of the world and industry sub-sectors.

8.4 Global Civil & military forecast comparison

The overall split in revenue between the global CAS and global MAS is expected to shift slightly over the next ten years with 3% of market share moving from the global MAS to the global CAS. This shift would result in the global CAS generating 51% of revenues in 2010 and thereby overtaking the global MAS as the primary source of revenue. In fact, the model suggests global CAS revenues surpassing global MAS revenues by 2018.

Figure 54: Global CAS and MAS revenue comparison



8.4.1 By sub-sector

The small shift in market share from the MAS to the CAS at the aggregate level masks significant changes when one looks at the sub-sector level. In general, the civil sector is forecast to gain in importance relative to the military sector for all sub-sectors except T&S. The increasing importance of the global CAS for revenue on the MRO is demonstrated in a 6% increase from 2009 to 2020.

Table 32: Change in CAS industry market share by subsector

Sub-sector	Civil revenue, 2009 (%)	Civil revenue, 2020(%)	Delta (%)
MRO	37%	44%	8
Engine & engine parts	55%	61%	5
Aircraft & aircraft parts	49%	53%	4
Training & Simulation	67%	46%	-21
Space	-	-	-

Space is not included because the CAS forecast methodology would result in inaccurate values for revenue growth. Delta is calculated as 2020 market share minus 2009 market share.

8.4.2 By region

Regionally, the relative split of revenue between the global CAS and global MAS over the forecast horizon shifts significantly. These shifts are larger than by sub-sector. With the exception of Africa, all regions are forecast to see an increasing share of revenue from the CAS. In Africa, the forecast shows the relative split of revenue between the CAS and MAS remaining constant through 2020. The largest differential is seen in the European and Latin America regions; these regions are forecast to see 9% and 12% more revenue respectively from the CAS sector in 2020 relative to 2009 but driven by opposite underlying causes; in Europe, this trend is due to weakness in the MAS and in Latin America this trend is due to strength in the CAS.

Table 33: Change in global CAS industry market share by region

Region	Civil revenue, 2009 (%)	Civil revenue, 2020(%)	Delta (%)
Europe	58	68	9
Latin America	39	51	12
Middle East	40	48	7
Asia-Pacific	37	46	9
CIS	16	21	5
Africa	16	16	0
North America	43	41	2

Delta is calculated as 2020 market share minus 2009 market share.

8.5 Net present value of aerospace revenue growth

The NPV calculation assumes four possible paths for Canada's share of global aerospace revenue:

1. Canada's market share in 2020 remains at current levels ("status quo");
2. Canada's market share experiences a linear growth to end 1% percentage points higher for each sub-sector in 2020;
3. Canada's market share experiences a linear growth to end 5% percentage points higher for each sub-sector in 2020; and
4. Canada's market share experiences a linear decline to end 10% percentage points lower for each sub-sector in 2020.

The NPV calculation implemented in the model requires a constant discount rate which is set approximately equal to the average Government of Canada 10-year benchmark bond yield on September 1st, 2010 (3%).[230] The Government of Canada 10-year bond yield was used because it represents one

[230] Bank of Canada, "Rates and statistics: selected bond yields", accessed from http://www.bankofcanada.ca/en/rates/bonds.html in August 2010.

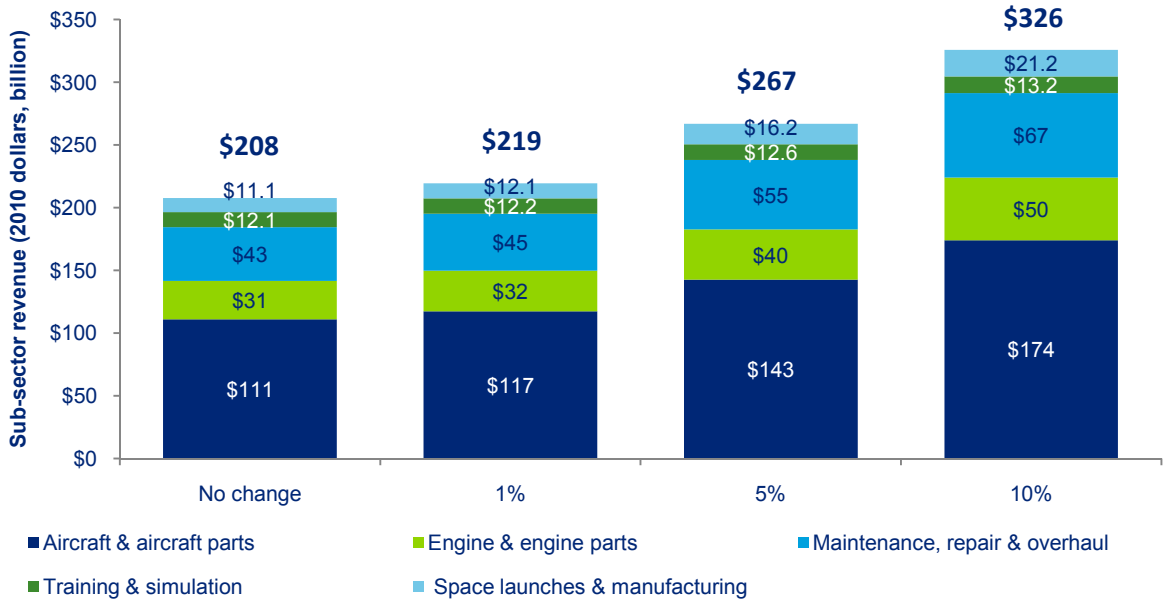
potential rate at which the federal government could raise the funds required to invest in the Canadian aerospace industry over the ten year forecast horizon.

8.5.1 Civil aerospace sector

The NPV analysis shows that maintaining Canada's current share of the global aerospace market constant through 2020 would result in an NPV of approximately $208 billion; this is significant and would be equal to 17% of Canada's 2009 GDP ($1.2 trillion).[231] If Canada were to increase CAS market share by 10% across all sub-sectors, the forecast predicts an NPV of $326 billion or 27% of 2009 GDP.

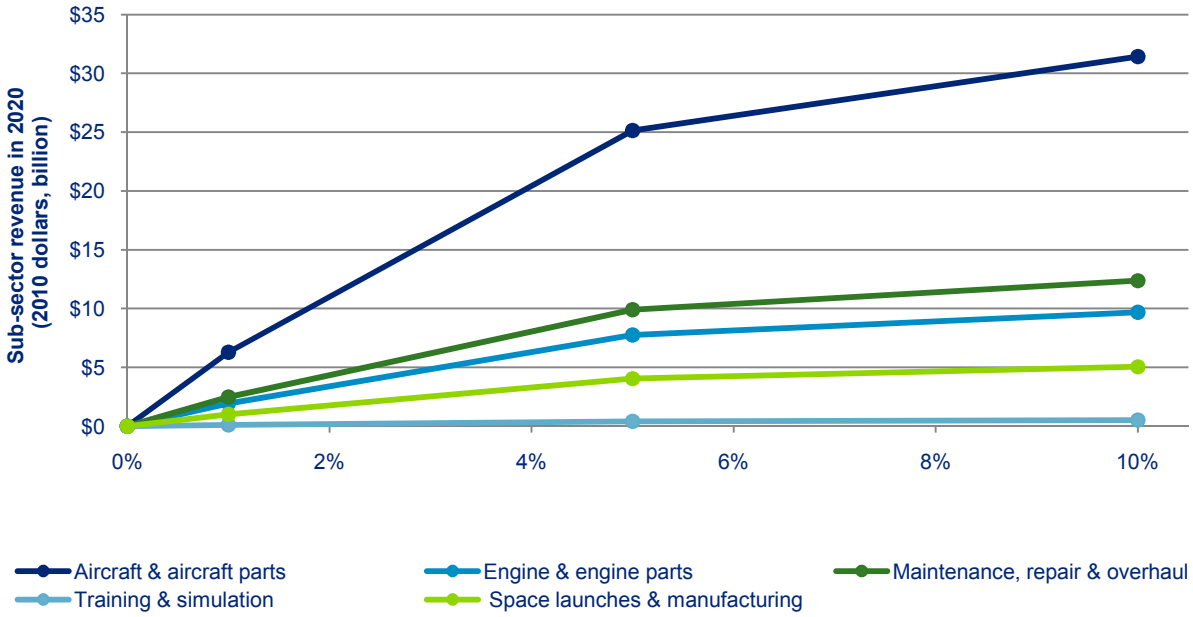
The analysis also shows that each percentage point of overall CAS market share gained by 2020 is worth approximately $11.8 billion to the Canadian economy today on a NPV basis. When looking at specific sub-sectors, the NPV of each percentage point of market share gain by 2020 is worth $6.3 billion for A&AP, $2.5 billion for MRO, $1.9 billion for E&EP, $1 billion for Space, and $100 million for T&S (see Figure 56). It is interesting to note that incremental revenue follows absolute revenue in all cases except Space and T&S.

Figure 55: CAS NPV result comparision



[231] International Monetary Fund. "World Economic Outlook" [online database]. accessed from http://www.imf.org/external/data.htm#data in July & August 2010.

Figure 56: NPV for incremental changes in global CAS market share



8.5.2 Military aerospace sector

The NPV analysis shows that the Canadian economy derives a smaller benefit, in terms of revenue, from the global MAS relative to the global CAS. This result is in line with the strong trend in Canadian aerospace exports towards the global CAS. The A&AP sub-sector is estimated to be a driving force, and this is also the case for North America and Europe.

The analysis shows that maintaining Canada's current share of the global MAS constant through 2020 would result in a NPV of approximately $48 billion; this is equal to 4% of Canada's 2009 GDP ($1.2 trillion).[232] If Canada were to increase its global MAS market share by 10% across all sub-sectors, the forecast predicts an NPV of approximately $165 billion or 14% of 2009 GDP.

Each percentage point of overall MAS market share gained by 2020 is worth approximately $11.7 billion to the Canadian economy today on a NPV basis, marginally lower than the $11.8 billion from the CAS. The revenue from a percentage point of market share gained by 2020 is worth $6 billion for A&AP, $3.4 billion for MRO, $1.3 billion for E&EP, $1 billion for Space, and $100 million for T&S (see Figure 58). Similar to the CAS, incremental revenue from the Space sub-sector is greater than from the T&S sub-sector.

For the MRO sub-sector, a gain in global MAS market share has a higher impact on revenue growth than a gain in global CAS market share. However, for the A&AP and E&EP sub-sectors a gain in the global CAS market is worth more, on an NPV basis, than a gain in the global MAS. The incremental benefit derived from market gains in the Space and T&S sub-sectors were comparable for the global CAS and global MAS.

[232] International Monetary Fund. "World Economic Outlook" [online database]. accessed in July & August 2010 from http://www.imf.org/external/data.htm#data in July & August 2010.

Figure 57: MAS NPV result comparison

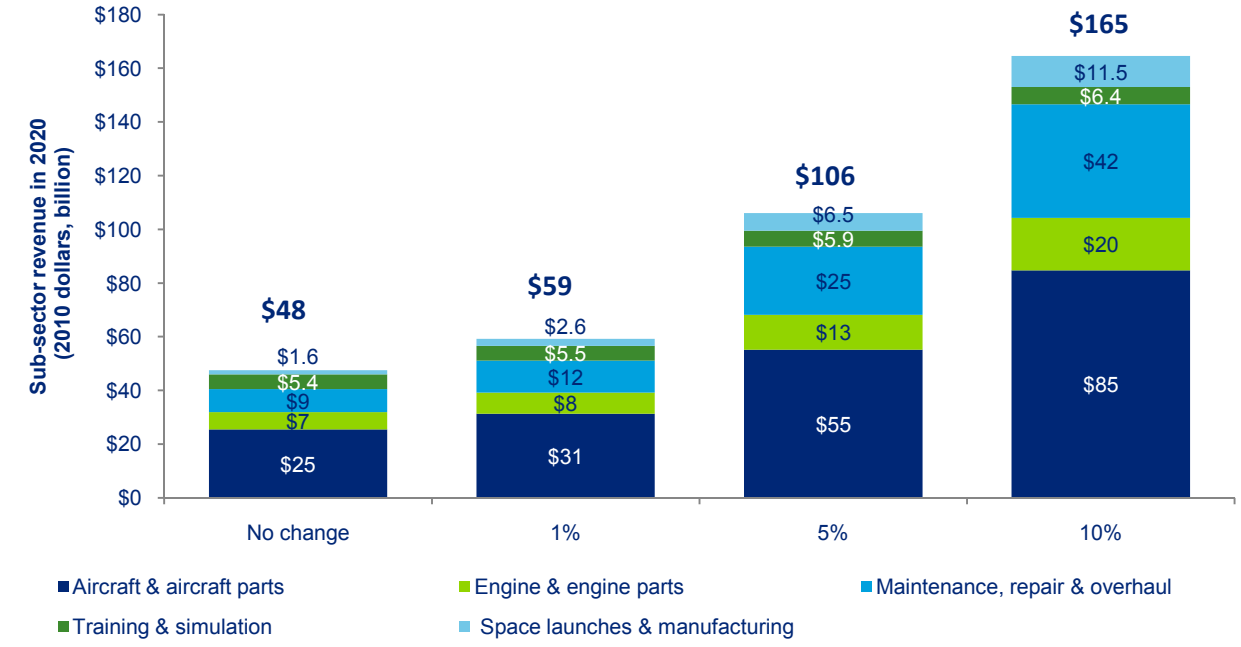
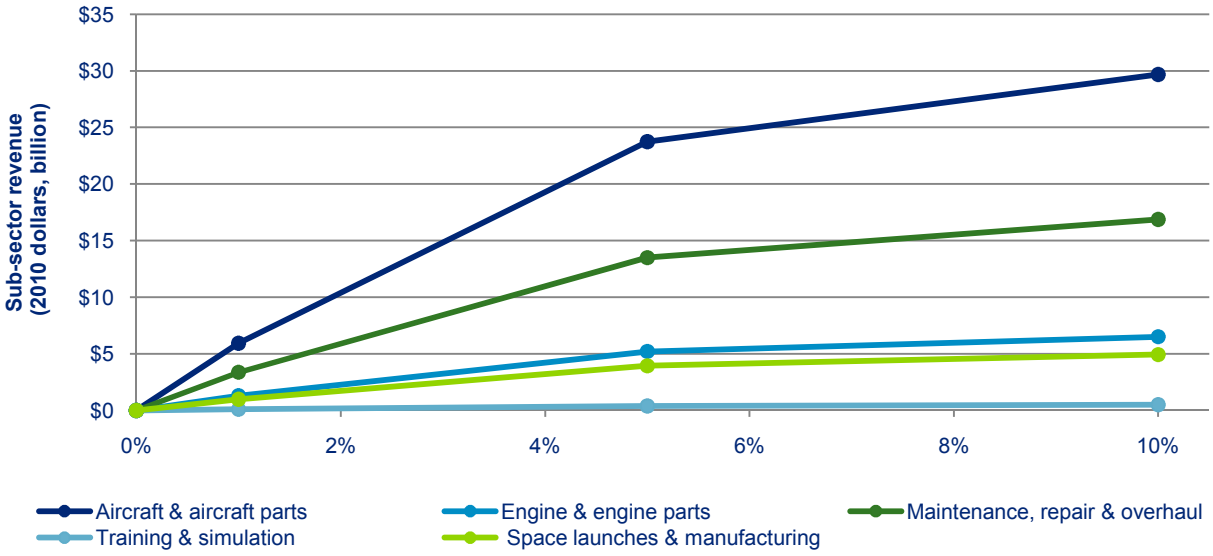


Figure 58: NPV for incremental changes in global MAS market share



9 Policy scenarios

Canadian values presented in this section are based off data from the current and historical AIAC surveys. Limitations in the underlying data-set will inherently limit the results presented. Also, definitional and coverage issues may exist when comparing values across countries. For example, R&D spending may be defined to include different things in the US and Canada. Therefore, this section should be read as qualitative and not as a source of quantitative estimates.

9.1 Introduction

The principal purpose of the policy scenarios is to tie the global market forecast provided to key global drivers and significant domestic issues which are expected to impact the Canadian aerospace industry. The three scenarios examined are:

1. Job creation;
2. R&D investment; and
3. Emerging market growth.

Scenarios were selected for two primary reasons. First, they represent important issues for the domestic aerospace industry. Second, each scenario corresponds to a critical component of Canada's National Aerospace and Defence Strategic Framework. Scenario one relates to skills development, scenario two corresponds to technology development and commercialization, and scenario three relates to trade policies and trade development initiatives.[233]

A final scenario is examined in which Canada's aerospace employment doubles by 2020. This scenario estimates the required increase in Canada's share of the global aerospace market and R&D investment if Canada's goal is to double the size of the industry, in terms of employment, by 2020.

9.2 By 2020, the Canadian aerospace industry has the potential to add significant net new jobs to the Canadian labour force

> *"A highly skilled and trained workforce is a key enabler in the aerospace and defence industry … Maintaining Canada's current aerospace and defence industry production will also require a significant increase in recruitment as the workforce ages. Initiatives under this strategic area will help address skills and training issues by improving the skills base of the industry, attracting young people to the sector and improving the linkages between industry and educational institutions. Improved workforce skills will also increase productivity and competitiveness." – A&D Strategic Framework*

The Canadian aerospace industry is a significant employer within Canada, as the aerospace industry employed an estimated 79,000 people in 2009, with a corresponding payroll cost of approximately C$4.6 billion. The types of jobs generated by the Canadian aerospace industry can be divided into four categories: engineering and scientific staff, production staff, technicians and/or technologists, and all others. Of these four groups, production staff is the largest category of employment (an estimated 47.2%

[233] Industry Canada, "The National Aerospace and Defence Strategic Framework: The Canadian Industry to 2025", accessed from http://www.ic.gc.ca/eic/site/ad-ad.nsf/eng/ad03881.html#securing in July 2010.

of the Canadian aerospace workforce).[234] In addition, the majority of jobs are located in the hubs of Montreal and Toronto.

In terms of job qualifications, the aerospace industry tends to impose higher standards. A US study showed that the majority of aerospace jobs require a bachelor's degree or higher, and that aerospace employees earn nearly 50% more, on average, than the median manufacturing wage.[235] Therefore, aerospace jobs are highly lucrative and presumably offer greater ancillary benefits to other parts of the economy (due to higher levels of disposable income, etc.).

Aerospace industries around the world have expressed concerns over possible skilled labour shortages. In the US, a report by the American Institute of Aeronautics and Astronautics found that:

> *"26% of aerospace employees will be eligible to retire this year, and potential additional retirements of "baby-boom" personnel will create a virtual "silver tsunami" of skilled workforce reduction."*[236]

In Europe, similar concerns were raised in a report to the European Commission which stated:

> *"Worries about skills shortages are widespread in the aerospace industries. European industry sources indicate that the availability of skilled workers and engineers has emerged as an important issue. Demand for highly skilled European aerospace workers is also growing at the lower levels of the value chain. Most of the worries about skills shortages are directed at engineering."*[237]

Labour issues in the Eurozone may be heightened by natural limits on cross-border labour mobility.

9.2.1 Job creation - methodology

The following scenario examines future employment levels in the aerospace industry under three revenue growth scenarios through 2020:

1. Canada's global aerospace market share remains the same.
2. Canada's global aerospace market share experiences a linear decline of 10% over current levels by 2020.[238]
3. Canada's global aerospace market share experiences a linear increase of 10% over current levels by 2020.

