

REGIONAL COLLABORATION STUDY:
ASSESSING THE ECONOMIC IMPACT OF THE
RUNWAY AT THE NASA PLUM BROOK FACILITY

OHIO COLLABORATION GRANT
G-08-036-1

BY
MICHAEL C. CARROLL, PH.D.
WILL M. BURNS
CENTER FOR REGIONAL DEVELOPMENT
BOWLING GREEN STATE UNIVERSITY

DONALD T. IANNONE
DONALD T. IANNONE & ASSOCIATES

STEPHEN QUILTY
SMQ AIRPORT SERVICES

SEPTEMBER 2009

RESEARCH STATEMENT

The purpose of this report is to identify and measure the economic impact created by the addition of a 9,000 foot runway to be constructed at the NASA Plum Brook facility. This report estimates the economic impact of the NASA facility and as well as the economic contribution made by spin-off companies. Estimates are also provided for the impact on existing businesses of the new facility.

The baseline data used in this report is from Federal and State sources such as the Bureau of Labor Statistics, Economic Development Administration, Bureau of Economic Analysis, and the Ohio Department of Development. All of the economic forecasts were based on reported data. No forecasts were begun with an assumed or estimated parameter. The agency information was taken as datum and no attempt was made to verify or audit financial systems and procedures of the data reporting agencies. The runway construction cost estimates were provided by the Erie County Commissioners and were taken as datum.

Every attempt was made to accurately measure and spatially place the relevant, “real” economic impacts. It should be noted that this report contains only openly reported activities and no attempt was made to estimate “off the books” activity. The runway construction costs were provided by the Erie County Commissioners and were taken as datum.

Center for Regional Development

Bowling Green State University

TABLE OF CONTENTS

Research Statement

Table of Contents

1. Executive Summary	4
2. Project Objectives	6
3. Existing Situation	7
4. Economic Impact Analysis	11
5. National Industry Analysis	20
6. Governance and Management.....	50

Appendices

A. Demographic Profiles

B. Economic Impact Detail of Runway Construction

1) Employment Impact by Industry

2) Economic Impact by Industry

C. Annual Economic Impact Scenario Detail of NASA Operating Activity and Related Startups

D. Industry Analysis

EXECUTIVE SUMMARY

The addition of the 9,000 foot runway at the NASA Plum Brook facility will have a significant impact on the local economy. Not only will NASA base employment increase but the potential for spin-off operations to locate in the region¹ is very high. This study estimates that for every NASA job created as a result of the added runway, approximately five additional jobs are created in the local community. On the surface this appears high, but it is due to the “bundled” nature of the scientific testing work conducted at Plum Brook. At testing locations such as this, there are generally a number of private contractors present during every test. Therefore, the employment multipliers are high for this industry.

Selected Highlights:

- The one-time construction impact is \$82.5 million on the region
- 773 jobs will be created during the construction phase
- Construction would create \$6,827,091 in federal taxes
- Construction would create \$4,065,698 in state and local taxes
- If NASA employment reaches 325 workers:
 - \$168 million will flow into the local economy annually
 - 1,776 jobs would be supported annually
 - Generate \$13,625,191 in Federal taxes annually
 - Generate \$5,742,644 in state and local taxes annually
- If NASA employment reaches 100 workers:
 - \$45.5 will flow into the local economy annually
 - 470 jobs would be supported annually
 - Generate \$3,688,068 in Federal taxes annually
 - Generate \$1,550,839 in state and local taxes annually

¹ The region is defined as Erie and Huron Counties. The two county region was stipulated by the State of Ohio Collaboration Grant.

One-time Construction Impact

	Direct	Indirect	Induced	Total
Economic Impact	\$60,238,856	\$9,600,635	\$12,633,804	\$82,473,296
Employment	545	88	140	773

Fiscal Tax Impacts from Construction

Federal	\$6,827,091
State and Local	\$4,065,698

Operating Impact Scenarios

	100 NASA Jobs	175 NASA Jobs	325 NASA Jobs
Total Employment Impact	470	929	1,776
Total Economic Impact	\$45,486,108	\$88,451,916	\$167,978,925
Fiscal Tax Impact			
Federal Taxes	\$3,688,068	\$7,156,535	\$13,625,191
State and Local Taxes	\$1,550,839	\$3,015,004	\$5,742,644
Jobs per NASA Worker	4.7	5.3	5.5
Economic Impact per NASA Worker	\$450,486	\$505,439	\$516,858

PROJECT OBJECTIVES

The operating principles for this project are listed below. The objectives were defined by the State of Ohio Collaboration Grant No. G-08-036-1. This project report includes:

- An economic impact study that estimates the value of the runway construction at the NASA Plum Brook facility. The impact includes the dollar and employment value of the project and includes an estimate of tax revenues associated with the runway construction.
- An estimate of the economic value of startups and technology transfers associated with NASA Plum Brook facility. The report also identifies existing business in the region that may benefit from the construction and operation of the Plum Brook facility.
- An examination of a variety of organizational structures for the operation of the proposed entity. Special emphasis was given to the organizational structure's ability to conduct to economic development projects that include revenue sharing strategies for the political entities involved. A number of alternatives are offered including, public ownership, public/private partnerships, and privately owned and operated.
- A set of strategies for collaboration of the various partners involved in regional economic development as it relates to the proposed facility. The report also includes a listing of barriers to collaboration.
- An evaluation report that examines key trends in national aviation, airline service, space and aerospace and related transportation services.

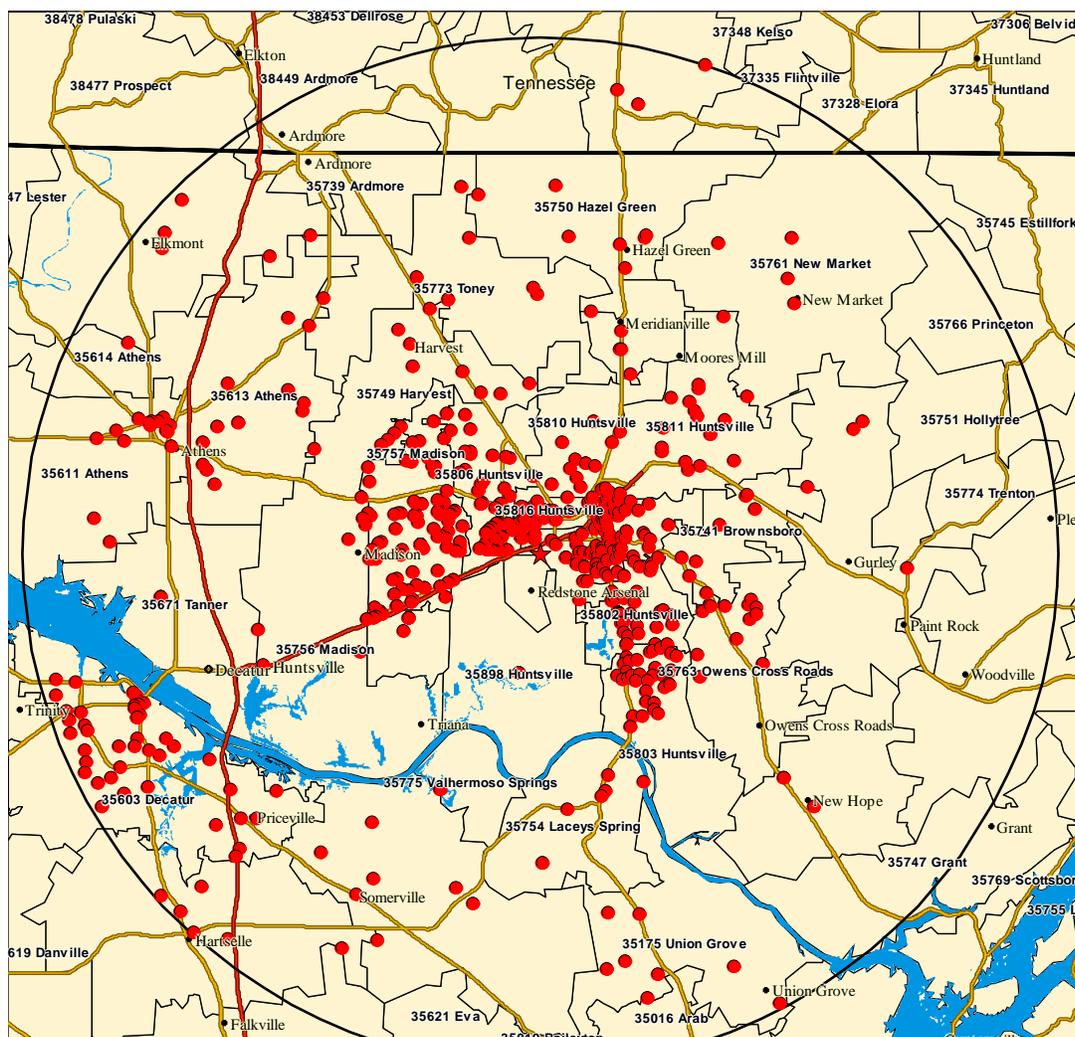
EXISTING SITUATION

The Huron-Erie County region has experienced significant economic decline in the past decade. Large declines in manufacturing employment occurred since the 2000 recession. The loss of these manufacturing jobs results in a drop in household income, as the new jobs created, primarily in the service sector; do not have the same earning potential as the eliminated manufacturing jobs. The current recession has caused even a greater spike in the area's unemployment. The recovery will be slower in this region based on the industrial mix. This emphasizes the need for this collaborative project that focuses economic development activities on expanding a regional asset as the key to succeeding in this transitional economy.

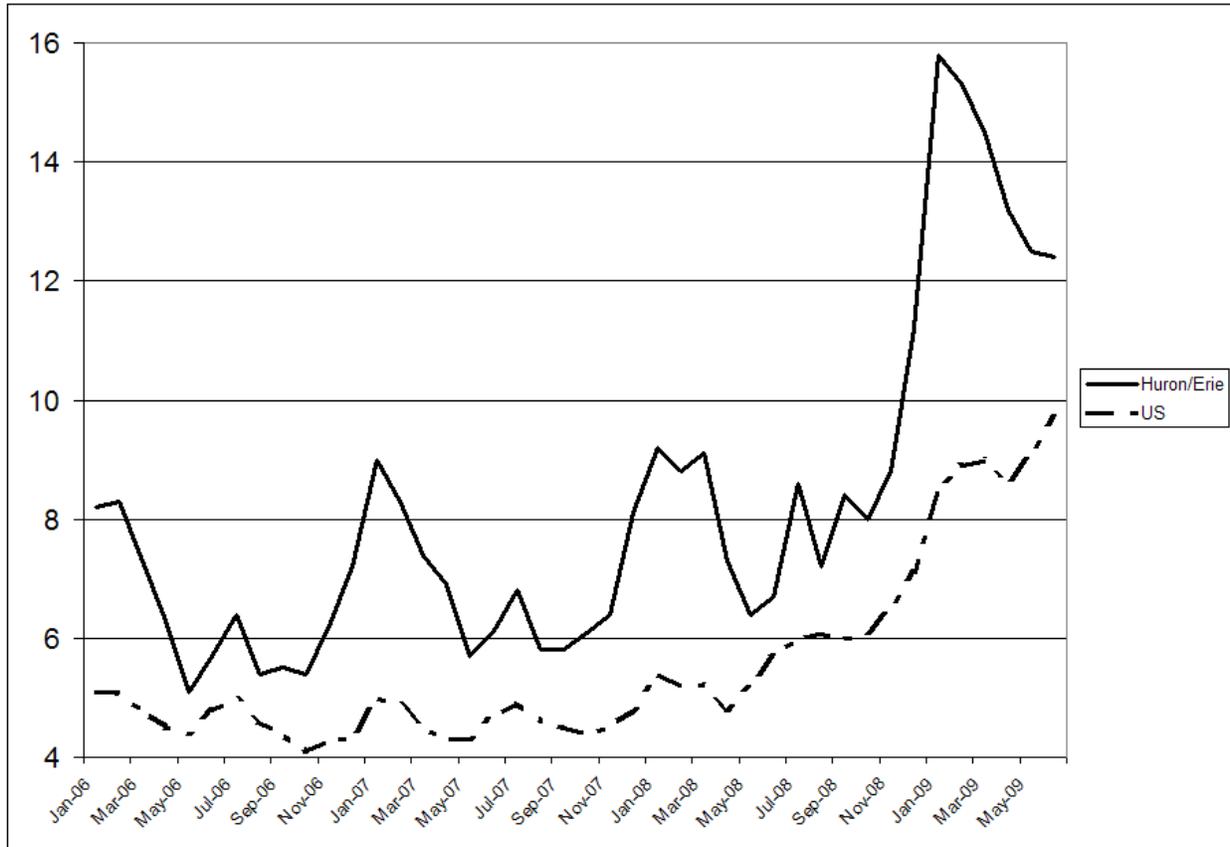
Employment Change 1999-2008

Sector	Employment, 1999	Employment, 2008	Employment Change	Percent Growth, 1999 - 2008
Manufacturing	19,562	12,152	-7,410	-37.9
Education and Health Services	10,822	11,915	1,093	10.1
Trade, Transportation, and Utilities	12,679	11,315	-1,364	-10.8
Leisure and Hospitality	9,178	10,375	1,197	13.0
Professional and Business Services	3,013	2,990	-23	-0.8
Construction	2,836	2,549	-287	-10.1
Public Administration	1,957	1,879	-78	-4.0
Other Services	2,153	1,586	-567	-26.3
Financial Activities	1,537	1,425	-112	-7.3
Natural Resources and Mining	1,054	889	-165	-15.7
Information	981	855	-126	-12.8
	65,772	57,930	-7,842	

The above table shows the employment change for the two county study region from 1999 to 2008 by industrial sector. There are only two sectors that show positive growth over that time period, Education and Health Services and Leisure and Hospitality. The Professional and Business Service sector remained fairly stable in the region, however it was a growth sector for the state as a whole. The decline in manufacturing was greater than all of Ohio for the period and these figures are before the massive contraction of the automotive industry which has further decimated the manufacturing sector in this region.



This map shows the concentration of business surrounding the Marshall Space Flight Center in Huntsville Alabama. The circle represents a 25 mile radius around the NASA facility and demonstrates, in terms of distance from the anchor facility, what type of development pattern we can project for the Plum Brook Station if runway construction project is completed.



The above line graph shows the unemployment rates for the two county region of Huron and Erie compared to the State of Ohio. The rates are not seasonably adjusted and thus show the normal peaks and valleys experienced by the region. The alarming fact is that the normal valley during peak summertime employment is still over 12% and we would expect to see another sharp rise by the end of 2009. The outlook for future employment gains is dependent on transitioning the economic base of the region from dependency on declining sectors into a knowledge based economy. The first step is building around the existing assets. In this region, the NASA Plum Brook Station gives the area an unprecedented leg up on attracting scientific and testing facilities to the area.

The following table compares the change in employment by sector for the two county study region against the expected change if the economy was to mimic national growth trends. It also incorporates the regions industrial mix, showing which industries are growing or decline taking out the national growth percentage. The competitive share column gives the net result from actual employment change and the effects of the national growth and industrial mix. If the number is positive, then the region has a competitive advantage in that sector. This region's sectors are all declining, and there is no competitive advantage. Even in the sectors that had positive growth, they are not growing at a rate that would be expected when considering national growth trends and industrial mix.

10 Year Shift Share 1998 - 2008

Sector	National Growth Component, Jobs	Industrial Mix Component, Percent	Industrial Mix Component, Jobs	Competitive Share Component, Percent	Competitive Share Component, Jobs
Information	61	-16.8	-165	-2.2	-22
Financial Activities	96	-0.2	-3	-13.3	-205
Natural Resources and Mining	66	3.4	36	-25.3	-266
Public Administration	122	3.7	73	-13.9	-273
Professional and Business Services	188	4.6	138	-11.6	-349
Leisure and Hospitality	571	11.0	1,005	-4.1	-380
Construction	177	5.0	140	-21.3	-604
Other Services	134	3.3	72	-35.9	-773
Education and Health Services	674	15.6	1,690	-11.7	-1,271
Trade, Transportation, and Utilities	789	-3.6	-454	-13.4	-1,699
Manufacturing	1,218	-29.2	-5,722	-14.9	-2,906
	4,096		-3,190		-8,748

ECONOMIC IMPACT ANALYSIS

METHODOLOGY

This section outlines the general methodology used to calculate the economic impact. A brief discussion of the models employed is followed by a description of the pertinent data used in the economic calculations. The primary data which includes industry employment levels and local demographic characteristics are taken from state and national data sources.

General Economic Forecasting Model Specification

This study employed an Input\Output model to make the primary economic forecasts. Input\Output methodology allows the examination of forward and backward linkages that are present in any regional economy. The model measures the total annual economic activity that results from inter- and intra-industry transactions. The model breaks the economy into approximately 500 separate sectors with each sector representing an individual industry. It then uses a sectoring scheme developed by the IMPLAN Group and is closely related to the Bureau of Economic Analysis (BEA) REIS model. The model is a approximate 500X500 (row x column) matrix that shows all the economic activity between the individual sectors. The entries in the matrix are based on the dollar amount that each industry sells to (and purchases from) other industries in the Ohio economy. It measures the amount of final consumption by the residents of the region as well as how much each industry exports from the area. The model uses data collected at the county level, which are obtained from the IMPLAN Group and the BEA. County data are in turn aggregated or “rolled-up” to form service areas such as local areas, states or larger geographic regions such as the Midwest.

Input\Output models estimate economic impacts by taking advantage of the relatively stable patterns in the flow of goods and services within the economy. Predictions can be made of an industry’s total economic impact by examining the purchasing patterns of the individual sectors. The BEA collects extensive data on these regional trade flows and reports their findings annually.

Spatial patterns are then defined through a Geographical Information System (GIS) interface. This GIS interface affords the ability to spatially locate and describe the economic phenomena under consideration. It further allows the forecasting model to accurately describe (+-30 ft from a centroid location) the physical location of any economic activity reported. Economic activity, once accurately defined, can be tracked through to its ultimate destination. Any degradation of the economic impact is assumed to be a function of distance decay or information/transportation infrastructure inadequacies.

Primary Data

Data selected in this study are from a variety of sources. The research team attempted to use the most recent reliable data sources. They include:

- Dun and Bradstreet (D&B) firm data from the Selectory database (2009)
- Bureau of Economic Analysis (2008)
- U.S. Bureau of Labor Statistics, Census of Employment and Wages (2008)
- IMPLAN Structural Matrices² (2007)
- State of Ohio County Profiles (2009)

Once the primary (direct) impact is identified, it is necessary to estimate the ultimate impact on the economy. This study's forecasting model utilizes variables from a variety of national data sets. To reduce potential confusion, a specific definition of the major variables may be of use.

Industry Output

Industry output represents the value of the industry's total production. Industry output can be thought of as the value of industry sales plus or minus inventory changes. It should be emphasized that industry output is not a measure of an industry's income and, therefore, cannot be directly compared to the Gross State Product (GSP) numbers reported by the BEA. The value of industry output is typically higher than GSP. It is a more comprehensive measure and, therefore, is a better measure of true economic impacts. The IMPLAN model estimates the industry output data, which are derived from the Bureau of Census Economic Census, the

² Structural matrices are used to determine the industrial supply chains.

Annual Survey of Manufacturers, and the Bureau of Labor Statistics growth model.

Employment

Employment is the total number of full-time wage and salary employees, plus the number of self-employed workers within a particular industry. Part-time workers' hours are aggregated into full-time equivalents (2,080 hours), and reported with the full-time workers. In our process, each year's activity is computed separately so that the employment effects are computed each year.

No single source of employment data is adequate for accurately estimating employment impacts. Due to nondisclosure rules, the employment figure reported by government agencies often underestimates true employment in a given county. In accordance with U.S. Code Title 13, Section 9, no datum is published that would disclose the operations of an individual employer or put an individual employer at an unfair disadvantage. In this study, as we narrow our focus to the county level, the number of firms representing an industry inevitably decreases. It is not uncommon for a single business establishment to be the sole operator in that industry in a particular county. If this is the case, the employment numbers are not disclosed and the employment in that region is understated. Fortunately, it is possible to reconstruct a region's employment by combining data from a variety of sources. Non-disclosure rules require that the individual reporting agency not reveal confidential information. However, other government agencies may report the missing data in another form. For example, the U.S. Department of Labor collects labor data as part of the Unemployment Insurance ES-202 program. These data are for "covered employees" of the Unemployment Insurance Program. Workers not "covered," such as self-employed workers, would not be included in the data. However, "not covered" workers would be included in the employment figures captured by the Department of Census County Business Patterns. By carefully combining the employment figures reported in the ES-202 data set, the County Business Patterns, the REIS data and the Internal Revenue Service Quarterly Payroll File (FICA), a fairly comprehensive employment figure can be reconstructed. The raw data are then "sectored" into the appropriate SICs and, in turn, combined into the necessary industry vectors and IMPLAN matrices.

Local Interviews

The CRD research team conducted eleven interviews with local business leaders. The purpose of those interviews was to gain local perspective and assess local concerns/enthusiasm regarding the project. CRD also met with NASA leadership, local elected officials, and the economic development personnel from Erie and Huron Counties.

“Job Bundles”

Most impact studies estimate the number of workers in the industry under investigation. The direct jobs are determined then the I/O model estimates the indirect and induced impacts. Unlike other industries, this project requires a matching of private and public sector jobs. The scientific testing that will be conducted at the Plum Brook facility generally occurs with the outside contractors present at the tests. Therefore, it is necessary to “bundle” the jobs. The bundle used in this project was one NASA worker and two private sector contractors (1:2 ratio). This ratio is a conservative estimate. Plum Brook currently employs about twenty workers that were with eighty external contractors (1:4 ratio). The 1:4 ratio is also present in the more mature cluster at the Marshall facility in Huntsville. It would be unrealistic to use a 1:4 ration in a start-up cluster but as the cluster matures, the region will see an increase in the ratio.

Service Area

The service area is defined as Huron and Erie Counties in Northern Ohio. This area was predetermined by the grant that funded this project. It should be noted that limiting the impact to two counties does underestimate the economic activity. There will be significant economic activity that will flow out of the two counties. An impact on Ohio’s economic may be a more appropriate measure. This is especially true give the location of the NASA Glen station in Cleveland.

RESULTS

This section provides the economic analysis of the NASA project’s impact on the two county (Huron and Erie) region. It shows the dollar amount and employment impacts for construction, and related spin-off companies.

Understanding Multipliers:

As mentioned in the introduction, the operation of NASA facility affects the economy in three ways. The *direct* impact includes the purchases of resources (labor, goods, and services) of the NASA operation and the resulting spin-off companies. The *indirect* impact measures the volume of industry-to-industry purchases. The *induced* impact reflects the change in household demand as those employees of the spin-off companies and its suppliers earn dollars for consumer spending. Therefore, the total impact to the economy is the summation of the *direct*, *indirect* and *induced* components. The amount of the indirect and the induced portions are found by using a multiplier. The multiplier shows how the initial (direct) expenditures get multiplied through the economy. Calculating the multipliers based on the supplier relationships and employee consumptions patterns are much more accurate than simple multiplier tables. Couple this information with the BGSU GIS location methodology and the results have a level of accuracy that was not obtainable even a few years ago.

One Time Construction Impact

The one-time construction impact was calculated using the data provided by the Erie County Commissioners. The information was taken as datum and no attempt was made to audit the numbers provided. The impact was based on the following cost estimates:

- Runway estimate \$29,840,000
- Associated infrastructure \$30,398,855
- Total \$60,238,855

Taking these estimates from the Erie County Commissioners, we can estimate the economic impacts of construction on the local community. The \$60,238,856 in direct expenditure yields an indirect amount of \$9,600,635 in indirect (business to business expenditure) and \$12,633,804 in indirect (consumer spending) for a total economic impact of construction of \$82,473,296. This impact would occur over the construction phase which has been estimated to be approximately eighteen to twenty four months. The employment impact would be 545 direct

jobs, 88 indirect and 140 induced for a total employment impact of 773 created for the construction period. It must be emphasized that these are not permanent jobs. They only exist in the construction phase. The impacts are summarized in the table below.

One-time Construction Impact

	Direct	Indirect	Induced	Total
Economic Impact	\$60,238,856	\$9,600,635	\$12,633,804	\$82,473,296
Employment	545	88	140	773

The construction phase will also generate significant tax revenues at the national and state and local levels. It is estimated that more than \$4 million dollars in state and local taxes will be generated during the construction phase. This would include state and local sales taxes, property taxes, income taxes, and other fee income paid to state and local entities. The Federal tax is estimated to be \$6.8 million and would include FICA, income and other federal fees. The fiscal impact is summarized in the table below.

Fiscal Tax Impacts from Construction

Federal	\$6,827,091
State and Local	\$4,065,698

Annual Economic Impact of NASA Operations and Spin-offs

The addition of the 9,000 foot runway at the NASA Plum Brook facility will have a significant impact on the local economy. Not only will NASA base employment increase but the potential

for spin-off operations to locate in the region³ is very high. This study estimates that for every NASA job created as a result of the added runway, approximately five additional jobs are created in the local community. On the surface this appears high, but it is due to the “bundled” nature of the scientific testing work conducted at Plum Brook. At testing locations such as this, there are generally a number of private contractors present during every test. Therefore, the employment multipliers are high for this industry.

We have estimated the annual economic impact for three different NASA employment levels, 100, 175 and 325 workers. The first scenario is for the creation of 100 NASA workers. We chose to include this because it allows the impact to be phased in over time. It is useful to see the impact and industrial changes as the facility develops. You will notice in the table below that the changes in magnitude over the three scenarios.

Operating Impact Scenarios

	100 NASA Jobs	175 NASA Jobs	325 NASA Jobs
Total Employment Impact	470	929	1,776
Total Economic Impact	\$45,486,108	\$88,451,916	\$167,978,925
Fiscal Tax Impact			
Federal Taxes	\$3,688,068	\$7,156,535	\$13,625,191
State and Local Taxes	\$1,550,839	\$3,015,004	\$5,742,644
Jobs per NASA Worker	4.7	5.3	5.5
Economic Impact per NASA Worker	\$450,486	\$505,439	\$516,858

³ The region is defined as Erie and Huron Counties. The two county region was stipulated by the State of Ohio Collaboration Grant.

At 100 workers the impact per NASA job is 4.7 jobs but that increases to 5.3 at 175 NASA jobs and is 5.5 at 325 NASA workers. This change is due to the relative scale of the industry cluster. Industrial clusters do not develop on a linear scale. As the cluster matures, the impact of new workers is spread over the existing infrastructure. The relative impact of the jobs decreases as they can be absorbed into the existing plant and facilities. However, it is often necessary to increase infrastructure at various periods. In our estimates it appears this occurs at about 300 NASA workers. At approximately 300 workers, impacts per worker increases as additional infrastructure is added to accommodate the additional employment. The associated dollar amounts follow the same pattern. The impact per NASA job begins at \$450,484 at the 100 worker level. At 175 the impact is \$505,439 and then increases to \$516,858 at the 325 level.

The tax impacts are also summarized in the table above. The federal and state and local revenue streams are given for each scenario. At the 325 NASA employment level more than \$13 million dollars are generated at the federal level and \$5.7 million in state and local tax revenues.

The economic impact of the project takes many forms. Much of the impact results from spin-off industries that relate directly to the NASA activity. These are net new additions to the local economy. They would not occur if it were not for the Plum Brook project. The impact on each industry is given in the table located in Appendix C. The economic and employment impacts are detailed for each scenario. Using the data in the table, it is possible to estimate the impact for all existing industries in the region. For example, the local hospitals would see an increase in revenue of \$259,375 at the 100 NASA job level and \$956,565 at the 325 NASA job level.

When examining the impact a new runway/regional airport would have on the existing commercial and industrial base of the two county region, it is important to understand the different modes of transportation and how they interrelate. Goods and services both rely on freight. The air cargo industry, like the air carrier industry, is a service industry. The distinction between airfreight and air cargo has become somewhat blurred over the years. The expedited airfreight package industry, sometimes referred to as integrated carriers, is represented by operators such as FedEx and United Parcel Service and is normally distinguished by handling packages that weigh less than 150 pounds.

