Introduction to Aviation
Aero 1022
Lesson Number 2

University of South Australia

Chapter 2 - Aviation: An Overview

The objectives of this lesson are to introduce you to the aerospace industry and its contribution to the economy. At the end of the lesson you should be able to define and discuss:

- The aerospace industry and its basic characteristics
- The problems faced by the government marketplace
- The economic outlook for the civil aviation marketplace
- The factors affecting commercial air transport sales and related products and services

Overview continued

- The characteristics of air transportation industry and distinction between certificated air carriers and general aviation
- How the air transportation industry contributes to the general economy
- How air transportation contributes to the efficient conduct of business and affects personal and pleasure travel patterns

The Aerospace Industry

The aerospace industry engages in research, development and manufacture of:

- Manned and unmanned aircraft
- Missiles
- Space-launch vehicles
- Spacecraft
- Airborne and ground-based service and support equipment

The Aerospace Industry continued

Technological capabilities of aerospace industry influence national security, foreign policy, the space program, and other national and regional goals.

Aerospace industry is vital to economy

- Trade Balance
  - Aerospace products and services needed for overseas markets
  - Aerospace industry can help to balance international trade
- Employment
  - Aerospace maintenance, training and services are a source of highly technical and high paying jobs
- Research and Development (R&D)
  - Aerospace R&D have linkage to other modes of transport as well as telecommunication and defense
  - For every 100 aerospace jobs about 73 are created in other industries

Early Commercial Aviation

- How would you characterize the aerospace industry prior to 1950s?
  - Who were the passengers?
  - What were their reasons to travel?
  - How did this impact the economy?
  - Was there a significant support structure?

Aerospace in Australia

The Australian Aerospace Industry has a rich history with rapid growth during WWII.

• Both Australia and Canada were heavily involved in aircraft production and aircrew training in support of the war.

- Australia primarily focused on homeland defense and regional support
- Canada's focus was on support for the US and Europe
  - The Canadian industry became about 4 time as large as Australia
  - Today Canada has about a 20 billion dollar annual aerospace industry with 60% of its sales to the US.

Australian Aerospace Industry

- Following WWII Australia essentially stopped aircraft production.
- Between 1980 and 2000 the majority of the remaining Australian aerospace industries were acquired by Boeing.
- By 2007 the industry had approximately 11,000 employees with a output of $1.7 billion annually. This also started to show a slow transition from Boeing toward European Aeronautic Defense and Space Company (EADS). In 2014 EADS became Airbus Group.

AIRBUS GROUP

Some indications of progress

- By 2012 the Australian aviation industry compromised about 750 primary and support aerospace companies with about 12,000 employees and an annual income of $4 billion
  - 20% of its products were for export
  - Expanded technology base for design and support for the B-787 and F-35.

Department of Infrastructure and Regional Development https://infrastructure.gov.au/

- Following the 2013 elections the *Department of Infrastructure and Transport* was renamed the *Department of Infrastructure and Regional Development*.
- The government established the Australian Aerospace Industry Forum to help support and promote the industry and its sustainability.

Aerospace in Asia-Pacific

Today, many of the Australian aerospace companies have close associations with regional and international aircraft manufacturers, product and service providers, and training organizations. Key Australian aerospace resources include:

- Boeing 16%
- BAE 12%
- Australian Aerospace 11%
- Hawker Pacific 5%
- Others associated with the Australian Defense Force

(source: GlobalSecurity.org)

Characteristics of the Industry

- Prior to 1950, limited R & D activity in the aerospace industry
- The production of jet-powered supersonic aircraft in the early 1950s initiated a transformation of the industry
- Higher complexity required more skills
  - Managerial skills required to optimize processes
- The aerospace industry was going away from volume production and toward tailored manufacture of fewer types of aircraft and equipment

Characteristics of the Industry

Although the Australian aerospace industry is not as robust as other regions, it does have many of their attributes. A half-century of evolution has left the aerospace industry of North America with a set of interesting characteristics:

1. Performance demands for new systems require continual advancement of the technological frontier, which in turn involves unusual degrees of uncertainty and risk.
    - For example, Remotely Piloted Vehicles (RPV) or Unmanned Aerial Systems (UAS) in Australia are a rapidly expanding industry and somewhat ahead of the US program.