For each scenario, employee requirements are generated using historical trends in industry revenue per employee (termed "employment intensity" for the purposes of this report). To account for changes in labour productivity, historical employment intensity values are taken from a number of important global aerospace countries. For each revenue growth scenario, the various employment intensities are applied to show the outcome on industry employment. Asking questions such as, "what if the Canadian aerospace industry was to increase market share by 10% through productivity increases that had the side-effect of lowering employment intensity to levels seen in the US?"

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[234] Deloitte, AIAC Phase 1 report, September 2010.

[235] Bureau of Labor Statistics, "Career Guide to Industries: Aerospace Product and Parts Manufacturing", 2009-2009 edition.

[236] American Institute of Aeronautics and Astronautics, "Working together to Build the Aerospace workforce of Tomorrow", May 2008.

[237] EcoRYS Research and Consulting, "Competiveness of the EU Aerospace Industry", 2009.

[238] Market share increases in this section are applied on a multiplicative basis. For example, a 10% increase in Canada's market share would correspond to multiplying Canada's current market share by 1.1. Note that this differs from the way increases are applied in the NPV calculations.

Table 34: Employment intensity of selected countries

Country	Employment intensity (%)
Canada[i]	28
Brazil[ii]	27
France[iii]	39
Germany[iv]	43
Japan[v]	41
United Kingdom[vi]	33
United States[vii]	25

[i]Source: AIAC, average of 6 years of historical data [ii]Source: AIAB, average of 4 years of historical data.
[iii]Source: GIFA, average of 2 years of historical data [iv]Source: BDLI, average of 4 years of historical data.
[v]Source: SJAC, average of 5 years of historical data [vi]Source: SBAC, average of 6 years of historical data.
[vii]Source: AIA, average of 6 years of historical data.

The 2020 labour requirements are compared to Statistics Canada and Conference Board of Canada labour force forecasts to illustrate how the importance of Canada's aerospace industry to total employment would change under the various scenarios. Historically close to half a percent of Canada's total labour force has been employed in the aerospace industry and each scenario will illustrate the impact of developments in the aerospace sector on its importance to the national labour market.

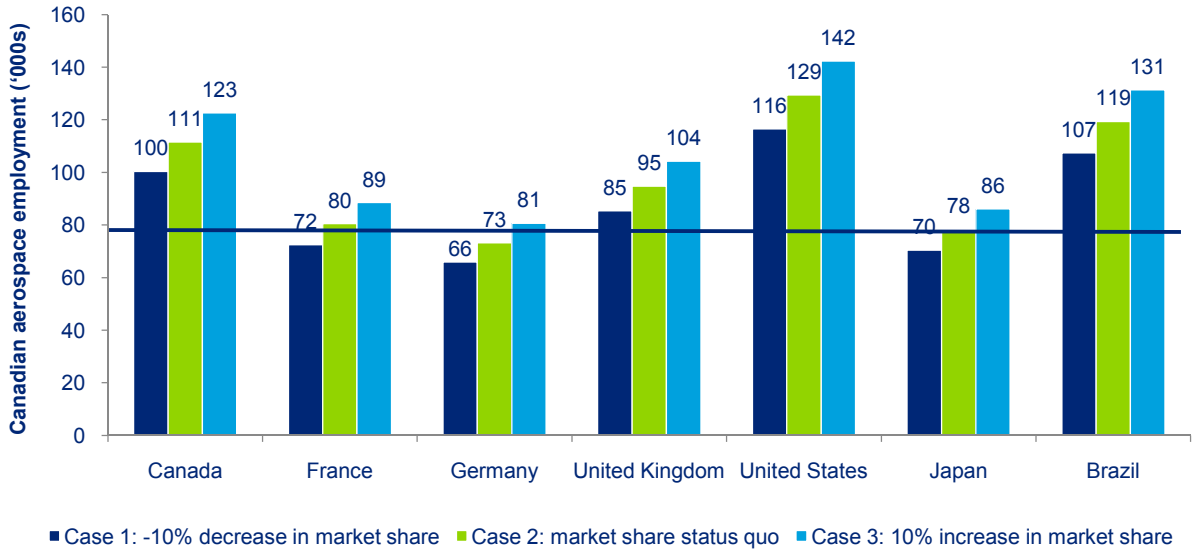
9.2.2 Job creation - results

The Canadian aerospace industry is a significant employer within Canada. The proceeding analysis provides an explanation of the impact on the Canadian aerospace industry and the Canadian economy, if Canada were to increase or decrease its global market share position in 2020. Given Canada's current labour intensity, the Canadian aerospace sector will support over 100,000 jobs in 2020; this corresponds to approximately 22,000 net new high value jobs.

If labour intensity remains constant and the Canadian aerospace industry increases its current market share by a factor of 10%, over 44 thousand new jobs is expected to be created. Each percentage increase in global market share requires approximately 1,000 highly-skilled employees.

Labour gains from the industry will be significant even if Canada's labour intensity decreases (due to productivity gains or product shifts) to levels seen in Japan or Germany. The industry will still require 78,000 employees in 2020 even if Canada were to follow Japan's historical labour intensity while holding Canada's market share constant.

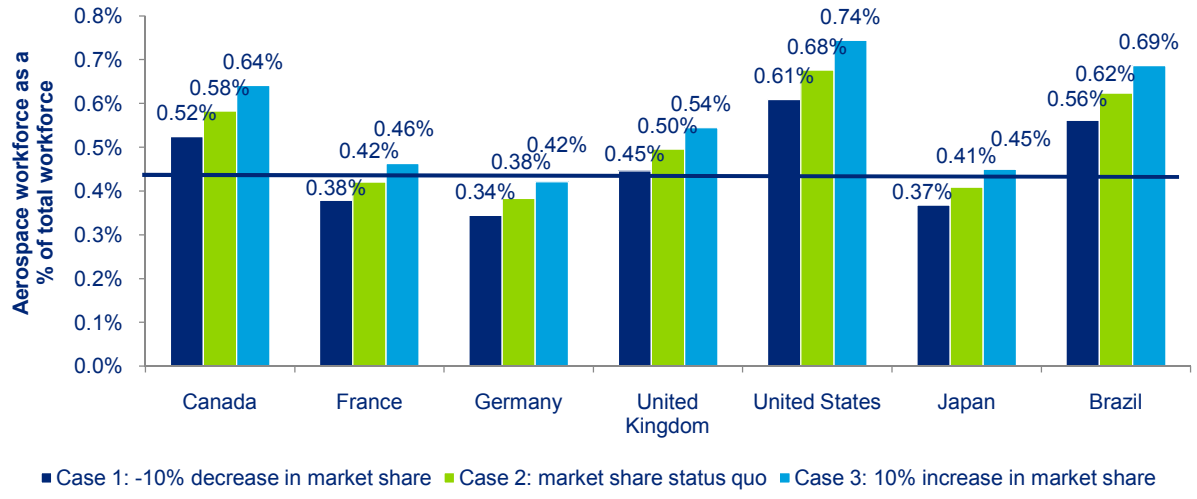
Figure 59: Forecasted 2020 Canadian aerospace employment and job creation opportunities



The line (79,000) corresponds to the current (2009) Canadian aerospace workforce.[239] Any value above the benchmark is assumed to be new jobs to the Canadian economy. Changes in the number of jobs can be calculated by finding the difference between the value of a bar and the value of the line.

When compared to Canada's forecasted labour force, the growing importance of the aerospace industry in the Canadian economy becomes more apparent. Even if Canada's share of the global aerospace market decreased 10% by 2020 the industry would still employ a larger percentage of the Canadian labour force (0.52%) than has been seen in the historical data examined. Approximately 60% of all market share and labour intensity scenarios examined resulted in the aerospace industry employing a larger share of the workforce than has been seen in recent years.

Figure 60: Forecasted 2020 percentage of Canadian workforce in the aerospace industry



The line (0.46%) corresponds to the average percentage of the Canadian workforce in the aerospace industry between 2005 and 2009.[240] Total 2020 labour force projections are taken from Statistics Canada and the Conference Board of Canada.[241]

[239] AIAC, historical annual surveys.

[240] AIAC, historical annual surveys.

[241] Statistics Canada, "CANSIM Table 282-0002" & Conference Board of Canada, "Economic Outlook 2009", 2009.

9.3 R&D investment remains a critical issue in driving innovation and ensure Canada's overall competitiveness

"One of the fundamental drivers of the aerospace and defence industry is R&D. Growth of the most successful aerospace and defence firms are directly linked to investment in R&D that leads to successful product commercialization. The Canadian industry can thrive and prosper if it strengthens its commitment to R&D at all stages" – A&D Strategic Framework

R&D investment in the Canadian aerospace industry is focused on R&D initiatives and investments in physical capital or property, plant, and equipment ("PPE"). In 2009 the Canadian aerospace industry invested an estimated C$1.9 billion in R&D and PPE. R&D spend constituted 72.7% of investments (C$1.4 billion) with the PPE spend constituting 27.3% of investments (C$0.5 billion). The Canadian government provided an estimated C$0.5 billion in funding for R&D activities to Canadian aerospace companies in 2009, which represents 33.8% of these companies' total R&D spend. However, the sector's largest source of financing for R&D projects comes from internal company financing. In terms of sector revenue, internal company financing that is used for R&D spend represents a total of 4.2% of revenues, while total R&D spend (from all sources of financing) represents 6.4% of revenues.[242]

Public sector aerospace R&D investment and involvement is critical because of the aerospace industry's high R&D intensity. Suppliers must invest heavily to develop the technology required to position themselves for the next generation of aircraft platform; this is particularly crucial because of the long period between platform refreshes and the relatively small number of aircraft platforms in production at any given time. The level of competition in the regional aircraft market means that innovation will be critical to Canada's success. The importance of innovation in the regional aircraft market is illustrated by Bombardier's Q400 program outlined in the Phase 2 report.

The public and private sectors in Canada already recognize the importance of R&D investment and have developed a number of innovative programs (e.g., SADI, and GARDN).

9.3.1 R&D investment - methodology

This scenario looks at future R&D investment levels in the aerospace industry under three revenue growth scenarios:

1. Canada's global aerospace market share remains the same ("status quo").
2. Canada's global aerospace market share experiences a linear decline of 10% over current levels by 2020.[243]
3. Canada's global aerospace market share experiences a linear increase of 10% over current levels by 2020.

R&D requirements are generated using historical trends in the amount of R&D required to generate a unit of revenue ("R&D intensity"). This R&D intensity includes both public and private sector sources of R&D funding and is partitioned into private and public R&D spending based on historical averages.

Based on the competitive market analysis, Canada's R&D intensity may need to increase to the levels seen in many European countries for competiveness purposes. To account for potential changes in R&D intensity, historical R&D intensity values are taken from a number of important aerospace countries. Canada's R&D intensity dropped significantly in 1999 and therefore two scenarios are created, a pre- and post-1999 scenario. Note that the level of R&D investment by the public sector also varies significantly between countries.

[242] Deloitte, AIAC Phase 1 report, September 2010.

[243] Market share increases in this section are applied on a multiplicative basis. For example, a 10% increase in Canada's market share would correspond to multiplying Canada's current market share by 1.1. Note that this is different than the way increases are applied in the NPV calculations.

Table 35: R&D intensity and public sector R&D investment for selected countries

Country	R&D intensity (%)	Percentage of R&D from private sector (%)
Canada (Pre 1999)[i]	10	67
Canada (Post 1999)[i]	6	67
France[ii]	16	56
Germany[iii]	16	25
United Kingdom[iv]	11	49
United States[v]	10	28

[i]Source: AIAC & Conference Board of Canada, R&D intensity based on approximate long-run average, average of 1 year (2009 due to lack of pre-1999 data) of data for private sector R&D investment.
[ii]Source: AIAC & Conference Board of Canada, R&D intensity based on approximate long-run average, 1 year (2009) of data for R&D from private sector.
[iii]Source: GIFA, 5 years of historical data for R&D intensity, average of 4 years of data for private sector R&D investment.
[iv]Source: SBAC, 6 years of historical data for R&D intensity, average of 3 years of data for private sector R&D investment.
[v]Source: AIA, 2 years of historical data for R&D intensity, average of 2 years of data for private sector R&D investment.

The 2020 R&D requirements are converted into a CAGR in total aerospace R&D investment. This R&D CAGR provides a general guide to the growth in yearly R&D spending required to meet the demands put forth by the Canadian aerospace industry.

9.3.2 R&D investment - results

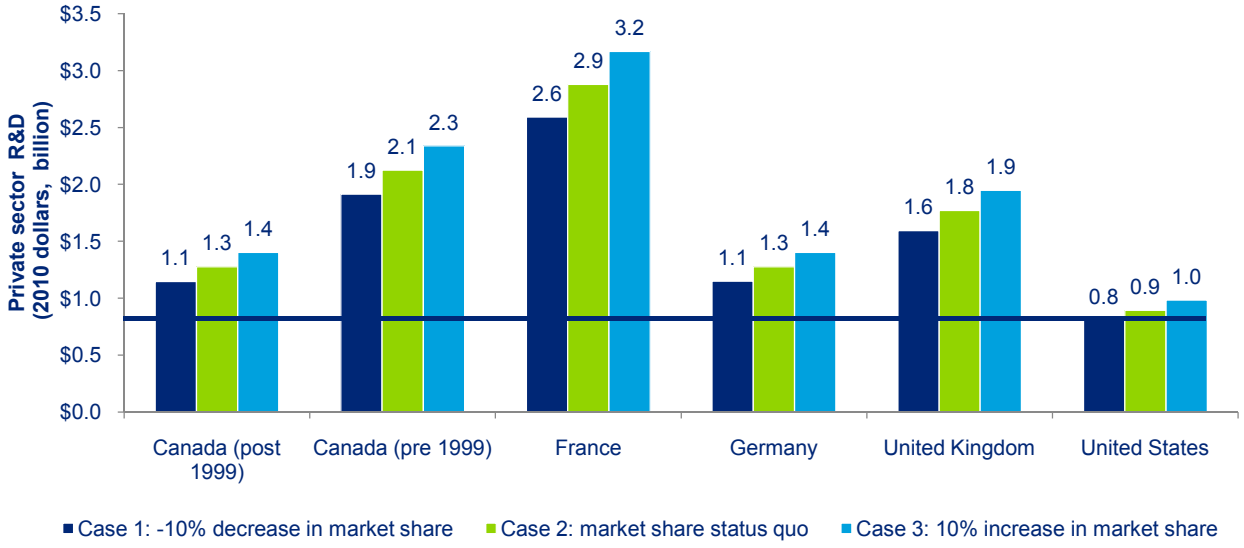
This analysis considered a number of different cases when analyzing R&D intensity in Canada and the required investment to maintain Canada's competitiveness. Current Canadian public and private sector R&D spending is lower than that of France and Germany. Additionally, total Canadian R&D spending is lower than that of the US.

In 95% of the scenarios examined, forecasted 2020 aerospace R&D spending is higher for both the public and private sector than it was in 2009. The required increase in R&D spending is marginally greater in the public sector given Canada's current trajectory; in the baseline scenario, using a post-1999 R&D intensity, the private sector would need to contribute an additional $0.5 billion in R&D investment and the public sector would need to add an additional $0.6 billion in R&D funding.

The forecast also predicts that significant R&D investments are required from both the public and private sector if Canada wishes to use R&D investment as a mechanism to grow market share. R&D funding would need to be increased by $1.8 billion over current levels ($1.5 billion from the private sector and $0.3 billion from the public sector) if Canada were to increase market share by a factor of 10% through the increasing of R&D intensity to pre-1999 levels.

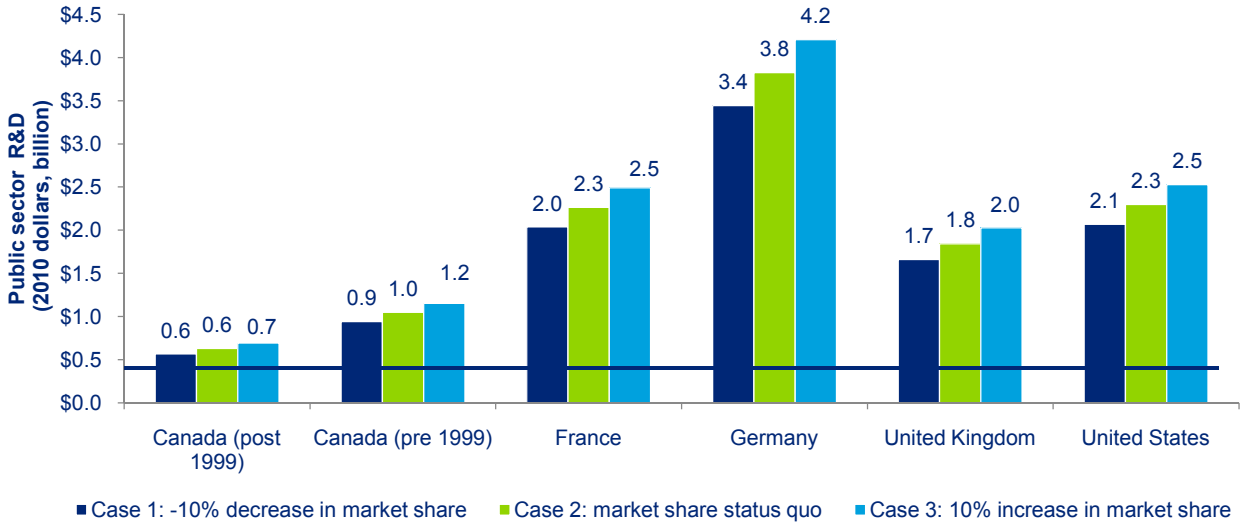
The majority of countries examined receive a larger share of R&D funding from the public sector. To match US public sector R&D spending levels would require a significant investment from the Canadian government. Public sector R&D funding would need to increase by $1.3 billion to be in line with the US's 72% of R&D funding from the public sector under a status quo scenario. Further, $1.9 billion in public sector R&D funding would be required if Canada were to also increase R&D intensity to the level seen in the US.

Figure 61: Forecasted private sector R&D spending in 2020 for three scenarios of Canadian aerospace market share growth



The line ($0.82 billion) corresponds to the level of Canadian private sector R&D spending in the aerospace industry in 2009.[244] Additional R&D spending can be found by calculating the difference between the bar and the line.

Figure 62: Forecasted public sector R&D spending in 2020 for three scenarios of Canadian aerospace market share growth



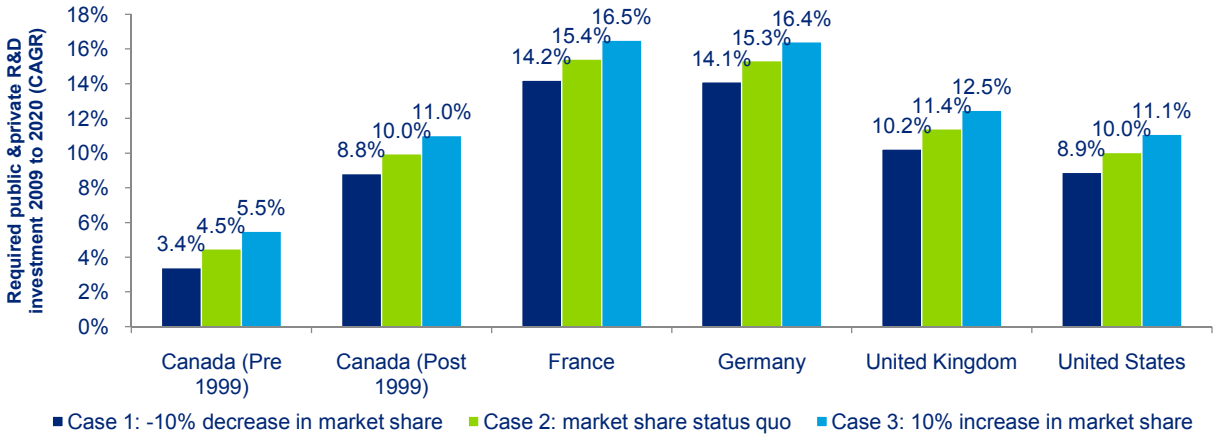
The line ($0.41 billion) corresponds to the level of Canadian public sector R&D spending in the aerospace industry in 2009.[245] Additional R&D spending can be found by calculating the difference between the bar and the line.