Airfreight transport is the method of choice for time-sensitive, high value, fragile, or lightweight products, components and finished products. Horticulture products and other perishables are gaining in volume. These factors make airfreight operations highly time critical in their operation.

Five factors are known to enter into a decision by airfreight operators to establish a distribution site at a particular airport. Those factors are: (1) markets to be served, (2) transportation arteries to feed those markets, (3) labor, (4) a favorable tax structure to shippers, and (5) overall business costs. However, the overriding concern is the ability of a market area to generate package or cargo volume.

The last point, the ability of a market area to generate package or cargo volume is related to the proverbial chicken versus egg argument. While an airport is a prime consideration in developing economic access, it is not necessarily what generates economic activity. It is the mutual growth of businesses to generate the volumes or commodities necessary that drives the demand and service levels, and that does not appear to exist in the Huron/Erie County area. The large air freight haulers are going to use consolidators for their traffic generation. Freight forwarders use trucks to gather the commodities and transport to the airport hubs. The cost of air transportation versus ground transportation is heavily in favor of ground vehicle operation. Ground vehicle transportation is roughly 50% less in cost unless the distances between points are large (think Montana, Wyoming, etc.). Another factor is weight versus size. Air freight shipping is restricted by the weight of the commodity and the volume (size) of the package compared to the aircraft used. This is not the case with trucks or rail.

Summary of the National Industry Analysis

(See Appendix D for Full Analysis)

By Don Iannone

Introduction

As part of the BGSU consulting team, Donald T. Iannone & Associates (DTIA) prepared a report discussing key national aviation, airline service, space and aerospace, and related transportation service and manufacturing industry trends and issues. Because of its immediate significance to Huron and Erie Counties, this report begins with a summary description of the main activities of NASA's Plum Brook Station. The report provides an informed backdrop for future airport service decisions by Huron and Erie County leaders. This is an executive summary of the full report, which is contained in an appendix to this report.

Why is national industry information of importance to Huron and Erie County leaders? It is important because too often local officials make policy and investment decisions strictly in light of local information, and they ignore the larger industry and economic contexts that have a major impact on the success of their policy and investment decisions. For one, Huron and Erie County air facilities must compete for future business with other Ohio and national network airports.

The national industry analysis includes five industry sectors: 1) aviation services; 2) air charter services; 3) commercial airlines; 4) freight shipping services; and 5) space and aerospace. The first two are most important to Huron and Erie County officials' decision-making about their local airports, and the last three are most relevant in consideration of business expansion and attraction opportunities from an economic development standpoint.

NASA Plum Brook Facility

Overview

The 6,400-acre Plum Brook field station near Sandusky is a part of the Glenn Research Center in Cleveland. It specializes in very large-scale tests, which would be hazardous within the confines of the main Glenn campus. Of key interest, the Spacecraft Propulsion Facility at Plum Brook Station (PBS) is the world's only facility capable of testing full-scale upper-stage launch vehicles and rocket engines under simulated high-altitude conditions.

PBS' mission is to assure safe, cost-effective, responsive and reliable performance of research testing at Plum Brook Station to accomplish the R&D mission of the Glenn Research Center, other government agencies, and the private sector.

Space Power Facility

The Space Power Facility (SPF) houses the world's largest space environment simulation chamber measuring 100 ft. in diameter by 122 ft. high. The facility was designed and constructed to test both nuclear and non-nuclear space hardware in a simulated Low-Earth-Orbiting environment. Although the facility was designed for testing nuclear hardware, only non-nuclear tests have been performed throughout its history.

Spacecraft Propulsion Research Facility

NASA's Spacecraft Propulsion Research Facility (B-2) is the world's only facility capable of testing full-scale upper-stage launch vehicles and rocket engines under simulated high-altitude conditions. The engine or vehicle can be exposed for indefinite periods to low ambient pressures, low-background temperatures, and dynamic solar heating, simulating the environment the hardware will encounter during orbital or interplanetary travel.

Cryogenic Propellant Tank Facility

The Cryogenic Propellant Tank Facility (K-Site) is a space-environment test chamber 25 ft in diameter with a 20 ft-diameter door. The design and construction of this facility allows large-scale liquid hydrogen (LH2) experiments to be conducted safely. Control and data systems are located in a separate, remote building and electrical control systems include explosion-proof hardware.

Designed to conduct research, development, and acceptance testing of hypersonic air-breathing propulsion systems, the Hypersonic Tunnel Facility (HTF) is a fully self-contained facility. Its experimental infrastructure includes a shop area for fabrication of materials for facility subsystems and assembly of customer hardware. Due to the high-energy nature of the facility, it is operated remotely from a control room approximately one-quarter mile from the actual facility.

Aviation Services Industry

Overview

Aviation Services is defined as SIC Codes 4522 and 4581 or NAICS Codes 48819, 481219, and 488119. About 1,500 companies provide airport support services to the general aviation (private and business plane) market, with combined annual revenue of \$3 billion. Most companies are either privately held, like Air Serv, or are divisions of larger corporations, such as TAC Air, owned by Truman Arnold Companies, and Signature Flight Support, owned by BBA Aviation. Most aviation services firms are single-facility operations with annual revenue less than \$1 million. About 50 companies have annual revenue over \$10 million and operate facilities at multiple airports. The industry serves a broad range of aircraft and airport operation.

Service Definition

Aviation services consist of refueling operations and fixed base operations (FBOs). Full-service FBOs usually include refueling. Over 4,000 FBOs operate in the US, often with several servicing the larger airports. By the way, the US has 5,300 public airports. The services provided are similar to the airport services that airline companies have for their commercial fleets: line operations, such as parking, refueling, de-icing, tie-down, hangar, and preheating; aircraft management services, such as maintenance, inspection, parts sales, aircraft sales, aircraft rental, chartering, and flight instruction; and personal services, such as food service, VIP terminals, car rentals, conference rooms, pilot lounges, flight planning, and business services.

Fuel sales are usually one of the most profitable services. Jet fuel is the predominant type of aviation fuel in commercial aviation, but aviation gasoline (avgas) is the primary fuel used by general aviation (GA). Companies typically buy fuel from wholesalers. Fuel tanks, usually kept above ground, must comply with EPA regulations. Because aircraft can choose where to refuel during travel, companies go to great lengths to compete, as refueling revenue for a typical private jet may be as much as \$2,000. Airplane owners lease hangar space at daily and monthly rates that depend on the size of the airplane. Typical hangar space for a small plane may cost \$30 per day or \$200 per month. Many locations consider long-term hangar rentals as loss-leaders.

Companies, which usually lease their space and facilities from the host airport, provide low monthly hangar rates to make more lucrative sales of fuel, maintenance, and other services. Companies, particularly those with multiple locations, may use customer-oriented computer technology to support clients. Websites allow customers to plan trips, reserve services at various airports, and track maintenance and service records and reminders. Waiting rooms offer modem hook-ups and high-speed Internet connections. New computerized maintenance tools give maintenance personnel information about any part on a specific plane.

Business Challenges

Critical Issues

Dependence on Local Aviation Activity - National economic trends, like demand for general aviation (GA) planes and weather trends, may impact aviation services. However, most aviation service companies operate locally or regionally; as a result, they're especially vulnerable to local business demands. Service companies must be able to endure cyclical economic periods of lower business and recreational flying activity, when revenue from fuel sales and maintenance may be down sharply.

Vulnerable to High Fuel Prices - Companies that carry large fuel inventories are exposed to considerable price risk. In recent years, the spot price of jet fuel has varied sharply from month to month. Because of intense competition, companies can't always pass higher costs to customers. High fuel costs also discourage recreational flyers.

Regulatory Restrictions on General Aviation - Airspace and airport restrictions and security regulations may decrease the attractiveness of general aviation (GA) and reduce demand for aviation services. GA passengers and baggage may eventually have to be screened. FAA requires general aviation to adhere to strict maintenance procedures as part of their overall responsibility for ensuring safety in operation. For example, maintenance operations are required to verify and calibrate all tooling, to the satisfaction of the FAA.

Long-Term Labor Shortage - The national aviation industry requires about 12,000 new mechanics a year, with a shortage of 4,000 to 5,000 annually. While the military was formerly a prime training source, the end of the Cold War cut the number of military mechanics; today, only one civilian mechanic in thirty has military experience. Also, due to the suppressed pay structure and high responsibilities, certified mechanics find positions in other fields of endeavor to be more lucrative and valuable given their level of skill and knowledge.

Small Shops Can't Afford Required Capital Investments - Smaller repair shops may be

unable to buy the expensive equipment needed to work on the complex jets now rolling off assembly lines, or to invest in finding more efficient ways to accomplish repairs. Independent shops debate whether they should continue to repair older jets or invest millions in equipment to repair new high-tech aircraft. The price of test equipment increases about 6 percent a year.

Air Traffic Control (ATC) Privatization will Increase Costs - If FAA air traffic services are privatized, GA costs would increase. GA pilots account for 20 percent of total air traffic control services demand, but pay only about 3 percent toward infrastructure maintenance. Privatized air traffic services would probably be financed by user fees that boost GA costs. As a note, supply and demand may well play a roll here if ATC fees were to increase.

Trends and Opportunities

Business Trends

Sport Aircraft - Technology and integration are increasingly important to modern aviation maintenance, even light-sport aircraft, which are small, simple-to-operate, and low-performance. Due to new classification definitions, sport aircraft are now likely to be sold along with jet skis, and sport aircraft technicians will likely be inexperienced and working for minimum wage. The critical issue is that the low weight and size of sport aircraft don't necessarily mean that they are less complex to maintain.

Fractional Charter Activity - The rise of fractional ownership programs and charter flights, along with increased corporate activity, has increased demand for aircraft maintenance. To meet greater customer demand for increased aircraft availability, more fixed base operations are moving to round-the-clock operations.

E-Commerce for Maintenance Parts, Training - Since aviation parts trading was introduced in the 1990s, e-maintenance has evolved into an important economic tool for aircraft maintenance. Today, there are over 300 aircraft maintenance-related websites. With benefits that include

traceability, market reach for maintenance repair operations (MRO) providers, and reduced paperwork, it's easy to understand why the aviation business is taking advantage of the Internet.

Industry Opportunities

Growing Corporate Demand - Because of scheduling and security problems at the major airlines, more corporate travel is expected to be through general aviation (GA). The number of corporate business jets increased more than 50 percent during the past decade to 16,000, according to the National Business Aviation Association (NBAA). The number of recreational planes fell during the last recession, but corporate jets increased.

Automation and Technology - With more sophisticated computerized equipment, fixed base operations (FBOs) can offer specialized and efficient services to smaller aircraft owners and airlines. Many operators are turning to new software to track and plan maintenance repair operation tasks. To improve efficiency, safety, and convenience, general aviation is using more technology, including global positioning systems, weather communications, and flight information systems.

Fuel Discount Programs - Large chains can offer substantial fuel discounts and other amenities when customers enroll in maintenance programs. Often long-term programs are not as profitable, but they help build loyalty and business volume.

Luxury Services - Asian operators, like Cathay Pacific, a commercial air carrier, are opening airport spas for business- and first-class passengers that offer everything from facials to custom haircuts. US operators typically don't yet provide such services, but at some airports the volume of traffic might be sufficient to support the cost.

Air Charter Services

Overview

The industry includes SIC Code 4522 or NAICS Code 4812. The air charter services industry includes about 2,500 companies with combined annual revenue of \$8 billion. Major companies include NetJets, Flexjet, Evergreen Aviation, and Global Aero Logistics. The industry is concentrated: the 50 largest companies account for 60 percent of industry revenue. Air charter is the on-demand, nonscheduled transportation of passengers and cargo and is distinct from the \$20 billion commercial airline industry which is defined as scheduled transportation of persons and baggage for compensation or hire.

Service Definition

Major services include domestic passenger travel (50 percent of industry revenue); international passenger travel (15 percent); domestic air freight (10 percent); and international air freight (5 percent). Other services include surveying and photography, crop dusting, and aerial advertising. Charter flights are used by individuals, small and large corporations, sports teams, the US military, and government agencies. In general, charter flight is more flexible, extensive, and efficient than traditional commercial air travel. Air charter planes have access to over 5,000 general aviation airports; scheduled commercial aircraft are restricted to the 429 US commercial airports. Note: Scheduled air carriers can only operate into and from airports that are certificated under 14 CFR Part 139.

Charter aircraft include small piston-prop planes; helicopters; turboprop aircraft; light, mid-weight, and heavy jets; and large, multi-engine jet airliners. Of the 12,000 charter aircraft in operation, around 85 percent are fixed-wing aircraft and 15 percent are helicopters. The smallest piston-prop charter plane accommodates one pilot and one to five passengers, has a non-pressurized aircraft cabin, and a range of several hundred miles. A typical turboprop is cabin-pressurized, accommodates one or two pilots and eight passengers, has a range of around 1,000 miles, and travels 200 miles per hour. Traveling up to 8,000 miles at 500 miles per hour,

pressurized heavy jets are flown by two pilots, can accommodate 18, and include a full bathroom and flight attendant service. Depending on fuselage configuration, large charter jet airliners can transport cargo or accommodate up to 500 people. Jet airliners transporting more than 30 passengers must fly under the more restrictive FAA Part 121 guidelines governing scheduled commercial air transportation. Scheduled air carriers include both large and small aircraft. Small aircraft are more than 9 but less than 30 seats. Technically, they still follow Part 121 rules with some flexibility.

Trends and Opportunities

Business Trends

Rising Airfares - The cost to fly on nonscheduled air charter services has increased 50 percent over the past 10 years. Skyrocketing fuel prices passed to customers account for a large portion of the increased costs.

Higher Jet Fuel Prices - Fuel prices can be volatile. To reduce risk, most operators and brokers issue fuel surcharges to cover rising costs. High prices can lead to reduced demand if customers switch to lower-priced commercial air travel or limit the number of chartered flights.

Cargo Load Factor Steady - Ton mile load factor, the ratio of the total weight of nonscheduled cargo shipped to available capacity, has remained steady at 60 percent for the past 10 years. Revenue ton miles (total weight transported) and available ton miles (total capacity) have risen in unison over the past decade. While freight aircraft use has remained steady for 10 years, prices for nonscheduled cargo fell 5 percent from July 2006 to July 2007.

More High Net Worth Individuals - According to Merrill Lynch, the number of high net worth individuals in North America grew over 10 percent in 2006, the highest in seven years. High net worth individuals often have the financial resources to consider air charter travel. Long lines, increased airline delays, and a rising number of flight cancellations may result in more high net worth individuals using air charter. Fractional ownership and jet cards make the cost of charter

air more attractive to upper-middle class professionals.

Scheduled Airlines Add Charter Services - Several mid-sized commercial airlines now offer chartered flights in addition to regularly scheduled air travel. Airlines such as Frontier and Delta have discovered that charter flights can take advantage of aircraft that might otherwise be sitting idle on the runway. A chartered Delta round trip flight for 50 from Raleigh, NC, to Dallas costs around \$1,000 a person, including catering, taxes, fees, and a dedicated charter coordinator.

Industry Opportunities

Very Light Jets - Early versions of a new class of aircraft, very light jets (VLJ), show initial promise in lowering the cost of air charter. VLJ are lighter than conventional jets and able to land on shorter runways. Operating costs are one-tenth the cost to operate a heavy jet and one-quarter the cost to run a traditional light jet. About 20 VLJ models are in design and production stage by companies such as Honda and Cessna. Analysts expect to see 4,000 to 10,000 VLJ in service within the next decade.

GPS Air Surveillance - By 2020, the FAA will replace current outdated radar systems with GPS-based air traffic control technology. In October 2007, the FAA awarded a \$200 million contract to ITT Corp. to develop an Automatic Dependent Surveillance-Broadcast (ADS-B) system that is 10 times more accurate than the current radar system air traffic controller's use. Air charter services anticipate that GPS will improve air safety, increase air traffic control capacity, and allow more planes to fly in the nation's airspace.

Flying Carbon Neutral - Many air charter companies now cooperate with carbon offset programs to help reduce carbon emissions. Private air charter service Jets.com has partnered with Carbonfund.org to reduce carbon emissions through the Carbon Neutral Flights Program. Customers can pay a small additional fee, about 5 percent of the total flight cost, to offset emissions from the flight. Carbon offsets can be applied toward alternative energy sources and reforestation projects, reducing environmentalists' and the general public's concern about the large amount of carbon dioxide jets produce.

Alternative Fuels - The aviation industry is actively seeking an energy source that isn't oil-dependent. Some companies are testing biodiesel jet fuel. NetJets has partnered with Princeton University to research and produce an alternative "synfuel" that would use half the amount of bio-material of biofuels and emit near zero levels of greenhouse gas emissions.

Commercial Airlines

Overview

Commercial Airlines is defined as SIC Code 4512 or NAICS Code 4811. The US airline industry consists of about 3,000 companies, with combined annual revenue of \$120 billion. Major airlines include American, United, and Delta, and the air operations of cargo and courier companies, such as FedEx and UPS. The industry is highly concentrated: almost 90 percent of revenue comes from the top 12 companies.

The government classifies airlines as "major," "national," "regional," and various others. About 40 national airlines have annual revenue between \$100 million and \$1 billion, and 90 regional airlines have annual revenue under \$100 million. The remainder of the industry consists of small air companies that generally have annual revenue between \$5 and \$50 million.

Service Definition

Airlines carry passengers, cargo, and mail, or have specialized functions, such as medical air transport or oil platform servicing. Flights may be scheduled or nonscheduled (charter). About 70 percent of industry revenue comes from scheduled passenger traffic, 10 percent from carrying cargo and express mail, 4 percent from charter flights, and 1 percent from hauling US mail. Other revenue comes from providing maintenance, servicing, training, and reservations. Some airlines carry only cargo, using specially equipped planes. Some major airlines, including United, Northwest, and American, have large cargo operations that contribute 5 to 10 percent of revenue. For smaller passenger airlines, cargo may contribute more than 10 percent of revenue.

The basic operations of airlines include acquiring and maintaining airplanes, acquiring and operating airport facilities, acquiring passengers or freight, managing staff, and operating flights.

The flight equipment (airplanes) that an airline uses is crucial to efficient operations. The cost, capacity, and fuel efficiency of airplanes vary substantially. The major airlines operate about 20 types of aircraft with a total of about 4,700 planes; of these, around 600 were made by Airbus and around 4,000 by Boeing. Manufacturers of smaller aircraft for regional airlines, with seating capacities of 30 to 90, include Bombardier, Air Transport Regional, and Embraer. The largest aircraft can hold 360 passengers or 70 tons of cargo, and are used for long flights with a "stage length" of more than 3,000 miles, but the major carriers operate mainly planes that hold from 130 to 175 passengers.

Business Challenges

Critical Issues

Profitability Depends on Business, Consumer Travel - Both business and tourist travel are reduced when the economy slows. Global aviation traffic rises and falls at twice the pace of economic output, so a change in the economy doubles the impact for airlines. Because of relatively high fixed-costs of airplanes, airport facilities, and labor, airlines can't easily adjust to reduced passenger traffic.

Fuel Costs can Vary Highly - Aviation fuel accounts for 15 to 20 percent of industry operating costs, relatively more for airlines with low labor costs. Fuel costs can change rapidly, making it difficult for airlines to adjust ticket prices. Some airlines use futures contracts to protect against cost increases. Newer planes have better fuel consumption.

High Labor Costs - Labor costs for many large airlines have remained high, despite lower ticket prices and reduced passenger volume. Wages, salaries, and benefits accounted for 32 percent of American Airlines parent company AMR's operating costs in 2005. The financial success of discount airlines has depended heavily on lower labor costs. A segment of the air transport

industry known as low cost carriers (as compared to the traditional legacy carriers that have existed for some time) are typically low cost because they have lower labor costs at start up. However, as time progresses, the labor costs for low cost carriers rise while the legacy carriers have been seeking concessions from labor. Southwest Airlines is an example of a low cost carrier that is now starting to see costs on par with the restructure legacy carriers.

Capital-Intensive Industry - Airplanes are expensive to acquire and maintain. Most new airplanes typically cost between \$50 and \$200 million (with seating capacity for 130 to 360). Newer planes are usually more fuel-efficient, but the high prices deter many airlines from buying them.

Industry Widely Regulated - The FAA, DOT, and TSA impose various fees on the industry, and can interfere with airline operations. To expand operations, airlines need to get route permission from DOT and gates from local airports.

Fatal Accidents Severely Damage Airline's Reputation - Although airplane accidents are rare, they can be financially damaging. Even though insurance coverage is usually adequate to cover the cost of liability lawsuits, a drop in consumer confidence can cripple an airline. The crash of one of its planes in the Everglades in 1996 eventually led to the demise of ValuJet.

Airlines Depend on Skilled Employees - Airlines can't fly without FAA-certified pilots and mechanics, whose training takes years. The unions that represent these employees at most airlines have an exceptionally important voice in labor issues.

Trends and Opportunities

Business Trends

Shift to Low-Cost Carriers - The high cost structure of traditional airlines, like American and United, coupled with tighter business travel budgets, has provided expansion opportunities for low-cost airlines in recent years. Low-cost national carrier Southwest ranked fourth in domestic

market share in 2005. Southwest held 10 percent of the market, behind American, Delta, and United, which collectively held 42 percent. US Airways, once among the big four, fell to seventh.

Code-sharing, Marketing Alliances - Airlines that serve a limited number of airports can expand their network through code-sharing agreements with airlines that serve other airports. With code-sharing, connecting flights can be booked on the other airline's planes. Marketing alliances typically include code-sharing as well as frequent-flyer programs and common use of airport lounges. Revenue from code-shared tickets is split between the partners. Because of potential antitrust problems, code-sharing and marketing alliances have to be approved by the Department of Justice.

TSA - Following 9/11, passenger and property screening at airports was taken over by the newly created TSA using federal employees rather than private security companies. TSA activities receive funding partly from a tax on tickets, but the agency can impose additional charges on the airlines, if necessary to cover federal aviation security costs. The TSA assessed a \$50 million Security Infrastructure Fee on Southwest for its share of costs in 2005.

Hub-and-Spoke Routes - Hub-and-spoke route structures are used both by small and large airlines. Small airlines use them to serve a central city that is the destination of regional customers, and large airlines, like American and United, take regional customers to a central hub, then fly them to other hubs. A steady supply of regional passengers from the spokes allows big airlines to fill large planes that fly between hubs, but the need for connecting flights can make trips long and undependable. Any fall-off in traffic also means that large planes may have to fly with low load factors.

Point-to-Point Routes - Point-to-point produces direct flights to final destinations, but the number of airports that can be served with a fleet of planes is smaller. Smaller aircraft are required and a falloff in traffic is more easily accommodated. Almost 80 percent of flyers on Southwest, the major point-to-point airline, flew nonstop to their destinations in 2005.

Frequent Flyer Loyalty Programs - Most airlines have loyalty programs, typically based on how many miles or trips a customer makes, that reward repeat customers by giving them free tickets, service upgrades, or merchandise. These plans don't cost the airlines much, as many flights have empty seats anyway. Usage of free travel awards equated to over 6 percent of Southwest's passenger revenue in 2005. However, as the airlines have drastically reduced capacity by parking aircraft over the last two years due to the economic conditions, fewer seats are available for frequent flyers. Several airlines have restructured their programs to increase the number of miles necessary for redemption, thereby trying to reduce their financial impact on the bottom line.

Industry Opportunities

Fuel-Efficient Aircraft - The fuel consumption of aircraft varies widely. An Airbus 319 that carries 122 may burn 758 gallons of fuel per hour, while a Boeing 747-400 that carries 369 may burn 3,500 gallons per hour. Because of high fuel costs, newer planes and engines have been designed to be as efficient as possible for a particular type of service.

Internet Ticket Sales - The convenience of buying airplane tickets over the Internet appeals to passengers and is an inexpensive source of customers for airlines. Internet sites allow customers to easily compare airline schedules and fares, buy tickets, reserve flights, and, in some cases, choose seats and generate their own boarding passes. Southwest's website handles about 65 percent of the company's passenger revenue.

Frequent Flyer Sales to Businesses - Some airlines sell frequent flyer miles or points, as if they were a product, to companies unrelated to the loyalty program. This practice is a way to further commercialize the frequent flyer asset beyond the traditional airline, hotel, and credit card partners. Businesses that buy the miles or points use them in their own incentive programs for customers or employees.

Efficiencies with Electronic Documents - Computer technology allows customers to board flights without paper tickets and to generate their own boarding passes. Bar coded baggage tags

improve handling and identification for ticketless and self-serve travelers. Over 90 percent of Southwest's customers, and over half of AirTran's, chose not to receive a paper ticket for their flights in 2005.

Freight Shipping Services

Overview

Freight shipping services is defined as SIC Code 4731 or NAICS Code 4885. The freight shipping service industry includes about 17,000 companies with combined annual revenue of \$34 billion. Major companies include CH Robinson Worldwide, UPS Supply Chain Solutions, and BAX Global, a US subsidiary of Deutsche Bahn. The industry is fragmented: the top 50 companies account for 45 percent of total industry revenue.

Freight shipping service providers, commonly known as freight forwarders and customs brokers, are companies that arrange the transportation of goods from shippers to receivers. The industry doesn't include carriers that directly handle cargo, logistics management consultants, or supply chain management software manufacturers.

Major services are freight forwarding and customs brokering. Unlike fully integrated carriers that own truck, rail, air, or ocean assets and transport cargo, freight forwarders arrange the transportation of goods without owning any transportation equipment or handling ("fingerprinting") the cargo. Customs brokers add another layer of expertise by facilitating the clearing of goods through international customs barriers. Most companies specialize in either freight forwarding or customs brokering, though companies and individuals can provide both. Forwarders are well-versed in the schedules, rates, and availability of cargo carriers. They use this expertise to solve logistics challenges, lower expenses, and minimize delays for companies that ship or receive goods. Forwarders book cargo space with carriers; negotiate rates; arrange insurance; calculate the weight, volume, and cost of goods to be moved; prepare quotations, invoices, bills of lading, and letters of credit; and keep extensive records of all transported products. Forwarders may also act as freight consolidators, buying bulk cargo space on trucks,

ships, and airlines only to resell it at a higher rate. Many forwarders specialize in a particular region, industry, or mode of transportation.

Customs brokers 'clear' goods through international customs on behalf of an importing or exporting business. Key responsibilities include preparing documents; submitting information electronically; paying taxes, duties, and excises on behalf of the client; and facilitating communication among the shipper, receiver, and government agencies. Government entities can be both international and domestic, as many goods require clearance and inspection from agencies like the FDA, USDA, or the US Fish and Wildlife Service. Just as forwarders tend to specialize, many customs brokers specialize in certain types of transactions, such as clothing, perishables, or obtaining clearance for the crew and manifest of large ocean vessels.

Shipping service providers can range from a sole, independent proprietor working out of a local office to large corporations with a network of hundreds of small offices and agents. Forwarding companies can also be a part of a freight services franchise. Local offices are largely autonomous: they serve local customers and are responsible for local marketing and for dealing with local contract carriers. In addition to their own offices, forwarders also may maintain a network of agents, especially in foreign locations.

Major technological advances center around proprietary computer systems that find the best routes for a shipment, present alternative fares and schedules, consolidate loads, confirm and bill orders, track and trace shipments, produce management reports, and allow logistics analysis. Some firms allow orders to be placed over the Internet, and by phone, fax, and electronic data interchange (EDI) with large customers. Customs brokers can be connected to the US Customs Automated Export System (AES), which allows shippers to electronically file a Shipper's Export Declaration and Ocean Manifest.

Business Challenges

Critical Issues

Demand Tied to Economic Cycles - Freight shipping services depend highly on the volume of domestic and international trade. Economic slowdowns or a drop in consumer confidence typically results in less products being manufactured and shipped; thus, less business for companies that specialize in the efficient transfer of cargo. Shipping volume falls faster than manufacturing activity during an economic slowdown, as distributors and retailers have less inventory turnover.

Dependence on Free Trade - Forwarders and customs brokers are highly dependent on the free flow of goods among nations. Embargoes, protectionist policies, and trade sanctions can limit or completely halt commerce among nations. Customs brokers that specialize in specific nations can see opportunities shut off entirely when free trade is blocked. Too much free trade can also harm the industry: the free flow of goods with limited customs barriers can reduce the need for experts to deftly navigate customs, tariffs, and filings.