Characteristics continued

2. Because the government (military) is the principal customer, the product line is subject to revisions in program levels occasioned by changing requirements and funding availability.
3. Equipment that challenges the state of the art is necessarily costly, the more so because requirements generally dictate short production runs, negating the economies of large-scale production.

More characteristics

4. Technologically demanding programs require personnel emphasis in the higher skill levels. Hence, labor input per unit of output is substantially larger than other manufacturing industries.
5. The combination of technological uncertainty and long lead times, often 7–10 years and frequently longer, between program initiation and completion, makes advance estimation of costs particularly difficult.

Characteristics continued

6. Because there are few customers and relatively few programs, competition for the available business is intense.
7. All of these characteristics contribute to exceptional demand for industry capital, profit as a percentage of sales is consistently well below the average for all manufacturing industries.

Economic profile of the Industry

- The aerospace industry is composed of about 60 major firms operating some 1,000 facilities, backed by thousands of subcontractors, vendors, and suppliers
- Activity, as measured by sales volume, focuses on aircraft, both civil and military, which account for almost 55 percent of the industry’s workload

Profile continued

- Sales in 2013 amounted to approximately $215 billion, compared to $205 billion in 2011, and is broken down as follows:
  - Aircraft, $119 billion;
  - Missiles, $21 billion;
  - Space-related materials, $44 billion
  - Related products and services, $30 billion

US aerospace sales

TABLE 2-1 Aerospace Industry Sales by Product Group,* 2002–2013

Year	Total Sales	Aircraft			Missiles	Space	Related Products & Services
		Total	Civil	Military			
Current Dollars (Billions)							
2002	$154.35	$78.62	$41.34	$37.28	$15.71	$34.62	$25.39
2003	152.59	75.96	32.44	43.52	16.93	35.86	23.84
2004	157.88	78.32	32.52	45.80	19.66	35.70	24.20
2005	169.41	86.58	37.16	49 42	20 80	36.66	25.36
2006	185.26	100.19	45.85	54.34	21.03	37.56	26.48
2007	204.50	112.96	52.55	60.41	22.59	39.90	29.06
2008	210.17	112.19	48.18	64.01	24 59	43.22	30.18
2009	209.86	110.69	51.30	59.39	24.70	45.03	29.44
2010	208.49	109.96	48.16	61.80	23.46	45.39	29.68
2011	210.79	112.81	53.15	59.66	23.39	44.59	30.01
2012(P)	217.87	118.82	60.59	58.24	23.13	44.90	31.01
2013(E)	223.55	124.29	67.48	56.81	21.84	45.60	31.82

Tough years

Better years

(Wensveen, 2015, p22)

US Sales by Customer

TABLE 2-2 Aerospace Industry Sales by Customer,* 2002–2013

Year	Total Sales	Aerospace Products and Services				Related Products & Services
		Total	Department of Defense	NASA and Other Agencies	Other Customers	
Current Dollars (Billions)						
2002	$154.35	$128.96	$61.70	$16.39	$50.87	$25.39
2003	152.59	128.75	71.28	16.52	40.95	23.84
2004	157.88	133.68	75.38	16.98	41.32	24.20
2005[a]	169.41	144.05	80.71	17.25	46.09	25.36
2006	185.26	158.78	84.04	17.22	57.52	26.48
2007	204.50	175.45	94.17	17.80	63.48	29.06
2008	210.17	179.99	101.47	19.51	59.01	30.18
2009	209.86	180.41	99.43	20.81	60.17	29.44
2010	208.49	178.82	101.23	21.10	56.49	29.68
2011	210.79	180.78	99.64	21.17	59.97	30.01
2012(P)	217.87	186.86	96.24	20.25	70.37	31.01
2013(E)	223.55	191.73	93.16	20.81	77.76	31.82

(Wensveen, 2015, p22)

Government market

- Despite growing percentages of non-government and non-aerospace business, industry activity is still dominated by government contracts in the US mainly with:
  - Department of Defense (DOD)
    - Foreign military sales
  - National Aeronautics and Space Administration (NASA)
    - Basic R&D for implementation by FAA and general aviation

Civil Aviation Marketplace

- Compared to other industries, the customer base for commercial passenger jets is limited and the volume of orders is generally low
- Very high capital requirements for new product development force companies to compete on a global scale

Civil Aviation Marketplace

- Between 400 and 600 aircraft must be sold before a program reaches the break-even point
- Since 1990, foreign sales have accounted for over 70 percent of commercial transport and civil helicopter sales and about 40 percent of general aviation aircraft sales

Where have all the aircraft manufacturers gone?