The analysis also shows that a significant yearly growth in R&D investment will be required to meet the forecasted R&D requirements. For example, if Canada's global aerospace market share were to fall by a factor of 10%, the industry would still require a 3.7% CAGR in R&D investment. Under an aggressive scenario, in which Canada matches the R&D spending of France or Germany, the required CAGR in R&D investment would be over 14%. The forecast shows Canada requiring a CAGR in R&D spending of 4.8% if Canada were to hold R&D intensity constant and follow a status quo market share scenario.

[244] Deloitte, AIAC Phase 1 report, September 2010.

[245] Deloitte, AIAC Phase 1 report, September 2010.

Figure 63: Required 2009 to 2020 CAGR of combined public and private R&D spending to meet forecasted 2020 R&D requirements



9.4 Emerging markets will be an opportunity for Canada if the Canadian aerospace industry can reconfigure itself to capture this growth

> "The Canadian industry is successful in international markets. … Canadian firms require continued access to foreign markets and investment. This requires promotion of Canadian aerospace and defence firms and their capabilities as well as the development of contacts in foreign markets." – *A&D Strategic Framework*

The Canadian aerospace industry is largely export based, with an estimated C$17.3 billion in revenue (or 77.9% of total aerospace revenues) generated from sales to foreign markets. The largest foreign market for Canadian aerospace products and services is the United States, accounting for an estimated C$9.9 billion in revenues (or 57.0% of total industry exports).[246]

As mentioned previously, emerging markets are forecast to have an impact on the global aerospace industry. For example, China is making an impact both in terms of air travel and manufacturing with an RPK growth-rate three percentage points over North America and with the burgeoning state-sponsored aircraft manufacturer COMAC. However, growth may be overstated given the small base from which these emerging markets are growing. Approximately 90% of civil aerospace manufacturing revenue[247] is generated in Europe or North America, and the developed countries accounted for almost 45% of global RPK volumes in 2008.[248]

The impact of the emerging markets on future aerospace growth in Canada is analyzed. This scenario examines whether emerging markets are a serious issue for Canada through 2020 and if the Canadian aerospace industry can look to emerging markets to grow global market share. This scenario gives Canada increased clarity on the nature of emerging markets for use in developing trade strategies.

9.4.1 Emerging market growth - methodology

For the purposes of this scenario, emerging markets are defined as all regions excluding North America and Europe. In particular, this scenario looks at three growth scenarios:

1. Emerging market aerospace manufacturing grows at the baseline rate in the forecasting model through 2020 ("baseline scenario").
2. Emerging market aerospace manufacturing grows at rate that is 25%[249] above the baseline forecast through 2020.

[246] Deloitte, AIAC Phase 1 report, September 2010.

[247] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

[248] Boeing, "Market Outlook 2009-2028", 2009

[249] The percentage is applied by adjusting the slope of the regression model up by 25% or 50% respectively.

3. Emerging market aerospace manufacturing grows at rate that is 50% above the baseline forecast through 2020.

All three scenarios assume Canada's share of the global market remains constant. For each scenario, the shifts in the geographical distributions of global revenue are examined.

9.4.2 Emerging market growth - results

This analysis suggests that emerging markets represent an opportunity for the Canadian aerospace industry because domestic demand in emerging markets for aerospace products will outstrip domestic supply. When coupled with the results from the market forecast, the picture emerges of developed countries remaining the main drivers of revenue with emerging markets representing an increasingly important opportunity for manufacturing revenue growth.

On a CAGR basis, the baseline aerospace manufacturing revenue growth for Asia-Pacific is only 1% higher than the same value for North America (4.8% vs. 3.74%). Consider the assumption that the forecast model underestimated the slope of emerging market aerospace manufacturing by 50%; this assumption results in a small 0.2% reduction in the CAGR of aerospace manufacturing in North America and Europe and a 1.3% to 1.5% increase in the CAGR of aerospace manufacturing in Asia-Pacific, Latin America, Africa, CIS, and the Middle East.

RPK growth outpaces manufacturing growth for most of the forecasted emerging market scenarios. RPK growth will outpace manufacturing growth in the "worst case" scenario for all emerging markets except Latin America (See Figure 64). Specifically, RPK growth would outpace growth in aircraft manufacturing by 1.6% in Asia-Pacific and 3.5% in the Middle East.

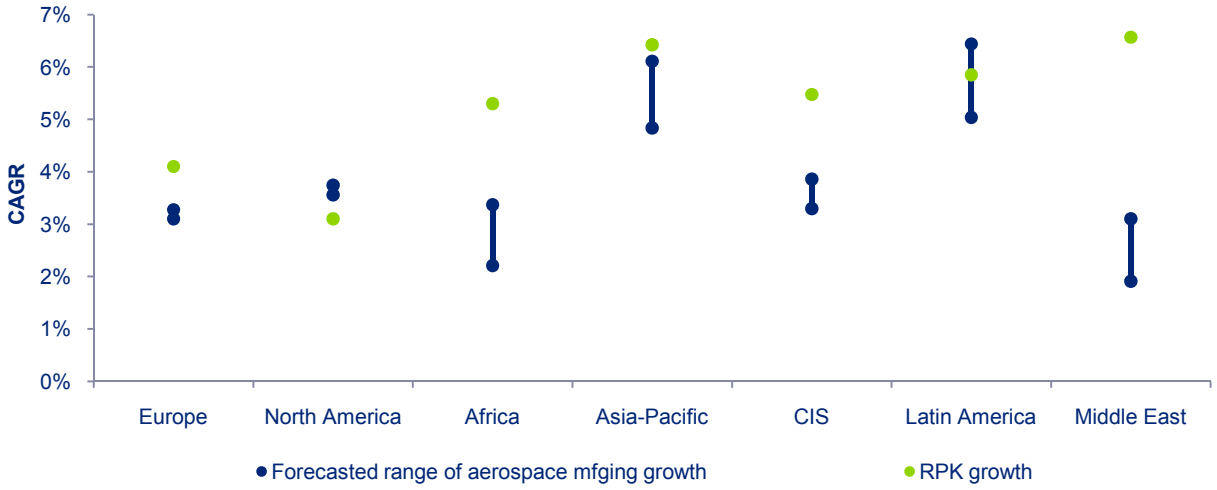
From a public policy perspective, it is important to note that the differential between RPK growth and aircraft manufacturing growth suggests that a significant gap exists in the ability of emerging markets to meet future increases in domestic demand for aerospace products using internal sources of supply (e.g., China using only COMAC aircraft for regional flights); this gap represents an opportunity for the Canadian aerospace industry and a basis for shaping trade policies.

Table 36: Emerging market manufacturing and RPK growth comparison

All values expressed as a %	Scenario 1 (baseline), 2009-2020 revenue CAGR	Scenario 2, 2009-2020 revenue CAGR	Scenario 3, 2009-2020 revenue CAGR	Difference between Scenario 3 & Scenario 1 CAGR[i]	Difference between CAGR of RPK & Scenario 3[ii]
Developed Markets					
Europe	3.28	3.19	3.10	-0.2	1.00
North America	3.74	3.65	3.56	-0.2	-0.46
Emerging Markets					
Africa	2.2	2.8	3.4	1.2	1.9
Asia-Pacific	4.8	5.5	6.1	1.3	0.3
CIS	3.3	3.6	3.9	0.6	1.6
Latin America	5.0	5.8	6.4	1.4	-0.6
Middle East	1.9	2.5	3.1	1.2	3.5

[i]A negative number corresponds to manufacturing revenue growth is slower in scenario 3 than in the baseline scenario 1. [ii]A negative number corresponds to manufacturing revenue growth that is greater than regional RPK growth.

Figure 64: Emerging market aerospace manufacturing and RPK growth



Note that RPK growth is forecast to outpace manufacturing growth for any regions in which the RPK line is above the forecasted range of aerospace manufacturing growth.

The forecast model estimated that the majority of revenues will originate from North America and Europe. However, the analysis suggests that the Middle East, CIS and Africa (albeit Africa is still a small market) are still net growth opportunities for Canada in 2020 because demand for aerospace products will outstrip domestic supply. As a result, this analysis suggests that public policy should focus on viewing emerging markets as a net opportunity rather than a threat to Canadian aerospace manufacturing and focus on policies that encourage free trade between Canada and emerging markets.

9.5 Canada has the potential to double aerospace employment by 2020

This scenario looks at what would be required if the goal were to double aerospace industry employment from approximately 79 thousand in 2009 to approximately158 thousand in 2020. At current employment intensity (i.e., productivity), the Canadian aerospace's share of the global market would need to grow by approximately 55% with CAS market share growing 10% to 14% and MAS market share growing from 2% to 3%.[250] However, to gain this market share the industry may need to become more productive (i.e., less labour intensive). If the industry were to become as productive as Germany, Canada's share of the global CAS would need to more than double with growth in CAS market share of 10% to 20% and growth in MAS market share of 2% to 4%.

This increase in market share implies increases in R&D investment, ranging from $0.8 billion to $7 billion by 2020 depending on R&D intensity. To growth market share, an increase in R&D intensity to that of other competitive countries may be required. The R&D investment, market share, and revenues required to double employment by 2020 are outlined below:

Figure 65: 2020 market share, revenue, and R&D investment required to a double aerospace industry employment[251]

R&D intensity	Labour intensity: Low	Labour intensity: High (Current)
High	2020 CAS revenue = **$52 billion** CAS market share = **20%** 2020 MAS revenue = **$11 billion** MAS market share = **4%** R&D increase = **$6.8 billion**	2020 CAS revenue = **$38 billion** CAS market share = **14%** 2020 MAS revenue = **$8 billion** MAS market share = **3%** R&D increase = **$4.4 billion**
Low (Current)	2020 CAS revenue = **$52 billion** CAS market share = **20%** 2020 MAS revenue = **$11 billion** MAS market share = **4%** R&D increase = **$1.7 billion**	2020 CAS revenue = **$63 billion** CAS market share = **14%** 2020 MAS revenue = **$8 billion** MAS market share = **3%** R&D increase = **$0.8 billion**

[250] This assumes that the current mix of MAS and CAS activity remains constant (i.e, 83% of revenues coming from the CAS).

[251] The high R&D and employment intensity assumes Canada achieves Germany's respective values by 2020 as outlined in the previous scenarios. The low R&D and employment intensity assume Canada's values remain constant through 2020 as outlined in the previous scenarios.

Appendix I - CAS sub-sector overview

For the purposes of sub-sector discussions, the A&AP and E&EP subsectors will be treated as a single sub-sector called aerospace manufacturing.

Aerospace manufacturing overview

The economic downturn had a negative impact on manufacturers in the CAS, with revenue dropping by 4% from FY 2008 to FY 2009. This value is in line with the drop seen in overall airline traffic of 4.1%. Manufacturing experienced strong revenue growth in 2006-2007 before a slowdown that started in 2007 and peaked in 2009. Current forecasts show positive growth for FY 2010.

Table 37: Historical civil aerospace manufacturing revenue

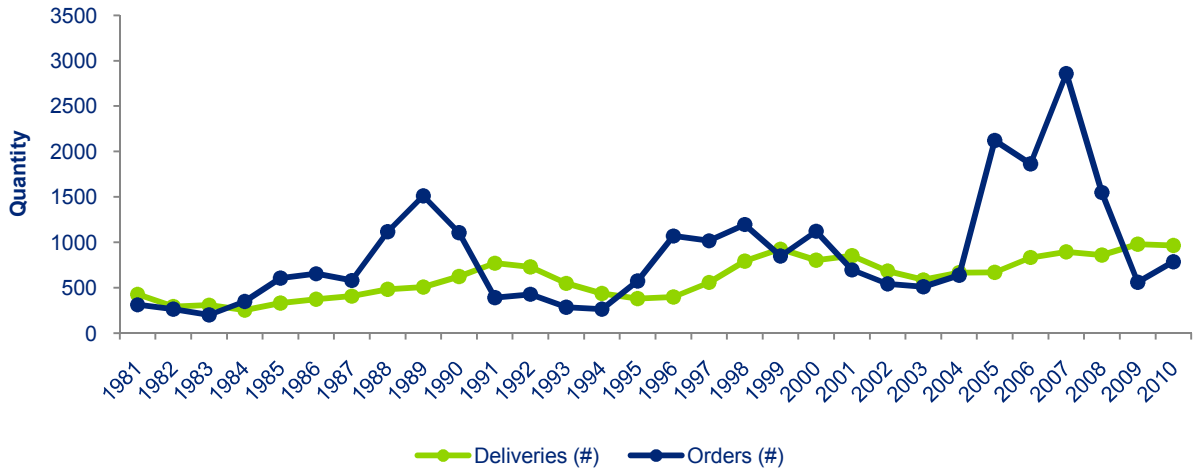
	2006	2007	2008	2009	2010F
Revenue (USD billion)	121.98	132.43	134.56	127.22	129.32
YoY real growth (%)	9.5	8.6	1.6	-5.5	1.7

In 2008, new commercial aircraft orders declined of 80%.[252] However, declines in new orders will likely impact future cash-flows and not current cash-flows derived from deliveries. Aircraft OEMs increased delivery volumes in 2009 by shuffling orders in their large order backlog. Boeing, for instance, offset deferrals in 2009 by moving forward the delivery date for airlines in a stronger financial position.[253]

[252] Scotiabank, "Global Economic Research Industry Tends – Aerospace", April 20 2010.

[253] Scotiabank, "Global Economic Research Industry Tends – Aerospace", April 20 2010.

Figure 66: New orders and deliveries of large commercial aircraft[254]



A turbulent business aircraft market was also a factor in the 2009 decline in manufacturing revenue. Estimates have put declines in the number of shipments of business aircraft at 38-40% between Q4 2008 and Q3 2009.[255] Cessna saw 2009 revenue declines of 42% for their business jet unit. [256]

Product segmentation

Aerospace manufacturers can be segmented based on the type of end product as shown in Table 38.

Table 38: CAS manufacturing revenue by product type

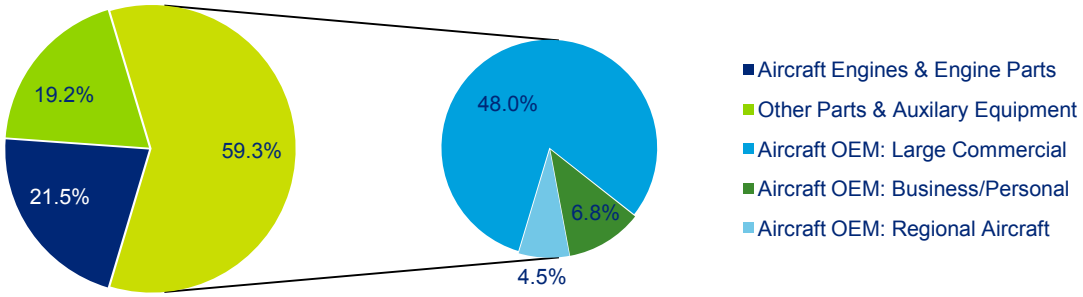
Segment	2009 Revenue (USD billion)	2005 Revenue (USD billion)	2005-2009 CAGR (%)	Change in share of total revenue from 2005 to 2009 (%)
Engines & engine parts	28.63	21.45	7	1
Other parts & auxiliary equipment	23.54	19.15	5	-0.7
Aircraft OEM	75.06	21.45	7	-0.3
Large commercial aircraft	59.79	47.88	6	-1%
Business/Personal/Rotorcraft	8.905	6.783	7	0.2
Regional Aircraft	6.361	4.488	9	0.5

[254] Aboulafia, Richard (Teal Group), "The Last Healthy of the Global Economy" [presentation], May 2010.

[255] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[256] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

Figure 67: 2009 CAS manufacturing segmentation by product type[257]



Aircraft OEMs are the dominate source of manufacturing revenue and therefore have significant influence over the entire CAS. For example, the two largest aircraft OEMs, Boeing and Airbus (EADS), are estimated to have influence of over 90% of parts suppliers.[258]

Within Aircraft OEM, the dominant product category is large commercial aircraft ("LCA"). The prominence of the LCA product segment is due to the inclusion of virtually all aircraft used for long-haul and freight applications within its definition. The LCA segment has, however, seen a decline in revenue share since 2005 when it accounted for 48% of revenues.

In contrast, regional aircraft's share of manufacturing revenue has grown 6.8% since 2005. Regional aircraft have been favourably impacted by the growing domestic markets for airline travel in the developing world because they offer a low-cost solution for short-haul intra-country flights.

The general aviation category (including rotorcraft, business aircraft, and personal aircraft) has grown as a share of the manufacturing revenue since 2005, rising from 6.8% to 7%. Sales of business jets have been supported by the rise in alternative financing options, such as fractional ownership. Fractional ownership arrangements covered approximately 20% of the business aircraft fleet in 2007.[259]

Engine & engine part manufacturers per unit revenues have increased since 2005 due to more stringent aircraft fuel efficiency standards. Tightening fuel efficiency requirements have also resulted in faster development cycles for engine manufacturers. The E&EP segment accounted for approximately 23% of manufacturing revenues in 2009.

Aircraft parts (including avionics) have seen a decrease in manufacturing revenue share, from 22.5% in 2005 to 19.2% in 2009. The drop in revenue share is primarily due to downward pressure on component prices as production facilities move from traditional markets (Europe, Japan, and North America) to low-cost markets (China, Russia and South America).

Geographic segmentation

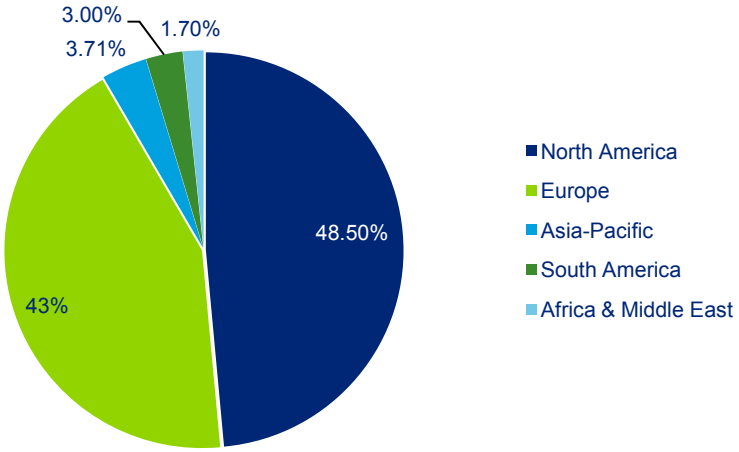
As of 2010, CAS manufacturing remained heavily concentrated in North America and Europe despite the growing influence of China, Russia, and Brazil.

[257] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

[258] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[259] Aviation Week, "Formerly Fractionalized", February 16 2010.

Figure 68: 2010 geographic segmentation of A&AP manufacturers by revenue[260]



India, despite being a major source of airline travel growth, is absent from the aerospace manufacturing industry (< 0.01% of global activity). The US remains the global hub of civil aerospace manufacturing and accounts for 41.5% of global manufacturing revenue. The remainder of the North American market share (7%) comes from Canada. In Europe, the high GDP EU member states – England (26%), Germany (18%), France (40%), Italy (unspecified), and Spain (unspecified) – account for 80% of Europe's aerospace manufacturing revenue. European activity is primarily linked to LCA (89.1% of revenue) with a significantly smaller contribution from business (4.4% of revenue) and regional (2.5% of revenue) aircraft.