Increased Competition - The giants of the small package business, FedEx and UPS, have expanded operations to move heavy cargo. Both now maintain internal divisions focused on cargo forwarding. Excellent brand recognition and a network of existing customers have given these larger firms an immediate advantage. Some truck, rail, ship, and air carriers have used Internet technologies to develop internal forwarding and customs capabilities, and have eliminated relationships with third-party forwarders and brokers.

Expensive Information Systems - Advanced computer information systems select the best routes and rates for a shipment and allow customers to track and trace loads in real time. Most systems rely on bar coders, scanners, and other devices to make them function properly. Comprehensive systems are costly; only fairly large shippers can afford the investment. The competitive advantage of these systems has increased industry consolidation in recent years.

Perishable and Fragile Goods - Forwarders often arrange the delivery of perishable and fragile goods, which can be complex and unpredictable. Temperature control from harvest to delivery is essential, especially for products like seafood, produce, and flowers. Delivery timing is critical to reduce the risk of spoilage. To comply with a country's regulations on specific perishables, companies may be challenged by international import and export authorities. Forwarders and customs brokers typically maintain expensive insurance policies to protect them against delivery mishaps.

Security Concerns Increase Costs - Insurance premiums for air freight companies have increased sharply because of terrorism concerns. Tighter screening requirements cause delays and increase costs. Depending on the route or type of cargo, shippers may impose war or terrorism risk surcharges.

Customer, Industry Concentration - Although large freight shipping service providers typically receive no more than 5 percent of business from any single customer, local forwarders often rely on just a few large accounts for the bulk of revenue. Many independent forwarders specialize in shipping goods for a particular industry, such as electronics or fresh produce, leaving them vulnerable to a slowdown in that industry. Customs brokers that specialize in a particular country are subject to the economic strength of that country and its major trading partners.

Trends and Opportunities

Business Trends

Technology Improves Tracking - Custom brokers and forwarders can rely on sophisticated software and hardware to monitor the flow of cargo. Companies have developed advanced proprietary systems that can reduce delivery times, lower loss rates, and track cargo as it moves. RFID tags and scanners can automatically detect a shipment and enter the information into a centralized computer system.

Fees Flat - The fees charged by forwarders and brokers to manage cargo have remained relatively flat over the past decade. In the last 10 years, railroads have increased fees nearly 50 percent, air cargo companies 30 percent, and ocean carriers and trucking companies, 25 percent; forwarders and brokers have raised fees only 7 percent. Most carrier fees have increased due to rising fuel costs; forwarders don't incur shipping fees, but rising carrier costs can increase their spread.

International Trade Expands - The ease of global importing and exporting has fueled the growth of the freight shipping services industry. The rapid expansion of electronics and clothing factories in China and India has resulted in volumes of new business to companies specializing in air and sea freight services. The annual volume of US international trade in goods (imports plus exports) has doubled over the past decade.

Wages Rise - Average wages in freight shipping services have increased 50 percent in the past 10 years, but overall employment has remained relatively unchanged. Productivity levels have steadily risen due to advancements in logistics software and the proliferation of global trade.

Industry Opportunities

Deregulation Opens Markets - Deregulation of the trucking, rail, and airline industries has resulted in complex rates and a competitive free market. Instead of the federally mandated flat fees common in decades past, rates vary due to carrier supply and demand, volume, weight, and the type of materials transported. Shippers generally prefer to hand the responsibility of navigating this free market to forwarders and brokers who can aggressively source the best deal.

Logistics Consulting, Analysis - Forwarders can take advantage of customers' greater logistics needs to provide services beyond basic freight scheduling. Consulting opportunities include supply chain management, logistics analysis, and just-in-time (JIT) inventory management. Large companies are developing logistics consulting divisions; individual forwarders often take on work as project consultants.

International Expansion - Domestic forwarders and customs brokers are in high demand in

nations experiencing high growth. Cities like Dubai and countries like China and India need international freight forwarders (IFF) that understand the import and export business, tariffs, and international trade. Forwarders and brokers that can navigate through increased inspections and heightened security may have opportunities that extend well beyond domestic freight services.

Branding - Despite the growth of the freight shipping service industry, it remains a fragmented market led by independent agents and small offices; the industry has no market leader. Large corporations like FedEx and UPS are getting into the game, but their core expertise and brand is in parcel delivery. A large integrated forwarder and broker may be able to establish a strong brand and reputation, potentially consolidating the market.

Space and Aerospace Sector

Space Sector

This industry overview summary is based upon a 2008 space industry study by the National Defense University, which prepares annual studies of strategic industries important to US defense and security.

Structure and Markets: The U.S. space industry is comprised of individual businesses and several national and intergovernmental organizations. The industry is segmented into three distinct areas: space, control, and user. The space segment deals with launch and platform components, usually a satellite or scientific experiment. The control segment addresses infrastructure required to operate platforms, while the user segment enables the user to access the platform for the designed capability, such as television or telephone signals. To address these segments, the industry deals with two primary markets and one secondary market. Satellite production or manufacturing and launch services, including booster development and infrastructure, represent the two primary markets. These markets are organized in terms of support for commercial, civil, and military (including intelligence) clients.

A Cold War acquisition mentality, where schedule and cost are tradeoffs to performance, still permeates the space industry. Rapidly changing technology, coupled with a desire to produce decisively superior capability, has led to large cost overruns and unacceptable delays in system fielding. As payloads get larger, more capable, and significantly more expensive, launch vehicle performance has become paramount and economic aspects are ignored in favor of reliability.

The primary markets for satellite production services are concentrated within a narrow range of companies producing a majority of the systems and services in these markets. Satellite production is centered on Lockheed Martin, Boeing, Northrop Grumman, Space Systems/Loral, Alcatel Alenia, and EADS Astrium Space Systems. Launch is likewise concentrated. Booster production is focused on United Launch Alliance (ULA), which combines the Boeing and Lockheed Martin Evolved Expendable Launch Vehicles (EELV) under a single management structure. Arianespace produces the Ariane 5 booster. Sea Launch is a joint venture between Boeing, Energia, Aker Kvaerner, and SDO Yuzhnoye/PO Yuzhmash. The Ukrainian Zenit booster, a former ICBM and the Soyuz rocket are also strong competitors in launch, as well. SpaceX, a new entrant to the launch market, was founded as an alternative to higher cost launch. SpaceX is taking an innovative approach to the design and production of an entirely new booster vehicle.

The secondary market for ground services and infrastructure is more difficult to define. Aspects of this market, such as launch facilities and range control, represent a direct tie to the use of space. Major launch control and ranges in the U.S. are Kennedy Space Center and the Cape Canaveral Air Force Station in Florida, along with Vandenberg Air Force Base (AFB) in California. Arianespace, the marketing commercial launch component of the European Ariane rocket, is located in French Guiana, South America. The Russian component launches from the aging Baikonur Cosmodrome in Kazakhstan. Sea Launch, an international consortium, modified a mobile oil platform to launch rockets from an equatorial location in the Central Pacific.

The ground control segment is fairly robust, with major facilities for communications at Intelsat in the U.S. and the European Space Operations Center at Darmstadt. Governments with robust space programs generally provide control for their own assets on orbit. The United States

controls its military and intelligence assets through the U.S. Air Force Satellite Control Network, located at the 50th Space Wing at Shriever AFB, and in Cheyenne Mountain. U.S. Civil spacecraft are controlled through a number of different facilities across the country, including the Johnson Space Center which controls the space shuttle and the International Space Station.

Industry Conditions

Mature Industry and Entry Barriers: Characterized as mature within the industry life cycle, the space industry experiences few emerging markets and little opportunity for growth. High barriers to entry include: (a) a significant capital investment to support land, plant, technology, and labor; (b) a highly skilled workforce that can provide both for current needs and also adapt to evolving technologies; (c) a reliance on government contracts and acquisition systems for the majority of industry revenues; (d) the use of governmental grants and subsidies, which provides an unfair advantage to incumbent producers; and (e) stringent regulations, such as the International Traffic in Arms Regulations (ITAR), which limit the ability of industry to compete in the global market.

These barriers support the large scale, vertical integration that characterizes the industry. Boeing's earlier mergers with North American Rockwell, McDonnell Douglas, and Hughes Electronics, are representative of the consolidation throughout the industry. Similar industry consolidation took place on the other side of the Atlantic, resulting in the creation of European Aeronautic Defense and Space Corporation (EADS) from the merger of a number of European aerospace giants including Dassault, Aerospatiale, Fokker, Vereinigte Flugtechnische Werke, Messerschmitt Bölkow-Blohm, Construcciones Aeronauticas Sociedad Aónima, and Aeronautica Industrial SA. This merger was significant because it crossed a number of national borders to create a dominant regional company capable of competing with similarly realigned Lockheed Martin and Boeing.

Government Reliance: The industry's heavy reliance on government contracts and support comes with some concern. When access to space is characterized as a national security issue, the industry becomes a fertile ground for governmental regulations. Barriers to trade, such as the

ITAR, significantly reduce free and open exchanges of information, leading to diminished innovation and competition in the market. Heavy use of grants and subsidies distorts market conditions, increases government costs, and lowers competition by raising barriers for would-be entrants.

The Nature of the Market

Market Size: The global space industry is a growing and strategic component of the world economy, though industry observers see the industry as mature in the U.S. The Space Foundation estimates that global space industry revenues were just over \$250 billion in 2007 with annual growth of 11%. Of this total, US Government space spending accounts for 25%. Other international government space budgets were only 6% combined. Commercial satellite services accounted for the lion's share of 2008 revenues at 55% of the total. The other 16% comes from commercial infrastructure (14%), space commercial transportation services (1%), and infrastructure support industries (1%).

Segments: The two major markets within the space industry are satellite development and production and booster manufacturing/launch services. The North American Industry Classification System, or NAICS, defines these two sectors as 336414, Guided Missile and Space Vehicle Manufacturing and 334220, Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.

While these two sectors include the majority of the space industry, they do not include all of it. For example, booster propulsion falls under NAICS code 336415 and portions of the launch and manufacturing infrastructure falls under 336416. While a good deal of the space industry falls outside the two primary codes, several elements within these two codes are not related to space. As a consequence, accurate data relating specifically to the space industry is obfuscated, resulting in a chronic degree of uncertainty as to the industry's fiscal condition and developments. Since reliable economic data is required for complex budgeting processes, to provide valid cost estimates, to accurately account for research and development spending, and

to better understand the role of government within the market, there is a need to improve the economic data analysis of the industry.

According to the NDU report, Nascent industries are marked by growth, innovation, and competition among a large number of companies, which was representative of the space industry fifty years ago. Today the industry reflects lower levels of innovation, little competition, low capacity, and high cost. As U.S. reliance on space continues to increase, these industry conditions become cause for concern. It is certainly worth asking why newer technologies have not emerged in the last forty years. In part, this may be due to the very small market for space capabilities. Until new and different technologies are developed, which is not likely to occur without an interest and investment by government, the current dynamic will sustain a condition of limited innovation and capacity.

Aerospace Sector

The aerospace sector is defined as SIC Codes 3721, 3724, 3728, 3761, 3764, 3769, or NAICS Code 3364. This analysis is included in our report because it, in small part, captures the space sector, which is a part of Huron and Erie Counties' economic base with the presence of the NASA Plum Brook Facility.

The US aerospace industry includes about 1,500 companies with combined annual revenue of \$125 billion. Large companies include Boeing, Northrop Grumman, Lockheed Martin, Raytheon, and General Dynamics. The industry is highly concentrated: the 20 largest companies account for more than 90 percent of industry revenue. Many companies work primarily as subcontractors to the five largest manufacturers.

Service Definition

Major products are aircraft, including commercial, military, private and business planes; aircraft components, including engines, fuselages, interiors, and avionics; missiles and satellites; and space vehicles. Aircraft manufacturing accounts for over 50 percent of industry revenue, aircraft

components for about 30 percent, missiles and satellites for about 10 percent, and space vehicles for less than 5 percent.

Boeing is the only US manufacturer for commercial aircraft, but outsources portions of its business to numerous subcontractors. Private and business aircraft are made by companies such as General Dynamics, through its Gulfstream subsidiary, and Cessna. Subcontractors specialize in producing assemblies for various systems, such as engines, fuselages, interiors, rotors, electronic and hydraulic control systems, avionics, and guidance systems.

The manufacturing process involves forming, forging, metal fabricating, painting, and finishing activities. These activities require greater precision and higher grade materials such as aluminum, titanium, and special steel alloys, than in general manufacturing. Assemblies and systems are manufactured according to designs specified by the prime contractor, and often developed in tandem by the prime and subcontractor. Small contractors generally work for a specific prime contractor.

Manufacturing costs are dominated by the costs of materials and supplies, especially aluminum, titanium, and carbon and boron composites. Some materials are available from only a few suppliers. As such, the timing and pricing of some materials and commodities can fluctuate widely.

Technology is constantly changing in the industry. R&D expenses approximate 2 percent of company revenues. Systems development is especially important in the manufacture of guidance systems, communications, and space vehicles. Lockheed Martin and Raytheon both have business units devoted solely to electronic systems development. Aircraft are designed through CAD that allows companies to design an entire aircraft, including its components, by computer. Investment in computer-aided manufacturing (CAM) is common. Computer systems are critical for designing, testing, and operating aerospace products.

Business Challenges

Critical Issues

Volatility of Government Spending - Dependent in large part on federal government spending, the aerospace industry is cyclical by nature and unpredictable, due to uncertainty of the annual government budgeting process, election cycles, and the ebb and flow of spending levels. In five of the last 15 years, annual production of aerospace products and parts fluctuated over 10 percent from the previous year.

Dependence on Air Travel - Commercial aircraft and parts production, which is twice as large as military aircraft production, depends highly on worldwide air travel. Air travel, in turn, depends greatly on general economic activity and security issues. Consumers reduce pleasure travel as prices rise, and business travel falls as security measures lengthen how long it takes to get to destinations. Reduced air travel decreases the need for new aircraft and changes existing orders from developed planes to newer, more efficient aircraft.

Access to Foreign Markets Depends on Government Policy - Sales outside the US are influenced by US government relationships and trade policies with specific foreign countries. Federal law prohibits US manufacturers from paying foreign officials to win contracts. Sales cycles can last many years, during which the domestic political environment can change, affecting US foreign relations and trade policies.

Difficulty Attracting Qualified Workforce - According to the Commission on the Future of the US Aerospace Industry, over a quarter of all aerospace workers will be eligible to retire by 2008. Of aerospace workers, 80 percent of aerospace workers say they wouldn't recommend the industry as a profession for their children. The lack of skilled workers could jeopardize the leadership position of the US industry in the global marketplace.

Increasing Foreign Competition - The European aerospace manufacturing industry has consolidated into a few companies supported by multiple governments. Airbus' parent EADS is

the leading pan-European company and is developing the world's largest jetliner. Pan-European companies are offering solutions for European and developing countries' military needs that compete against US products. The Korean and Israeli aerospace industries are undergoing extensive consolidation and are expanding their marketing to other countries.

Long Procurement Cycles - Aerospace companies constantly invest in technology and systems development in hopes of winning future contract bids. While upfront investment is no guarantee that companies will win particular contracts, it may help position the company for the future. Contract bidding is long and involved, and even if a contract bid is won, the contract may not continue to completion. Government contracts are subject to potential annual budget cuts and commercial airlines change existing orders based on economic conditions.

Trends and Opportunities

Business Trends

Emergence of “Micro Jet” Airplanes - Several companies are introducing smaller, more affordable planes designed to provide passengers more efficient travel. This emerging market is driven primarily by business travelers' dissatisfaction with flying conditions, large airports, and increased security. Several new aerospace companies have introduced air taxi services that transport travelers from point to point, avoiding commercial aviation's hub-and-spoke system. Eclipse Aviation, Honda Motor Company, and Safire Aircraft have all tested micro jets that seat four to eight and two crew members and are more affordable than commercially available jets.

Increased Emphasis on Operational Efficiency - Continued oil price rises and increased competition from discount and new airlines has led to greater focus on efficiencies. US carriers have demanded a more fuel-efficient plane. Boeing responded by developing the 7E7, scheduled for delivery in 2008. Eclipse, a small jet manufacturer, has introduced friction stir welding that eliminates the need for rivets and creates stronger and lighter joints, making jets more fuel-efficient.

Outsourcing Development, Manufacturing - Similar to what happened in the auto industry, the aerospace industry is developing partnerships and alliances to outsource significant components of both development and manufacturing. Boeing is introducing the 7E7, a smaller but more efficient commercial aircraft. Boeing will outsource development and assembly of the 7E7 to several of its partners and suppliers, in hopes that these components will be produced just-in-time and faster than Boeing could internally, creating greater efficiencies.

Industry Consolidation, Partnerships - Since the 1990s, the aerospace industry has consolidated into five major firms that dominate, with several hundred suppliers competing for subcontracts. Much partnering with suppliers exists, and even the Big Five are suppliers to each other. Boeing and Lockheed Martin each have a 50 percent partnership responsible for all ground processing of the space shuttle fleet.

Growth of Business Jets - The business jet segment is growing faster than other industry segments, due in part to the greater connectivity to more than 5,300 US airports as opposed to the 550 airports serving commercial aircraft. Forecast growth is driven largely by fractional ownership, where an aircraft has multiple owners. More than half of back orders are due to fractional ownership companies.

Increasing Use of Automated Controls - Operations of commercial, military, and business aircraft are becoming more automated through advances in avionics. New computerized controls and software systems are allowing planes to "fly themselves" without continual pilot involvement. Avionics and related parts suppliers must keep pace with this technological innovation to remain competitive.

Industry Opportunities

Unmanned Combat Aerial Vehicles (UCAV) - Future generations of fighter jets will be robotic and pilotless vehicles that transmit signals through satellite relays to ground stations and piloted aircraft. These unmanned aircraft will be cheaper to produce, since they won't require the same level of redundancy and safety requirements as manned aircraft, and will be safer to operate

since no human pilot is at risk. The Department of Defense plans to spend \$4 billion over the next 10 years to developUCAV technologies, and expects that one-third of US military combat planes will be robotic by 2020. Potential applications outside the military include robotic cargo planes, weather monitoring, and border patrol surveillance.

After-Market Industry Growth - As existing fleets age, emphasis is on maintenance and modernization, which are increasingly being outsourced. Service and maintenance programs can generate revenues and help contractors secure their position as a preferred partner. Delta Airlines outsourced its aircraft maintenance to save \$250 million over five years. Timco Aviation Services expanded its facilities to service aging commercial airplanes. As the market for micro jets grows, the need for after-market services, including modifications and maintenance, will grow.

Defense Focus on Quick-Strike Capability - As the US shifts defense spending to quick-strike capability, emphasis will be on rotorcraft and other mobile transport carriers and on missiles. Demand for helicopters in both the US and Europe is increasing as existing fleets age. Raytheon is the leading supplier of missiles, making both air-to-air and land combat. Lockheed Martin is the leader in fleet missiles for the US Navy.

Moon, Mars Initiative - The federal government's current Vision for Space Exploration outlines US plans for establishing an outpost on the moon as a stepping stone to explore Mars. This goal will be NASA's focal point for the near future, including building an international space station scheduled for completion in 2010. Boeing, the leading US contractor for the space station, is also working on the crew exploration vehicle, which is to be developed and tested by 2008, with its first manned mission by 2014.

Updating Air Force Fleet - The Secretary of the US Air Force believes that the largest challenge facing it is to recapitalize its fleet. Nearly all aircraft will have to be replaced in the next 15 to 20 years; the F-15 fighter is 30, and the average age of Air Force tankers is 45. The F/A-22 Raptor program aims at providing next generation planes for updating the fighter fleet.

AIRPORT GOVERNANCE OPTIONS

This Chapter of the BGSU CRD feasibility study addresses the issue of which governing structure might be most suitable for managing and operating a proposed new airport.

A feasibility study completed in 2007 by RS&H provides a brief synopsis of the different possible forms of government/management. Outlined in that study are the basic types of ownership structures:

1. Federal
2. State
3. Privately owned, Private-use
4. Privately owned, Public-use
5. Publicly owned, Public-use
 - 5.a. Municipal ownership
 - 5.b. Joint municipal ownership
6. Port or Airport Authority

There are various arguments both for and against each of the different methods of ownership or operation. The BGSU Center for Regional Development (CRD) study describes below in more detail the advantages and disadvantages of the different types of airport ownership and operation for the benefit of the communities involved.

Federal Ownership

The RS&H study commented that federally-operated airports tend to be military installations and was therefore not considered as a governing possibility for the new proposed airport. However, the involvement of the NASA Plum Brook Research Station may well be a preferred method of management and operation. An example is NASA's current responsibility for several facilities, including the NASA Shuttle Landing Facility at the John F. Kennedy Space Center in Titusville, FL. Whereas the facility is on federal land, NASA is the assigned owner. However, NASA contracts out the actual management to a private management firm.

There are no federally managed commercial airports in the U.S. That form of government ownership ended with the conversion of Washington Dulles and Washington National (Reagan) airports into the Metropolitan Washington Airports Authority (MWAA). There are a number of airport landing facilities that are managed by the U.S. Department of Natural Resources, primarily for firefighting and national parkland administration purposes. They are located on federal lands.

In considering a new airport facility located on federal land (NASA Plum Brook), there are several advantages and disadvantages.

ADVANTAGES:

- Construction costs are funded by the federal government through the NASA budget process or through congressional earmark.
- No requirement for land acquisition by the county or joint governments, though NASA may need additional land to satisfy on the overall length of the runway required and the related airspace and safety needs.
- Local government economic development efforts can concentrate on support industries.
- Existing municipal airports can remain in operation.
- Complaints about aircraft operations would be directed toward NASA.
- Local government would have little liability exposure.

DISADVANTAGES:

- County or joint government agency would have little say in airport operation and its operation may be restricted to military operations only, or public access may be otherwise restricted.
- Businesses located on the airport may not contribute to the local tax base but infrastructure costs (utilities, roads, etc.) may fall to local government.

State Ownership

As noted in the RS&H study, several states own and operate their own commercial airports, primarily in Alaska, Connecticut, Hawaii, Maryland, and Rhode Island. It is possible for the state to take a lead in the development of the airport and then turn the operation over to a municipality, authority, or other governing body.

Regardless of whether the State would build, operate, and maintain the airport, the creation of a new airport within the State of Ohio is governed by Ohio Statute 4561. A new airport will require approval and inclusion of the airport within the State Aviation Plan.

A State operated airport has certain advantages and disadvantages.

ADVANTAGES:

- Construction costs funded by the state government through the legislative process.
- State responsible for land acquisition or in concert with NASA or the local governments.
- Local government economic development efforts can concentrate on support industries.
- Existing municipal airports can remain in operation.
- Complaints about aircraft operations would be directed toward the State.
- Local government would have little liability exposure.

DISADVANTAGES:

- Funding of construction, operation and maintenance by the state government through the legislative process may be difficult.
- State's ability to manage an airport is not demonstrated or identified as part of the charge of the Bureau of Aviation.
- County or joint government agency would have little say in the airport's operation and its operation may be restricted to military operations only, or public access may be limited or restricted.
- Businesses located on the airport may not contribute to local tax base.
- Economic development benefits may accrue to the State rather than to local governments

Privately Owned, Private-use

Most airports throughout the U.S. are privately owned, private use airports (approximately 8,500). These airports are normally located on private property (i.e., farms or similar parcels) and restrict access to users for primarily liability purposes. They tend to be less than 3,000 feet in length. A private use airport is not a viable option for the purpose of this study.

Privately Owned, Public-use

It is common in Europe for the private sector to be involved in commercial airports. It is different in the United States. Privately developed and operated commercial aviation is still a new concept in the United States. A short discussion on privatization efforts in the United States is provided later in this chapter.

Griffing–Sandusky Airport is one of approximately 180 airports in the United States that is an example of a privately owned, public use facility. All are general aviation facilities but with one exception. Most notably is one privately held commercial service airport opened in May, 2009, as the Branson Regional Airport in Missouri (<http://www.flybranson.com>).

ADVANTAGES:

- Airport operation is not subject to FAA grant assurances if federal grants are not accepted, thereby providing greater flexibility for management and operation.
- Market forces drive airport performance, which can help enhance local economic development.
- Local governments benefit from taxable property.

DISADVANTAGES:

- Airport is subject to liability concerns that could affect its operation.
- Market forces drive airport performance, which can help hinder local economic development.
- Local governments do not have a say in the airport's management and operation.

- Land acquisition may be necessary for the airport but eminent domain is not an option for private purposes.
- Airport development is subject to the ability of the private entity to raise capital since federal monies are not available. Federal monies would be used to install navigational aids, as that is a prime purpose of the FAA responsibility.

A group of private investors developed a commercial airport in Branson, Mo., creating the first privately developed and operated commercial airport in the United States. Branson hopes it will attract more tourists to its entertainment and recreation industry through the use of the airport.

At Branson, private investors established a Limited Liability Corporation (LLC) in 2002 and the airport opened in 2009. It utilized private investment and revenue bonds to fund much of its development. To its advantage, Branson, Missouri is an established tourist destination with good market draw that is expected to maintain its customer base. Because the Branson Regional Airport serves commercial air carrier operations, it is required to conform to 14 Code of Federal Regulations Part 139 Certification of Airports, which is intended to ensure proper safety requirements for the traveling public.

As a private airport not utilizing monies from the Airport Improvement Program (AIP), Branson is not subject to the numerous grant assurances and other federal regulatory requirements. Several unique aspects about the airport operation and management exist: it is selective as to which carriers it allows to operate on the airport; the fee structure reflects a more market based approach rather than government function, including incentive offering; it is able to grant exclusive operating rights to businesses; the City of Branson pays the airport for each passenger it brings into the airport based on economic impact calculations; the airport accrues revenue through naming rights of its facilities and a host of other unique financing measures.

Prior to the development of the Branson airport, there was a privately operated airport in Alliance, Texas. In seeking to expand its investment potential, the company turned the airport over to the City of Forth Worth to make it eligible to receive federal grants. The airport then

became a joint venture between the city and Hillwood Development Company, a real estate development company owned by [H. Ross Perot, Jr.](http://www.allianceairport.com/) (<http://www.allianceairport.com/>). The airport is now owned by the City of Fort Worth and managed by Alliance Air Services, a subsidiary of Hillwood. The airport itself is a 17,000-acre master-planned community, and includes three distinctive developments — Alliance Aviation Services (a full-service fixed-base operation (FBO)), Circle T Ranch, (a corporate campus, championship golf and recreational component) and Heritage (a high tech residential neighborhood development). Together, they offer world-class aviation, office, industrial, retail, educational, residential and recreational opportunities.

The management, operation, and development of the Alliance/Ft. Worth airport is that of a publicly owned, public use airport, but it is presented in this section as having started out as a privately owned, public use airport developed with private investment. It does not have scheduled commercial air service (due to a unique federal legislative law) but instead is a cargo hub for [FedEx Express](#), a maintenance base for [American Airlines](#), and it serves as a general aviation reliever airport.

Publicly Owned, Public-use: Municipally Owned

There are approximately 5,100 publicly owned, public use airports in the United States. Most commercially operated airports fall under this category, including the existing airports of Erie-Sandusky County and Huron County. Of the 5,100 airports, approximately 430 of them are served by scheduled air carriers.

ADVANTAGES:

- Airport eligible for up to 95% federal and state airport planning and development grants, assuming airport becomes included in the National Plan of Integrated Airport Systems (NPIAS) program.
- Local government has full control over the airport's development and improvements.
- Municipal bonds may be used for financing airport projects.
- Local government can lease airport property and buildings with revenue generation used to support airport operations and maintenance per FAA grant assurance.

- Various options exist for the management and operation of the airport.
- Local government has land use and zoning authority over adjacent property.
- Airport would have access to the resources of other city or county departments for assistance in maintenance and operations.
- Airport is supported by fee and rate charges, and/or taxing authority of local government.
- Community pride of ownership evident.