What is the primary cause for consolidation in the commercial aircraft manufacturing industry?

Why has Boeing accused Airbus Industrie of unfair competition?

Why has there been a greater emphasis on international cooperation in building aircraft components and subassemblies?

Civil Aviation Market continued

- The Civil Aviation Market is dominated by Airbus and Boeing:
  - Boeing has been able to maintain approximately 60 percent of the market for large jet aircraft
  - Airbus' market share has been steadily growing since its establishment in 1995
- Although US aerospace companies have dominated the global market for many years, the use of overseas suppliers of components and subassemblies is increasing
- Other aircraft companies are emerging as the number 3 aircraft manufacturer: Brazilian (Embraer, ERJ-195), China (COMAC, C919), Canada (Bombadier, CRJ-900)

US aircraft shipments

TABLE 2-3 Civil Aircraft Shipments, 2002–2013

Year	Total	Transport Aircraft	Helicopters	General Aviation
NUMBER OF AIRCRAFT SHIPPED				
2002	2,904	379	318	2,207
2003	2,935	281	517	2,137
2004	3,445	285	805	2,355
2005	4,094	290	947	2,857
2006	4,443	398	898	3,147
2007	4,729	441	1,009	3,279
2008	4,538	375	1,084	3,079
2009	2,636	481	570	1,585
2010	2,135	462	339	1,334
2011	2,365	477	435	1,453
2012(P)	2,624	593	478	1,553
2013(E)	2,895	671	519	1,705

Recession

What happened

(Wensveen, 2015, p28)

Factors Affecting Commercial Transport Sales

- Economic Growth and Inflation
  - Economic growth causes demand for air transport & increases aircraft sales
  - A 1% increase in world economic growth causes 2.5-3% increase in air traffic
- Fleet Capacity
  - When load factor is low, airlines have more excess lift capacity than when the load factor is high
  - High load factors and rising air traffic place airlines under pressure to buy aircraft
- Replacement Aircraft
  - Airlines order aircraft to increase their capacity, they also purchase new transport to replace their older and less efficient models
  - The advancing age of current fleet suggests that replacement orders should be on the rise through the late 2000s

Factors continued

- Airline Profitability
  - New aircraft are required for fleet growth for profitable airlines
- A Cyclical Industry
  - Since 1971, orders of US transport have peaked 5 different times, and the average period between a trough and a peak has been 3 years that causes orders and deliveries to swing abruptly

Factors continued

- Future Trends in Air Transport
  - The air transport sector has shown a strong tendency to recover from each downturn with renewed vigor
  - Efficiency through computer aided design, testing, simulated maintenance and configuration management
  - Economic growth and low inflation have been the key factor that have fed the demand for air transportation

General Aviation

- After record shipments of 17,817 units in 1978, the general aviation segment of the aerospace industry, which manufactures light aircraft and components, experienced a 16-year downward slide in sales
- The general aviation industry has undergone deep and broad structural changes; the major independent manufacturers have been taken over by conglomerates
- Experimental and amateur built aircraft are evolving

Helicopter segment

- The helicopter commercial industry has generally been the response to military and aeromedical demands
- The cost of training, maintenance and operating has limited access from pleasure and recreational flying
- Some airports have even posted limitations on helicopter operations due to environmental (noise) and safety concerns

Australian registered aviation industry

- Registered aircraft – 15,287 as of 2014 per CASA
- Air operator certificates – 824 to fly for compensation
- Maintenance engineers – 8462
- Pilot licenses – 33,000 for private or higher ratings
- Medical certificates – 25,000
- Certificated airports – 192
- Registered airports - 135

Australian Sports Aviation Industry

- The Australian Sports Aviation Industry involves approximately 40,000 participants and 9,000 aircraft.
  - Ultralights
  - Gliders
  - Parachutes (more than 300,000 jumps per year)
  - Warbirds
  - Amateur build
  - Non-commercial ballooning

GA Sales

- What are some of the factors that led to the decline in general aviation aircraft sales?
- How has the development of the Sports Aviation program impacted the aviation industry?