Aerospace manufacturing performance in Asia-Pacific is highly dependent on the country of interest. China is often discussed as a major manufacturing growth market and manufacturers are positioning themselves to gain access to the domestic Chinese market. For example, in 2009 Airbus produced its first commercial aircraft in China. On the other hand Japan's aircraft manufacturing output has declined in recent years. The decline in aircraft manufacturing in Japan has been partially offset by an increase in parts and engine manufacturing which now accounts for approximately 69% of civil aerospace manufacturing revenues. Japan currently produces enough aircraft parts to meet 5% of domestic demand. [261]

South America is also experiencing significant civil aerospace manufacturing growth. Growth is particularly strong in Brazil which now controls 78% of regional aerospace exports. South American growth is being driven by strong growth in domestic travel. Currently, there are approximately 120 airlines in South America operating 1,460 aircraft. Mexico has also been experiencing significant growth in aerospace manufacturing because of: 1) low-cost labour; 2) relatively reliable workforce; and 3) proximity to the US market. Some of the regional differences that are particularly relevant to the Canadian market are highlighted in Table 39.

[260] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

[261] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

Table 39: Summary of civil aerospace manufacturing for regions of interest

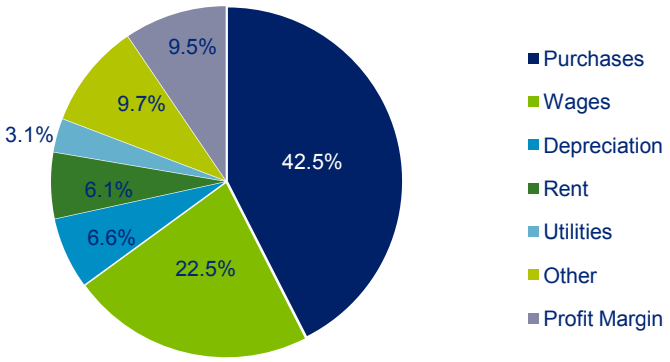
Region	Predominate sub-regions	Predominant class of manufacturing activity	Future outlook
US	-	LCA	Decline
Canada	-	Regional Jets	Stable
Mexico	-	LCA	Growth
Europe	France, Germany, UK, Italy Spain	LCA, Engines (UK)	Decline
Asia-Pacific	China, Japan	LCA (esp. airframes)	Growth
South America	Brazil, Argentina, Paraguay	Regional Jets	Growth

Industry cost structure

Almost 43% of manufacturing revenue is used to cover the cost of raw materials and equipment. The reason for this is twofold: first, by definition aircraft require significant resources and energy to produce; secondly, manufacturers are increasingly using more expensive composite materials, originally introduced in the 1970s, to meet demanding performance specifications. The large portion of revenue consumed by purchases highlights the vulnerability among primary aircraft OEMs to volatility in input prices.

The next largest cost constituent of revenue is labor costs, at 22.5%. It is estimated that the average A&AP manufacturing employee earns approximately $55,754; however, the average wage is approximately $66,000 in the US versus approximately $29,319 in Brazil representing a 2.25 times labour cost differential. Despite rising labor and purchase costs, the manufacturing industry's profit margins are projected to remain at a healthy 9.5% in 2010 and may improve further as manufacturing is increasingly outsourced to low-cost centers. IBISWorld estimates that a move to lower cost manufacturing markets would allow manufacturers to reduce component prices by 5-15% while growing profit margins.[262]

Figure 69: Allocation of A&AP manufacturing revenues[263]



The market conditions that are currently shaping aerospace manufacturing are the increasing levels of technology intensity and globalization. Technology intensity is reflected in the degree of R&D spending among manufactures and can be linked to trends in aircraft optimization with respect to fuel efficiency, passenger capacity, and environmental emissions. The rise of developing countries is the primary driver behind increasing levels of globalization. Manufacturers may be required to shift capacity, in line with shifts in passenger volumes, to Latin America, Asia-Pacific, and the Middle East. Some of the key industry conditions, as highlighted by IBISWorld, are summarized in Table 40.

[262] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

[263] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

Table 40: Key conditions in the global CAS manufacturing sub-sector[264]

Condition	State	Trend
Competition	High	Stable ⟷
Barriers to entry	High	Stable ⟷
Regulation	High	Increasing ↑
Capital & labour intensity	Medium	Stable ⟷
Technology intensity	High	Increasing ↑
Volatility	Medium	Increasing ↑
Globalization	High	Increasing ↑

Manufacturing, repair, and overhaul overview

The MRO sub-sector was hit particularly hard by the recession of 2008-2009 with a reduction in business volumes of 15-20% in 2009. A trend was seen in which the degree of decline in MRO activity correlated closely to how expensive the MRO activity was to undertake for the airline. For example, BE Aerospace Inc., reported a drop in heavy maintenance of 50% in 2009. Despite this drop in activity, profit margins for MRO activities remain higher than those of airlines.[265] For 2010, Standard & Poor's estimates an increase in MRO volumes of 6-10%.[266]

Unlike aircraft orders, which must be placed years in advance, MRO expenses can be cut sharply as market conditions deteriorate. When faced with a downturn, airlines follow one of three courses of action that can result in a significant drop in MRO activity:

1. Deferral of non-essential maintenance;
2. Removing aircraft from service that are in need of significant MRO activity; and
3. Cannibalizing parts from parked aircraft.

Much of the global MRO activity comes from the servicing wings of large aircraft OEMs and commercial airlines. It may be reasonable to assume, therefore, that the recession had a different impact on these diversified companies as opposed to companies whose primary focus is on providing MRO services. To investigate the effect of the downturn on pure MRO players, the performance of the top three "pure MRO" companies over the last four years, as stated by Standard & Poor's, is examined. [267] As a group, these companies saw continual civilian MRO revenue growth throughout the recession. However, there is a drop in the fraction of revenue coming from civil MRO activity. This is likely due to an increase in revenue coming from defence MRO activity as noted by AAR Corp.:

> "*During fiscal 2009, sales to government/defence customers increased 17%, representing 43% of consolidated sales. By comparison, in 2001, sales to the defence market represented only 17% of consolidated sales.*"[268]

[264] IBISWorld, "Global Civil Aerospace Products Manufacturing", February 2010.

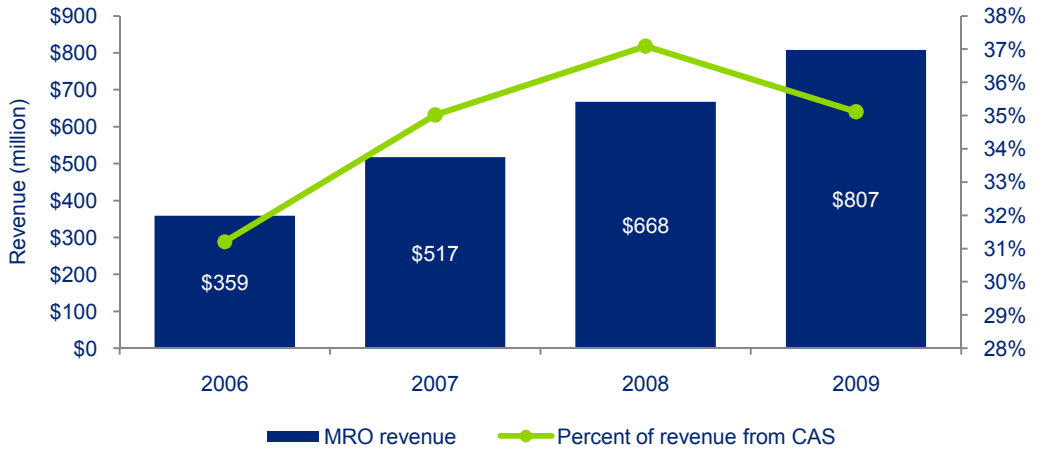
[265] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[266] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[267] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

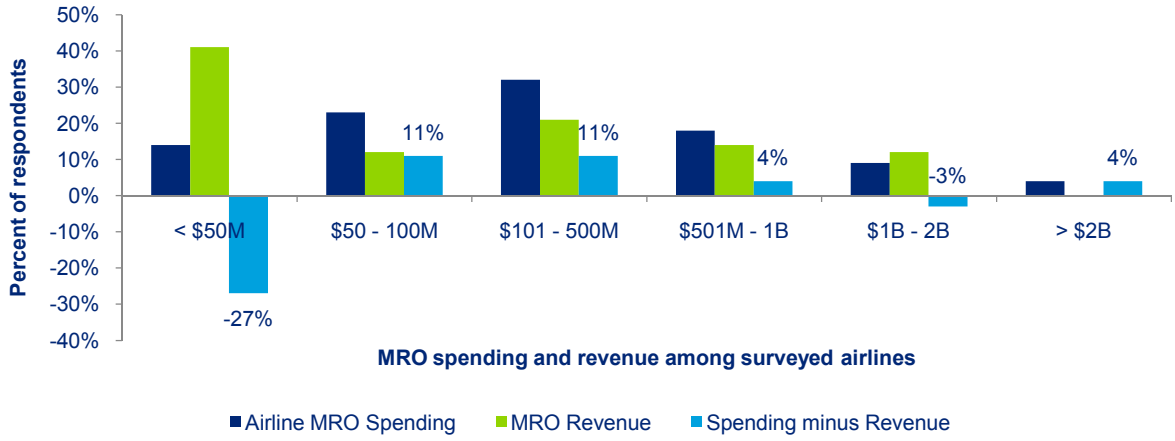
[268] AAR Corp , "2009 Annual Report", accessed from corporate webpage in June 2010.

Figure 70: Net performance of civil MRO divisions of Triumph Global, AAR Corp., & Heico Corp.



In the past decade, airlines have increasingly outsourced MRO activity. Approximately 68% of airline MRO activity is outsourced and this number is expected to grow to 70% in 2013.[269] This outsourcing trend can be shown by contrasting the MRO spending profiles of airlines and the amount of revenue airlines generate from MRO activities as shown in Figure 71 below. For example, only 15% of respondents stated that they spent less than $50 million on MRO activity while 47% stated that that received less than $50 million in MRO revenue.

Figure 71: Airline spending and revenue from MRO activity[270]

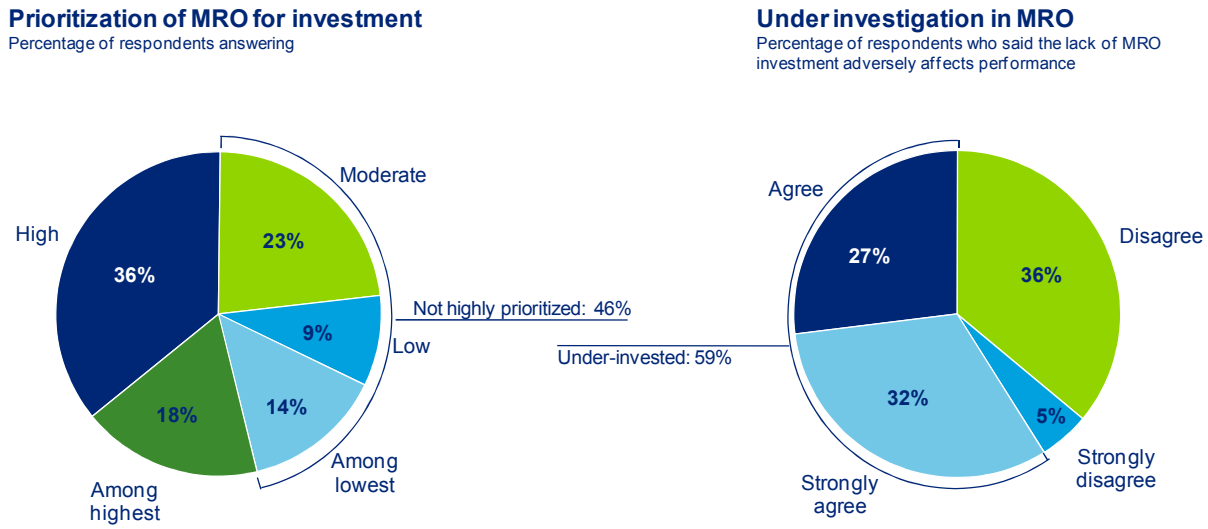


Net outsourcing of MRO activity has lead to an under-investment in MRO by commercial airlines. Almost 60% of airlines surveyed in 2008 by Oliver Wyman stated that they agree with the statement that they have under-invested in MRO.

[269] Oliver Wyman, "MRO survey", 2009.

[270] Oliver Wyman, "MRO survey", 2009.

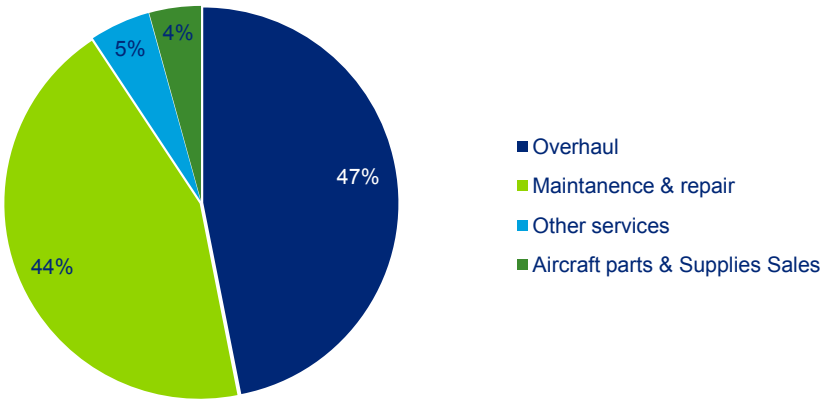
Figure 72: Airlines opinions of the state of internal MRO investment activities[271]



Product segmentation

Global data on MRO product segmentation is not available; however, information regarding MRO segmentation in the US is available. Based on this date, there is an even split in US revenue between maintenance and repairs, and overhauls services.

Figure 73: US segmentation of MRO industry[272]



Other services include: ferrying, inspections, and sales of fuel, lubricant & other merchandise.

Geographic segmentation

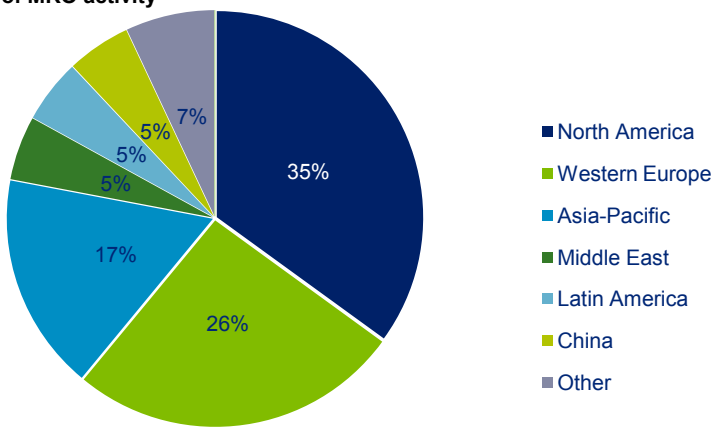
In the developed world it is rare for MRO services to be provided to international airlines. For example, in 2005 only 3.4% of US MRO revenues were generated from international airlines.[273] Further, Standard & Poor's gave the following 2009 breakdown of MRO activity by geographic region:

[271] Oliver Wyman, "MRO survey", 2009.

[272] IBISWorld, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

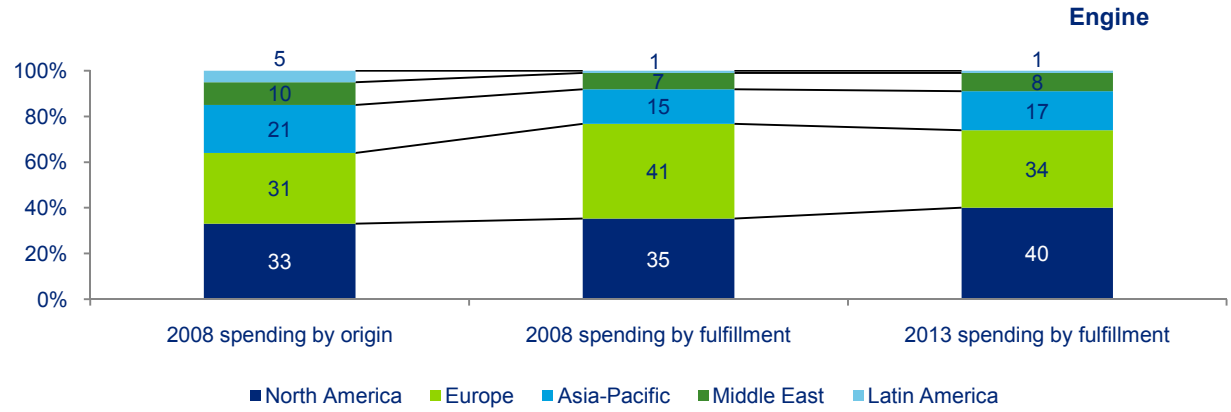
[273] IBIS World, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

Figure 74: Geographical distribution of MRO activity[274]



Maintenance, repair, and overhaul activities remain predominantly centered in North America and Europe, albeit to a lesser extent than is seen with aerospace manufacturing. Historically, it has made sense for MRO activity to be centralized around major network hubs. However, data shows that there is not a one-to-one match between where the aircraft is used (its origin) and where the MRO activity is conducted (fulfillment).

Figure 75: Geographical distribution of engine MRO by region of origin and fulfillment[275]



[274] S&P, "Industry Surveys – Aerospace & Defence", February 11 2010.

[275] Source: Oliver Wyman, "MRO survey", 2009.