DISADVANTAGES:

- Airport operation is subject to FAA grant assurances if federal grants are accepted.
- A new airport may require relinquishing control of existing county airports or pay back to the federal government of grants previously accepted.
- Local government has financial risk for development, operation and maintenance.
- Airport is normally exempt from property tax payments due to its government operation.
- Land acquisition would be necessary for the airport if not located on Plum Brook property.
- The airport is supported by the taxing authority of local government and limits on bond indebtedness and voter approval.
- Local government is subject to noise and other complaints about the airport.

Publicly Owned, Public-use: Joint Municipal Ownership

Sometimes identified as Special District airports, joint municipal ownership airports are found where different governmental jurisdictions are involved in the ownership, management, or operations of an airport. It is common to have several counties or cities bind together to mutually operate an airport. Different types of joint operating agreements (JOA) exist for the operation of airports that serve these multiple governmental jurisdictions.

An example of a joint ownership airport is the Wilkes-Barre/Scranton International Airport in Pennsylvania. It is operated jointly by the Counties of Lackawanna and Luzerne through a Bi-County Airport Board. The Airport is a governmental subdivision controlled by six (6) Commissioners: three from Lackawanna County and three from Luzerne County who preside as the Airport Board of Commissioners (<http://www.flyavp.com>). Another example is the

Pangborn Memorial Airport in Washington, which is owned jointly by the Port of Chelan County and the Port of Douglas County and is overseen by three Commissioners from each Port District.

Very similar to a singular municipal operation, joint ownership has added advantages and disadvantages.

ADVANTAGES:

- Resources of each joint owner can be used to support the airport.
- Joint owners share benefits of taxes or economic impact of the airport.
- Joint owners have a say in the operation and maintenance of the airport.
- Joint agreement can satisfy the requirements of Ohio Statute 4563 regarding the development of airport hazard zoning.

DISADVANTAGES:

- A new airport will most likely require decisions about the continued funding and operation of existing county airports in light of federal grants being used to develop them. A new airport would require inclusion in the National Plan of integrated Airports (NPIAS) in order to receive federal monies and navigation aids.
- Joint owners may have disagreements about the management and operation of the airport resulting in political and economic fallout.

Port or Airport Authority

The creation of an airport or port authority is often viewed as a way to provide the advantage of focused leadership and specialized attention to a significant community asset. They often help to insulate the management and operation of the airport from political impact. Additionally, Authorities can also provide for a more efficient operation and economy of scale. The latter two reasons represent a positive vision for helping an airport to grow or to be responsive to the needs of a whole region. Because of all these reasons, there has been a trend toward the establishment of more airport authorities over the last fifty years.

Airport authorities can have varying powers and responsibilities depending on the legislation enabling the authority to exist. Some authorities have the power to enter into long-and short-term agreements and obligate the airport for long periods of time. Others have jurisdiction for multiple airports or represent several different governing bodies. A port authority is a special type of legally chartered institution that generally has the same status as public corporations, but that in addition to the airport, operate other types of public facilities such as harbors, toll roads, rail, or other public transportation systems.

The power and effectiveness of an airport or port authority can often be assessed by determining the answer to three questions: (1) who controls the appointments to the authority's governing body; (2) does the authority have total control over its budget, contracts, and personnel practices; and (3) does the authority have the power of eminent domain and/or the power to levy taxes. Answers to these questions give an indication of the authority's ability to operate independently, to share power with another entity, or to act as another layer of bureaucracy.

Within Ohio, Ohio Revised Code Chapter 308 governs the creation of an airport authority and Chapter 4582 governs the formation of a port authority. For both Erie and Huron counties, the formation of an airport authority would comprise the counties only, such as the existing Erie-Ottawa Regional Airport. This appears to preclude the cities of Sandusky and Norwalk from forming such an entity. An airport authority may be difficult to form among joint municipalities given that Chapter 4582.01 (A) (2) states the following regarding its location within a territorial jurisdiction:

A municipal corporation with a population of less than one hundred thousand according to the most recent federal decennial census that has joined an existing port authority in a county with a population of five hundred thousand or less may create a port authority within the territorial jurisdiction of the municipal corporation.

An option exists for the new airport to be part of an existing port authority. Ohio Revised Code Section 4582.22 authorizes counties and municipal corporations to act jointly to create a "Port Authority" as defined in those sections. Section 4582.03 (B) (2) calls out the following:

A municipal corporation and a county jointly may create a new port authority if both of the following apply: (a) The municipal corporation created a port authority after July 9, 1982, and that port authority operates an airport; (b) The county joined a port authority after July 9, 1982, and that port authority operated an airport.

Some airport authorities have the power only to make daily operating policies, while others have tax levy capability or the power of eminent domain.

ADVANTAGES:

- Focused leadership on airport matters can be provided.
- Deemed to have less political interference in the management and operation of the airport than other municipal type operation.
- Can serve a metropolitan community better through shared representation or equitable taxation not normally available due to political boundaries or jurisdiction.
- Airport operations, maintenance, and financial responsibilities are separate from the general municipal budgets of the county or city.
- Bonding capability, if allowed, is not tied to municipalities cap restrictions.

DISADVANTAGES:

- Port authority property is exempt from real and property taxes.
- Port authority has legal liability and exposure.
- Public pressure, scrutiny and complaints are focused on the authority.
- If not self sufficient, management organization cannot rely on municipalities for assistance.

Airport Privatization

The operation of an airport can be either by a private enterprise or by a public entity.

Municipalities are not required to operate an airport, but many choose to do so. Operating an airport is considered to be a proprietary function of government as compared with the operation of a government for redistributive (social or welfare) or protective (police or fire) purposes. The term proprietary means to act as a private enterprise. In operating an airport, a governing body

may not necessarily be immune from all state or local tort laws unless it is specifically granted such immunity. An airport is generally immune when acting in its governmental capacity, but is not immune when acting in its businesslike or enterprise operations. Ohio Revised Codes spell out such provisions.

The predominant form of public ownership is the municipally owned and operated airport, particularly at the smaller commercial and general aviation facilities. However, there has been a gradual transition in the last several decades from city and county controlled airports to independent single or multipurpose authorities. There are several reasons for this transition:

1. Many airport market or service areas have outgrown the political jurisdiction whose responsibility the airport entails. In some cases there is considerable, actual, or potential tax liability to a rather limited area. In these cases the creation of an authority to spread the potential or actual tax support for the airport might be recommended. By spreading the tax base of support for the airport, more equitable treatment of the individual taxpayer can result and, in most cases, the taxpayers supporting the airport more closely match the actual users of the facility.
2. Authority control of an airport allows for the governing board to concentrate and specialize on airport matters rather than general social or community issues not related to airports.
3. Efficient operation and economies-of-scale can be obtained when several political jurisdictions, each with separate airport responsibilities, choose to combine these responsibilities under one board. This has been done quite successfully in many areas of the country. Normally, the staff required by an airport authority can be quite small compared with the personnel requirements of a city or county government. This factor generally results in better coordination within the airport management team.
4. Authorities can provide the on-scene decision makers that result in less political impact on the business of running the airport.

Converting government-owned-and-operated enterprises to private sector management is supported across the United States at all levels of government. Privatization became a familiar part of American local government policy in the early 1980s. There was an extraordinary growth in the total net amount of privatization and in the variety of services privatized. Municipal governments were privatizing everything from refuse collection to fire protection services to wastewater treatment and solid and hazardous waste management. Airports, however, have resisted this trend due to the history of federal involvement in the development of airports.

The sale of government assets to the private sector, or the development of an airport with public money and turned over to a private enterprise raises a number of legal, regulatory, and public interest questions. The intent of privatization is to maximize the efficiencies and capitalizes on the strengths of the private sector while minimizing the influence of the unproductive elements of political control. This type of goal is often best achieved by a public-private partnership, which maximizes private investment.

Privatization of airports is not a single theory with a single definition. The concept of privatization includes a broad spectrum of potentially useful mixes of public and private features that are within the extremes of all public and all private enterprises. Privatization is a strategy for having private firms do what government has previously done before. There are basically three distinct strategies being considered for airports:

1. The sale or lease of existing government-owned enterprises to a private firm, usually with restrictions and obligations as to how the enterprise will be run.
2. The private development of new facilities that has been traditionally provided by the government, accompanied by government oversight.
3. The contracting out by government to private firms of the operations, maintenance or management of a service previously or traditionally provided by government employees.

A National Transportation Policy announced in early 1990 reflected a change in attitude within government toward the privatization of public facilities. The document stated that future federal policy was to minimize barriers to private participation in the ownership, planning, financing, construction, maintenance, and management of transportation facilities and services,

while encouraging state and local governments to do the same. The National Transportation Policy and the language of the state laws were reflected in several landmark privatization provisions included in the Intermodal Surface Transportation Efficiency Act of 1991. Under that Act, state grant recipients were authorized to invest and/or lend their highway grants to privately developed and owned toll highway, tunnel, bridge projects and high-speed rail facilities.

In 1995 the House Aviation Subcommittee asked the General Accounting Office (GAO) to examine the feasibility of airport privatization. Several factors, such as the ability to attract additional private capital for development and the tax exempt status of airport operation, are motivating interest in privatization. However, in a report issued in November 1996, the GAO concluded that although there was significant private sector participation in U. S. airports, current legal and economic constraints inhibit extensive privatization.

The privatization or other sale of airport property is discouraged and hindered by a series of federal statutory requirements identified in grant assurances on the use of airport revenue, fair and reasonable fees for airport users, and the disposition of airport property and other policies incorporated in federal grant agreements. Additionally, the restrictions contained in the Airport and Airways Improvement Act of 1982 concerning the prohibition against illegal airport revenue diversion have been strengthened since 1992. Federal public policy toward airport facilities has been for the facilities to be government owned and managed in a way that is responsive through the political process to national and community needs for public convenience, economic development, environmental protection, and the mitigation of negative effects on area residents.

Federal laws are not the only hindrance to certain airport privatization efforts. Many state statutes authorizing the creation of airport boards prohibit transfers of the facility to non-public entities. Property condemnation laws are limited to government entities and do not cover private parties. Exemption from state and local property and income taxes is primarily available only for public agency airports and leaseholds. Airport bonds contain numerous restrictions on sales, transfers and the identity of the sponsoring entity.

The possibility for privatization of any new airport is contingent upon its economic feasibility as viewed from an investor standpoint. In the case of a new airport to serve the Erie and Huron counties and NASA, the analogy of which comes first, the chicken or egg? is prudent. Does economic development occur and then the airport, or does is airport developed and then economic development occurs? By all appearances given the current factors and situation, it will need to be the airport first.

Options

The RS&H 2007 study identified three possible management structure scenarios identified under public-use, public-owned options. They were:

Alternative One – which would establish an airport authority or commission that would report to the Erie County Board of County Commissioners. An airport manager would be hired to oversee the day-to-day operations and a fixed based operator (FBO) would be selected to provide airport services to the facility.

Alternative Two – which would hire an airport manager who would be an employee of Erie County and would typically report to the Public Works Department. With this option, Erie County would provide airport services such as fuel sales and repairs in lieu of a FBO.

Alternative Three – which presents a scenario where Erie County would hire a FBO that would not only provide airport services, but would provide day-to-day management of the facility. It is important to note each option could be modified to meet the particular needs of Erie County.

The assumption of each of the three alternatives outlined in the RS&H report assume that Erie County would be the host county since that is where the airport would be located. However, several other options exist:

Alternative Four – which would establish an airport authority that would be created by both the Huron County and Erie County Board of County Commissioners. A governing board would be appointed or elected according to Ohio statutes. The Board would then hire their own employees,

contract with a management company, or seek private developers to operate and maintain the airport, or even turn the airport over to an economic development agency.

Alternative Five – which would have the counties become part of an existing port authority for the purpose of folding the airport into its operation.

Alternative Six – which would have a private developer build, operate and eventually transfer (BOT) the airport to the county or other political subdivision.

Alternative Seven – which would have NASA build, own and operate (BOO) on their property.

Alternative Eight- Huron County would be the host county for an airport that would be an expansion of the existing Huron County-Norwalk Airport, or would be an entirely new facility closer to NASA Plum Brook and within the county's borders.

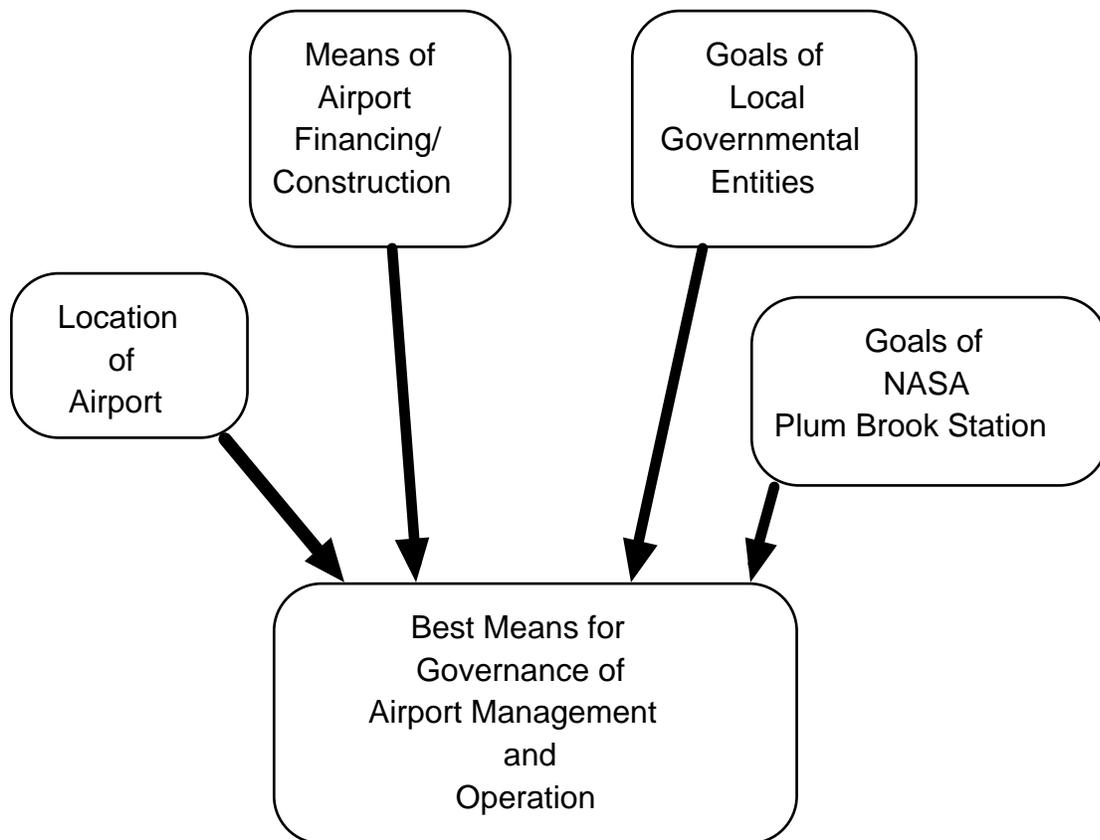
Decision Factors Affecting Governance Structure

Identifying a preferred choice for governance and operation of the proposed airport is primarily contingent upon the following decision factors:

- the location of the airport
- the method of financing airport construction
- the goals of local government for the airport
- the goals of the Plum Brook NASA Research Facility for the airport

The location of the airport affects its economic draw, interest, and feasibility. The typical methods of financing airport construction can be through local government capital budgeting, the federal AIP process, municipal or industrial development bond issuance, or private development. The goals of local government reflect the strategic planning effort for overall regional development. And the goals of the Plum Brook NASA Research Facility dictate the timeliness of all the effort and most notably where the airport is located.

As illustrated in the below diagram, the strategic development of the airport is contingent upon a determination by the parties involved of how and to what extent these factors play a role in the creation of the airport. Keep in mind that the creation of an airport governing body is contingent upon (1) who controls the appointments to the authority's governing body; (2) does the authority have total control over its budget, contracts, and personnel practices; and (3) does the authority have the power of eminent domain and/or the power to levy taxes. Answers to these questions give an indication of the authority's ability to operate independently, to share power with another entity, or to act as another layer of bureaucracy.



Located Within NASA Plum Brook Station

If the airport is to be constructed within the property lines of the existing Plum Brook NASA Research Facility, the airport will be owned by NASA as a federal facility; therefore, the type of governance suitable for a federal facility are as follows:

1. Managed and operated by NASA.
2. NASA contracts the management and operation to a private firm, company, or individual (i.e., Economic Development Corporation similar to the Alliance-Ft. Worth Airport; professional management firm similar to the operation of the NASA Shuttle Landing Facility, Titusville, FL; private FBO similar to the existing Norwalk-Huron county airport or Morristown, NJ).
3. NASA enters into an agreement with a local governmental entity to manage and operate the facility (i.e., (Erie County, an Airport Authority, a Joint Special District).

Located Within A Single Governmental Jurisdiction

If the airport is to be located outside the property lines of the existing Plum Brook NASA Research Facility and within one single governmental jurisdiction, the airport can fall under a number of different governing units, depending on the parties involved:

1. If located wholly within one county:
 - a. A single municipality can manage and operate the airport.
 - b. A single municipality contracts the management and operation of the airport to a private firm or transfers/assigns the same to a quasi-governmental organization (i.e., Chamber of Commerce, or an Economic Development Agency).
 - c. The single municipality seeks private investment, management, and operation, either through an outright sale of property, or through a public-private partnership.
 - d. A single municipality seeks joint ownership with other governmental entities, either through an intergovernmental agreement or a State authorized authority under Ohio Revised Codes 308, 4563, or 4582.

Located Across Several Governmental Jurisdictions

If the airport straddles the boundaries of two different municipalities, and is either partially within or completely outside the property lines of the existing Plum Brook NASA Research Facility, the airport can fall under a number of different governing arrangements, depending on the parties involved:

1. The governmental entities involved can manage and operate the airport through legal agreements.
2. The governmental entities involved can create an authority to manage and operate the airport under Ohio Revised Codes 308, 4563, or 4582.
 - a. The authority contracts the management and operation of the airport to a private firm or transfers/assigns the same to a quasi-governmental organization (Chamber of Commerce, Economic Development Agency).
 - b. The authority seeks private investment, management, and operation through a public-private partnership.
 - c. The municipality seeks joint ownership with other governmental entities, either through an intergovernmental agreement or a State authorized authority under Ohio Revised Codes 308, 4563, or 4582.
3. The governmental entities can seek a private developer and operator for the airport.

Roadmap for Development and Operation

Below are listed several steps the local governments need to take to make the airport a reality. The list is not all inclusive but it does provide a roadmap of sorts toward a new airport.

1. Determine the role and capabilities of NASA in the building, management or operation of the airport.
2. Come to agreement on what entities wish to be part of the new airport and their role in the building, management or operation of the airport.
3. Engage a lead organization or individual to spearhead the airport development.
4. Identify the location of the airport. A site selection and airport master plan would need to be developed.
5. Coordinate with the State of Ohio Division of Aviation the development of a new airport.
6. Coordinate with the FAA the development of a new airport and resolve issues with the FAA regarding the stature of existing airports.
7. Obtain funding for the airport.

8. Develop a hazard zoning board and resulting hazard zone boundaries for the airport.
9. Build the airport and associated infrastructure.
10. Determine the best method for operating the airport if not operated by NASA.

Recommendation

Regarding the possible governance structure of the airport, the best approach may well be for NASA to build and operate the airport. Operation by NASA would be the most expedient possibility. The next best option would be for the creation of an authority similar to that of the Erie-Ottawa Airport Authority, understanding decisions about existing airports would need to be made and resolved, and the length of time to acquire property and build the airport may be very lengthy.

Collaborative Efforts

Joint Port Authority

A joint port authority would be the best governance structure to further cooperative economic development activities between Huron and Erie Counties. A joint two county port authority would be formed pursuant to Sections 4582.201 to 4582.59 of the Ohio Revised Code. A port authority is more than a cooperative economic development agency; it is a corporate and political body that is governed by a Board of Directors. Port Authorities are given a wide range of statutory powers to coordinate, participate and direct economic development projects. The list of statutory powers include:

- Ability to acquire, construct, enlarge, maintain, sell, lease, or operate Port Authority facilities, i.e. a newly formed regional airport.
- Ability to make available the use of any Port Authority facility to one or more persons or businesses. This would open up the airport to be a catalyst for economic development activities within the two county region.
- Ability to issue revenue bonds for the purpose of paying the costs of any Port Authority owned or operated facilities.

- Ability to establish, operate and maintain foreign trade zones within the jurisdiction of the Port Authority furthering the economic development potential of a regional airport or industrial park.
- Ability to acquire by gift or purchase, and to hold, lease or dispose of real and personal property.
- Ability to accept federal grants to aid in the construction of any Port Authority facility.
- Ability to accept aid or contributions including money, property, labor or other items of value.

A joint Huron and Erie County Port Authority would be relatively easy to set up, but challenging to operate. There are many port authorities that have been formed in the State of Ohio that simply exist on paper. It takes an active board with focused leadership if a region is going to see economic value from the creation of a port authority.

Barriers to Collaboration

Has there been any animosity between the county governments historically? Has something happened in the past that will prevent collaboration from succeeding because there is a lack of trust between the leaders? These are some the questions that must be addressed as the collaborative process proceeds. Geographically close and economically interdependent counties share many of the same issues. Trying to work together in an effort to better the region is admirable, but certainly not easy.

In the case of economic development efforts by a joint port authority, there may be concern and even disagreement on which of the two counties will receive the most benefit from a development project. Each county may want to have a new development within their borders, ignoring the regional impact of the project. Being a member of a joint port authority requires everyone to see the big picture, to realize that development in the region can be a win-win situation. Overcoming the trust barrier requires a strong commitment and well written agreement. The board of directors must have bought into concept and keep themselves insulated from citizen pressure.

Another one of the barriers affecting collaboration is control. Most county leaders are accustomed to making decisions for the county they represent only. The decision making process is more complex with a collaborative agreement in place. The two counties must reach a consensus on decisions based on what is best for the region. Some leaders are pressured by their constituency into making decisions that are contrary to the collaborative effort. Making decisions in opposition to their constituency can lead to an elected official failing in a bid to stay in office. The balance between those issues can often be difficult to obtain.

Fiscal control is another issue. In many collaborative agreements, one government entity becomes the fiscal agent for the collaborative group. The other must be willing to allow the fiscal agent the right to make decisions that will affect the collaborative group in their best interest. The perceived lack of tight fiscal accountability can lead to problems with elected official's constituents.

Strategies to overcome the fiscal control barriers involve timely reporting to the governmental leaders. Additionally, reports should include sufficient detail and be clear and easily understood. It is also helpful if the port authority adopts fiscal policy that matches the exiting policies of the member counties regarding accounting, auditing and investing. As a means of cost savings, it may make sense to have one county provide fiscal services for a small administrative charge rather than having to duplicate fiscal systems.

A final barrier that would need to be overcome is community relations. Communities have strong self identities that can affect the success of a collaborative effort. Many residents feel that any service or program that is purchased or provided by another local government unit will lead to a loss of autonomy. They also feel that they will lose the ability to question or complain about the service or program. The joint port authority board will become too bureaucratic to meet their needs.

These are some of the barriers that would need to be overcome to have a successful collaborative project focusing on economic development and the runway at Plum Brook Station.

APPENDIX A

DEMOGRAPHIC PROFILES



Center for Regional Development

BGSU

Complete Demographic Comparison Report

	Erie County	Huron County	Ohio	Entire US
Q1 2009 Demographics				
Total Population	77,724	60,177	11,564,603	306,180,648
Total Households	30,985	22,565	4,511,016	114,422,681
Female Population	39,727	30,584	5,915,606	155,476,667
% Female	51.1%	50.8%	51.2%	50.8%
Male Population	37,997	29,593	5,648,997	150,703,981
% Male	48.9%	49.2%	48.8%	49.2%
Population Density (per Sq. Mi.)	303.59	121.63	280.32	85.14
Age				
Age 0 - 4	5.7%	6.2%	6.2%	6.6%
Age 5 - 13	10.7%	12.2%	11.5%	11.9%
Age 14 - 17	5.1%	6.1%	5.4%	5.5%
Age 18 - 21	6.0%	6.5%	6.4%	6.3%
Age 22 - 24	4.0%	4.3%	4.2%	4.1%
Age 25 - 34	10.9%	12.3%	12.1%	12.4%
Age 35 - 44	11.5%	12.9%	13.0%	13.5%
Age 45 - 54	15.1%	14.4%	14.9%	14.7%
Age 55 - 64	13.7%	11.6%	12.2%	11.6%
Age 65 - 74	9.3%	7.3%	7.5%	7.2%
Age 75 - 84	5.9%	4.6%	4.8%	4.6%
Age 85 +	2.0%	1.5%	1.7%	1.7%
Median Age	42	37	38	38
Race and Ethnicity				
White	88.8%	97.3%	84.7%	79.5%
Black	8.6%	1.1%	12.0%	13.2%
Asian or Pacific Islander	0.7%	0.4%	1.7%	4.5%
Other	1.9%	1.2%	1.6%	2.8%
Ethnicity				
Hispanic	2.5%	5.2%	2.5%	15.5%
Non-Hispanic	97.5%	94.8%	97.5%	84.5%

Household Income

Income \$ 0 - \$9,999	5.7%	5.9%	7.1%	6.9%
Income \$ 10,000 - \$14,999	4.9%	4.5%	5.0%	4.9%
Income \$ 15,000 - \$24,999	10.1%	12.2%	10.9%	10.1%
Income \$ 25,000 - \$34,999	13.2%	12.2%	11.4%	10.6%
Income \$ 35,000 - \$49,999	15.6%	19.1%	16.4%	15.1%
Income \$ 50,000 - \$74,999	21.9%	24.6%	21.3%	20.2%
Income \$ 75,000 - \$99,999	13.6%	12.0%	12.4%	12.8%
Income \$100,000 - \$124,999	7.4%	5.4%	6.9%	7.6%
Income \$125,000 - \$174,999	4.8%	3.0%	5.1%	6.6%
Income \$175,000 +	1.6%	0.7%	2.0%	3.0%
Average Household Income	\$62,946	\$54,862	\$62,992	\$69,982
Median Household Income	\$50,556	\$46,845	\$49,115	\$52,594
Per Capita Income	\$25,094	\$20,572	\$24,572	\$26,153
Number of Employees (Full Time)	26,318	17,006	4,965,170	125,969,284
Number of Establishments	2,160	1,480	291,530	8,274,120

Seasonal Population (Puerto Rico not included)

Seasonal Est 07Q1	42	3	2,229	1,811,234
Seasonal Est 07Q2	995	161	49,248	3,313,521
Seasonal Est 07Q3	4,540	526	99,688	6,076,905
Seasonal Est 07Q4	2,197	324	68,999	4,536,323
Seasonal Est 08Q1	18	0	771	1,695,027
Seasonal Est 08Q2	1,060	167	50,715	3,386,272
Seasonal Est 08Q3	4,505	531	101,308	6,127,453
Seasonal Est 08Q4	2,206	324	68,561	4,472,020
Seasonal Est Current Qtr	66	9	4,412	1,875,713

Transient Population (Puerto Rico not included)

Transient Est 07Q1	3,102	308	113,621	3,882,329
Transient Est 07Q2	2,778	406	122,409	4,003,678
Transient Est 07Q3	6,091	1,188	212,426	5,100,369
Transient Est 07Q4	3,624	602	169,833	4,434,397
Transient Est 08Q1	2,983	296	112,285	3,880,686
Transient Est 08Q2	3,202	449	125,001	4,032,286
Transient Est 08Q3	6,195	1,200	210,944	5,094,178
Transient Est 08Q4	3,572	597	169,885	4,474,459
Transient Est Current Qtr	2,886	287	113,755	3,886,854

2014 Demographics

Total Population	78,437	60,884	11,717,966	322,884,516
Total Households	31,270	22,830	4,561,556	120,339,655
Female Population	40,060	30,918	5,981,698	163,737,422
% Female	51.1%	50.8%	51.0%	50.7%
Male Population	38,377	29,966	5,736,268	159,147,094

% Male	48.9%	49.2%	49.0%	49.3%
--------	-------	-------	-------	-------

2000 Census Demographics

Total Population	79,551	59,487	11,353,140	281,421,906
Total Households	31,756	22,258	4,446,621	105,539,122
Female Population	40,806	30,286	5,841,562	143,505,720
% Female	51.3%	50.9%	51.5%	51.0%
Male Population	38,745	29,201	5,511,578	137,916,186
% Male	48.7%	49.1%	48.5%	49.0%