Air Transportation Industry

- The **air transportation industry** includes all civil flying performed by certificated air carriers and general aviation
- The US Civil Aeronautics Act of 1938 defined and established various classifications within aviation:
  - "*Air carrier*" means any citizen of the United States who undertakes-… to engage in air transportation.
  - "Interstate air transportation"-… mean[s] the carriage by aircraft of persons or property as a common carrier for compensation or hire
- For the US, the appropriate term for airlines is not commercial airlines, but **certificated (common) air carriers**

Economic contributions

- Over the past 60 years, the air transportation industry has become an increasingly important part of the US and the world's economy
- Aviation employs many thousands of people, and thousands more work in aviation's support industries, such as hotels, restaurants, rental cars, real estate, construction, and manufacturing

Economic contributions continued

- Aviation's final "products" are passengers and cargo safely and efficiently delivered to their destination:
  - In 2004, US airlines carried 698 million passengers and registered 28 billion ton-miles of cargo on approximately 9 million scheduled departures.
  - US airlines also carried more than 11 million passengers and over 6 billion ton-miles of cargo on approximately 400,000 nonscheduled departures
  - One-stop shopping for travel or cargo is expected, where an entire trip can be booked from one site.

Economic impact

- *Economic impact is usually measured in direct effects and secondary effects (indirect and induced effects)*

Contribution to efficient conduct of Business

Air transportation is now as much a part of our way of life as the telephone or the computer and essential for efficient conduct of business:

Impact	Primary			Induced (nearly double)			Total		
Aviation Activity	Output	Earnings	Jobs	Output	Earnings	Jobs	Output	Earnings	Jobs
Commercial Service	446.2	119.2	3,282,000	778.6	251.9	7,599	1,224.80	371.1	10,881,000
General Aviation	31	7.9	198,000	59.6	17.3	433	90.5	25.2	631,000
Total	**477.2**	**127.1**	**3,480,000**	**838.2**	**269.2**	**8,032**	**1,315.30**	**396.3**	**11,512,000**

(Wensveen, 2015, p38)

Efficiency and effectiveness

Air transportation enables business and government organizations to reach any point in the world within hours, whether flying by air carrier or a general aviation aircraft. This allows:

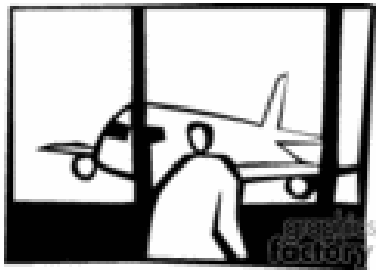
1. Quicker on-the-spot decisions and action
2. Less fatigue associated with travel
3. Greater mobility and usefulness of trained, experienced executives, engineers, technicians, troubleshooters and sales personnel
4. Decentralized production and distribution
5. The ability to expand market areas through more efficient use of management and sales personnel

Impact on personal and pleasure travel

- Prior to WWII very few had flown, mostly rich businessmen or “barnstorming thrill rides”
- WWII introduced many to the efficiency of air travel
- In the 1960s about 1/3 of US population had flown, and this increased to nearly 7/8 by 2006. In part this was due to better economic conditions linked with flat airline pricing.
- Today it is common for students, grandparents or families to make pleasure flight to regional or international locations.
- Government support for the development of airports and aviation infrastructure is essential for sustained growth!

Funding for US airports

In the US, 35% of all Airport Improvement Grants were allocated for non-primary commercial airports, while only 0.25% of air passenger used these smaller airports.



Discuss in a group why the government should continue to fund these small airports and what are the implications for primary airports?

Hon Warren Truss MP

- On 10/12/15 the Minister announced $11.6 million for aerodrome (airstrip) upgrades for isolated communities:
  - NSW (8), QLD (15), WA (7), SA (9), NT (12), Tasmania (1).
- This was part of a $33.7 million budget for 4 years
- Emphasis is on better access to health care, essential services and economic growth in remote areas
- Upgrades include animal-proof fences, runway surfacing and drainage, and lighting

Summary

In this lesson we have discussed:

- aerospace industry and its basic characteristics and economic magnitude
- some of the problems faced by the government market
- the economic outlook for the three segments of the civil aviation market
- the factors affecting commercial air transport sales, products and services
- distinctions between certificated air carriers and general aviation
- the impact of the air transportation industry on the economy
- how air transportation contributes to the efficient conduct of business and how it affects personal and pleasure travel