Figure 76: Geographical distribution of component MRO by region of origin and fulfillment[276]

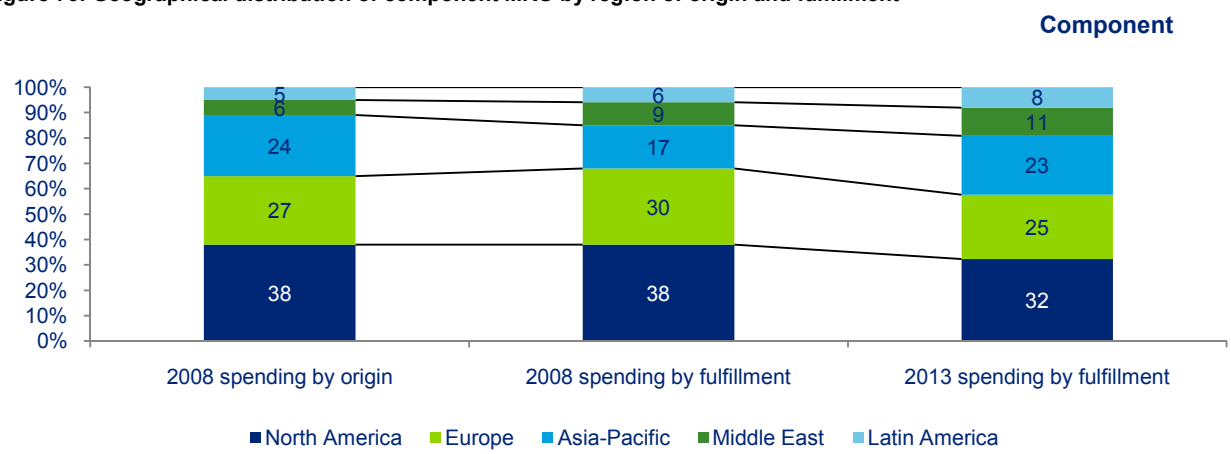
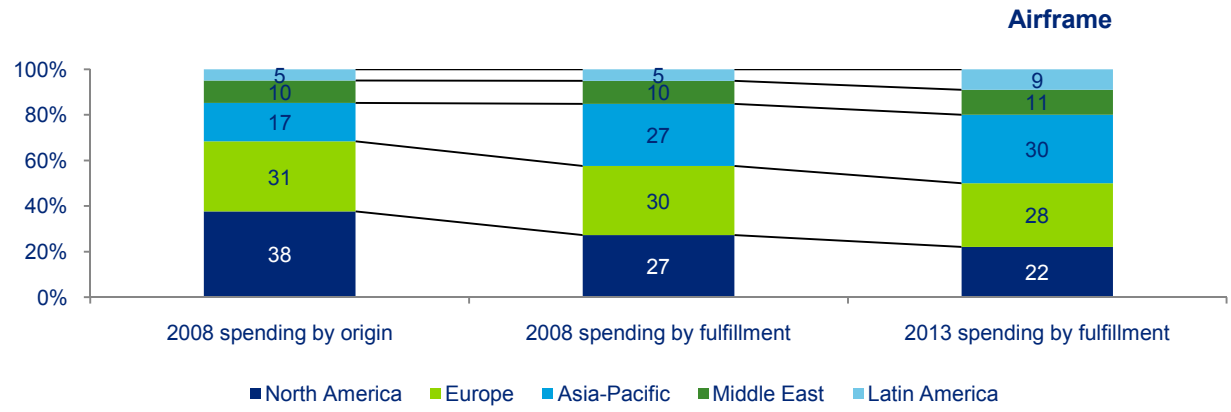


Figure 77: Geographical distribution of airframe MRO by region of origin and fulfillment[277]



The greatest variance between where the aircraft is used and where the MRO work was performed is seen for airframe and engine related MROs. For example, there is a variance of 11% between region of origin and region of fulfillment for airframes used in North America. This trend reflects the general fact that MRO outsourcing will be more favourable for labour-intensive activities. A notable exception to this trend is Europe, which saw a one-to-one match between aircraft origin and MRO related maintenance. It is hypothesized that the trend in Europe is an artifact created by the number of countries in Eastern Europe that are potential sources of low-cost labour. Outsourcing, therefore, to Eastern European countries may still appear as activity internal to Europe.

Oliver Wyman forecasts for MRO activity to continue shifting to the developing world through 2013. The downtown in MRO fulfillment is projected to be highest in Europe and North America with the notable exception being North American engine MRO activity. A possible reason for the strength in engine MRO activity in North America is that it is capital-intensive as opposed to labour-intensive and therefore favours advanced economies. The greatest growth in MRO fulfillment is projected in Asia-Pacific and Latin America as outlined below in Table 41.

[276] Source: Oliver Wyman, ”MRO survey”, 2009.
[277] Source: Oliver Wyman, “MRO survey”, 2009.

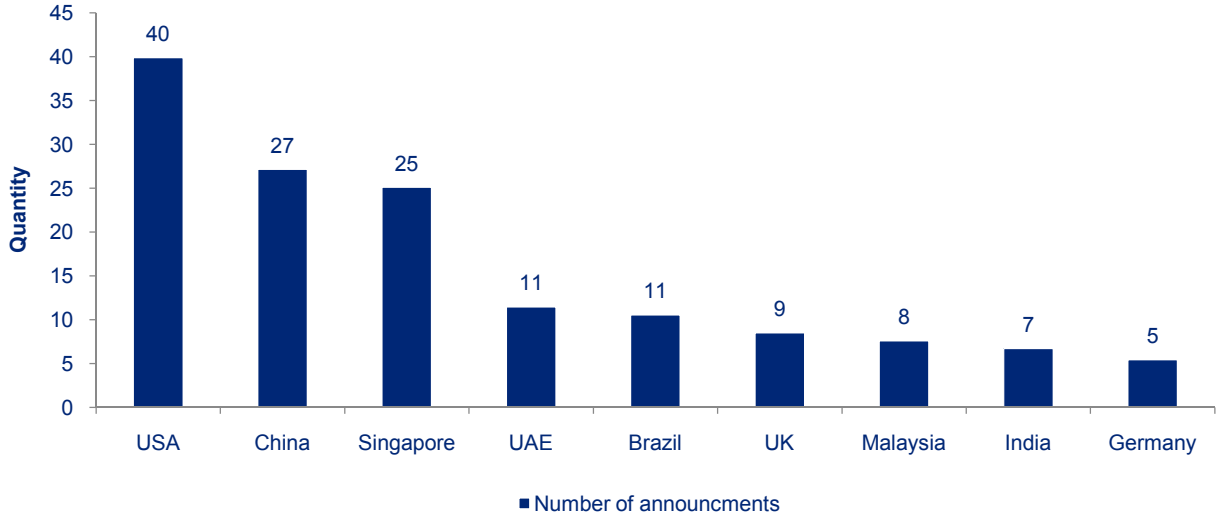
Table 41: 2008 - 2013 change in MRO airline fulfillment by geography[278]

Region	Engines (% of total)	Airframes (% of total)	Components (% of total)
North America	14.3	-18.5	-15.8
Europe	-17.1	-6.7	-16.7
Asia-Pacific	13.3	11.1	35.3
Middle East	14.3	10.0	22.2
Latin America	0.0	80.0	33.3

A negative number corresponds to a projected decrease in MRO fulfillment in that geography. A positive number corresponds to a projected increase of MRO fulfillment in that geography.

The changes in geographic fulfillments is roughly in line with the number of announcements made related to MRO and parts distributions from 1990 to 2009 as reported by AeroStrategy:

Figure 78: Major MRO and parts investment announcements by region[279]



The US has been the greatest source of MRO announcements in recent years. AeroStrategy attributes the number of announcements in the US to the rise of MRO activity to support business aircraft as 70% of the international fleet is located within the US.[280] Two of the top three countries for MRO announcements, China and Singapore, fall in Asia-Pacific albeit with different underlying reasons for their success in the MRO space. China has become a low-cost centre for airframe maintenance due to low labour costs. Singapore has become a centre for technology-intensive MRO activity due to a business friendly environment and a highly skilled workforce.

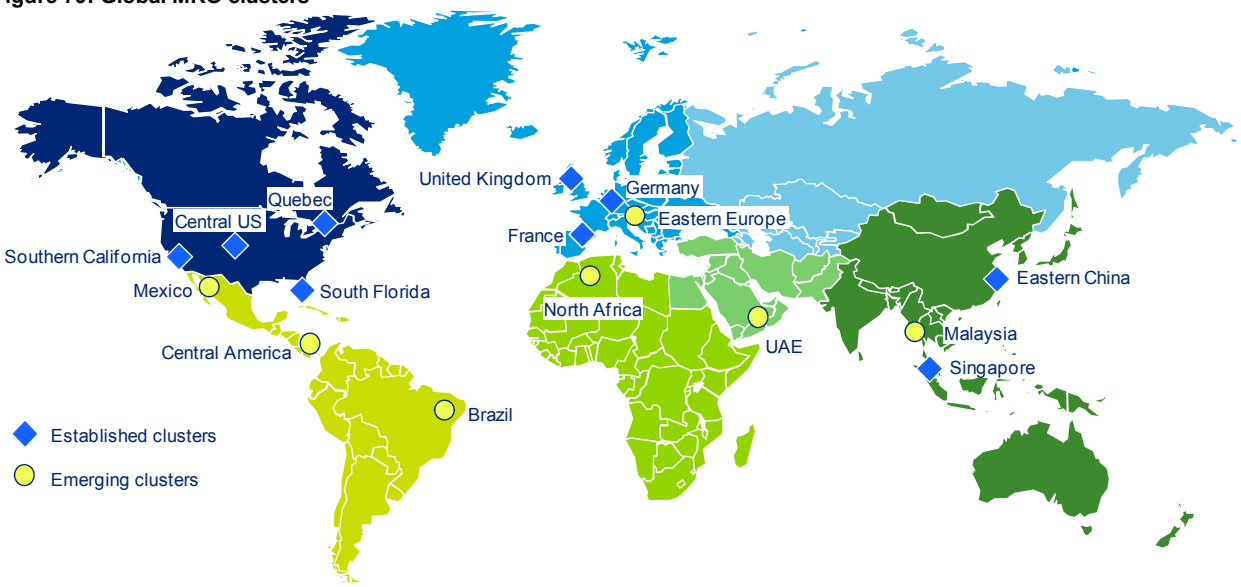
Aerostrategy also mapped the location of the world's developed and developing MRO hubs, as illustrated below in Figure 79. The location of the hubs highlights the tendency to locate MRO hubs near major centers of airline traffic.

[278] Source: Oliver Wyman, MRO survey, 2009.

[279] Source: Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[280] Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

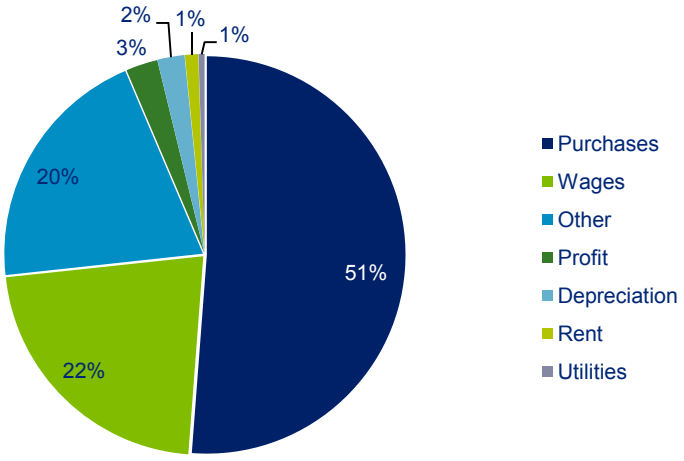
Figure 79: Global MRO clusters[281]



Industry cost structure

Similar to manufacturing, the largest share of revenues are used to cover labour and purchasing costs. In the US it is estimated that for every dollar of capital invested in MRO activities approximately ten dollars of labour costs are incurred. Net profits accounted for approximately 2.6% of 2010 industry revenue, down from 3.2% in 2005.[282]

Figure 80: Cost structure of the US MRO Industry in 2010[283]



The key market conditions in the global MRO sub-sector are the increasing levels of competition and technology intensity. Some of the key industry conditions, as highlighted by IBISWorld, are summarized in Table 42.

[281] Source: Aerostrategy, "Aerospace Globalization 2.0: Implications for Canada's Aerospace Industry", November 2009.

[282] IBISWorld, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

[283] IBIS World, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

Table 42: Key conditions in the global civil MRO sub-sector[284]

Condition	State	Trend
Competition	High	Increasing ↑
Barriers to entry	Medium	Steady ↔
Regulation	High	Steady ↔
Capital & labour intensity	Low	Decreasing ↓
Technology intensity	Medium	Increasing ↑
Volatility	High	Increasing ↑

Training & simulation overview

The T&S sub-sector has traditionally included the following product and service offerings for the civil aerospace market:

- Simulator products
- Full flight simulators ("FFS")
- Flight training devices ("FTD")
- Parts and maintenance services
- Training services
- Initial training
- Recurring training
- Ab-initio pilot training

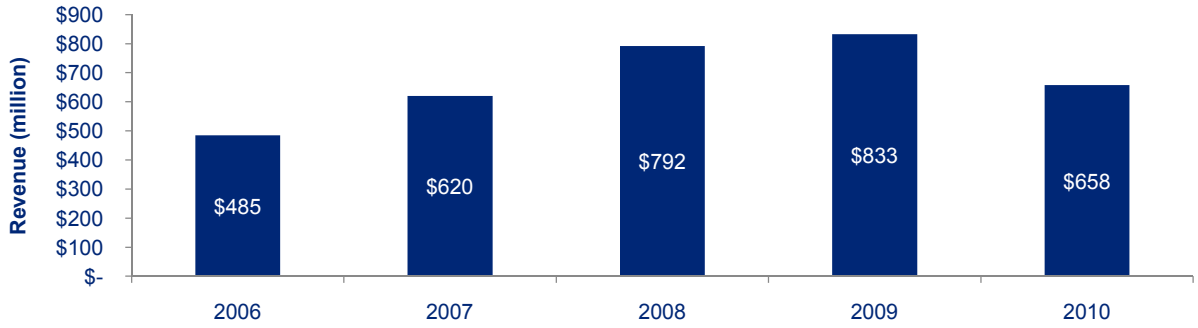
Civil simulation product sales are correlated with aircraft deliveries and tend to be cyclical. Between 2002 and 2004, the market for FFS increased from 15–25 units per year. In 2008, the market size of FFS was estimated to be approximately $500 million.[285]

Reliable data on the global performance of the T&S sub-sector during the economic downturn does not exist. However, performance can be inferred by looking at pure T&S companies; for example, CAE's revenue held up well for the year ending March 2009 but dropped sharply for the year ending March 2010. The trend in CAE revenue highlights that declines in civil T&S revenues may lag declines in aircraft passenger traffic.

[284] IBISWorld, "Aircraft Maintenance, Repair, & Overhaul in the US", March 2010.

[285] Deloitte analysis.

Figure 81: CAE civil T&S revenues[286]



The types and number of simulators built will also be a function of the mix of aircraft in operation. Based on existing aircraft data collected for the FFSs in the market, the aircraft to FFS ratio per category is calculated and given in Table 43.

Table 43: Aircraft by category[287]

Segment	Ratio
Wide-body	18:1
Narrow-body	27:1
Regional turboprop	40:1
Regional jet	35:1

Based on the ratios in Table 43, the simulation market is buoyed by a preference towards wide-body aircraft for network flights and jets for regional flights. For regional flights, one key factor influencing the relative mix of turboprops and jets will be fuel prices.[288] Turboprop orders are, in general, positively correlated with fuel prices; therefore, high fuel prices may put downward. For network routes, the trend is also counter-current to simulator sales with single-aisle aircraft being widely viewed as preferred going forward. This trend is echoed by the following comments from the major aircraft and engine OEMs:

- Boeing stated that narrow-body demand has exceeded forecast expectations by 10% due to low cost carriers, emerging markets, and fleet replacement;[289]
- Rolls-Royce stated that airlines are showing a preference for larger variants of narrow-body aircraft for regional flights as opposed to wide-body aircraft;[290] and
- In Airbus's 2009 forecast, narrow-body aircraft account for 68% of forecasted deliveries through 2028.[291]

Regionally speaking, simulator sales have grown worldwide over the last five years. As shown in Figure 82, the most significant sales growth has been seen in European and emerging markets. The geographic diversification of these sales helped minimize the negative effects of the financial crisis on simulation product providers.

[286] OneSource, "Company Profile".

[287] Source: Deloitte Analysis.

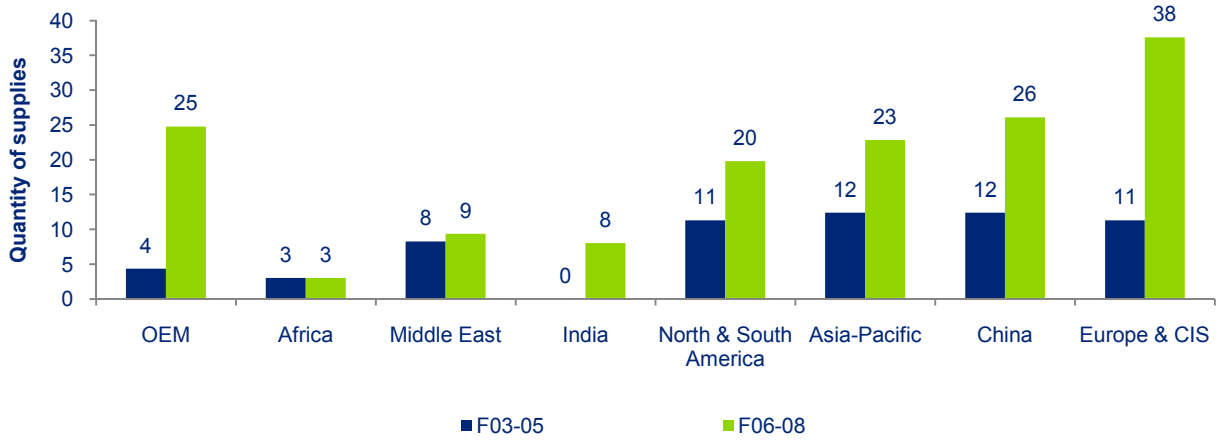
[288] Bombardier, "2009-2028 Market Forecast", 2009.

[289] Boeing, "Farnborough presentation", 2010.

[290] Rolls-Royce, "2009-2028 Market Outlook", 2009.

[291] Airbus, "2009-2028 Market Outlook", 2009.

Figure 82: FFS sales by region[292]



There are also noteworthy trends in simulator design. The first is a move away from hydraulically actuated simulators to electrically actuated models. Sources claim that electronic actuators can result in lifecycle savings of 30-40% due to decreased maintenance costs.[293] Another major design trend is a move to modular designs which reduce upgrade costs and add flexibility. This added flexibility can result in a more true-to-life simulator for customers with limited capital because a small number of base simulators can be augmented to match specific aircraft designs.

Space overview

This sub-sector is defined to include satellite and satellite component manufacturing, and launch-related services (e.g., use of rockets to put satellites into orbit). In principal, the space industry can include other categories of manufacturing that are too small/new for adequate data availability. Further, the space industry is often defined to include ground equipment used to interface with satellites and satellite services. However, inclusion of satellite services and ground equipment inflates revenue generated by this sector because many of the products/services included in these two categories are only tangentially related to the aerospace industry. For example, companies who provide mobile phone service may be counted as a "satellite service" provider and manufacturers of GPS devices may be counted as a "ground equipment" manufacturer. Due to the breadth of their definition, satellite service providers and ground equipment manufacturers produce approximately eight times more revenue than manufacturers and launch service providers.

The recent recession had a mixed impact on the civil space sub-sector. Manufacturing revenue contracted by 8% in 2008 and US manufacturing employment contracted by 5.5% in 2009. However, launch services saw a growth in revenue of approximately 20% from FY 2007 to FY 2008. Following the recession, manufacturing revenue rebounded 29% in 2009, the highest increase of any of the space sub-sectors. The second highest growth in 2009 was in launch services whose revenues increased by 18%.

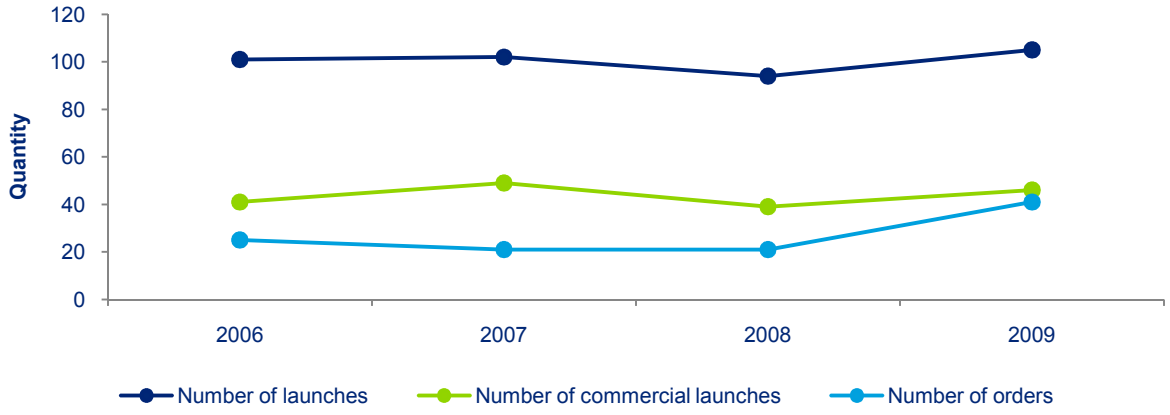
Much of the changes in revenue can be linked to changes in per unit prices as opposed to changes in the volume of satellites/spacecraft sold because orders and launches have remained relatively flat since 2006.[294] The number of micro-satellites launched nearly doubled from nine in 2008 to sixteen in 2009 and this trend to smaller satellites is putting downward pressure on per-unit prices.