Age				
Age 0 - 4	6.0%	7.5%	6.6%	6.8%
Age 5 - 13	11.4%	12.7%	11.6%	11.8%
Age 14 - 17	7.3%	8.0%	7.2%	7.1%
Age 18 - 21	4.2%	5.1%	5.6%	5.7%
Age 22 - 24	3.0%	3.5%	3.7%	4.0%
Age 25 - 34	11.3%	13.2%	13.3%	14.1%
Age 35 - 44	15.9%	15.6%	16.1%	16.3%
Age 45 - 54	15.1%	13.3%	13.7%	13.4%
Age 55 - 64	10.4%	8.7%	8.9%	8.6%
Age 65 - 74	8.1%	6.8%	7.0%	6.6%
Age 75 +	7.4%	5.6%	6.3%	5.9%
Median Age	40	35	36	35

Housing Units Trend

Total Housing Units	35,909	23,594	4,783,051	115,904,641
Owner Occupied Housing Units	63.6%	68.3%	64.2%	60.2%
Renter Occupied Housing Units	24.7%	26.3%	28.7%	30.8%
Vacant Housing Units	11.6%	5.5%	7.1%	9.0%

Race and Ethnicity

White	88.5%	95.4%	84.9%	75.1%
Black	8.6%	1.0%	11.3%	12.2%
Asian or Pacific Islander	0.4%	0.3%	1.2%	3.6%
Other	2.4%	3.4%	2.6%	9.1%

Ethnicity

Hispanic	1.8%	3.6%	1.9%	12.5%
Non-Hispanic	98.2%	96.4%	98.1%	87.5%

Educational Attainment

Total Population Age 25+	54,232	37,576	7,411,740	182,211,639
Grade K - 9	4.0%	4.7%	4.5%	7.6%
Grade 9 - 11, No diploma	12.0%	14.3%	12.6%	12.1%

High School Graduate	41.0%	48.8%	36.1%	28.6%
College Degree	22.5%	15.6%	27.0%	30.7%
Some College, No Degree	20.5%	16.7%	19.9%	21.0%

Household Income

Income \$ 0 - \$19,999	19.4%	19.5%	22.0%	22.1%
Income \$ 20,000 - \$29,999	15.1%	15.0%	13.7%	13.0%
Income \$ 30,000 - \$39,999	12.2%	14.7%	13.0%	12.3%
Income \$ 40,000 - \$49,999	11.1%	12.6%	11.1%	10.6%
Income \$ 50,000 - \$74,999	22.3%	23.9%	20.4%	19.5%
Income \$ 75,000 - \$99,999	10.9%	8.6%	10.0%	10.2%
Income \$100,000 - \$124,999	4.3%	3.2%	4.5%	5.2%
Income \$125,000 - \$149,999	2.0%	1.1%	2.0%	2.5%
Income \$150,000 - \$199,999	1.3%	0.4%	1.6%	2.2%
Income \$200,000 or More	1.5%	0.9%	1.7%	2.4%

Average Household Income	\$53,326	\$47,611	\$52,836	\$56,644
Median Household Income	\$42,897	\$40,617	\$41,088	\$42,318
Per Capita Income	\$25,094	\$20,572	\$24,572	\$26,153

Vehicles Available

0 Vehicles Available	6.2%	5.6%	8.6%	10.3%
1 Vehicle Available	33.1%	30.5%	33.5%	34.2%
2 Vehicles Available	41.7%	42.8%	39.4%	38.3%
3+ Vehicles Available	18.9%	21.4%	18.6%	17.1%

Housing Value Comparison Report

	Erie County	Huron County	Ohio	Entire US
Housing Units Q1 2009				
Total Housing Units	34,723	23,764	4,823,924	124,628,010
Owner-Occupied Housing Units	64.61%	68.76%	65.29%	61.19%
Renter-Occupied Housing Units	24.62%	26.19%	28.23%	30.62%
Vacant Housing Units	10.77%	5.05%	6.49%	8.19%
Housing Value				
Under \$10,000	1.14%	2.56%	1.37%	0.77%
\$ 10,000 to \$14,999	1.40%	0.01%	0.39%	0.83%
\$ 15,000 to \$19,999	0.00%	1.91%	0.77%	0.82%
\$ 20,000 to \$25,000	0.79%	0.84%	0.77%	0.69%
\$ 25,000 to \$29,999	0.88%	0.98%	0.88%	0.77%
\$ 30,000 to \$34,999	0.63%	0.91%	0.95%	1.02%
\$ 35,000 to \$39,999	0.48%	0.95%	1.02%	0.86%

\$ 40,000 to \$49,999	2.46%	1.64%	2.42%	2.24%
\$ 50,000 to \$59,999	1.31%	3.04%	3.17%	2.42%
\$ 60,000 to \$69,999	4.61%	3.56%	3.52%	2.67%
\$ 70,000 to \$79,999	5.63%	4.53%	5.09%	2.93%
\$ 80,000 to \$89,999	4.18%	8.11%	6.17%	3.29%
\$ 90,000 to \$99,999	7.92%	5.03%	6.89%	3.65%
\$ 100,000 to \$124,999	16.30%	24.14%	17.13%	9.68%
\$ 125,000 to \$149,999	15.45%	12.01%	12.55%	9.25%
\$ 150,000 to \$174,999	11.16%	9.00%	10.03%	8.00%
\$ 175,000 to \$199,999	6.89%	7.26%	7.29%	6.83%
\$ 200,000 to \$249,999	8.43%	7.40%	8.43%	10.99%
\$ 250,000 to \$299,999	4.11%	2.61%	4.29%	7.94%
\$ 300,000 to \$399,999	3.46%	1.91%	3.82%	9.71%
\$ 400,000 to \$499,999	1.25%	0.78%	1.52%	5.14%
\$ 500,000 to \$749,999	0.79%	0.32%	0.88%	5.51%
\$ 750,000 to \$999,999	0.33%	0.15%	0.34%	1.77%
Over \$1,000,000	0.39%	0.35%	0.32%	2.22%
Median Housing Value	\$128,466	\$116,330	\$124,142	\$175,382

Average Home Value by Quarter

Average Home Value 07Q1	\$171,601	\$139,941	\$159,433	\$290,252
Average Home Value 07Q2	\$163,198	\$140,125	\$159,585	\$290,901
Average Home Value 07Q3	\$165,553	\$139,342	\$158,652	\$290,650
Average Home Value 07Q4	\$160,718	\$138,050	\$157,104	\$289,045
Average Home Value 08Q1	\$156,310	\$138,164	\$156,998	\$286,564
Average Home Value 08Q2	\$167,379	\$139,487	\$158,234	\$281,420
Average Home Value 08Q3	\$161,792	\$137,797	\$156,195	\$273,008
Average Home Value 08Q4	\$141,747	\$134,047	\$151,394	\$262,060
Average Home Value Current Qtr	\$151,558	\$134,791	\$152,164	\$258,194

Population Comparison Report

	Erie County	Huron County	Ohio	Entire US
Q1 2009 Population:				
Total Population	77,724	60,177	11,564,603	306,180,648
Female Population	39,727	30,584	5,915,606	155,476,667
% Female	51.1%	50.8%	51.2%	50.8%
Male Population	37,997	29,593	5,648,997	150,703,981
% Male	48.9%	49.2%	48.9%	49.2%
Group Quarters Population	2.4%	0.9%	2.6%	2.5%
Seasonal Population	66	9	4,412	1,875,713

Transient Population	2,886	287	113,755	3,886,854
----------------------	-------	-----	---------	-----------

Educational Attainment:

Total Educated	53,236	38,919	7,660,538	200,987,860
Grade K - 8	4.0%	4.7%	4.4%	7.5%
Grade 9 - 12	12.0%	14.3%	12.2%	11.9%
High School Graduate	41.0%	48.8%	35.8%	28.4%
College - Associate	5.8%	4.7%	6.0%	6.4%
College - Bachelors	11.0%	7.6%	14.2%	15.7%
College - Doctorate	0.4%	0.2%	0.8%	1.0%
College - Masters	3.7%	1.9%	5.1%	5.9%
College - Professional	1.5%	1.2%	1.7%	2.0%
Some College	20.5%	16.7%	19.9%	21.3%

Race and Ethnicity (Hispanic shown separately):

Asian	0.6%	0.4%	1.7%	4.5%
Black	8.5%	1.0%	11.9%	12.6%
Hispanic	2.5%	5.2%	2.5%	15.5%
White	86.6%	92.4%	82.5%	65.1%
Other	1.8%	1.1%	1.5%	2.3%

2014 Population:

Total Population	78,437	60,884	11,717,966	322,884,516
Female Population	40,060	30,918	5,981,698	163,737,422
% Female	51.1%	50.8%	51.1%	50.7%
Male Population	38,377	29,966	5,736,268	159,147,094
% Male	48.9%	49.2%	49.0%	49.3%
Group Quarters Population	2.4%	0.9%	2.5%	2.4%

2000 Census Population:

Total Population	79,551	59,487	11,353,140	281,421,906
Female Population	40,806	30,286	5,841,562	143,505,720
% Female	51.3%	50.9%	51.5%	51.0%
Male Population	38,745	29,201	5,511,578	137,916,186
% Male	48.7%	49.1%	48.6%	49.0%

Group Quarters Population	2.4%	1.0%	2.6%	2.8%
---------------------------	------	------	------	------

Educational Attainment:

Total Educated	54,232	37,576	7,411,740	182,211,639
Grade K - 9	4.0%	4.7%	4.5%	7.6%
Grade 9 - 12	12.0%	14.3%	12.6%	12.1%
High School Graduate	41.0%	48.8%	36.1%	28.6%
College - Associates	5.8%	4.7%	5.9%	6.3%
College - Bachelors	11.0%	7.6%	13.7%	15.5%
College - Advanced (Master/PHD/etc)	5.6%	3.3%	7.4%	8.9%
Some College	20.5%	16.7%	19.9%	21.1%

Race and Ethnicity (Hispanic shown separately):

Asian	0.4%	0.3%	1.2%	3.6%
Black	8.6%	0.9%	11.3%	12.0%
Hispanic	1.8%	3.6%	1.9%	12.5%
White	87.5%	93.9%	84.0%	69.1%
Other	1.7%	1.3%	1.7%	2.8%

1990 Population:

Total Population	76,779	56,240	10,847,118	248,709,852
Group Quarters Population	1.6%	0.9%	2.4%	2.7%

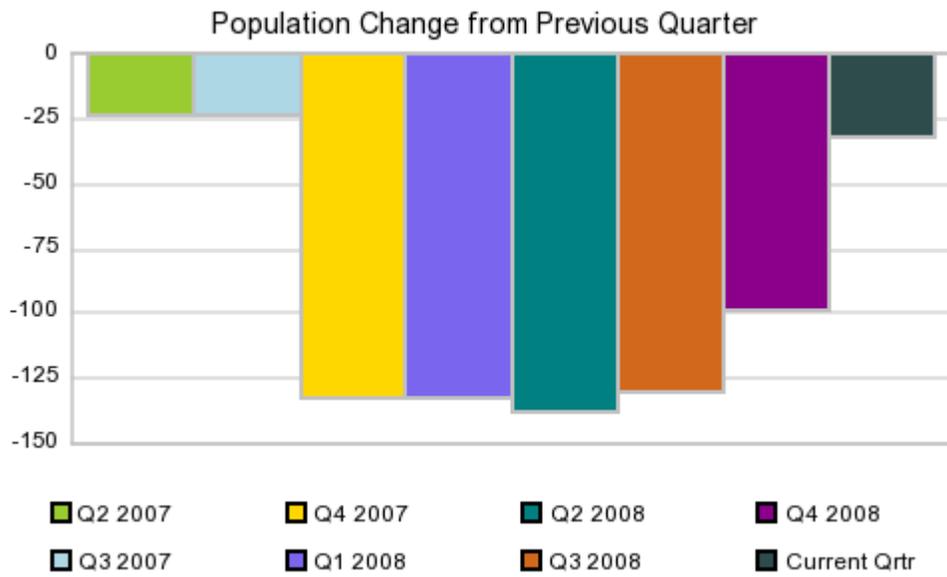
Educational Attainment:

Total Educated	50,109	34,521	6,924,754	158,868,366
Grade K - 9	7.5%	8.1%	7.9%	10.4%
Grade 9 - 12	16.3%	17.8%	16.4%	14.4%
High School	42.0%	48.3%	36.3%	30.0%
College	18.7%	13.5%	22.3%	26.5%
Some College	15.5%	12.4%	17.0%	18.7%

Race and Ethnicity:

Asian	238	226	89,239	7,226,984
Black	6,245	601	1,152,232	29,930,473
Hispanic	915	804	131,994	21,900,097
White	69,893	54,959	9,525,020	199,827,251
Other	403	454	80,627	11,725,144

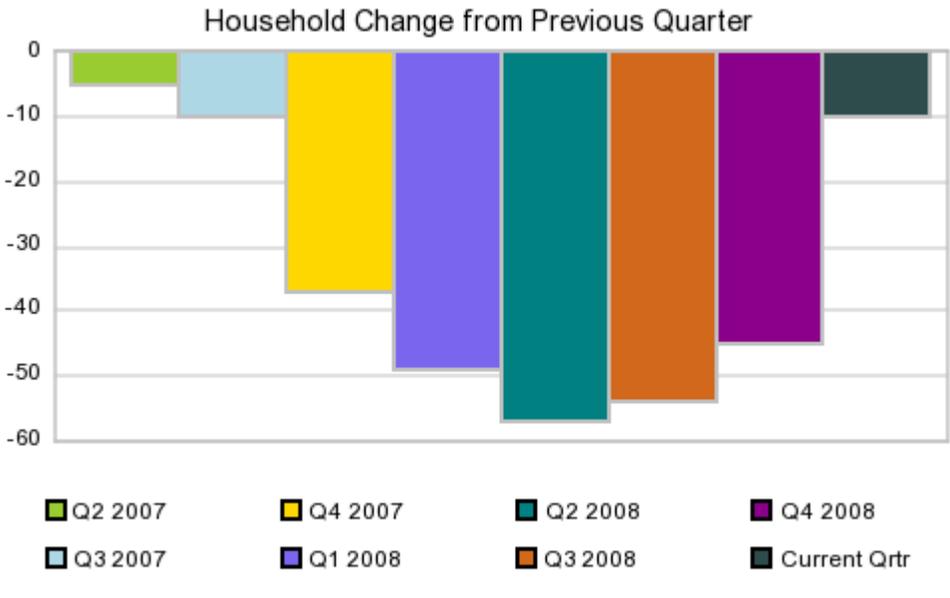
Growth Summary Report (Erie and Huron)



In 2000, the population was **139,038**. By Q1 2009, the population was estimated to be **137,901**, representing a change of roughly **-0.8%** and an annualized change of approximately **-0.2%**.

Population Change

Quarter	Population	Population Change from Previous Quarter	
		Change	% Change
Q2 2007	138,588	-24	-0.0%
Q3 2007	138,564	-24	-0.0%
Q4 2007	138,432	-132	-0.1%
Q1 2008	138,300	-132	-0.1%
Q2 2008	138,162	-138	-0.1%
Q3 2008	138,032	-130	-0.1%
Q4 2008	137,933	-99	-0.1%
Current Qtr	137,901	-32	-0.0%



In 2000, there were **54,014** households. By Q1 2009, the household count was estimated to be **53,550**, representing a change of roughly **-0.9%** and an annualized change of approximately **-0.2%**.

Household Change

Quarter	Households	Household Change from Previous Quarter	
		Change	% Change
Q2 2007	53,812	-5	-0.0%
Q3 2007	53,802	-10	-0.0%
Q4 2007	53,765	-37	-0.1%
Q1 2008	53,716	-49	-0.1%
Q2 2008	53,659	-57	-0.1%
Q3 2008	53,605	-54	-0.1%
Q4 2008	53,560	-45	-0.1%
Current Qtr	53,550	-10	-0.0%

Source: Synergos Technologies, Inc., Austin, TX. All Rights Reserved.
 Business List data © 2008 by D&B®. All rights reserved. All D&B information is powered by DUNSRight™, D&B's Quality Process.

ERIE COUNTY

BEARFACTS 1997 – 2007

Erie County is one of 88 counties in Ohio, and it is part of the Sandusky, OH MSA. Its 2007 population of 77,162 ranked 32nd in the state.

PER CAPITA PERSONAL INCOME

In 2007 Erie County had a per capita personal income (PCPI) of \$35,222. This PCPI ranked 10th in the state and was 102 percent of the state average, \$34,468, and 91 percent of the national average, \$38,615. The 2007 PCPI reflected an increase of 3.1 percent from 2006. The 2006-2007 state change was 4.4 percent and the national change was 4.9 percent. In 1997 the PCPI of Erie County was \$25,026 and ranked 14th in the state. The 1997-2007 average annual growth rate of PCPI was 3.5 percent. The average annual growth rate for the state was 3.4 percent and for the nation was 4.3 percent.

TOTAL PERSONAL INCOME

In 2007 Erie County had a total personal income (TPI) of \$2,717,791*. This TPI ranked 30th in the state and accounted for 0.7 percent of the state total. In 1997 the TPI of Erie County was \$2,003,960* and ranked 30th in the state. The 2007 TPI reflected an increase of 2.7 percent from 2006. The 2006-2007 state change was 4.6 percent and the national change was 6.0 percent. The 1997-2007 average annual growth rate of TPI was 3.1 percent. The average annual growth rate for the state was 3.6 percent and for the nation was 5.4 percent.

COMPONENTS OF TOTAL PERSONAL INCOME

Total personal income includes net earnings by place of residence; dividends, interest, and rent; and personal current transfer receipts received by the residents of Erie County. In 2007 net earnings accounted for 65.5 percent of TPI (compared with 65.4 in 1997); dividends, interest, and rent were 15.8 percent (compared with 19.8 in 1997); and personal current transfer receipts were 18.7 percent (compared with 14.8 in 1997). From 2006 to 2007 net earnings increased 0.4 percent; dividends, interest, and rent increased 7.0 percent; and personal current transfer receipts increased 8.1 percent. From 1997 to 2007 net earnings increased on average 3.1 percent each year; dividends, interest, and rent increased on average 0.8 percent; and personal current transfer receipts increased on average 5.5 percent.

EARNINGS BY PLACE OF WORK

Earnings of persons employed in Erie County decreased from \$1,967,485* in 2006 to \$1,949,459* in 2007, a decrease of 0.9 percent. The 2006-2007 state change was 3.5 percent and the national change was 4.9 percent. The average annual growth rate from the 1997 estimate of \$1,475,709* to the 2007 estimate was 2.8 percent. The average annual growth rate for the state was 3.7 percent and for the nation was 5.4 percent.

**Note: All income estimates with the exception of PCPI are in thousands of dollars, not adjusted for inflation.*

HURON COUNTY

BEARFACTS 1997 – 2007

Huron County is one of 88 counties in Ohio, and it is part of the Norwalk, OH Micropolitan SA. Its 2007 population of 59,715 ranked 43rd in the state.

PER CAPITA PERSONAL INCOME

In 2007 Huron County had a per capita personal income (PCPI) of \$26,730. This PCPI ranked 66th in the state and was 78 percent of the state average, \$34,468, and 69 percent of the national average, \$38,615. The 2007 PCPI reflected an increase of 2.6 percent from 2006. The 2006-2007 state change was 4.4 percent and the national change was 4.9 percent. In 1997 the PCPI of Huron County was \$21,941 and ranked 42nd in the state. The 1997-2007 average annual growth rate of PCPI was 2.0 percent. The average annual growth rate for the state was 3.4 percent and for the nation was 4.3 percent.\

TOTAL PERSONAL INCOME

In 2007 Huron County had a total personal income (TPI) of \$1,596,185*. This TPI ranked 42nd in the state and accounted for 0.4 percent of the state total. In 1997 the TPI of Huron County was \$1,295,603* and ranked 41st in the state. The 2007 TPI reflected an increase of 2.5 percent from 2006. The 2006-2007 state change was 4.6 percent and the national change was 6.0 percent. The 1997-2007 average annual growth rate of TPI was 2.1 percent. The average annual growth rate for the state was 3.6 percent and for the nation was 5.4 percent.

COMPONENTS OF TOTAL PERSONAL INCOME

Total personal income includes net earnings by place of residence; dividends, interest, and rent; and personal current transfer receipts received by the residents of Huron County. In 2007 net earnings accounted for 64.8 percent of TPI (compared with 67.4 in 1997); dividends, interest, and rent were 13.4 percent (compared with 16.9 in 1997); and personal current transfer receipts were 21.8 percent (compared with 15.8 in 1997). From 2006 to 2007 net earnings increased 0.1 percent; dividends, interest, and rent increased 5.8 percent; and personal current transfer receipts increased 8.3 percent. From 1997 to 2007 net earnings increased on average 1.7 percent each year; dividends, interest, and rent decreased on average 0.2 percent; and personal current transfer receipts increased on average 5.5 percent.

EARNINGS BY PLACE OF WORK

Earnings of persons employed in Huron County increased from \$1,138,722* in 2006 to \$1,140,826* in 2007, an increase of 0.2 percent. The 2006-2007 state change was 3.5 percent and the national change was 4.9 percent. The average annual growth rate from the 1997 estimate of \$967,015* to the 2007 estimate was 1.7 percent. The average annual growth rate for the state was 3.7 percent and for the nation was 5.4 percent.

**Note: All income estimates with the exception of PCPI are in thousands of dollars, not adjusted for inflation.*

APPENDIX B

ECONOMIC IMPACT DETAIL OF RUNWAY CONSTRUCTION

Employment Impact of Construction Phase				
Industry	Direct	Indirect	Induced	Total
Water- sewage and other treatment and delivery	285.5	0	0.1	285.5
Construct new nonresidential commercial and	259.3	0	0	259.3
Maint & repair construct of nonresident struc	0	26.1	0.6	26.6
Food services and drinking places	0	3.1	17.3	20.4
Private hospitals	0	0	10	10
Offices of physicians- dentists- and other he	0	0	9.6	9.6
Retail Stores - General merchandise	0	0.8	6.7	7.5
Real estate establishments	0	2.5	3.9	6.4
Architectural- engineering- and related servi	0	6.3	0.1	6.3
Nursing and residential care facilities	0	0	6.3	6.3
Retail Stores - Food and beverage	0	0.6	5.3	6
Civic- social- professional- and similar orga	0	2.9	3.1	6
Retail Stores - Motor vehicle and parts	0	0.7	4.9	5.6
Monetary authorities and depository credit in	0	3.5	2	5.5
Transport by truck	0	3.5	1.6	5
Employment services	0	3	1.9	4.8
Accounting- tax preparation- bookkeeping- an	0	3.8	0.5	4.2
Automotive repair and maintenance- except ca	0	2.1	1.9	4
Retail Nonstores - Direct and electronic sale	0	0.4	3.3	3.7
Retail Stores - Building material and garden	0	0.3	2.8	3.1
Retail Stores - Miscellaneous	0	0.4	2.7	3.1
Legal services	0	2	0.9	2.9
Hotels and motels- including casino hotels	0	1.3	1.5	2.8
Retail Stores - Clothing and clothing accesso	0	0.2	2.4	2.7
Retail Stores - Health and personal care	0	0.3	2.3	2.6
Services to buildings and dwellings	0	1.5	0.9	2.5
Personal care services	0	0	2.4	2.4
Private household operations	0	0	2.4	2.4
Retail Stores - Gasoline stations	0	0.2	2.1	2.3
Individual and family services	0	0	2.2	2.2
Retail Stores - Sporting goods- hobby- book a	0	0.3	1.8	2.1
Medical and diagnostic labs and outpatient an	0	0	2.1	2.1
Amusement parks- arcades- and gambling indt	0	0	2.1	2.1
Private elementary and secondary schools	0	0	2	2
Spectator sports companies	0	0.4	1.5	2
Telecommunications	0	0.9	0.9	1.8
Environmental and other technical consulting	0	1.6	0.1	1.7
Advertising and related services	0	0.6	1	1.6

Employment Impact of Construction Phase				
Industry	Direct	Indirect	Induced	Total
Commercial and industrial machinery and equ	0	1.5	0.2	1.6
Community food- housing- and other relief ser	0	0	1.5	1.5
Performing arts companies	0	0.1	1.4	1.5
Other plastics product manufacturing	0	1.2	0.2	1.4
Wholesale trade businesses	0	0.8	0.7	1.4
Retail Stores - Furniture and home furnishing	0	0.3	1	1.3
Other state and local government enterprises	0	0.3	1	1.3
Wood kitchen cabinet and countertop manufac	0	1.1	0.1	1.2
Retail Stores - Electronics and appliances	0	0.2	1	1.2
Promoters of performing arts and sports and a	0	0.2	1	1.2
Personal and household goods repair and main	0	1	0.2	1.2
Insurance carriers	0	0.1	1	1.1
Child day care services	0	0	1.1	1.1
Fitness and recreational sports centers	0	0.2	0.9	1.1
US Postal Service	0	0.6	0.5	1.1
Computer systems design services	0	0.8	0.2	1
Home health care services	0	0	1	1
Material handling equipment manufacturing	0	0.8	0	0.8
Business support services	0	0.6	0.2	0.8
Other amusement and recreation industries	0	0.1	0.7	0.8
Religious organizations	0	0	0.8	0.8
Electric power generation- transmission- and	0	0.3	0.4	0.7
Management- scientific- and technical consult	0	0.4	0.3	0.7
Independent artists- writers- and performers	0	0.4	0.3	0.7
Dry-cleaning and laundry services	0	0.1	0.6	0.7
Printing	0	0.3	0.4	0.6
Motor vehicle parts manufacturing	0	0.4	0.3	0.6
Insurance agencies- brokerages- and related a	0	0.1	0.6	0.6
Commercial and industrial machinery and equ	0	0.6	0	0.6
Other private educational services	0	0	0.6	0.6
Newspaper publishers	0	0.2	0.3	0.5
Waste management and remediation services	0	0.3	0.2	0.5
Car washes	0	0.1	0.3	0.5
Death care services	0	0	0.5	0.5
* Not unique commod (S&LG passenger trans	0	0.1	0.4	0.5
Extraction of oil and natural gas	0	0.3	0.2	0.4
Animal (except poultry) slaughtering- renderi	0	0	0.4	0.4
Wood windows and doors and millwork manu	0	0.4	0	0.4

Employment Impact of Construction Phase				
Industry	Direct	Indirect	Induced	Total
Machine shops	0	0.4	0	0.4
Upholstered household furniture manufacturing	0	0.2	0.2	0.4
Couriers and messengers	0	0.2	0.2	0.4
Nondepository credit intermediation and related activities	0	0.1	0.3	0.4
Securities- commodity contracts- investments- and financial instruments	0	0.2	0.3	0.4
Electronic and precision equipment repair and maintenance	0	0.4	0	0.4
Grantmaking- giving- and social advocacy organizations	0	0	0.4	0.4
Commercial Fishing	0	0	0.2	0.3
Transport by rail	0	0.2	0.1	0.3
Scenic and sightseeing transportation and support activities	0	0.1	0.2	0.3
Motion picture and video industries	0	0	0.3	0.3
General and consumer goods rental except video and motion picture	0	0.1	0.3	0.3
Video tape and disc rental	0	0	0.3	0.3
Other accommodations	0	0	0.3	0.3
Vegetable and melon farming	0	0	0.2	0.2
Dairy cattle and milk production	0	0	0.2	0.2
Natural gas distribution	0	0.1	0.1	0.2
Maint & repair construct of residential structures	0	0	0.2	0.2
Bread and bakery product manufacturing	0	0	0.2	0.2
Cookie- cracker- and pasta manufacturing	0	0	0.2	0.2
Asphalt shingle and coating materials manufacturing	0	0.2	0	0.2
All other chemical product and preparation manufacturing	0	0.1	0	0.2
Other commercial and service industry machinery	0	0.1	0	0.2
Transit and ground passenger transportation	0	0.1	0.1	0.2
Lessors of nonfinancial intangible assets	0	0.1	0	0.2
Veterinary services	0	0	0.2	0.2
Management of companies and enterprises	0	0.1	0.1	0.2
Travel arrangement and reservation services	0	0.2	0	0.2
Office administrative services	0	0.1	0.1	0.2
Other personal services	0	0	0.2	0.2
Grain farming	0	0	0.1	0.1
All other crop farming	0	0.1	0	0.1
Animal production- except cattle and poultry	0	0	0.1	0.1
Support activities for agriculture and forest	0	0	0	0.1
Fluid milk and butter manufacturing	0	0	0.1	0.1
Nonwoven fabric mills	0	0	0	0.1
Mens and boys cut and sew apparel manufacturing	0	0	0.1	0.1
Sawmills and wood preservation	0	0.1	0	0.1