[292] Deloitte Analysis.

[293] Air Transit World, "Simulators move forward", accessed from www.atwonline.com in July 2010.

[294] Satellite Industry Association, "State of The Industry", 2010.

Figure 83: Space launch and order trends



Commercial launches refer to launches of satellites for commercial (e.g., private sector) customers.

In general, over 50% of the activity in this space sub-sector is still tied to government spending. However, much of the revenue and order volatility can be linked to commercial spending.[295]

Product segmentation

Manufacturing

Manufacturing revenue in this industry is volatile, with yearly growth-rates varying between positive 60% and negative 10% between 2006 and 2009. This revenue volatility is a byproduct of the small number of orders and large per-unit prices.

Regionally speaking, the US has consistently accounted for over one-third of the global manufacturing revenue with a spike to approximately 60% in 2009. The US's strong position is a result of the high levels of spending by civilian organizations (e.g., NASA), and the capital and technology intensity of the industry. Major nations in the "rest of world" category include: Canada, Russia, Japan, Germany, and France.

Manufacturing revenue generated from commercial customers (as opposed to civil) peaked at 50% in 2008 before falling sharply in 2009. The 2009 decline has two probable causes; first, restrictions in capital experienced during the financial crisis would have made the high cost of launching a satellite untenable. Secondly, the peak in 2008 may have been a spike in fleet updates to deal with the increases in wireless data traffic.

[295] Satellite Industry Association, "State of The Industry", 2010.

Figure 84: Space Manufacturing Revenue[296]

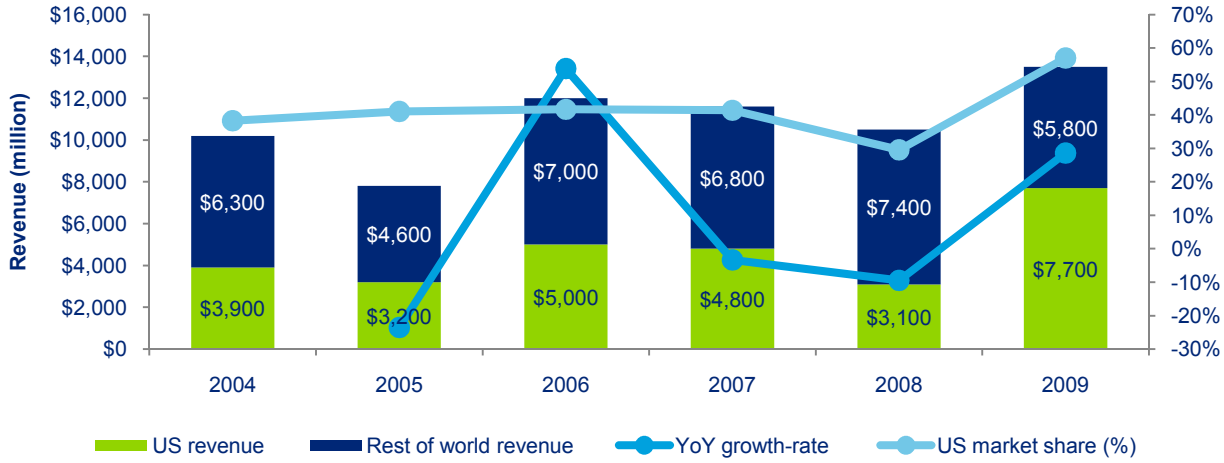
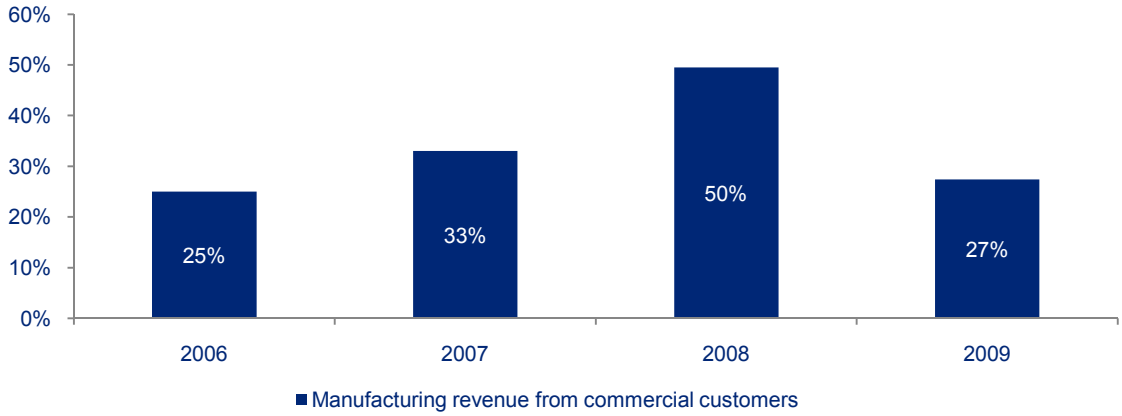


Figure 85: Percentage of space manufacturing revenue generated from commercial customers[297]

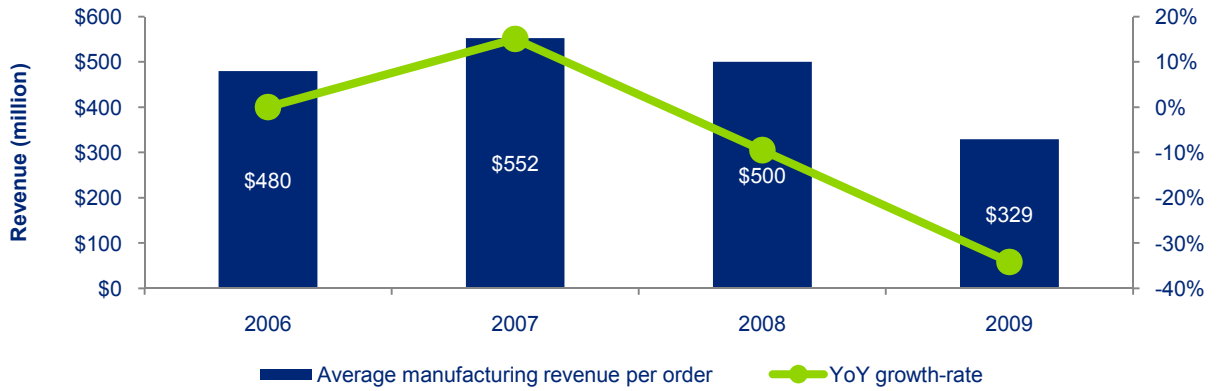


The move to small satellites (micro-, nano-, and pico-satellites) may account for some of the decline in average manufacturing revenues per order in 2009. Recent developments in communication and propulsion technology now allow companies to replace larger satellites with a number of smaller satellites that are cheaper to build and launch.

[296] Satellite Industry Association, "State of The Industry", 2010.

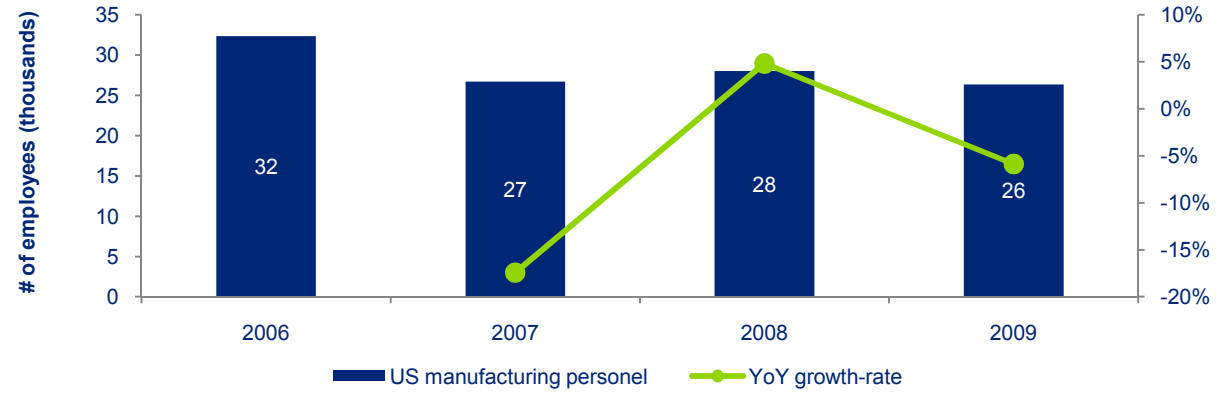
[297] Satellite Industry Association, "State of The Industry", 2010.

Figure 86: Average manufacturing revenue per new order[298]



It may be assumed that the US is representative of the global Space sub-sector given its prominent role. With respect to employment, therefore, data shows that the number of manufacturing personnel in the US dropped slightly in 2009. However, manufacturing employment in the space industry held up better than manufacturing employment in general which dropped in the US by 8% between January and December 2009.[299]

Figure 87: US space manufacturing personnel[300]



Launch services

Launch services remained strong during the economic recession with a trough of activity in 2006. Since the beginning of 2007, the launch services industry has seen consistent YoY revenue growth exceeding 10%. However, manufacturing has historically accounted for a larger share of the space sub-sector revenues with two to four dollars of manufacturing revenue generated per dollar of launch revenue.

Similar to manufacturing, the US has been the dominate source of revenue for launch services. However, there was a consistent decline in US revenue share between 2005 and 2008. The 2009 reversal in the US market share may be an artifact of the depressed commercial activity in 2009 and a corresponding reliance on the civil sector to drive revenue growth.[301]

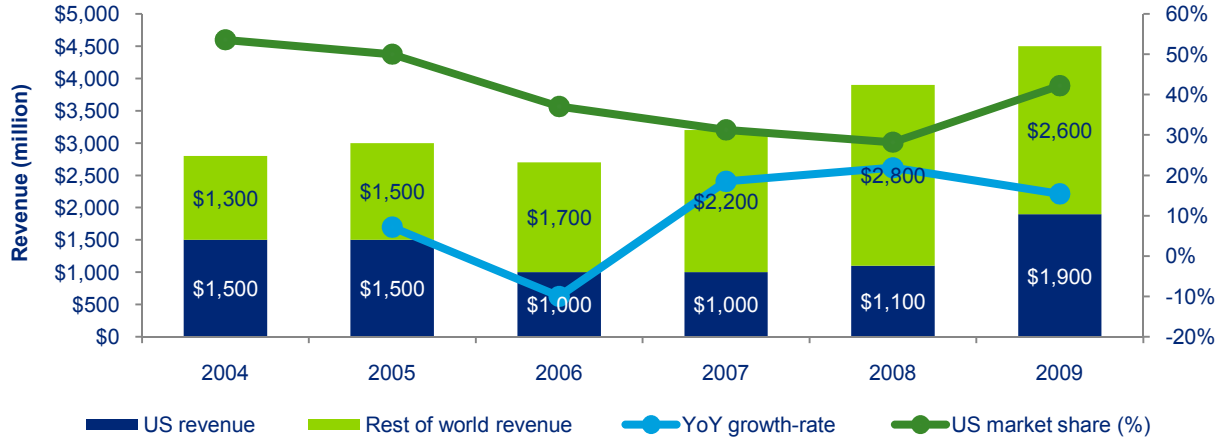
[298] Satellite Industry Association, "State of The Industry", 2010.

[299] U.S. Bureau of Labor Statistics Data, data series CS3000000001.

[300] Satellite Industry Association, "State of The Industry", 2010.

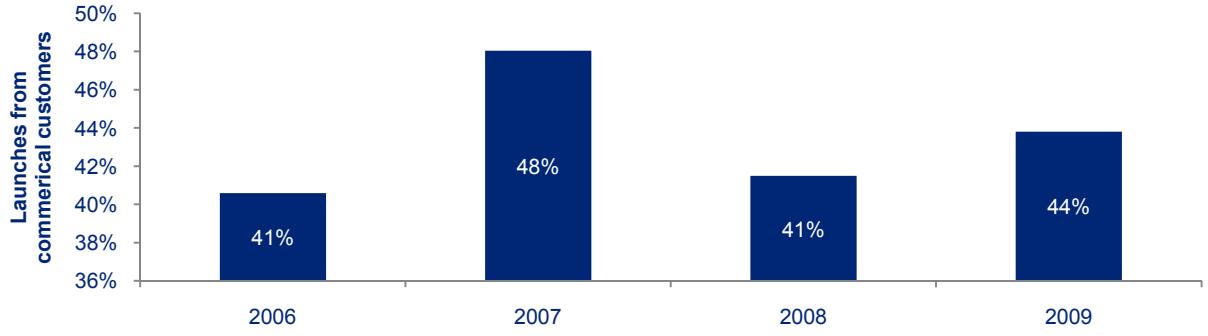
[301] Satellite Industry Association, "State of The Industry", 2010.

Figure 88: Space launch service revenue[302]



The number of launches by commercial customers has consistently resided between 41% and 44% with a small peak in 2007. It is notable that the market share of commercial launches grew in 2009 even while civil launches drove revenue growth; this may highlight how lucrative civil launches are relative to commercial launches.

Figure 89: Percentage of launches performed for commercial customers[303]

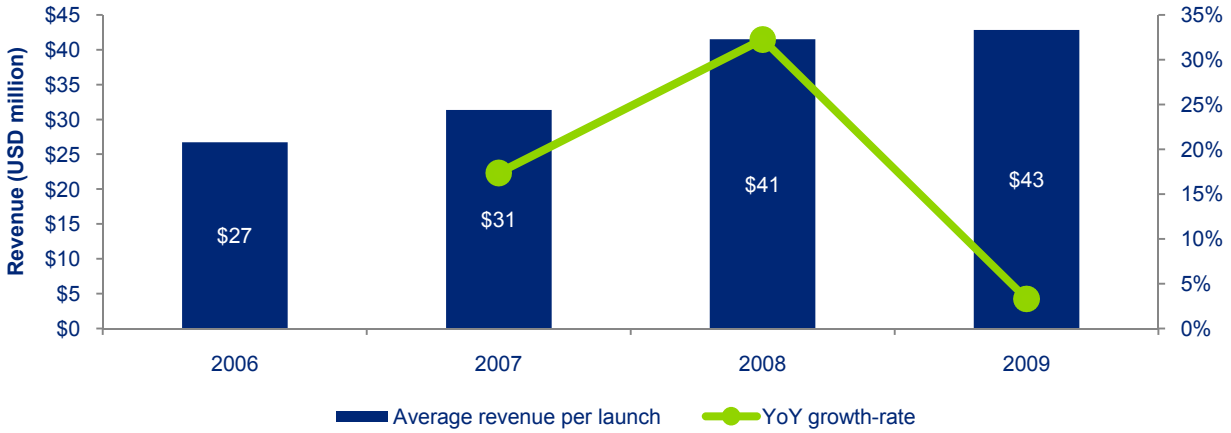


Unlike manufacturing, revenue per launch increased in 2009 but at a much smaller extent than was seen between FY 2007 and FY 2008.

[302] Satellite Industry Association, "State of The Industry", 2010.

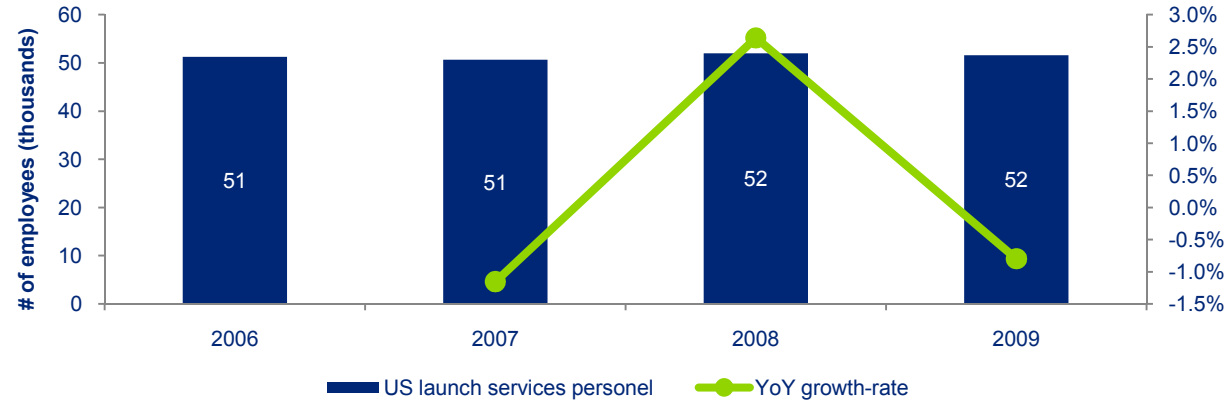
[303] Satellite Industry Association, "State of The Industry", 2010.

Figure 90: Average per launch revenue for the space launch services industry[304]



US launch employment levels are extremely stable relative to manufacturing employment staying at approximately 55,000 since 2006.

Figure 91: US launch services personnel[305]



[304] Satellite Industry Association, "State of The Industry", 2010.

[305] Satellite Industry Association, "State of The Industry", 2010.

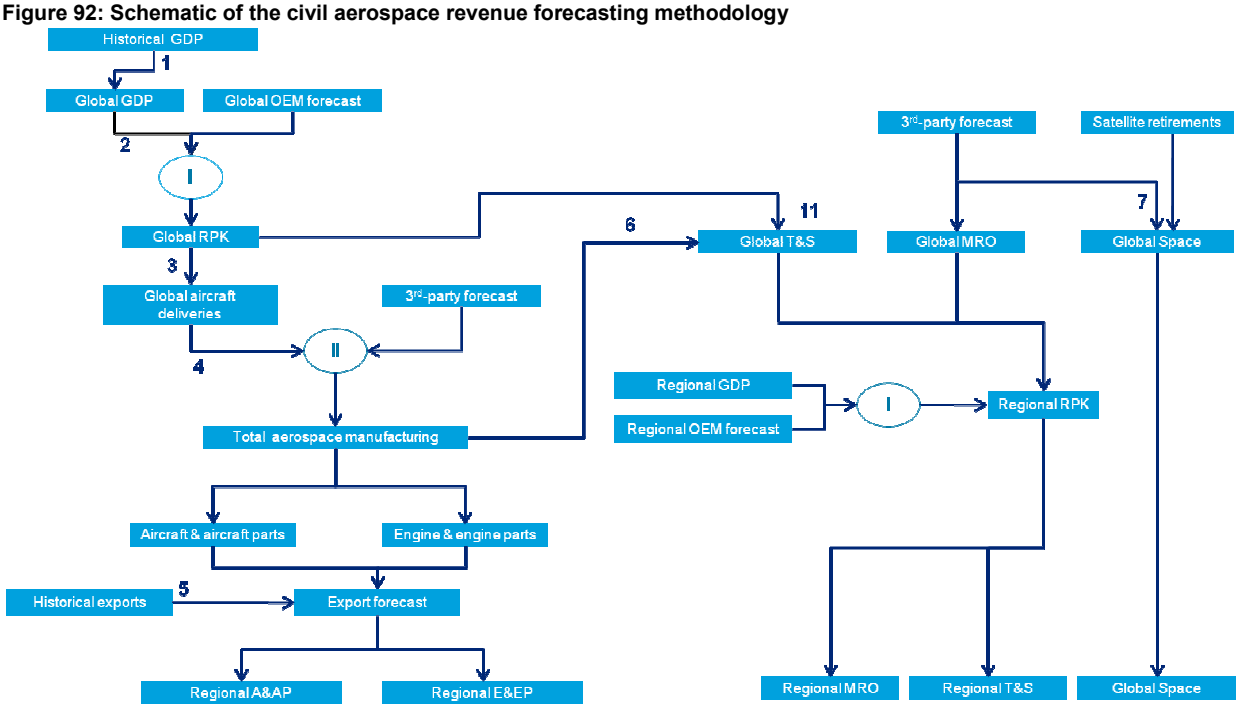
Appendix II - forecast methodology

This appendix explains the methodology and assumptions behind the forecasting model that accompanies this report. At each step various assumptions and data sources are used. The proceeding section of this report will outline those assumptions and data sources. The methodology used was derived in an iterative fashion and the final methodology presented is the most robust and reliable given the source data.

Civil forecasting model

Figure 92 gives a schematic of the civil forecasting methodology and Table 44 gives summary details for the same methodology.

Figure 92: Schematic of the civil aerospace revenue forecasting methodology



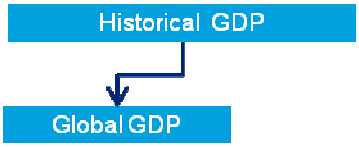
The numbers (Roman and Latin numerals) relate to things that can be adjusted in the forecasting model. On the spreadsheet, the corresponding lines are annotated in the "ref." Column on the "Assumption Selection" sheet.

Table 44: Civil revenue forecasting summary

	Global forecast	Global revenue derived from	Regional forecast	Regional revenue derived from	Key assumptions
A&AP	Yes	Global GDP or third-party estimates	Yes	Regional A&AP exports	• Constitutes a near constant 77% of total aerospace revenue
E&EP	Yes	Global GDP or third-party estimates	Yes	Regional E&EP exports	• Constitutes a near constant 23% of total aerospace revenue
MRO	Yes	third-party estimates	Yes	Regional RPK	• MRO leak between adjacent geographical regions will be limited
T&S	Yes	RPK and manufacturing revenue	Yes	Regional RPK	• CAE has accounted for 70% of global civil T&S revenue since 2000
Space	Yes	Third-party estimates and satellite retirement schedule	No	n/a	• Approximately 1800 payloads will be launched through 2028 • $3 of manufacturing revenue are generated per $1 of launch revenue • Launch revenue per payload will remain relatively constant over the next 10 years

Text in **blue** represents assumptions that can be adjusted in the model.

Projecting global GDP



Description

Global GDP (nominal dollars) was the starting point for the civil aerospace forecast. It was found that GDP values are highly correlated with RPK at both a global and regional level.

Data source

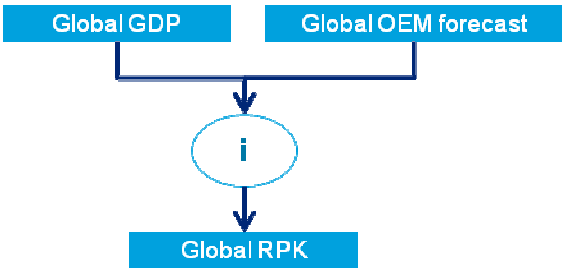
The International Monetary Fund ("IMF") publishes global GDP forecasts through 2015. These forecasts are published in the world economic outlook ("WEO") which is available through an online database.[306]

Methodology

The IMF forecasts were used directly through 2015. For the time period 2015 to 2020, the IMF forecasts were projected forward using a linear regression. The IMF's forecast assumes a constant year-over-year growth-rate, resulting in a regression with closely fit to the day.

[306] International Monetary Fund, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in August 2010.

Global RPK forecast



Description

The next step in the model was to derive a forecast of global RPK through 2020. This was done using two methods. First, it was found that historically GDP has been highly correlated with RPK. Therefore, the first method involved forecasting RPK values using the global GDP forecast found in step one. The second method involved using the average of the RPK forecasts for 2010-2028 published by the major aircraft OEMs.

Data source

For method one, historical RPK data going back to 1968 was sourced from Airbus.[307] For method two, RPK forecasts through 2028 were gathered from Rolls-Royce[308], Boeing[309], Embraer[310], and Airbus.[311]

Methodology

For method one, a linear regression model was developed using historical GDP and RPK data from 1980 to 2010. This regression model was then used to predict RPK values through 2020 based on the previously forecasted GDP values. In general, the historical fit between GDP and RPK has been very good (R^2 = 0.98). For method two, the forecasted RPK values from the five OEMs were averaged without bias. Note that the OEMs assume a constant average yearly RPK growth-rate.

Aircraft deliveries forecast

Description

Global civil aircraft deliveries were projected through 2020 using global RPK values. Historically, it was found that RPK is a reasonable predictor of global aircraft deliveries.

Data source

Historical aircraft delivery data was collected from an internal Deloitte document published by subject matter experts.

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[307] Airbus, “Global Market Outlook 2009-2028”, 2009.

[308] Rolls-Royce, “Market Outlook 2009”, 2009.

[309] Boeing, “Current Market Outlook 2009-2028” , 2009.

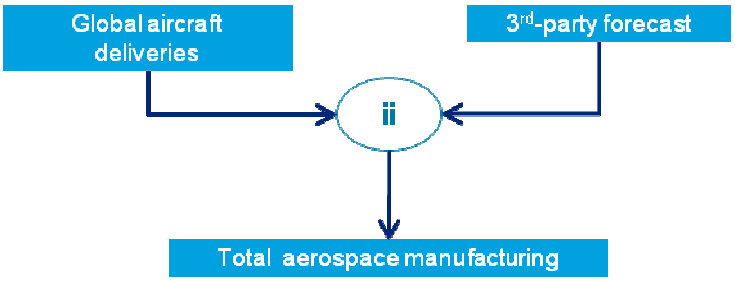
[310] Embraer, “Market Outlook 2009-2028” , 2009.

[311] Airbus. “Global Market Outlook 2009-2028”, 2010.

Methodology

A linear regression model was developed using historical RPK and deliveries data from 1980 to 2010. The regression model was then used to forecast aircraft deliveries using previously forecasted global RPK values. The historical fit between RPK and deliveries is reasonable but not as robust as the link between GDP and RPK (R^2 = 0.82).

Civil aerospace manufacturing revenue forecast



Description

The next step in the model was to forecast global civil aerospace manufacturing revenue (including both A&AP and E&EP). Two potential methods are included in the model. The first method forecasts the revenue using aircraft deliveries; it was found that aircraft deliveries were a reasonable predictor of global civil aerospace manufacturing revenue. The second method uses a third-party forecast. One caveat is that the third-party forecast ends in 2015 while the first method (based on deliveries) can develop a forecast through 2020.

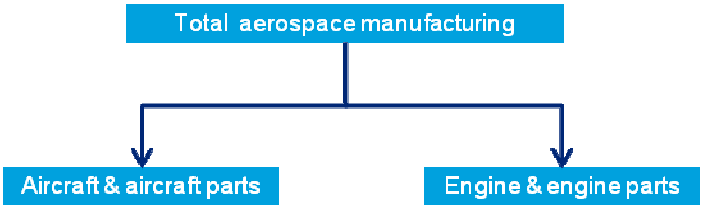
Data Source

Historical global civil aerospace manufacturing revenue and third-party forecasts were collected from an IBIS World research report.[312]

Methodology

For method one, a linear regression model was developed to predict global civil aerospace manufacturing revenue based on global aircraft deliveries using historical data from 1998 to 2010. The fit of the regression model was robust relative to many of the other regression models developed (R^2 = 0.91). For the second method, third-party forecasts were taken verbatim and added to the model.

Global A&AP and E&EP revenue forecast



Description

The next step was to segment global aerospace manufacturing revenue into A&AP and E&EP revenue.

[312] IBIS World, "Global Civil Aerospace Products Manufacturing", 2010.

Data source

Historical information related to the relative magnitude of A&AP and E&EP revenue was collected from the same data source as global civil aerospace manufacturing revenue.[313]

Methodology

It was found that the percentage of revenue from E&EP has remained relatively constant. For example, the percentage of E&EP revenue relative to total manufacturing revenue increased by 1% between 2005 and 2010. The increasing trend in revenue is thought to be related to increases in engine complexity due to fuel efficiency requirements. Fuel efficiency is expected to continue being a going concern and it was therefore assumed that the historical trend would continue; in the model. In other words, E&EP's percentage of total manufacturing revenue in the model is set to linearly increase by 1% between 2010 and 2015 and another 1% between 2016 and 2020.

Global A&AP and E&EP export forecast

Description

The forecast uses export data to segment A&AP and E&EP revenue by region. Therefore, forecasts of regional exports of A&AP and E&EP through 2020 were developed.

Data Source

Historical export data was collected from UN's Comtrade database[314] for 1988 to 2010. The following SITC (rev.3) codes were used to encapsulate A&AP and E&EPs exports:

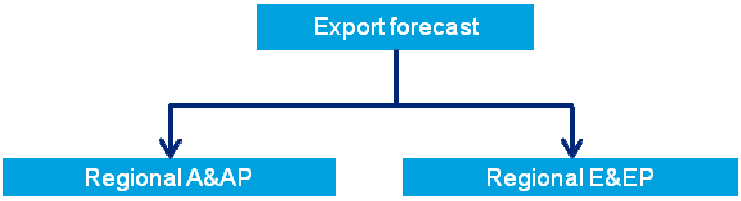
- A&AP: 7922, 7923, 7924, 7929
- E&EP: 71311, 71319

Definitions of the SITC codes can be found at the UN Comtrade website.[315]

Methodology

Data from individual countries was aggregated into the seven geographical regions in the forecast model. The percentage of total exports attributable to any given region has been relatively constant. Therefore, a linear regression was used to project each region's exports through 2020.

Regional A&AP and E&EP revenue forecast



Description

The projected exports by region were then used to segment the global A&AP and E&EP forecast into the seven geographical regions. The projected regional export values for both A&AP and E&EP were

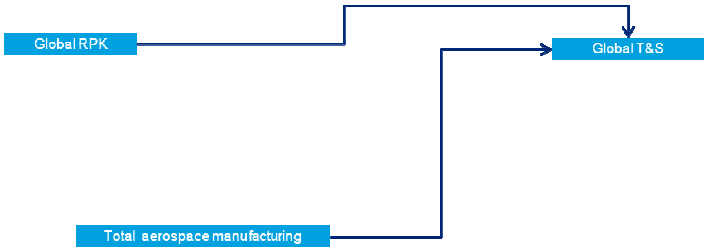
[313] IBIS World, "Global Civil Aerospace Products Manufacturing", 2010.

[314] United Nations, "Comtrade" [online database]. accessed from http://comtrade.un.org/db/dqQuickQuery.aspx in July 2010.

[315] United Nations, "Detailed structure and revisionary notes – SITC rev.4", accessed from http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=28 in August 2010.

converted into a percentage of global A&AP and E&EP exports respectively on a yearly basis. For example, North America accounts for 43% of A&AP exports in the year 2019. Global A&AP and E&EP revenue was then segmented using these regional export percentages for 2010 through 2020.

Global T&S revenue forecast



Description

Global T&S revenue was projected based on RPK and manufacturing revenue. Note that information on the global T&S market is sparse.

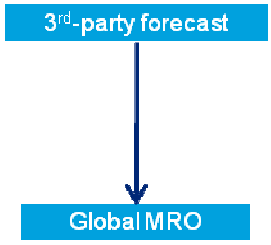
Data sources

Historical T&S revenue data was gathered from CAE annual reports spanning 2001 to 2010. Global RPK and manufacturing revenue sources are the same as described previously.

Methodology

CAE's T&S revenue was converted into global T&S by assuming that CAE has held a constant 75% of the civil T&S market.[316] A multi-linear regression model was then developed to forecast T&S revenue based on both global RPK levels and total manufacturing revenue.

Global MRO revenue forecast



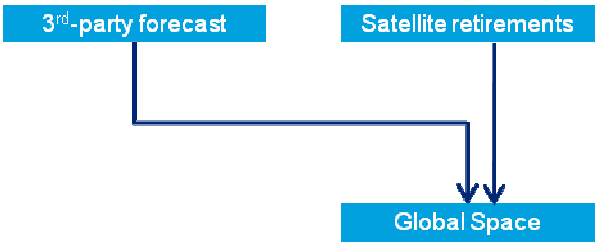
Description

Global MRO forecasts were collected from a 3rd-party report by Oliver Wyman.[317] There was not enough historical data on the civil MRO sub-sector to create an in-house forecast.

[316] The Montreal Gazette, "Civil aviation growth in Asia provides CAE with opportunity". 2006.

[317] Oliver Wyman, "Airline Economics Are Transforming the MRO Landscape". 2008

Space revenue forecast



Description

Space manufacturing and launch revenue was forecasted using a third-party payload forecast. The third-party forecasts were augmented by additional data in order to come up with a revenue estimate.

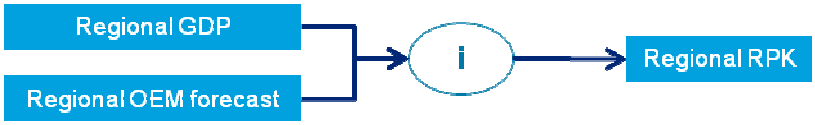
Data sources

Estimates for the number of civil space payloads through 2028 were taken from Teal Group.[318] Estimates of future satellite retirements were derived from data available through the USC satellite database.[319] Historical estimates of the amount of revenue generated in space manufacturing relative to space launches was found using historical revenue data from the Satellite Industry Association's ("SIA") annual "State of the industry" reports. Launch costs per payload were taken from SpaceX - a private satellite launching company.[320]

Methodology

An analysis of expected launch retirements showed that over 65% of retirements are scheduled to occur before 2016. Therefore, it was assumed that two-thirds of the 2,200 payloads projected for launch between 2010 and 2028 would occur between 2010 and 2016. The average price per payload for a launch provided by SpaceX was used (approximately 52 million USD per payload) to convert payloads into payload revenue. Note that the model assumes inputted launch cost will remain constant over the next ten years. Manufacturing revenue is then derived from launch revenues based on historical trends. It was found that the ratio of manufacturing to launch revenue has remained between 2.5 and 3.5 for the time period of 2002 to 2009. Therefore, it was assumed that 3 dollars of revenue will be generated by space manufacturing for every dollar of launch revenue generated.

Regional RPK forecast



Description

The next step in the model was to segment global MRO and T&S revenues into regional values. This was done using regional RPK values based on the assumption that MRO and T&S will follow passenger volumes. Regional RPK was forecasted using two methods, the first method projects regional RPK values based on regional GDP. The second method uses the average of the regional RPK forecasts published by Aircraft OEMs.

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[318] Teal Group, "World Space Systems Briefing". March 2010.

[319] Union of Concerned Scientists. "UCS satellite database" [online database], accessed in July 2010 from http://www.ucsusa.org/nuclear_weapons_and_global_security/space_weapons/technical_issues/ucs-satellite-database.html

[320] SpaceX, "Falcon 1 overview" & "Falcon 9 overview", accessed from www.spacex.com in August 2010.

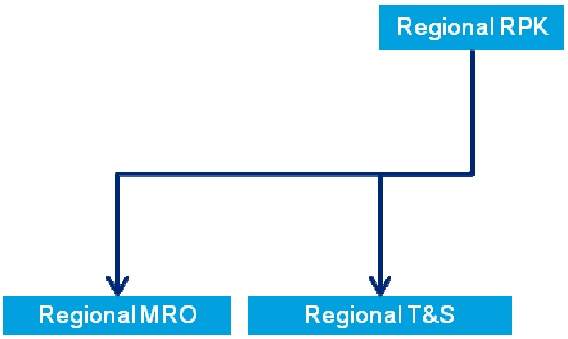
Data source

The International Monetary Fund ("IMF") publishes regional GDP forecasts through 2013. These forecasts are published in their world economic outlook ("WEO") which is available through an online database.[321] For method two, regional RPK forecasts through 2028 were gathered from Rolls-Royce[322], Boeing[323], Embraer[324], and Airbus[325].

Methodology

For method one, the IMF forecasts were used directly for 2010 through 2013. For the time period of 2013 to 2020, the IMF forecasts were projected forward using a linear regression. These regional GDP values were then converted into a percentage of global GDP for each year of the forecast. This regional fraction of global GDP was used to segment the global RPK forecast into a set of regional RPK forecasts. For method two, the forecasted regional RPK values from the five OEMs were averaged without bias; the OEMs assume a constant yearly RPK growth-rate through 2028.

Regional T&S and MRO forecast



Description

The assumption is made that MRO and T&S will follow RPK values at the regional value. For MRO, this assumption is made because MRO needs to be done close to where the aircraft operates. In turn, the number of aircraft operating in a region should be reflected in the regional RPK values. Further, it is assumed that the revenue for T&S (predominately related to training pilots) will be incurred in the country in which the aircraft operates another factor that should be reflected in the regional RPK values.

Revenue from T&S and MRO was split between the regions based on the percentage of the region's RPK relative to the global RPK forecast. The regional RPK being found by one of the two methods outlined in the previous step of the forecast model.

[321] International Monetary Fund, "World Economic Outlook" [online database], accessed from http://www.imf.org/external/data.htm#data in July & August 2010.

[322] Rolls-Royce, "Market Outlook", 2009"

[323] Boeing, "Current Market Outlook 2009-2028".

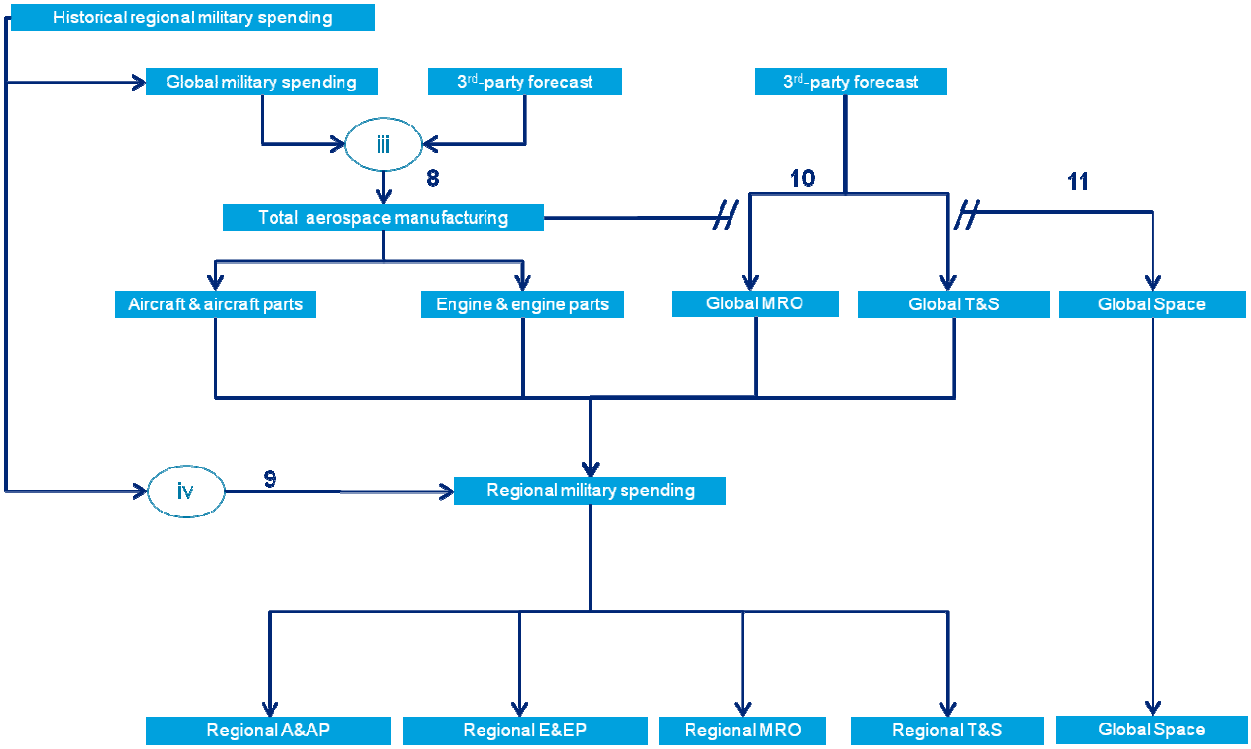
[324] Embraer, "Market Outlook 2009-2028".