Employment Impact of Construction Phase				
Industry	Direct	Indirect	Induced	Total
Wood container and pallet manufacturing	0	0	0	0.1
All other miscellaneous wood product manufa	0	0	0	0.1
Asphalt paving mixture and block manufacturi	0	0.1	0	0.1
Urethane and other foam product (except poly	0	0	0	0.1
Other pressed and blown glass and glassware r	0	0.1	0	0.1
Turned product and screw- nut- and bolt manu	0	0	0	0.1
Coating- engraving- heat treating and allied	0	0.1	0	0.1
Printed circuit assembly (electronic assembly	0	0	0.1	0.1
Motor vehicle body manufacturing	0	0	0.1	0.1
Nonupholstered wood household furniture ma	0	0	0	0.1
Surgical and medical instrument- laboratory a	0	0	0.1	0.1
Surgical appliance and supplies manufacturing	0	0	0.1	0.1
Sign manufacturing	0	0	0	0.1
Transport by air	0	0	0.1	0.1
Warehousing and storage	0	0.1	0.1	0.1
Radio and television broadcasting	0	0	0.1	0.1
Internet publishing and broadcasting	0	0	0.1	0.1
Data processing- hosting- ISP- web search por	0	0	0	0.1
Other information services	0	0	0.1	0.1
Specialized design services	0	0	0	0.1
Custom computer programming services	0	0.1	0	0.1
Scientific research and development services	0	0.1	0	0.1
Photographic services	0	0	0.1	0.1
Investigation and security services	0	0.1	0	0.1
Other support services	0	0.1	0	0.1
Museums- historical sites- zoos- and parks	0	0	0.1	0.1
Bowling centers	0	0	0.1	0.1
* Not unique commod (S&LG electricity)	0	0.1	0.1	0.1
Totals:	544.7	88.3	140.4	773.4

Economic Impact of One-Time Construction

Industry	Direct	Indirect	Induced	Total
Water- sewage and other treatment and delivery	\$30,398,856	\$936	\$6,559	\$30,406,352
Construct new nonresidential commercial and	29,840,000	0	0	29,840,000
Maint & repair construct of nonresident struc	0	2,558,672	55,266	2,613,937
Imputed rental activity for owner-occupied dw	0	0	2,106,514	2,106,514
Food services and drinking places	0	153,749	871,832	1,025,581
Offices of physicians- dentists- and other he	0	3	1,003,096	1,003,099
Private hospitals	0	5	953,003	953,008
Real estate establishments	0	259,347	405,607	664,954
Transport by truck	0	459,423	204,690	664,113
Monetary authorities and depository credit in	0	403,130	225,809	628,939
Telecommunications	0	296,609	288,430	585,039
Architectural- engineering- and related servi	0	481,366	6,412	487,778
Retail Stores - Motor vehicle and parts	0	57,974	391,757	449,730
Legal services	0	249,766	112,366	362,132
Electric power generation- transmission- and	0	151,635	210,085	361,720
Retail Stores - General merchandise	0	38,467	309,882	348,349
Accounting- tax preparation- bookkeeping- an	0	286,087	34,854	320,941
Other plastics product manufacturing	0	250,951	40,027	290,978
Automotive repair and maintenance- except ca	0	148,276	136,218	284,494
Retail Stores - Food and beverage	0	29,577	242,265	271,842
Insurance carriers	0	26,073	245,207	271,280
Civic- social- professional- and similar orga	0	128,294	137,443	265,736
Other state and local government enterprises	0	57,778	207,515	265,294
Retail Stores - Building material and garden	0	24,005	218,413	242,418
Material handling equipment manufacturing	0	241,360	574	241,935
Environmental and other technical consulting	0	225,990	12,630	238,620
Medical and diagnostic labs and outpatient an	0	92	232,772	232,864
Asphalt shingle and coating materials manufac	0	218,879	5,453	224,332
Wholesale trade businesses	0	120,454	100,641	221,095
Commercial and industrial machinery and equ	0	205,393	10,953	216,346
Motor vehicle parts manufacturing	0	128,055	82,224	210,279
Nursing and residential care facilities	0	0	196,088	196,088
Animal (except poultry) slaughtering- renderi	0	3,409	188,765	192,174
Natural gas distribution	0	103,409	65,760	169,169
Hotels and motels- including casino hotels	0	75,231	88,667	163,897
Commercial and industrial machinery and equ	0	145,061	14,923	159,984
Retail Stores - Health and personal care	0	17,832	136,349	154,181
Wood kitchen cabinet and countertop manufac	0	139,545	11,972	151,517

Industry	Direct	Indirect	Induced	Total
Retail Nonstores - Direct and electronic sale	0	15,334	132,149	147,483
Services to buildings and dwellings	0	91,392	56,081	147,472
Extraction of oil and natural gas	0	82,297	55,358	137,655
Amusement parks- arcades- and gambling ind	0	43	137,439	137,481
Retail Stores - Clothing and clothing accesso	0	11,394	114,003	125,396
Transport by rail	0	89,879	34,340	124,218
Personal and household goods repair and main	0	100,021	19,553	119,573
US Postal Service	0	66,388	50,523	116,911
Employment services	0	70,553	44,872	115,425
Computer systems design services	0	89,067	22,710	111,777
Retail Stores - Gasoline stations	0	9,305	95,145	104,450
Retail Stores - Furniture and home furnishing	0	24,472	78,910	103,382
Securities- commodity contracts- investments-	0	37,253	61,289	98,542
Personal care services	0	0	94,108	94,109
Retail Stores - Miscellaneous	0	10,576	78,887	89,463
Waste management and remediation services	0	50,658	36,698	87,356
Advertising and related services	0	34,238	53,110	87,348
Cookie- cracker- and pasta manufacturing	0	1,321	81,531	82,852
Maint & repair construct of residential struc	0	1,162	77,931	79,092
Management- scientific- and technical consult	0	43,669	33,382	77,051
Wood windows and doors and millwork manu	0	74,118	2,080	76,199
Retail Stores - Sporting goods- hobby- book a	0	9,251	64,871	74,123
All other chemical product and preparation ma	0	50,955	19,463	70,418
Asphalt paving mixture and block manufacturi	0	66,367	2,942	69,309
Nondepository credit intermediation and relat	0	18,541	47,732	66,273
Retail Stores - Electronics and appliances	0	9,735	55,608	65,343
Individual and family services	0	0	61,575	61,575
Electronic and precision equipment repair and	0	55,231	5,498	60,729
Printing	0	25,025	35,663	60,689
Insurance agencies- brokerages- and related a	0	6,478	53,384	59,862
Machine shops	0	56,039	3,278	59,317
Private elementary and secondary schools	0	0	58,769	58,769
Community food- housing- and other relief ser	0	0	57,437	57,437
Printed circuit assembly (electronic assembly	0	10,323	46,248	56,571
Business support services	0	42,137	13,122	55,259
Upholstered household furniture manufacturin	0	33,508	21,176	54,684
* Not unique commod (S&LG passenger trans	0	13,369	34,503	47,873
Fluid milk and butter manufacturing	0	968	46,024	46,992
Newspaper publishers	0	15,776	30,461	46,237

Industry	Direct	Indirect	Induced	Total
Home health care services	0	0	45,767	45,767
Spectator sports companies	0	10,063	35,160	45,223
Bread and bakery product manufacturing	0	832	42,221	43,053
Other amusement and recreation industries	0	5,662	37,084	42,746
Other commercial and service industry machinery	0	36,212	4,949	41,161
Religious organizations	0	0	36,544	36,544
Grantmaking- giving- and social advocacy organizations	0	9	35,606	35,614
Fitness and recreational sports centers	0	6,341	27,408	33,749
Death care services	0	0	32,633	32,633
Other pressed and blown glass and glassware manufacturing	0	22,468	9,391	31,859
Transport by air	0	9,755	21,943	31,698
Other personal services	0	1,122	30,506	31,627
Promoters of performing arts and sports and athletic events	0	6,286	24,213	30,500
Dry-cleaning and laundry services	0	4,505	25,393	29,898
Plastics material and resin manufacturing	0	22,583	6,880	29,463
Management of companies and enterprises	0	16,995	12,160	29,155
Child day care services	0	0	28,309	28,309
Office administrative services	0	17,099	10,675	27,774
Motion picture and video industries	0	2,570	25,133	27,703
Sawmills and wood preservation	0	26,312	838	27,149
Scenic and sightseeing transportation and support services	0	10,819	14,421	25,240
Urethane and other foam product (except polyurethane)	0	14,361	10,014	24,375
Vegetable and melon farming	0	129	23,760	23,889
Travel arrangement and reservation services	0	19,213	4,151	23,364
Motor vehicle body manufacturing	0	8,486	14,203	22,689
Other private educational services	0	522	21,273	21,796
Nonwoven fabric mills	0	12,962	8,775	21,736
Surgical appliance and supplies manufacturing	0	420	20,891	21,312
Coating- engraving- heat treating and allied	0	19,886	1,348	21,234
Surgical and medical instrument- laboratory and diagnostic equipment	0	359	20,496	20,855
General and consumer goods rental except video and motion picture	0	4,804	15,911	20,714
Dairy cattle and milk production	0	460	20,086	20,546
Other accommodations	0	190	19,030	19,220
* Not unique commodity (S&LG electricity)	0	7,729	11,024	18,753
Independent artists- writers- and performers	0	10,285	8,381	18,666
Performing arts companies	0	1,359	17,064	18,422
Automotive equipment rental and leasing	0	6,775	11,583	18,359
Car washes	0	4,201	13,852	18,053
Couriers and messengers	0	8,725	9,255	17,981

Industry	Direct	Indirect	Induced	Total
All other crop farming	0	16,093	1,559	17,652
Internet publishing and broadcasting	0	6,902	10,597	17,499
Museums- historical sites- zoos- and parks	0	0	16,332	16,332
Fertilizer manufacturing	0	14,872	766	15,639
Mens and boys cut and sew apparel manufactu	0	54	15,519	15,574
Radio and television broadcasting	0	4,902	10,150	15,052
Lawn and garden equipment manufacturing	0	7,616	7,213	14,829
Valve and fittings other than plumbing manufa	0	13,826	817	14,644
Video tape and disc rental	0	0	14,476	14,476
Wiring device manufacturing	0	13,394	350	13,744
Motor and generator manufacturing	0	12,071	755	12,827
Private household operations	0	0	12,727	12,727
Other support services	0	7,001	5,173	12,174
Ball and roller bearing manufacturing	0	9,801	2,173	11,974
Heavy duty truck manufacturing	0	281	11,493	11,774
Funds- trusts- and other financial vehicles	0	167	11,016	11,183
Warehousing and storage	0	3,736	7,433	11,169
Turned product and screw- nut- and bolt manu	0	9,368	1,792	11,160
Switchgear and switchboard apparatus manufa	0	10,483	436	10,919
Greenhouse- nursery- and floriculture product	0	188	10,485	10,673
Photographic services	0	1,374	9,249	10,623
Scientific research and development services	0	8,287	1,937	10,224
Soybean and other oilseed processing	0	43	9,953	9,996
Veterinary services	0	584	9,382	9,966
Other fabricated metal manufacturing	0	8,956	449	9,405
Mechanical power transmission equipment ma	0	8,351	983	9,333
Other general purpose machinery manufacturi	0	8,523	507	9,029
All other miscellaneous wood product manufa	0	6,010	2,925	8,934
Other information services	0	2,225	6,260	8,485
Relay and industrial control manufacturing	0	7,328	1,028	8,356
Periodical publishers	0	1,979	6,086	8,065
Sign manufacturing	0	4,047	3,704	7,751
Watch- clock- and other measuring and contro	0	2,187	5,519	7,706
Nonupholstered wood household furniture ma	0	1,769	5,826	7,595
Transit and ground passenger transportation	0	2,021	5,215	7,236
Ornamental and architectural metal products n	0	6,534	112	6,646
Plate work and fabricated structural product	0	6,527	39	6,566
Hardware manufacturing	0	5,449	994	6,443
All other miscellaneous professional- scienti	0	5,090	1,341	6,432

Industry	Direct	Indirect	Induced	Total
Wood container and pallet manufacturing	0	2,964	3,438	6,402
Data processing- hosting- ISP- web search por	0	2,366	3,629	5,995
Adhesive manufacturing	0	3,981	1,890	5,871
Commercial hunting and trapping	0	0	5,799	5,799
Irradiation apparatus manufacturing	0	64	5,526	5,590
Custom computer programming services	0	4,226	1,340	5,566
Travel trailer and camper manufacturing	0	253	5,243	5,496
Synthetic dye and pigment manufacturing	0	3,193	2,078	5,271
Investigation and security services	0	3,812	1,413	5,226
Animal production- except cattle and poultry	0	122	4,468	4,590
Lessors of nonfinancial intangible assets	0	3,436	999	4,435
Commercial Fishing	0	344	3,957	4,301
Poultry and egg production	0	25	4,224	4,248
Specialized design services	0	2,957	1,243	4,200
Directory- mailing list- and other publishers	0	1,090	3,098	4,188
All other textile product mills	0	2,178	1,837	4,014
Software publishers	0	1,722	2,131	3,853
Cattle ranching and farming	0	71	3,726	3,797
Transport by water	0	852	2,833	3,685
Other cut and sew apparel manufacturing	0	11	3,670	3,681
Other industrial machinery manufacturing	0	1,384	2,061	3,444
Grain farming	0	479	2,665	3,144
Coated and laminated paper- packaging paper	0	1,686	1,264	2,950
Construct other new residential structures	0	606	2,178	2,785
Lime and gypsum product manufacturing	0	2,606	131	2,737
Bowling centers	0	18	2,505	2,523
Industrial mold manufacturing	0	2,329	94	2,423
Fruit farming	0	7	2,185	2,192
Other concrete product manufacturing	0	2,046	37	2,083
Mining and quarrying stone	0	1,848	122	1,970
All other forging- stamping- and sintering	0	1,414	333	1,747
Other rubber product manufacturing	0	1,218	526	1,745
Oilseed farming	0	187	1,470	1,658
Sporting and athletic goods manufacturing	0	20	1,274	1,294
Plastics and rubber industry machinery manufa	0	950	148	1,098
Crown and closure manufacturing and metal s	0	890	76	966
Support activities for agriculture and forest	0	232	703	935
Textile and fabric finishing mills	0	252	588	840
Nonferrous metal foundries	0	611	227	838

Industry	Direct	Indirect	Induced	Total
Paint and coating manufacturing	0	740	64	804
Metal cutting and forming machine tool manu	0	593	211	804
Office furniture and custom architectural woo	0	703	87	790
Bare printed circuit board manufacturing	0	511	248	759
Paperboard container manufacturing	0	430	125	556
Secondary smelting and alloying of aluminum	0	372	61	432
Metal can- box- and other metal container (li	0	302	87	389
Chocolate and confectionery manufacturing fr	0	19	367	386
Confectionery manufacturing from purchased	0	27	352	379
Wineries	0	6	371	376
Construction machinery manufacturing	0	370	3	372
Fabric coating mills	0	220	135	355
Industrial process furnace and oven manufactu	0	255	101	355
Cut stone and stone product manufacturing	0	295	26	321
Special tool- die- jig- and fixture manufactu	0	207	52	260
Industrial process variable instruments manuf	0	228	30	258
Ready-mix concrete manufacturing	0	234	6	240
Textile bag and canvas mills	0	115	44	159
Rolling mill and other metalworking machiner	0	115	31	146
Flour milling and malt manufacturing	0	2	107	109
Concrete pipe- brick- and block manufacturing	0	84	2	86
Nonchocolate confectionery manufacturing	0	1	67	68
Power boiler and heat exchanger manufacturin	0	56	2	58
All other miscellaneous manufacturing	0	3	56	58
Truck trailer manufacturing	0	47	1	48
Air conditioning- refrigeration- and warm air	0	8	22	31
Narrow fabric mills and schiffli machine embr	0	6	23	29
Sugarcane and sugar beet farming	0	3	12	15
Tire manufacturing	0	10	6	15
Abrasive product manufacturing	0	3	3	6
Brick- tile- and other structural clay produc	0	3	0	3
Forestry- forest products- and timber tract p	0	2	0	2
Tree nut farming	0	0	1	1
Clay and nonclay refractory manufacturing	0	1	0	1
Totals:	\$60,238,856	\$9,600,635	\$12,633,804	\$82,473,296

APPENDIX C

ANNUAL ECONOMIC IMPACT SCENARIO DETAIL OF NASA OPERATING ACTIVITY AND RELATED STARTUPS

Industry	100 NASA Jobs		175 NASA Jobs		325 NASA Jobs	
	Employment	Output	Employment	Output	Employment	Output
NASA government researech and testing	41.3	4,643,245	72.4	8,320,086.18	134.4	15,335,984
Scientific research and development services	41.3	4,784,871	72.4	8,373,899.73	134.4	15,551,705
Architectural- engineering- and related servi	42.0	3,224,858	104.6	8,039,066.03	209.1	16,070,438
Imputed rental activity for owner-occupied dv	0.0	573,483	0.0	1,111,257.94	0.0	2,115,032
Food services and drinking places	7.9	398,116	15.7	793,129.26	30.2	1,518,872
Maint & repair construct of nonresident struc	3.1	304,786	5.6	546,936.57	10.4	1,022,197
Offices of physicians- dentists- and other he	2.6	272,951	5.0	528,898.03	9.6	1,006,635
Real estate establishments	2.6	273,121	5.0	523,321.00	9.6	993,482
Private hospitals	2.7	259,375	5.3	502,590.24	10.0	956,565
Services to buildings and dwellings	3.4	200,884	6.1	365,224.26	11.5	684,786
Monetary authorities and depository credit in	1.6	178,742	3.0	345,433.60	5.7	657,060
Telecommunications	0.5	170,240	1.0	331,885.27	1.9	632,532
Management- scientific- and technical consu	1.5	168,106	2.9	324,193.31	5.5	616,363
Insurance carriers	0.5	120,401	1.0	244,066.19	1.9	469,154
Employment services	5.1	121,680	10.2	241,910.34	19.5	463,057
Retail Stores - Motor vehicle and parts	1.4	110,731	2.7	214,295.49	5.1	407,747
Transport by truck	0.8	109,150	1.6	207,198.17	3.0	392,504
Electric power generation- transmission- and	0.2	107,126	0.4	203,120.37	0.8	384,676
Legal services	0.9	107,037	1.6	201,075.68	3.1	379,979
Other state and local government enterprises	0.5	95,870	0.9	182,153.64	1.7	345,134
Civic- social- professional- and similar orga	2.0	88,889	3.8	171,169.85	7.3	325,322
Retail Stores - General merchandise	1.9	87,065	3.6	168,528.45	6.9	320,678
Computer systems design services	0.7	80,174	1.4	155,417.74	2.7	295,829
Environmental and other technical consulting	0.5	74,876	1.1	150,491.57	2.0	288,751
Hotels and motels- including casino hotels	1.2	69,631	2.4	140,904.51	4.7	270,751
Automotive repair and maintenance- except	1.0	69,783	1.9	132,436.08	3.6	250,866
Retail Stores - Food and beverage	1.5	68,033	2.9	131,689.37	5.5	250,581
Medical and diagnostic labs and outpatient a	0.6	63,819	1.1	123,586.65	2.1	235,187
Retail Stores - Building material and garden	0.8	61,146	1.5	118,371.21	2.9	225,244
Animal (except poultry) slaughtering- renderi	0.1	58,280	0.2	112,678.90	0.5	214,351
Nursing and residential care facilities	1.7	53,371	3.3	103,417.06	6.3	196,831
Advertising and related services	1.0	53,147	1.9	101,483.53	3.6	192,506
Motor vehicle parts manufacturing	0.2	51,625	0.3	96,258.58	0.5	181,582
Accounting- tax preparation- bookkeeping- a	0.6	46,046	1.2	90,602.22	2.3	173,034
US Postal Service	0.4	42,164	0.8	83,684.25	1.5	160,127
Other plastics product manufacturing	0.2	42,533	0.4	80,286.63	0.7	151,892
Wholesale trade businesses	0.2	39,999	0.5	76,941.08	1.0	146,196
Office administrative services	0.3	38,214	0.5	75,237.31	1.0	143,708
Retail Stores - Health and personal care	0.7	38,373	1.2	74,273.23	2.4	141,326
Printing	0.4	38,353	0.7	73,946.37	1.4	140,581
Amusement parks- arcades- and gambling in	0.6	37,461	1.1	72,594.67	2.1	138,170
Veterinary services	0.7	41,650	1.2	73,481.48	2.2	136,748
Retail Nonstores - Direct and electronic sale	0.9	37,053	1.8	71,726.88	3.4	136,485
Business support services	0.5	34,176	0.9	66,395.73	1.8	126,444
Natural gas distribution	0.0	33,888	0.1	64,135.34	0.1	121,409
Retail Stores - Clothing and clothing accessc	0.7	31,835	1.3	61,634.02	2.5	117,284
Insurance agencies- brokerages- and related	0.3	30,700	0.7	60,791.44	1.2	116,264
Extraction of oil and natural gas	0.1	31,558	0.2	60,971.61	0.4	115,969
Securities- commodity contracts- investment	0.1	29,293	0.2	56,075.18	0.5	106,431
Waste management and remediation service	0.2	29,902	0.3	55,451.20	0.6	104,467
Commercial and industrial machinery and eq	0.3	29,363	0.6	54,940.44	1.1	103,725
All other chemical product and preparation m	0.0	27,689	0.1	52,149.45	0.2	98,608
Retail Stores - Gasoline stations	0.6	26,554	1.2	51,411.41	2.2	97,832
Cookie- cracker- and pasta manufacturing	0.1	26,045	0.1	50,136.58	0.2	95,280
Newspaper publishers	0.2	26,209	0.5	50,080.38	1.0	95,014
Personal care services	0.7	25,609	1.3	49,623.76	2.4	94,448
Transport by rail	0.1	24,256	0.1	45,247.18	0.2	85,363

Industry	100 NASA Jobs		175 NASA Jobs		325 NASA Jobs	
	Employment	Output	Employment	Output	Employment	Output
Retail Stores - Furniture and home furnishing	0.3	23,211	0.6	44,862.46	1.1	85,337
Retail Stores - Miscellaneous	0.7	22,220	1.5	43,006.62	2.8	81,832
Maint & repair construct of residential struc	0.0	21,966	0.1	42,521.90	0.2	80,913
* Not unique commod (S&LG passenger tran	0.2	19,336	0.4	38,336.24	0.8	73,338
Scenic and sightseeing transportation and su	0.2	20,968	0.5	38,427.15	0.9	72,190
Personal and household goods repair and m	0.2	20,654	0.4	38,044.08	0.7	71,558
Nondepository credit intermediation and rela	0.1	19,151	0.2	37,293.23	0.5	71,059
Retail Stores - Sporting goods- hobby- book	0.5	18,311	1.0	35,439.05	1.9	67,432
Commercial and industrial machinery and eq	0.0	18,223	0.1	35,333.26	0.2	67,258
Printed circuit assembly (electronic assembly	0.0	17,842	0.1	34,432.41	0.1	65,474
Transport by water	0.0	19,322	0.1	33,974.96	0.1	63,174
Individual and family services	0.6	16,765	1.2	32,485.66	2.2	61,829
Management of companies and enterprises	0.1	16,578	0.2	32,074.49	0.3	61,026
Spectator sports companies	0.7	15,947	1.4	31,727.37	2.6	60,741
Other pressed and blown glass and glasswa	0.0	17,749	0.1	31,921.59	0.2	59,693
Private elementary and secondary schools	0.5	16,015	1.0	31,032.31	2.0	59,063
Electronic and precision equipment repair an	0.1	15,676	0.2	30,680.64	0.4	58,524
Retail Stores - Electronics and appliances	0.3	15,824	0.5	30,617.83	1.0	58,255
Community food- housing- and other relief se	0.4	15,638	0.8	30,302.53	1.5	57,674
Internet publishing and broadcasting	0.1	14,769	0.2	28,447.52	0.3	54,070
Travel arrangement and reservation services	0.1	15,468	0.2	28,165.70	0.5	52,830
Other amusement and recreation industries	0.3	14,098	0.5	27,673.95	1.0	52,824
Fluid milk and butter manufacturing	0.0	14,110	0.0	27,339.22	0.1	52,033
Bread and bakery product manufacturing	0.1	12,626	0.1	24,500.71	0.2	46,646
Home health care services	0.3	12,455	0.5	24,134.59	1.0	45,934
Other personal services	0.1	12,249	0.2	23,888.71	0.3	45,533
Fitness and recreational sports centers	0.4	11,072	0.7	22,023.37	1.4	42,161
Nonwoven fabric mills	0.0	11,812	0.0	21,872.95	0.1	41,194
Promoters of performing arts and sports and	0.4	10,769	0.8	21,296.07	1.6	40,716
Transport by air	0.0	10,615	0.1	21,000.61	0.1	40,156
Surgical appliance and supplies manufacturi	0.0	11,084	0.1	20,736.14	0.2	39,148
Dry-cleaning and laundry services	0.2	10,895	0.5	20,558.04	0.9	38,890
Grantmaking- giving- and social advocacy or	0.1	9,993	0.2	19,307.59	0.5	36,723
Religious organizations	0.2	9,950	0.4	19,279.90	0.8	36,695
Other support services	0.1	9,049	0.2	18,905.51	0.3	36,573
Couriers and messengers	0.2	9,371	0.4	18,141.85	0.8	34,522
Independent artists- writers- and performers	0.3	8,693	0.7	17,571.59	1.2	33,756
Death care services	0.1	8,873	0.2	17,191.82	0.5	32,721
All other miscellaneous professional- scienti	0.0	8,668	0.1	16,784.79	0.2	31,941
Urethane and other foam product (except po	0.0	9,113	0.0	16,937.68	0.1	31,927
Motion picture and video industries	0.1	8,671	0.2	16,757.51	0.3	31,875
Radio and television broadcasting	0.0	8,294	0.1	15,857.49	0.2	30,089
Surgical and medical instrument- laboratory	0.0	8,425	0.1	15,897.57	0.1	30,073
Plastics material and resin manufacturing	0.0	8,552	0.0	15,920.30	0.0	30,021
Automotive equipment rental and leasing	0.0	7,776	0.0	15,247.96	0.1	29,099
Photographic services	0.1	7,560	0.2	15,145.07	0.3	29,038
Child day care services	0.3	7,708	0.6	14,937.21	1.1	28,430
General and consumer goods rental except v	0.1	7,720	0.2	14,929.36	0.5	28,402
Lawn and garden equipment manufacturing	0.0	7,709	0.0	13,988.01	0.1	26,215
Asphalt paving mixture and block manufactu	0.0	7,079	0.0	13,265.26	0.0	25,053
Machine shops	0.0	7,045	0.1	12,942.53	0.2	24,328
Vegetable and melon farming	0.0	6,585	0.1	12,775.16	0.2	24,321
Dairy cattle and milk production	0.0	6,517	0.1	12,566.07	0.2	23,890
Upholstered household furniture manufacturi	0.0	6,091	0.1	11,754.06	0.2	22,350
Asphalt shingle and coating materials manuf	0.0	6,256	0.0	11,804.89	0.0	22,332
Other private educational services	0.2	6,041	0.3	11,696.21	0.6	22,258
Periodical publishers	0.0	6,282	0.0	11,715.22	0.1	22,101