[325] Airbus, "Global Market Outlook 2009-2028".

Military forecasting model

Figure 93 shows a schematic of the military forecasting methodology and Table 45 gives summary details for the same methodology.

Figure 93: Schematic of the military aerospace revenue forecasting methodology



The numbers (roman and Latin numerals) relate to things that can be adjusted in the forecasting model. On the spreadsheet, the corresponding lines are annotated in the "Ref." Column on the "Assumption Selection" sheet.

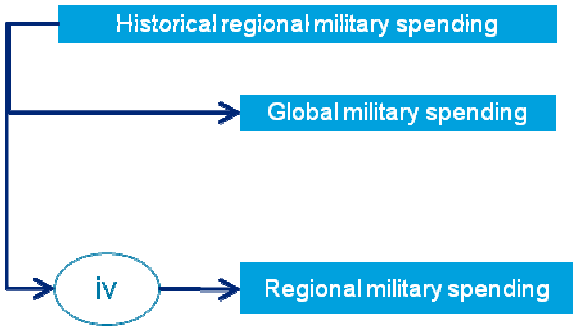
Table 45: Military revenue forecasting summary

	Global forecast?	Global revenue derived from	Regional forecast	Regional revenue derived from	Key assumptions
A&AP	Yes	Global military spending or third party estimates	Yes	Regional military spending	• Constitutes a nearly constant 82% of total aerospace revenue
E&EP	Yes	Global military spending or third party estimates	Yes	Regional military spending	• Constitutes a nearly constant 18% of total aerospace revenue
MRO	Yes	Third party estimates	Yes	Regional military spending	• 1.5% average CAGR in global revenues
T&S	Yes	Third party estimates	Yes	Regional military spending	
Space	Yes	Global military spending or third party estimates	No[i]	n/a	• Constitutes a constant 12% of total aerospace revenue

[i]A regional forecast is possible but is not done in order to keep the MAS Space sub-sector forecast in line, in terms of coverage, with the CAS Space forecast. Text in **blue** represents assumptions that can be adjusted in the model.

For the entire military forecast model the assumption is made that sub-sector spending will follow regional military expenditures.

Regional and global military spending forecast



Description

The first step of the military forecast model was to develop military spending forecasts for the seven regions. These regional forecasts can then be summed to give a global military spending forecast.

Data sources

Historical data on military spending was collected for the Stockholm International Peace Research Institute for the years 1986 to 2009.[326]

Methodology

SIPRI provides country specific historical military spending data; the model, however, requires military spending by region. Therefore, military spending data was aggregated for countries inside each region until at least 95% of the total military spending for that region in 2009 was accounted for. The regional historical military spending data was then fit with a trend line in order to forecast future values.

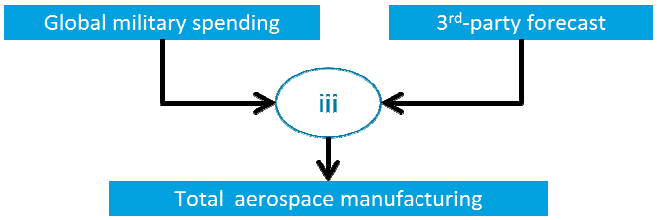
It was found that the military spending of North America and Europe had a sharp change in trend after 9-11. Prior to 9-11, both North America and Europe experienced declining military spending. Post 9-11, both North America and European military spending started increasing. Therefore, two forecasts for European and North American military spending were created - one forecast follows the pre 9-11 trend line and the other follows a post 9-11 trend line. The other five regions have seen generally consistent military spending growth over the historical time period. Note that some of the regions have been experiencing exponential, not linear, growth in military spending. Therefore, the type of trend line differed between the regions. The type of regression used for each region is given in Table 46.

Table 46: Military spending regional regression types

Region	Regression type
Pre-9/11 North America	Exponential (declining)
Pre-9/11 Europe	Linear (declining)
Post-9/11 North America	Linear (increasing)
Post-9/11 Europe	Linear (increasing)
All Years CIS (post Soviet Union)	Linear (increasing)
All Years Latin America	Linear (increasing)
All Years Asia-Pacific	Exponential (increasing)
All Years Middle East	Exponential (increasing)
All Years Africa	Exponential (increasing)

[326] SIPRI. "SIPRI military expenditure database" [online database], accessed from http://www.sipri.org/research/armaments/milex/research/armaments/milex/milex_database in July & August 2010.

Global aerospace manufacturing revenue forecast



Description

The next step in the model was to forecast global military aerospace manufacturing revenue (including both A&AP and E&EP revenue). Two potential methods are included in the model. The first method forecasts the revenue based on global military spending; it was found that global military spending is a reasonable predictor of global military aerospace revenue. The second method uses a third-party forecast. One caveat is that the third-party forecast ends in 2015 while the first method (based on military expenditures) can forecast revenue through 2020.

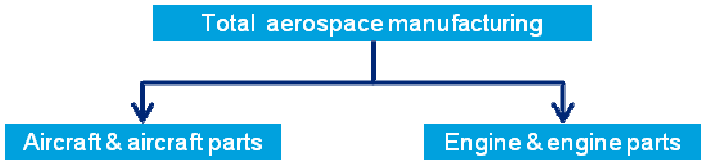
Data Source

Historical global military aerospace manufacturing revenue and third-party forecasts were collected from an IBIS World research report.[327]

Methodology

For method one, a linear regression model to predict global military aerospace manufacturing revenue as a function of global military expenditures was developed using historical data from 1998 to 2010. The fit of the regression model was robust relative to many of the other regression models developed (R^2 = 0.92). For the second method, third-party forecasts were added to the model verbatim.

Global A&AP and E&EP revenue forecast



Description

The next step was to segment global aerospace manufacturing revenue into A&AP and E&EP revenue.

Data source

Historical information related to the relative magnitude of A&AP and E&EP revenue was collected from the same data source as global military aerospace manufacturing revenue.[328]

Methodology

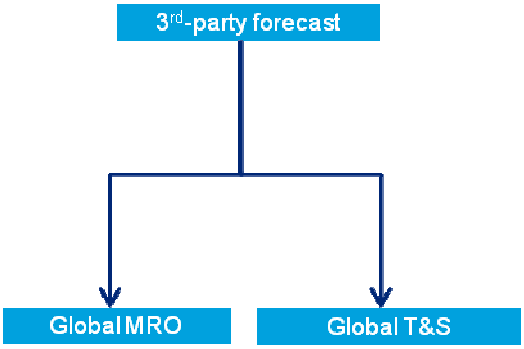
It was found that the percentage of revenue from E&EP has remained relatively constant. For example, the percentage of E&EP revenue relative to total manufacturing revenue decreased by 0.3% between 2005 and 2010. The decreasing trend in E&EP revenue is thought to be related to governments retiring aircraft instead of refurbishing them through the replacement of engines; the latter generating more revenue for the E&EP industry than the former. In the model, E&EP's percentage of total manufacturing

[327] IBIS World, "Global Military Aerospace Products Manufacturing", 2010.

[328] IBIS World, "Global Military Aerospace Products Manufacturing", 2010.

revenue is set to decline linearly by 0.3% between 2010 and 2015 and another 0.3% between 2016 and 2020.

MRO and T&S forecast



Description

Both MRO and T&S global revenue forecasts were collected from third-parties due to lack of historical data.

Data source

The global MRO forecast was based on work done by OAG Aviation Solutions.[329] The global T&S forecast was collected from a research report by Visiongain.[330]

Methodology

Both the MRO and T&S third-party forecasts ended in 2018. Therefore, both forecasts needed to be extended for this forecasting model. For the MRO forecast, this meant assuming the 1.4% CAGR forecasted by OAG will continue for another two years. For the T&S forecast, this meant projecting out the forecasted trend for two years. The third-party forecasts were used without modification for 2010 through 2018.

Space forecast

Description

The military space forecast is based off the same manufacturing revenue forecast as A&AP, and E&EP.

Data source

Historical information related to the relative magnitude of Space revenue was collected from the same data source as global military aerospace manufacturing revenue.[331]

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[329] OAG Aviation Solutions, "Global MRO spend on military aviation to increase by 14.9% over the next decade, reports OAG" [press release], December 2008.

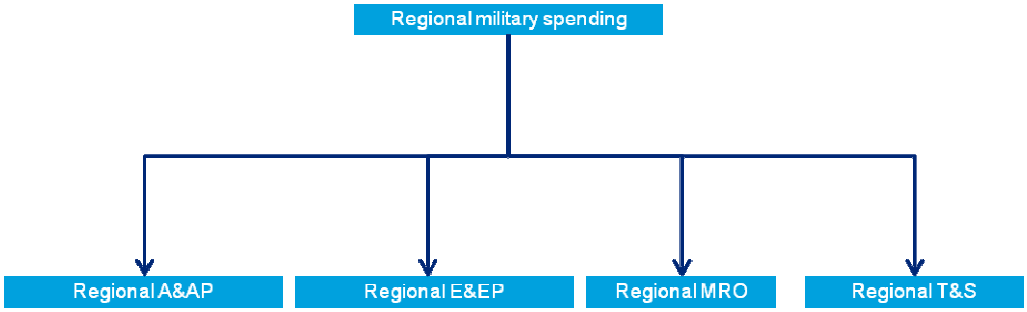
[330] Visiongain, "The Military Simulation and Virtual Training Market 2008-2018",2008.

[331] IBIS World, "Global Military Aerospace Products Manufacturing", 2010.

Methodology

It is assumed that a constant fraction of manufacturing revenue is attributable to the Space sub-sector. The default value is 12% which is the approximate value for 2009.

Regional A&AP, E&EP, MRO, and T&S revenue forecast



Description

All of the global revenue values were segmented to regional values based on the percentage that region contributes to global military spending. The assumption is therefore made that nations will keep all military aerospace spending in-country (or within a geographical region) for national security or domestic policy reasons.

Appendix III - report card data sources

This appendix briefly outlines the data and data sources used in constructing the competitive report card included in the body of this report. Dashes denote that data was unavailable.

Sales

Sales values were normalized by GDP prior to ranking.

Country	Revenue 2008 (USD billion)	Revenue normalized to 2008 GDP[xi]	Average YoY growth-rate
Developed markets			
Canada[i]	19.3	0.013	3%
France[ii]	49.1	0.017	11%
Germany[iii]	28.8	0.008	8%
Japan[iv]	16.6	0.006	14%
United Kingdom[v]	27.1	0.010	2%
United States[vi]	205.7	0.014	7%
Emerging markets			
Brazil[vii]	7.6	0.005	17%
China[viii]	12.0	0.003	-
India[ix]	4.0	0.003	-
Russia[x]	10.0	0.003	-

[i] Source: AIAC, average growth based off year over year growth from 2004 – 2008. [ii] Source: GFIAS, average growth based off year over year growth from 2004 – 2008.
[iii] Source: BDLI. average growth based off year over year growth from 2004 – 2008. [iv] Source: SJAC, average growth based off year over year growth from 2004 – 2008.
[v] Source: SBAC, average growth based off year over year growth from 2004 – 2008. [vi] Source: AIA, average growth based off year over year growth from 2004 – 2008.
[vii] Source: AIAB, average growth based off year over year growth from 2004 – 2008. [viii] Source: Market Avenue, only revenue from 2008 was available.
[ix] Source: AeroStrategy, only revenue from 2008 was available. [x] Source: AeroStrategy, only revenue from 2008 was available.
[xi] Source: GDP data sourced from the IMF; GDP values were expressed in current dollars, USD billion.

Research & development

Country	R&D intensity (%)	Percentage of R&D from public sector (%)
Developed markets		
Canada[i]	6	33
France[ii]	16	44
Germany[iii]	16	75
Japan	-	-
United Kingdom[iv]	11	51
United States[v]	10	72
Emerging markets		
Brazil	-	-
China	-	-
India	-	-
Russia	-	-

[i] Source: AIAC & Conference Board of Canada, R&D intensity based on approximate long-run average, average of 1 year (2009) of data for private sector R&D investment.
[ii] Source: GIFA, 5 years of historical data for R&D intensity, average of 4 years of data for private sector R&D investment.
[iii] Source: BDLI, 1 year of historical data for R&D intensity, average of 1 year of data for private sector R&D investment.
[iv] Source: SBAC, 6 years of historical data for R&D intensity, average of 3 years of data for private sector R&D investment.
[v] Source: AIA, 2 years of historical data for R&D intensity, average of 2 years of data for private sector R&D investment.

Exports

Exports were normalized to total country exports prior to ranking.

Country	Aerospace exports (USD million)	Percentage of national exports (%)
Developed markets		
Canada[i]	16,234	3.6
France[i]	73,526	12.4
Germany[i]	57,775	3.9
Japan[i]	5,288	0.7
United Kingdom[i]	295	0.1

Country	Aerospace exports (USD million)	Percentage of national exports (%)
United States[i]	140,213	10.8
Emerging markets		
Brazil[i]	11,857	6.0
China[i]	3,276	0.2
India[i]	-	-
Russia[i]	6	0.0

[i] Source: UN Comtrade, trade data for 2008.

Employment

Employment was normalized to national labour force prior to ranking.

Country	Employment ('000s)	Percentage of national employment (%)
Developed markets		
Canada[i]	77.6	0.46
France[ii]	160.0	0.62
Germany[iii]	93.7	0.23
Japan[iv]	30.1	0.05
United Kingdom[v]	100.3	0.35
United States[vi]	644.2	0.45
Emerging markets		
Brazil[vii]	27.1	-
China	-	-
India	-	-
Russia	-	-

[i] Source: AIAC & IMF WEO, based off information from 2009 . [ii] Source: GFIAS & IMF WEO, based off information from 2008.
[iii] Source: BDLI & IMF WEO, based off information from 2009. [iv] Source: SJAC & IMF WEO, based off information from 2008.
[v] Source: SBAC & IMF WEO, based off information from 2009. [vi] Source: AIA & IMF WEO, based off information from 2009.
[vii] Source: AIAB, employment figures from 2008, national employment figures not available.

Companies

Country	Number of companies
Developed markets	
Canada[i]	420
France[ii]	392
Germany[ii]	201
Japan	-
United Kingdom[ii]	594
United States	-
Emerging markets	
Brazil	-
China	-
India	-
Russia	-

[i] Source: Industry Canada, based off information from 2006, number is approximate because derived from a graph.
[ii] Source: EU Competitiveness Report December 2009, shows number of companies in 2006.

Appendix IV - forecast model settings

Figure 94 gives the forecast model settings used to generate the results presented in this report.

Figure 94: Forecast model settings used to generate results reported in report

Ref.	Forecast methodology	
	Manual override ability for forecasted values?	
I	RPK forecasting method	OEM
II	Civil Manufacturing forecasting method	Deloitte
III	Military Manufacturing forecasting method	Deloitte
10	Military MRO CAGR assumption	
v	North America military spending forecasting model	Post-911
v	Europe military spending forecasting model	Post-911
7	Civil - average satellite launch cost (2010 dollars, USD billion)	0.052
7	Civil - average multiple of manufacturing revenue to launch revenue	3
11	Civil - CAE's share of the global T&S market	70%
12	Military - Space manufacturing revenue as a % of total manufacturing revenue	12%
Ref.	**Forecast adjustments**	
2	RPK forecast	
3	Deliveries forecast	
4	Civil Aerospace manufacturing forecast	
6	Civil training and simulation forecast	
8	Military Aerospace manufacturing revenue forecast	
9	Military spending forecast	
	Africa military spending forecast	
	Asia-Pacific military spending forecast	
	CIS military spending forecast	
	Europe military spending forecast	
	Latin America military spending forecast	
	Middle East military spending forecast	
	North America military spending forecast	
5	Trade forecasts	
	Aircraft & aircraft parts Africa trade forecast	
	Aircraft & aircraft parts Asia-Pacific trade forecast	
	Aircraft & aircraft parts CIS trade forecast	
	Aircraft & aircraft parts Europe trade forecast	
	Aircraft & aircraft parts Latin America trade forecast	
	Aircraft & aircraft parts Middle East trade forecast	
	Aircraft & aircraft parts North America trade forecast	
	Aircraft & aircraft parts Other trade forecast	
	Engines & engine parts Africa trade forecast	
	Engines & engine parts Asia-Pacific trade forecast	
	Engines & engine parts CIS trade forecast	
	Engines & engine parts Europe trade forecast	
	Engines & engine parts Latin America trade forecast	
	Engines & engine parts Middle East trade forecast	
	Engines & engine parts North America trade forecast	
	Engines & engine parts Other trade forecast	
Input	**2009 Canadian revenue (billions)**	
	Currency	CAD
	Exchange rate (USD/CAD)	
	Percent of revenue from civil	
	Aircraft, aircraft parts, & components	
	Maintenance, repair, & overhaul	
	Aircraft engines & engine parts	
	Avionics & electro systems	
	Simulation & training	
	Space	

Restrictions, limitations, and major assumptions

Deloitte prepared this report ("Report") for the Aerospace Industries Association of Canada ("AIAC") to provide an estimate of the size of the global aerospace market ("market") and a forecast of market revenues through 2020 for the Canadian Aerospace Industry, using a base case and a number of industry scenarios.

In preparing this report, we have relied heavily upon the completeness and accuracy of primary research and data from Aerospace Industries Association of Canada, International Monetary Fund, Oliver Wyman, IBISWorld, OAG Aviation solutions, Boeing, Airbus, Rolls-Royce, Bombardier, Embraer, Visiongain, World Bank, Stockholm International Peace Research Institute, United Nation's Comtrade, and various other national aerospace associations. Our estimates and forecasts are conditional upon the completeness, accuracy, and fair presentation of such information. Except as expressly described herein, we have not attempted to verify independently the completeness, accuracy or fair presentation of the information.

No opinion, counsel, or interpretation is intended in matters that require legal or other appropriate professional advice. It is assumed that such opinion, counsel, or interpretations have been or will be obtained from the appropriate professional sources. To the extent that there are legal issues relating to compliance with applicable laws, regulations, and policies, we assume no responsibility therefore.

The market size and forecast estimates are rendered on the basis of economic, financial, and general business conditions prevailing as of August 1st, 2010. In the analyses and in preparing the market forecast estimates, we made numerous assumptions with respect to industry performance, general business, and economic conditions and other matters, many of which are beyond our control, including industry regulation. Events may have occurred since we prepared this report which may impact on the information therein and our conclusions. Should any of the above major assumptions not be accurate or should any of the information provided to us not be factual or correct, our estimates of the market, as expressed in this report, could be significantly different.

Our estimates must be considered as a whole. Selecting portions of the analyses or the factors considered by it, without considering all factors and analyses together, could create a misleading view of the process underlying the market size estimates.

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