Industry	100 NASA Jobs		175 NASA Jobs		325 NASA Jobs	
	Employment	Output	Employment	Output	Employment	Output
Other information services	0.1	6,249	0.1	11,512.32	0.2	21,654
Performing arts companies	0.5	5,514	0.9	10,757.75	1.7	20,506
* Not unique commod (S&LG electricity)	0.0	5,644	0.1	10,701.55	0.2	20,267
Other accommodations	0.1	5,315	0.1	10,302.37	0.2	19,610
Specialized design services	0.0	4,145	0.1	9,599.87	0.2	18,946
Car washes	0.1	4,789	0.2	9,185.39	0.5	17,441
Wood kitchen cabinet and countertop manuf	0.0	4,839	0.1	9,182.91	0.1	17,394
Warehousing and storage	0.1	4,801	0.1	9,137.04	0.2	17,319
Motor vehicle body manufacturing	0.0	4,615	0.0	8,849.02	0.1	16,802
Museums- historical sites- zoos- and parks	0.0	4,446	0.0	8,616.37	0.0	16,399
Mens and boys cut and sew apparel manufa	0.0	4,271	0.0	8,273.38	0.1	15,745
Video tape and disc rental	0.1	3,941	0.2	7,636.59	0.3	14,535
Sign manufacturing	0.0	3,942	0.0	7,497.33	0.1	14,209
Custom computer programming services	0.0	3,703	0.1	7,261.78	0.2	13,859
All other crop farming	0.0	3,977	0.0	7,325.01	0.0	13,778
Private household operations	0.6	3,465	1.2	6,714.66	2.4	12,780
Funds- trusts- and other financial vehicles	0.0	3,368	0.0	6,489.86	0.0	12,336
Soybean and other oilseed processing	0.0	3,345	0.0	6,382.00	0.0	12,104
Ball and roller bearing manufacturing	0.0	3,367	0.0	6,255.55	0.0	11,790
Heavy duty truck manufacturing	0.0	3,176	0.0	6,147.70	0.0	11,698
Greenhouse- nursery- and floriculture produc	0.0	3,079	0.0	5,967.94	0.0	11,360
Watch- clock- and other measuring and cont	0.0	2,944	0.0	5,846.04	0.0	11,188
Investigation and security services	0.1	2,913	0.1	5,829.10	0.3	11,173
Irradiation apparatus manufacturing	0.0	3,230	0.0	5,939.84	0.0	11,168
Transit and ground passenger transportation	0.1	2,922	0.2	5,794.38	0.3	11,085
Grain farming	0.0	3,061	0.1	5,552.23	0.2	10,404
Valve and fittings other than plumbing manuf	0.0	2,642	0.0	5,033.20	0.0	9,542
All other miscellaneous wood product manuf	0.0	2,777	0.0	5,066.68	0.1	9,508
Synthetic dye and pigment manufacturing	0.0	2,730	0.0	4,990.23	0.0	9,369
Lessors of nonfinancial intangible assets	0.1	2,623	0.2	4,947.25	0.4	9,358
Software publishers	0.0	2,448	0.0	4,831.55	0.0	9,234
Other industrial machinery manufacturing	0.0	2,558	0.0	4,656.33	0.0	8,733
Animal production- except cattle and poultry	0.1	2,456	0.1	4,555.09	0.2	8,581
Mechanical power transmission equipment m	0.0	2,336	0.0	4,421.62	0.0	8,371
Water- sewage and other treatment and deliv	0.0	2,278	0.0	4,376.16	0.1	8,313
Directory- mailing list- and other publishers	0.0	2,264	0.0	4,317.07	0.0	8,187
Travel trailer and camper manufacturing	0.0	2,307	0.0	4,315.00	0.0	8,146
Other commercial and service industry mach	0.0	2,062	0.0	3,891.02	0.0	7,361
Material handling equipment manufacturing	0.0	1,963	0.0	3,651.35	0.0	6,884
Wood container and pallet manufacturing	0.0	1,948	0.0	3,612.91	0.1	6,807
Data processing- hosting- ISP- web search p	0.0	1,850	0.0	3,545.14	0.0	6,730
Wood windows and doors and millwork manuf	0.0	1,763	0.0	3,305.47	0.0	6,244
Nonupholstered wood household furniture m	0.0	1,597	0.0	3,093.48	0.0	5,887
Commercial hunting and trapping	0.0	1,579	0.0	3,059.18	0.0	5,822
Commercial Fishing	0.1	1,540	0.2	2,995.13	0.3	5,705
Support activities for agriculture and forest	0.1	1,721	0.2	3,053.81	0.3	5,691
Relay and industrial control manufacturing	0.0	1,569	0.0	2,985.21	0.0	5,658
Motor and generator manufacturing	0.0	1,428	0.0	2,729.00	0.0	5,178
Coating- engraving- heat treating and allied	0.0	1,457	0.0	2,721.15	0.0	5,135
Cattle ranching and farming	0.0	1,384	0.0	2,632.31	0.0	4,989
Poultry and egg production	0.0	1,312	0.0	2,519.91	0.0	4,786
Turned product and screw- nut- and bolt mar	0.0	1,273	0.0	2,388.09	0.0	4,511
Adhesive manufacturing	0.0	1,147	0.0	2,157.50	0.0	4,078
All other textile product mills	0.0	1,068	0.0	2,040.56	0.0	3,872
Other cut and sew apparel manufacturing	0.0	1,005	0.0	1,947.99	0.0	3,708
Oilseed farming	0.0	1,057	0.0	1,948.82	0.0	3,666
Coated and laminated paper- packaging pap	0.0	1,016	0.0	1,925.26	0.0	3,646

Industry	100 NASA Jobs		175 NASA Jobs		325 NASA Jobs	
	Employment	Output	Employment	Output	Employment	Output
Construct other new residential structures	0.0	1,006	0.0	1,912.04	0.0	3,623
Hardware manufacturing	0.0	962	0.0	1,812.45	0.0	3,428
Sawmills and wood preservation	0.0	903	0.0	1,668.23	0.0	3,140
Switchgear and switchboard apparatus manu	0.0	768	0.0	1,535.17	0.0	2,942
Fertilizer manufacturing	0.0	824	0.0	1,502.94	0.0	2,820
Bare printed circuit board manufacturing	0.0	788	0.0	1,462.85	0.0	2,757
Bowling centers	0.0	694	0.0	1,346.32	0.0	2,563
Fruit farming	0.0	617	0.0	1,191.36	0.0	2,266
All other forging- stamping- and sintering	0.0	587	0.0	1,165.32	0.0	2,230
Other rubber product manufacturing	0.0	610	0.0	1,128.55	0.0	2,125
Other fabricated metal manufacturing	0.0	541	0.0	1,021.10	0.0	1,932
Wiring device manufacturing	0.0	473	0.0	898.37	0.0	1,702
Sugarcane and sugar beet farming	0.0	491	0.0	860.77	0.0	1,599
Totals:	194.1	18,796,459	383.7	36,551,441.51	733.8	69,414,798

APPENDIX D

INDUSTRY ANALYSIS

Industry Trend Analysis Report

By Donald T. Iannone & Associates

I. PURPOSE

This report discusses key national aviation, airline service, aerospace/space, and related transportation service and manufacturing industry trends and issues, which provide an informed backdrop for future airport service decisions by Huron and Erie County leaders. Because of its immediate significance to Huron and Erie Counties, this report begins with a summary description of the main activities of NASA's Plum Brook Station.

Why is this national industry information important to Huron and Erie County leaders? It is important because too often local officials make policy and investment decisions strictly in light of local information, and they ignore the larger industry and economic contexts that have a major impact on the success of their policy and investment decisions. For one, Huron and Erie County air facilities must compete for future business with other Ohio and national network airports.

The analysis includes five industry sectors: 1) aviation services; 2) air charter services; 3) commercial airlines; 4) freight shipping services; and 5) aerospace and space. The first two are most important to Huron and Erie County officials' decision-making about future local airports and air services, and the last three are relevant in consideration of future business expansion and attraction opportunities from an economic development standpoint related to NASA Plum Brook and air service development.

Finally, the information presented in this report is drawn from a wide range of public and private sources that monitor activities and developments in these five industry sectors.

II. NASA PLUM BROOK FIELD STATION

The 6,400-acre Plum Brook field station near Sandusky is a part of the Glenn Research Center in Cleveland. It specializes in very large-scale tests which would be hazardous within the confines

of the main Glenn campus. Of key interest, the Spacecraft Propulsion Facility at Plum Brook Station (PBS) is the world's only facility capable of testing full-scale upper-stage launch vehicles and rocket engines under simulated high-altitude conditions.

PBS' mission is to assure safe, cost-effective, responsive and reliable performance of research testing at Plum Brook Station to accomplish the R&D mission of the Glenn Research Center, other government agencies, and the private sector.

Space Power Facility

The PBS Space Power Facility houses the world's largest space environment simulation chamber. PBS also has cryogenic test facilities and a hypersonic wind tunnel.

The Space Power Facility (SPF) houses the world's largest space environment simulation chamber measuring 100 ft. in diameter by 122 ft. high. The facility was designed and constructed to test both nuclear and non-nuclear space hardware in a simulated Low-Earth-Orbiting environment. Although the facility was designed for testing nuclear hardware, only non-nuclear tests have been performed throughout its history. Some of the test programs that have been performed at the facility include high-energy experiments, rocket-fairing separation tests, Mars Lander system tests, deployable Solar Sail tests and International Space Station hardware tests. The SPF is located at the NASA Glenn Research Center at the Plum Brook site.

The facility can sustain a high vacuum (10^{-6} torr); simulate solar radiation via a 4-MW quartz heat lamp array, solar spectrum by a 400-kW arc lamp, and cold environments (-320 °F) with a variable geometry cryogenic cold wall.

The facility is available on a full-cost reimbursable basis to government, universities, and the private sector.

Spacecraft Propulsion Research Facility

NASA's Spacecraft Propulsion Research Facility (B-2) is the world's only facility capable of testing full-scale upper-stage launch vehicles and rocket engines under simulated high-altitude conditions. The engine or vehicle can be exposed for indefinite periods to low ambient pressures, low-background temperatures, and dynamic solar heating, simulating the environment the hardware will encounter during orbital or interplanetary travel.

Vehicle engines producing up to 400,000-lb of thrust can be fired for either single or multiple burn missions, utilizing either cryogenic or storable fuels or oxidizers. Engine exhaust conditions can be controlled to simulate a launch ascent profile. In addition, conditions can be maintained before, during, and after the test firing. B-2 offers a complete "test-as-you-fly" environment to thoroughly ground test flight hardware and reduce the likelihood of costly flight failures. In 1998, tests of the Boeing Delta III cryogenic upper stage were successfully conducted in the B-2 facility.

During a typical test program, the test article is installed within the B-2 vacuum chamber and the necessary electrical power, fuel, oxidizer, and purge gas connections are made. The low-pressure, temperature-controlled flight environment is established to thermally condition the hardware and propellants prior to engine firing.

A Programmable Logic Controller conducts all events of the engine test firing from the start of the water deluge system until the completion of the engine test firing and facility shutdown. An abort system provides monitoring through the test period of both facility and test parameters. Test-firing periods extending up to 880 s (14 min) can be accommodated. Multiple test firings and thermal conditioning periods can be conducted to fully simulate the actual flight scenario.

Cryogenic Propellant Tank Facility

The Cryogenic Propellant Tank Facility (K-Site) is a space-environment test chamber 25 ft in diameter with a 20 ft-diameter door. The design and construction of this facility allows large-

scale liquid hydrogen (LH2) experiments to be conducted safely. Control and data systems are located in a separate, remote building and electrical control systems include explosion-proof hardware.

Other features of K-Site include a removable LH2/LN2 cryogenic cold wall which can simulate deep space temperatures down to -423°F, vacuum-jacketed LH2 piping and chamber penetrations, a hydraulic shaker system, a vacuum-jacketed LH2 dump line and burn-off stack to handle accidental LH2 spills inside the chamber.

K-Site plays an essential role in the development of advanced insulation systems and on-orbit fluid transfer techniques for flight weight cryogenic fuel tanks and insulation systems. The facility includes an 800-gallon slush hydrogen batch production plant and a 200-gallon small scale densification system.

Cryogenic Components Lab

The Cryogenic Components Laboratory (CCL) is a new, state-of-the-art facility for research, development and qualification of cryogenic materials, components and systems. CCL specializes in cryogenic research utilizing liquid hydrogen, oxygen and nitrogen. The CCL is a complex of buildings and systems that is ideally suited for high-energy, high-risk development of cryogenic systems.

The Cryogenic Components Laboratory (CCL) consists of four individual test cells and areas. Cell 1 is dedicated for liquid oxygen (LOx) and liquid nitrogen (LN2) cryogenic tests while Cell 2 is dedicated for liquid hydrogen (LH2) tests. Also provided at the CCL is a large outdoor area for propellant densification studies, including the use of existing high volume throughput LOx and LH2 densification systems developed by GRC. A fourth area provides for remote pressure testing of pressure vessels and systems at high pressures.

The Densification Area is a 5000 ft² concrete paved area for the installation and operation of propellant densification systems. This area can be supplied with either liquid oxygen or liquid

hydrogen flows. The Densification Area uses a stand-alone PLC system and shares the CCL Pacific Instruments™ data acquisition system.

Operations are conducted from a new, state-of-the-art Central Control Building. The 7,500 ft² control building houses a large control room, office and conference spaces and storage facilities. Also provided are general assembly, instrumentation and machine shop areas. A 485 ft² HEPA-filtered build-up room is provided for projects requiring contamination-free assembly.

Hypersonic Tunnel Facility

Designed to conduct research, development, and acceptance testing of hypersonic air-breathing propulsion systems, the Hypersonic Tunnel Facility (HTF) is a fully self-contained facility. Its experimental infrastructure includes a shop area for fabrication of materials for facility subsystems and assembly of customer hardware. Due to the high-energy nature of the facility, it is operated remotely from a control room approximately one-quarter mile from the actual facility.

The HTF is a blow-down, non-vitiated, free jet wind tunnel that is capable of simulating Mach 5, Mach 6, and Mach 7 true enthalpy conditions. The primary performance differentiator between the HTF and other hypersonic free jet facilities is its non-vitiated (clean) flow. Whereas traditional facilities of this type utilize a combustion process to generate high enthalpy conditions required to simulate hypersonic flows, the HTF generates these conditions by flowing nitrogen gas through a 3 MW graphite core storage heater. This heated nitrogen is then mixed with ambient temperature oxygen and ambient temperature nitrogen to yield a flow of synthetic (true composition) air at the requisite stagnation temperature.

Three interchangeable nozzles are used to establish the facility Mach number condition of 5, 6, and 7. A nominal free jet test section 'characteristic dimension' is the nozzle exit diameter, 42 inches for the HTF. However, the hypersonic core flow varies with Mach number. The test section length can be adjusted from 10 feet to 14 feet in length. Utilization of aero-appliances

around test hardware is standard practice. A single stage steam ejector is used to exhaust the facility flow and provide altitude simulation.

The facility's size and long run duration allow for full systems testing of large flight rated structures and propulsion systems. The facility is capable of supporting both hydrogen and hydrocarbon fueled propulsion systems. In addition to free jet testing, the use of the facility to support direct connect subsonic and supersonic combustion is currently being developed. This capability would allow for the testing of large scale combustors in a non-vitiated flow.

III. AVIATION SERVICES

Industry Definition

Aviation Services is defined as SIC Codes 4522 and 4581 or NAICS Codes 48819, 481219, and 488119.

Industry Overview

About 1,500 companies provide airport support services to the general aviation (private and business plane) market, with combined annual revenue of \$3 billion. Most companies are either privately held, like Air Serv, or are divisions of larger corporations, such as TAC Air, owned by Truman Arnold Companies, and Signature Flight Support, owned by BBA Aviation. Most aviation services firms are single-facility operations with annual revenue less than \$1 million. About 50 companies have annual revenue over \$10 million and operate facilities at multiple airports. The industry serves a broad range of aircraft and airport operation.

Competitive Landscape

Local and regional air travel, especially business travel, drives demand for aviation services to small and private aircraft. Profitability is based on sales volume, as prices fluctuate only periodically. Small companies can compete effectively in hometown markets. Big companies have more clout in negotiating with suppliers, which allows them better pricing options for their own services.

Products, Operations and Technology

Aviation services consist of refueling operations and fixed base operations (FBOs). Full-service FBOs usually include refueling. Over 4,000 FBOs operate in the US, often with several servicing the larger airports. By the way, the US has 5,300 public airports. The services provided are

similar to the airport services that airline companies have for their commercial fleets: line operations, such as parking, refueling, de-icing, tie-down, hangar, and preheating; aircraft management services, such as maintenance, inspection, parts sales, aircraft sales, aircraft rental, chartering, and flight instruction; and personal services, such as food service, VIP terminals, car rentals, conference rooms, pilot lounges, flight planning, and business services.

Fuel sales are usually one of the most profitable services. Jet fuel is the predominant type of aviation fuel in commercial aviation, but aviation gasoline (avgas) is the primary fuel used by general aviation (GA). Companies typically buy fuel from wholesalers. Fuel tanks, usually kept above ground, must comply with EPA regulations. Because aircraft can choose where to refuel during travel, companies go to great lengths to compete, as refueling revenue for a typical private jet may be as much as \$2,000. Airplane owners lease hangar space at daily and monthly rates that depend on the size of the airplane. Typical hangar space for a small plane may cost \$30 per day or \$200 per month. Many locations consider long-term hangar rentals as loss-leaders. Companies, which usually lease their space and facilities from the host airport, provide low monthly hangar rates to make more lucrative sales of fuel, maintenance, and other services. Companies, particularly those with multiple locations, may use customer-oriented computer technology to support clients. Websites allow customers to plan trips, reserve services at various airports, and track maintenance and service records and reminders. Waiting rooms offer modem hook-ups and high-speed Internet connections. New computerized maintenance tools give maintenance personnel information about any part on a specific plane.

Sales and Marketing

While customers can be anyone from the hobby flyer to a corporation, business travel drives revenue for the typical service company. Sales representatives call on corporate accounts and individual aircraft owners. Marketing is through local advertising, telemarketing, and increasingly through the Internet. Competitive factors include turnaround time, safety, service quality, price, and personal knowledge. Recently, local operators have faced increased competition from national chains like Mercury Air Centers. Given the dire financial condition of many large corporations in various industries, including automotive, several companies have sold off their corporate aircraft.

Finance and Regulations

Revenue for companies in this sector may be seasonal and cash flow uneven, as air traffic slows during winter due to poor weather and fewer vacations. Some operators may hold significant inventories of aircraft parts or fuel. Some companies hold inventories of planes for sale. Companies must maintain adequate insurance. Typical policies include aircraft and hangar liability, property and casualty coverage, and automobile and workers' compensation. Insurance requirements may also dictate the length of runways for insured aircraft to operate from, typically a minimum of 5,000 feet.

The FAA closely regulates general aviation, mainly with regard to safety issues involved in flight operations, refueling, and maintenance. Fuel tanks must comply with EPA regulations. Aviation safety and the prevention of terror through use of aircraft is a concern of the Homeland Security initiatives. Aviation services companies are concerned about the number and extent of measures the government is imposing, but at the same time, want to protect customers and personnel.

Regional and International Issues

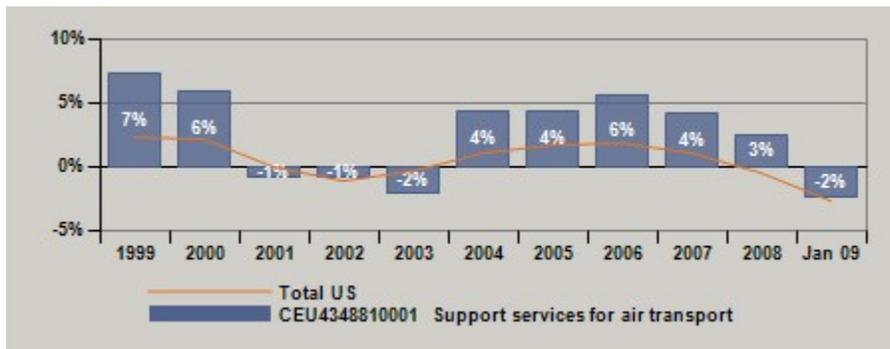
Because their operations are purely local, aviation service companies depend highly on the circumstances of the local economy. Local weather can also be an issue, particularly in winter months or in tornado areas.

Human Resources

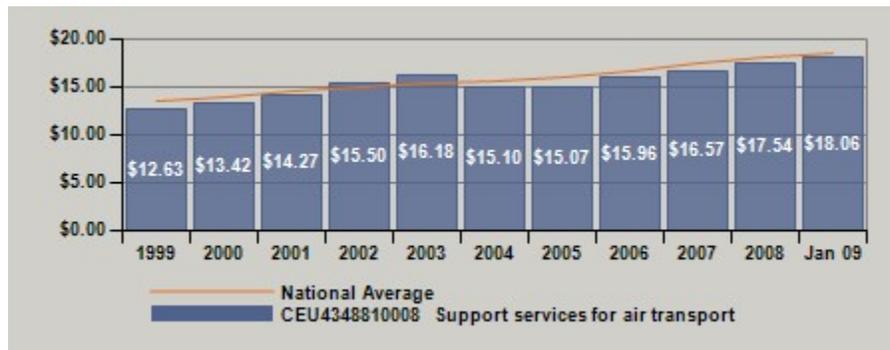
Aviation operations personnel earn an average wage slightly below that of the average US worker. The annual personnel turnover rate is 45 percent. The industry injury rate is slightly above average. Most jobs in the industry are maintenance-oriented or service-oriented.

Support Services for Air Transport Industry Employment Growth

Bureau of Labor Statistics



Support Services for Air Transport Average Hourly Earnings & Annual Wage Increase
Bureau of Labor Statistics



Recent Developments

Industry Indicators

US corporate profits, an indicator of local and regional business air travel, fell 9.2 percent in the third quarter of 2008 compared to the same period in 2007.

The spot price of crude oil, which affects jet fuel inventory values for aviation services, dropped 30 percent in the week ending March 6, 2009, compared to the same period in 2008. From an aviation standpoint, the fuel price drop is a good thing.

Quarterly Industry Update

Competition, Fluctuating Fuel Prices Limit Profits - Fuel sales, often a profitable operation for aviation services, can threaten revenue when fuel prices fluctuate from month to month, as they have in late 2008 and early 2009. US refined aviation fuel prices dropped from \$3.84 per gallon in September 2008 to \$2.99 per gallon in October 2008, according to the Energy Information Administration. Some aviation services hold large inventories of fuel. When the price of fuel plummets suddenly, aviation service companies may not pass on high fuel costs to airlines, in order to stay competitive, and revenue from fuel sales may decrease due to lower margins that do not cover a generally higher sale volume when the prices drop.

Airlines Test Biofuels - Airlines are attempting to reduce dependence on traditional jet fuel by testing biofuels, which could help aviation service companies become less vulnerable to volatile jet fuel prices. Air New Zealand became the world's first airline to fly a commercial jet powered

by biofuels in January 2009. The milestone flight tested jet fuel partly made from oil from the jatropa fruit. In the same month, Continental Airlines became the first US airline to fly a plane on jatropa-based fuel, according to AirportBusiness.com. Air New Zealand hopes to use fuel made of 10 percent biofuels by the year 2013.

Holiday Airport Woes May Promote Eco-Friendly De-Icers - The large number of canceled and late flights in the 2008 holiday season, partly due to a shortage of de-icing fluid, may lead aviation services to invest in bio-based de-icers. Airports in Chicago, IL and Portland, OR were unable to secure enough de-icer for runways during the 2008 holiday season due to the high price of de-icing solution. Snow and ice on runways was partly to blame for the high number of canceled flights; commercial flight cancellations were up 70 percent on December 19-21, 2008 compared to the same time in 2007, according to FlightStats. New bio-based de-icers that are both cost effective and environmentally friendly are planned to be tested at airports in the 2009-2010 winter season. As a note, during one snow or ice storm, a typical airport with one 7,000 foot runway can easily use up to 10,000 gallons of deicing fluid at a cost of \$8.30 per gallon.

Business Challenges

Critical Issues

Dependence on Local Aviation Activity - National economic trends, like demand for general aviation (GA) planes and weather trends, may impact aviation services. However, most aviation service companies operate locally or regionally; as a result, they're especially vulnerable to local business demands. Service companies must be able to endure cyclical economic periods of lower business and recreational flying activity, when revenue from fuel sales and maintenance may be down sharply.

Vulnerable to High Fuel Prices - Companies that carry large fuel inventories are exposed to considerable price risk. In recent years, the spot price of jet fuel has varied sharply from month to month. Because of intense competition, companies can't always pass higher costs to customers. High fuel costs also discourage recreational flyers.

Other Business Challenges

Regulatory Restrictions on General Aviation - Airspace and airport restrictions and security regulations may decrease the attractiveness of general aviation (GA) and reduce demand for aviation services. GA passengers and baggage may eventually have to be screened. FAA requires general aviation to adhere to strict maintenance procedures as part of their overall responsibility for ensuring safety in operation. For example, maintenance operations are required to verify and calibrate all tooling, to the satisfaction of the FAA.

Long-Term Labor Shortage - The national aviation industry requires about 12,000 new mechanics a year, with a shortage of 4,000 to 5,000 annually. While the military was formerly a prime training source, the end of the Cold War cut the number of military mechanics; today, only one civilian mechanic in thirty has military experience. Also, due to the suppressed pay structure and high responsibilities, certified mechanics find positions in other fields of endeavor to be more lucrative and valuable given their level of skill and knowledge.

Small Shops Can't Afford Required Capital Investments - Smaller repair shops may be unable to buy the expensive equipment needed to work on the complex jets now rolling off assembly lines, or to invest in finding more efficient ways to accomplish repairs. Independent shops debate whether they should continue to repair older jets or invest millions in equipment to repair new high-tech aircraft. The price of test equipment increases about 6 percent a year.

Air Traffic Control (ATC) Privatization will Increase Costs - If FAA air traffic services are privatized, GA costs would increase. GA pilots account for 20 percent of total air traffic control services demand, but pay only about 3 percent toward infrastructure maintenance. Privatized air traffic services would probably be financed by user fees that boost GA costs. As a note, supply and demand may well play a roll here if ATC fees were to increase.

Trends and Opportunities

Business Trends

Sport Aircraft - Technology and integration are increasingly important to modern aviation maintenance, even light-sport aircraft, which are small, simple-to-operate, and low-performance. Due to new classification definitions, sport aircraft are now likely to be sold along with jet skis,

and sport aircraft technicians will likely be inexperienced and working for minimum wage. The critical issue is that the low weight and size of sport aircraft don't necessarily mean that they are less complex to maintain.

Fractional Charter Activity - The rise of fractional ownership programs and charter flights, along with increased corporate activity, has increased demand for aircraft maintenance. To meet greater customer demand for increased aircraft availability, more fixed base operations are moving to round-the-clock operations.

E-Commerce for Maintenance Parts, Training - Since aviation parts trading was introduced in the 1990s, e-maintenance has evolved into an important economic tool for aircraft maintenance. Today, there are over 300 aircraft maintenance-related websites. With benefits that include traceability, market reach for maintenance repair operations (MRO) providers, and reduced paperwork, it's easy to understand why the aviation business is taking advantage of the Internet.

Industry Opportunities

Growing Corporate Demand - Because of scheduling and security problems at the major airlines, more corporate travel is expected to be through general aviation (GA). The number of corporate business jets increased more than 50 percent during the past decade to 16,000, according to the National Business Aviation Association (NBAA). The number of recreational planes fell during the last recession, but corporate jets increased.

Automation and Technology - With more sophisticated computerized equipment, fixed base operations (FBOs) can offer specialized and efficient services to smaller aircraft owners and airlines. Many operators are turning to new software to track and plan maintenance repair operation tasks. To improve efficiency, safety, and convenience, general aviation is using more technology, including global positioning systems, weather communications, and flight information systems.

Fuel Discount Programs - Large chains can offer substantial fuel discounts and other amenities when customers enroll in maintenance programs. Often long-term programs are not as profitable, but they help build loyalty and business volume.

Luxury Services - Asian operators, like Cathay Pacific, a commercial air carrier, are opening airport spas for business- and first-class passengers that offer everything from facials to custom haircuts. US operators typically don't yet provide such services, but at some airports the volume of traffic might be sufficient to support the cost.

Key Management Issues

Minimizing Exposure to Local Economic Downturns - During periods of local economic contractions, business and recreational flying can be curtailed as customers cut discretionary spending. To insulate themselves, firms may expand services and the types of aircraft they support, offer long-term rental and maintenance programs at good rates, or add ancillary services that cater to customer business or personal needs. Better service and prices encourage use of the facilities by local airplane owners and attract other pilots to land and refuel.

Complying with Government Regulations - Aviation service firms are subject to a variety of government regulations that require accountability and cause companies to incur costs. Management is responsible for complying with new security regulations, maintenance and reporting requirements, and restrictions at airports. By working through industry associations, service firms lobby to have the applicable laws and regulations minimize their burden on fliers.

Minimizing Impact of Fuel Cost Fluctuations - Fuel sales usually are one of the most profitable services for aviation support firms, so price fluctuations are a major concern. At particular risk are firms that provide solely refueling services, and fixed base operations (FBOs) that normally carry large fuel inventories. Larger companies may hedge their inventories with futures contracts. When costs rise, services firms aren't always able to pass increases to customers, due to competition in the industry. Smaller firms may have to survive with lower sales volumes at smaller margins and adjust inventory levels accordingly.

Managing Seasonal Revenue - Recreational flying and business travel are somewhat seasonal and can cause uneven cash flow. Firms vary prices only periodically and profitability depends on sales volume, so companies strive to find ways to increase off-season business. Companies that hold inventory – such as parts, fuel, or planes for sale – may finance purchases or carrying costs,

or give off-season discounts. Companies may also offer maintenance specials, such as overhauls, at reduced rates.

Providing Maintenance Information for Mechanics - To service a wide variety of small and private aircraft, aviation services firms acquire maintenance databases to ensure that their mechanics have the appropriate, detailed information about aircraft, parts, and service instructions. Service firms typically acquire the databases from third-party sources either for remote online access or installation on a local computer. The mechanics have access to computer monitors designed to withstand the rigors of a shop environment.

Supporting Customers with Information Technology - Ancillary services for pilots and passengers increasingly include computer access and computerized information. Facility waiting rooms have connections to local computer systems and high-speed wireless Internet access. Customers can check the weather, make flight plans and airport reservations, book hotels and rental cars, and access web-based maintenance records. Customer-oriented computer capability is a competitive advantage, especially among firms with multiple locations and those looking to increase stopovers for refueling.

Hiring Qualified Mechanics - The industry usually needs at least 30 percent more mechanics than are available yearly. Despite the shortage, wages are lower than the national average, a factor that inhibits recruitment. Firms typically can't afford to train mechanics from scratch, and trained mechanics from the military aren't as numerous as in previous decades. Companies may recruit from regional trade schools or competitors, though personnel turnover is low for the industry.

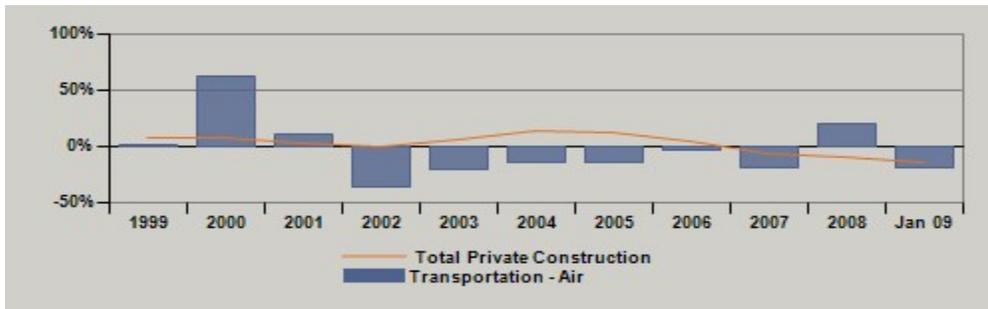
Training for Regulatory Compliance - Because government regulations play a large role in the aviation industry, service firms need to ensure that appropriate personnel are knowledgeable and up-to-date on applicable requirements. The scope of regulations is pervasive: from mandatory safety programs to approval of repair tools. Lack of compliance can lead to heavy fines and jeopardize certifications.

Selling Packages of Services - Fixed base operations (FBOs) sell multiple services, of which fuel is one of the most profitable. Firms often market a group of services as a package; for example, offering hangar rentals as loss leaders to win the more lucrative fueling and maintenance business. Due to the high degree of competition, offering the right product mix to meet customer price points and margins is important.

Protecting Market Share Against National Chains - National aviation services chains increasingly compete with local firms for corporate and owner-operator business travelers. To protect their markets, local firms emphasize their hometown identity and strengthen business services and amenities, such as adding lounges with refreshments and computer access to online services. They may also increase marketing to potential and first-time plane owners and offer flight certification training.

Economic Statistics and Information

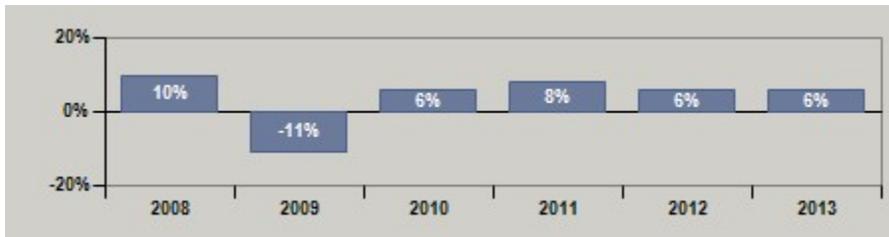
Annual Construction Put into Place - Census Bureau



Industry Forecast

The output of US air transport services is forecast to grow at an annual compounded rate of 3 percent between 2008 and 2013. Data Sourced: Aviation Week, December 2008

Air Transport Growth Dips Then Levels



Web Links and Acronyms

Industry Web Sites

Aircraft Maintenance Technology

Aviation news.

http://www.amtonline.com/article/article_news.jsp

Aircraft Owners and Pilots Association

Links, news, and more.

<http://www.aopa.org>

AirNav.com

Aviation fuel prices.

<http://www.airnav.com/fuel/>

Airport Business

News articles.

<http://www.airportbusiness.com/>

Aviation Week's Aviation Now

Aviation Week industry news.

<http://www.aviationweek.com/aw/index.jsp/>

FAA - Office of Aviation Research & Development

Research from hundreds of sources by topic.

<http://research.faa.gov/aar/>

FBOWeb.com

Airport information, flight training, aviation employment, business consultants, FBO directories, frequencies, file flight plans with the FAA, fuel price location map, and weather.

<http://www.fboweb.com>

National Air Transportation Association

Press releases, fact sheet, monthly reports, and links for GA business service providers.

<http://www.nata.aero>

National Business Aviation Association (NBAA)

Maintenance news.

<http://www.nbaa.org/>

Professional Aviation Maintenance Association (PAMA)

Industry news, publications, trade shows, regulatory information, and links.

<http://www.pama.org>

Thirty Thousand Feet - Aviation Directory

Aviation news and FBO listings.

<http://member.newsguy.com/~ericmax/fbo.htm>

[Glossary of Acronyms](#)

AOPA - Aircraft Owners and Pilots Association

FBO - fixed base operations

GA - general aviation

GAMA - General Aviation Manufacturers Association

MRO - maintenance repair operations

NBAA - National Business Aviation Association

PAMA - Professional Aviation Maintenance Association

IV. AIR CHARTER SERVICES

Industry Definition

SIC Code 4522 or NAICS Code 4812

Industry Overview

The air charter services industry includes about 2,500 companies with combined annual revenue of \$8 billion. Major companies include NetJets, Flexjet, Evergreen Aviation, and Global Aero Logistics. The industry is concentrated: the 50 largest companies account for 60 percent of industry revenue. Air charter is the on-demand, nonscheduled transportation of passengers and cargo and is distinct from the \$20 billion commercial airline industry which is defined as scheduled transportation of persons and baggage for compensation or hire.

Competitive Landscape

Demand is driven by corporate profits and the needs of the US military. The profitability of individual companies depends on effective marketing and customer service. Large companies have advantages in fleet size and name recognition. Smaller companies can compete effectively by serving small local markets and offering lower prices. The industry is capital-intensive: average annual revenue per worker is nearly \$250,000.

Products, Operations and Technology

Major services include domestic passenger travel (50 percent of industry revenue); international passenger travel (15 percent); domestic air freight (10 percent); and international air freight (5 percent). Other services include surveying and photography, crop dusting, and aerial advertising. Charter flights are used by wealthy individuals, small and large corporations, sports teams, the US military, and government agencies. In general, charter flight is more flexible, extensive, and efficient than traditional commercial air travel. Air charter planes have access to over 5,000 general aviation airports; scheduled commercial aircraft are restricted to the 429 US commercial airports. Note: Scheduled air carriers can only operate into and from airports that are certificated under 14 CFR Part 139.

Charter aircraft include small piston-prop planes; helicopters; turboprop aircraft; light, mid-weight, and heavy jets; and large, multi-engine jet airliners. Of the 12,000 charter aircraft in operation, around 85 percent are fixed-wing aircraft and 15 percent are helicopters. The smallest piston-prop charter plane accommodates one pilot and one to five passengers, has a non-pressurized aircraft cabin, and a range of several hundred miles. A typical turboprop is cabin-

pressurized, accommodates one or two pilots and eight passengers, has a range of around 1,000 miles, and travels 200 miles per hour. Traveling up to 8,000 miles at 500 miles per hour, pressurized heavy jets are flown by two pilots, can accommodate 18, and include a full bathroom and flight attendant service. Depending on fuselage configuration, large charter jet airliners can transport cargo or accommodate up to 500 people. Jet airliners transporting more than 30 passengers must fly under the more restrictive FAA Part 121 guidelines governing scheduled commercial air transportation. Scheduled air carriers include both large and small aircraft. Small aircraft are more than 9 but less than 30 seats. Technically, they still follow Part 121 rules with some flexibility.

A charter aircraft typically departs from a small general aviation terminal known as a fixed base operation (FBO). US TSA employees verify passenger identification but don't screen passengers or luggage. On smaller charter aircraft, pilots may be responsible for non-flying tasks such as checking baggage, seating passengers, and performing minor aircraft maintenance or repairs. Upon arrival, charter flights and crew may wait for the passengers until the return flight to the home base. However, around 40 percent of charter travel is comprised of "empty leg" flights: return trips to a plane's home base with no passengers or cargo. Each chartered plane flies an average of 400 hours annually. Charter flights last an average of one hour, and the average aircraft consumes 25 gallons of fuel per hour.

Common metrics in the industry include revenue passenger miles (the total distance traveled by all paying customers); available seat miles (total number of seats available multiplied by miles flown); load factor (the ratio of revenue passenger miles to available seat miles), and standard industry fare level (SIFL) (the amount of fare attributable to the distance flown and deemed to be taxable by the IRS). The air charter industry's annual 20 billion available seat miles is about one-fifth the size of the commercial airline industry. The average industry load factor is 60 percent; the commercial airline industry has an average load factor of 80 percent.

Major technical aircraft innovations include incorporating GPS on charter planes; developing prototypes of low-cost very light jets (VLJ); and improving a plane's aerodynamic efficiency and load capacity. Third-party companies provide online software and marketplaces for charter airline booking, billing, and customer service operations.

Sales and Marketing

Typical customers are high net worth individuals, companies seeking a competitive advantage or that have a wide distribution area, large corporations, sports teams, the US military, and government agencies. With an industry load factor around 60 percent, many planes are underused. Air charter brokers capitalize on this available capacity by connecting interested buyers with national networks of managed fleets and individual aircraft owners. Some brokers specialize in chartering empty leg flights that might otherwise return to a home base without passengers or cargo. Long-term contracts may be awarded by the military for on-demand cargo and personnel transport.

Companies rely on positive word-of-mouth, advertise in industry publications and magazines, and take advantage of media relations to attract new clients. A few larger companies have had success through effective product placement on popular TV shows.

Some brokers and operators use the Internet to provide price estimates, showcase the company's fleet, and highlight the company's safety record. While customers can use the Internet to explore prices and plane options, most charter sales are ultimately over the phone.

Typical prices vary based on customer needs, the type of aircraft, local and federal tax rates, and fuel costs. Charter flights are charged per-hour. Hourly prices can range from \$1,000 for a turboprop seating four to as much as \$15,000 per hour for a large jet. Additional fees such as fuel surcharges, empty leg fees, catering services, and pilot time can often double the quoted hourly rate.

New pricing models have lowered the cost of charter ownership. Around 20 percent of industry revenue comes from buying fractional ownership of a jet, usually sold in one-eighth or one-sixteenth fractions. A typical one-sixteenth fractional contract lasts five years, provides 50 annual flight hours, and costs \$500,000 each year plus additional hourly usage and monthly management fees.

Jet card programs account for around 10 percent of charter air service sales. Jet cards require deposits from \$100,000 to \$250,000 for 20 to 25 hours of flying time. Flying hours, which cost from \$5,000 to \$10,000 for domestic travel, are then deducted from the initial deposit.

Finance and Regulation

Cash flow is relatively steady, as summer tourism makes up for a slowdown in business-related charter travel. Accounts receivable averages 30 days. Capital spending and inventory levels are high, as expensive planes sit idle on runways the vast majority of their lifespan. Fractional

ownership companies and brokers have much lower capital and inventory costs. Ownership and maintenance costs are around 20 to 30 percent of total charter airline expenses. Labor costs are around 40 percent, and fuel costs range from 15 to 25 percent. Aviation insurance can be a significant expense for charter airlines, accounting for 5 to 10 percent of total expenses.

Air charter companies often lease planes to other operators. A dry lease involves only leasing the aircraft. In a wet lease, the lessor provides the aircraft, crew, maintenance, and insurance to another airline, which pays by the hours operated. The lessee pays for fuel, airport fees, duties, and taxes. Wet leases generally last one month to two years. In a wet lease, the lessor includes the cost of fuel in the rental. In a dry lease, the lessee pays for the cost of fuel beyond the rental charge.

Air charter services are regulated by the FAA under Federal Aviation Regulations (FAR). Most companies must comply with FAR Part 135, on-demand operating requirements that are much less stringent than the Part 121 rules governing scheduled commercial aircraft. However, if more than 9 seats, they have to comply with Part 119 which requires more expensive safety equipment.

Companies are assigned a local FAA Flight Standards District Office (FSDO), which issues an Air Carrier or Commercial Operating Certificate. Certification can take up to a year. Each aircraft must have a minimum equipment list (MEL), a categorized list of a plane's allowable operative and inoperative instrumentation.

The FAA conducts unannounced safety checks and audits and can penalize or withdraw a pilot's license for MEL violations. The US DOT ensures that air charter brokers don't represent themselves as flight operators. State DOTs may require operators to register in the state before using an airport or landing strip. The EPA regulates aircraft emissions and pollutants.

Regional and International Issues

Domestic flights account for 80 percent of all passenger air charter travel. General aviation aircraft are most common in populous, warm states such as California, Texas, Arizona, and Florida. California and Arizona are home to 12 of the 20 busiest general aviation airports. The southern US has the highest number of active pilots.

International passenger flights transport US military personnel, private contractors, federal employees, business executives, and tourists. Common destinations from the East Coast include the Middle East, London, and Paris. West Coast-based international travel includes flights to

Hong Kong, Tokyo, and Shanghai. High net worth individuals often charter leisure flights to European and Caribbean destinations.

Human Resources

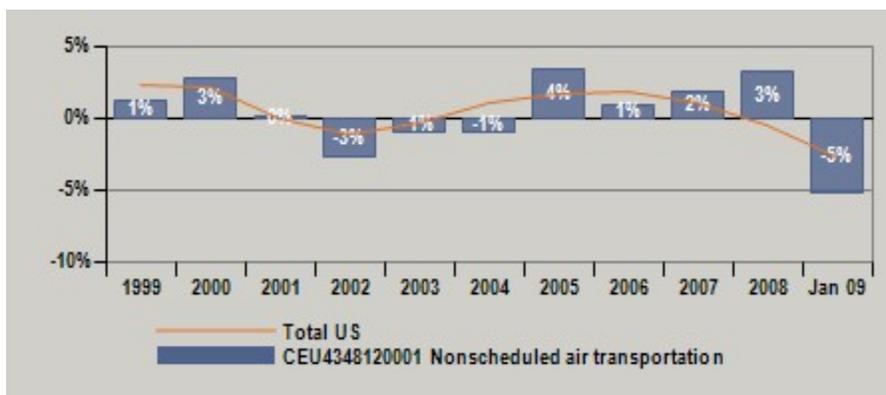
Wages are 50 percent higher than the national average. According to Bureau of Labor Statistics data, pilots earn on average \$100,000 annually. Charter pilots must hold a commercial pilot's license, an instrument rating, and a multi-engine rating. Before piloting a commercial aircraft, pilots must accumulate a minimum of 1,200 hours of pilot-in-command experience; however, insurance companies may require additional hours for more complex aircraft.

Every six months, pilots must pass a three-day FAA pilot flight check to demonstrate proficiency. Regular physical examinations are mandatory, and pilots must abide by FAA requirements for rest in between flights and abstention from drugs and alcohol. The overall industry injury rate is 35 percent higher than the national average. Common injuries include sprains, strains, and bruises, typically resulting from overexertion.

The chart below shows employment trends in the nonscheduled air service transportation industry over the last decade.

Nonscheduled Air Service Industry Employment Growth

Bureau of Labor Statistics



Recent Developments

Industry Indicators

US corporate profits, an indicator of business demand for air charter services, fell 9.2 percent in the third quarter of 2008 compared to the same period in 2007.

The spot price of crude oil, which affects charter airplane fuel costs, dropped 30 percent in the week ending March 6, 2009, compared to the same period in 2008.

Quarterly Industry Update

Bill Targets General Aviation Aircraft - A bill pending in Congress could hurt the US air charter services industry by requiring companies that receive government assistance to sell their general aviation aircraft. Air charter services companies often operate general aviation aircraft on behalf of their owners. The National Business Aviation Association (NBAA) opposes the bill, arguing that its adoption would lead to the loss of thousands of jobs in air charter services and related industries. The bill could also hurt corporate and business aviation. The charter side of business will be hurt also, but most NBAA members operate under Part 139 and do not allow use of their aircraft for Part 135 charter purposes (due to regulations and cost).

Fuel-Saving Technology Unveiled - New software that works with flight planning systems is intended to help US air charter services companies reduce fuel costs. The software, Scheduling Sidecar, is designed to provide information about fuel prices near flight destinations, plan fuel-efficient routes, and track fuel costs. The National Air Transportation Association promoted the new technology at an aviation industry conference in January 2009.

Business Jet Sales Fall - Orders for new business jets and other general aviation aircraft, an indicator of demand for US air charter services, have declined amid the downturn in the economy. About half of new business jet sales are financed, and a lack of access to credit is hampering some would-be buyers. In addition, some companies are selling aircraft to cut costs, thus putting used planes on the market in competition with new ones.

Trends and Opportunities

Business Trends

Rising Airfares - The cost to fly on nonscheduled air charter services has increased 50 percent over the past 10 years. Skyrocketing fuel prices passed to customers account for a large portion of the increased costs.

Higher Jet Fuel Prices - Fuel prices can be volatile. To reduce risk, most operators and brokers issue fuel surcharges to cover rising costs. High prices can lead to reduced demand if customers switch to lower-priced commercial air travel or limit the number of chartered flights.

Cargo Load Factor Steady - Ton mile load factor, the ratio of the total weight of nonscheduled cargo shipped to available capacity, has remained steady at 60 percent for the past 10 years. Revenue ton miles (total weight transported) and available ton miles (total capacity) have risen in unison over the past decade. While freight aircraft use has remained steady for 10 years, prices for nonscheduled cargo fell 5 percent from July 2006 to July 2007.

More High Net Worth Individuals - According to Merrill Lynch, the number of high net worth individuals in North America grew over 10 percent in 2006, the highest in seven years. High net worth individuals often have the financial resources to consider air charter travel. Long lines, increased airline delays, and a rising number of flight cancellations may result in more high net worth individuals using air charter. Fractional ownership and jet cards make the cost of charter air more attractive to upper-middle class professionals.

Scheduled Airlines Add Charter Services - Several mid-sized commercial airlines now offer chartered flights in addition to regularly scheduled air travel. Airlines such as Frontier and Delta have discovered that charter flights can take advantage of aircraft that might otherwise be sitting idle on the runway. A chartered Delta round trip flight for 50 from Raleigh, NC, to Dallas costs around \$1,000 a person, including catering, taxes, fees, and a dedicated charter coordinator.

Industry Opportunities

Very Light Jets - Early versions of a new class of aircraft, very light jets (VLJ), show initial promise in lowering the cost of air charter. VLJ are lighter than conventional jets and able to land on shorter runways. Operating costs are one-tenth the cost to operate a heavy jet and one-quarter the cost to run a traditional light jet. About 20 VLJ models are in design and production stage by companies such as Honda and Cessna. Analysts expect to see 4,000 to 10,000 VLJ in service within the next decade.

GPS Air Surveillance - By 2020, the FAA will replace current outdated radar systems with

GPS-based air traffic control technology. In October 2007, the FAA awarded a \$200 million contract to ITT Corp. to develop an Automatic Dependent Surveillance-Broadcast (ADS-B) system that is 10 times more accurate than the current radar system air traffic controller's use. Air charter services anticipate that GPS will improve air safety, increase air traffic control capacity, and allow more planes to fly in the nation's airspace.

Flying Carbon Neutral - Many air charter companies now cooperate with carbon offset programs to help reduce carbon emissions. Private air charter service Jets.com has partnered with Carbonfund.org to reduce carbon emissions through the Carbon Neutral Flights Program. Customers can pay a small additional fee, about 5 percent of the total flight cost, to offset emissions from the flight. Carbon offsets can be applied toward alternative energy sources and reforestation projects, reducing environmentalists' and the general public's concern about the large amount of carbon dioxide jets produce.

Alternative Fuels - The aviation industry is actively seeking an energy source that isn't oil-dependent. Some companies are testing biodiesel jet fuel. NetJets has partnered with Princeton University to research and produce an alternative "synfuel" that would use half the amount of bio-material of biofuels and emit near zero levels of greenhouse gas emissions.

Key Management Issues

Protecting Charter Rights - Air charter companies must aggressively defend the relaxed rules governing general aviation and nonscheduled charter travel. Conventional airlines pressure the FAA to impose consistent rules and regulations to both scheduled and nonscheduled flights. Air charter CEOs must work with legislators, lobbyists, and multiple federal and state agencies to ensure that the charter airspace is protected and that the industry remains only modestly regulated.

Selecting Aircraft Mix - Establishing the right mix of aircraft is critical to an air charter company's overall profitability. Smaller planes cost less but can carry only small groups; larger planes can travel longer distances but are expensive. Determining the capacity, age, and condition of the fleet is essential, particularly for a growing charter company.

Developing Pricing Model - As competition increases and the industry matures, consumer prices have stabilized. Upper-middle class customers are seeking maximum value and low charter fares. Establishing a sustainable pricing model is essential for a company to survive, as more customers shop around for low prices. New business models such as jet cards can have a major impact on profitability.

Adjusting Pricing and Contract Terms - Profitability generally occurs when chartered planes are more than half full. Increasing a fleet's overall load factor, a measure of how full planes are when traveling, is essential to spreading out fixed costs. CFOs must match an aircraft's capacity with the individual needs of chartered groups and cargo. Long-term contracts with government agencies, air charter brokers, or freight forwarders can help increase an airline's load factor.

Optimizing Flight Logistics - Air charter companies must manage, track, and anticipate fleet operations that are marketed to customers as capable of "flying anywhere at any time." A company's IT department needs to track highly irregular flight patterns and thousands of destinations. Software solutions can help a charter company determine if a plane should stay at a destination or come back on an empty leg to transport other groups.

Improving Online Sales and Scheduling - Charter scheduling and sales have traditionally been phone-based. Customer demand for comprehensive, quick information about cost is driving companies to publish estimated prices on the web. A CIO's key challenge is to design systems that can accurately assess flight costs when most charter trips are highly customized to customer needs.

Retaining Pilots - Competition for jobs comes from unionized, commercial airlines, which is often seen as the highest rung on the pilot's ladder. Pilots passionate about charter air travel may seek to own their own plane and work independently. Charter companies need to build long-term pilot loyalty, retaining pilots that might otherwise jump to a larger airline or start their own small service. Air charter services emphasize flexible schedules, newer planes, a thriving industry, and lack of bureaucracy to attract and retain pilots.

Establishing Uniform Training Procedures - The charter airline industry is highly regulated. An airline's maintenance and safety policies are detailed and complex. HR departments must standardize training procedures and regulatory compliance to ensure that the company meets or exceeds safety standards.

Securing Strategic Relationships - Charter companies seeking to grow must develop repeat business with customers. Strategic alliances with customers and complementary service providers allow charter companies to quickly grow revenue and rise above the crowded field of small operators. Examples of alliances include an exclusive partnership with a renowned air charter broker or a jet card joint venture.

Reaching the Upper-Middle Class - Increased competition, new pricing schemes such as fractional ownership and jet cards, and more efficient operations are lowering the cost to fly charter air. Sales and marketing executives must prove that air charter isn't the sole domain of the upper class. Media coverage and advertisements stressing the affordability of charter flight, and the true cost of inefficient commercial air travel, can be effective marketing to reach the upper-middle class.

Industry Forecast

The output of US air transportation, an indicator for charter air services, is forecast to grow at an annual compounded rate of 3 percent between 2008 and 2013. Data Sourced: National Air Transportation Association, December 2008

Air Transportation Growth Falters Then Stabilizes



Web Links and Acronyms

[Industry Web Sites](#)

AirCharterGuide.com: Aircraft Information

Descriptions of charter aircraft.

<http://www.aircharterguide.com/ChooseAircraft.aspx>

General Aviation Manufacturers Association

Industry association for small plane manufacturers.

<http://www.gama.aero/>

Halogen Guides - Jets

Fractional jet ownership news.

<http://jets.halogenguides.com/>

National Air Transportation Association

Industry association for general aviation.

<http://www.nata.aero>

National Business Aviation Administration

General aviation aircraft news.

<http://web.nbaa.org/public/news/update/>

Thirty Thousand Feet: Aviation Directory

Air charter resources and service providers.

<http://www.thirtythousandfeet.com/charter.htm>

Wedge Travel

Online charter reservations through an air charter broker.

<http://wedgetravel.com>

Glossary of Acronyms

ACS - air charter service

ADS-B - automatic dependent surveillance - broadcast

FAR - Federal Aviation Regulation

FBO - fixed base operation

FDSO - Flight Standards District Office

MEL - minimum equipment list

NATA - National Air Transportation Association

NBAA - National Business Aviation Administration

VLJ - very light jet

V. COMMERCIAL AIRLINES

Industry Definition

Commercial Airlines is defined as SIC Code 4512 or NAICS Code 4811.

Industry Overview

The US airline industry consists of about 3,000 companies, with combined annual revenue of \$120 billion. Major airlines include American, United, and Delta, and the air operations of cargo and courier companies, such as FedEx and UPS. The industry is highly concentrated: almost 90 percent of revenue comes from the top 12 companies.

The government classifies airlines as "major," "national," "regional," and various others. About 40 national airlines have annual revenue between \$100 million and \$1 billion, and 90 regional airlines have annual revenue under \$100 million. The remainder of the industry consists of small air companies that generally have annual revenue between \$5 and \$50 million.

Competitive Landscape

Airlines depend highly on the health of the US economy, which affects air travel by business and consumer passengers. Because many costs are fixed, the profitability of individual companies is determined by efficient operations and on favorable fuel and labor costs. Small airlines can compete by servicing local or regional routes. The industry is highly capital-intensive: average annual revenue per employee is about \$200,000.

Products, Operations and Technology

Airlines carry passengers, cargo, and mail, or have specialized functions, such as medical air transport or oil platform servicing. Flights may be scheduled or nonscheduled (charter). About 70 percent of industry revenue comes from scheduled passenger traffic, 10 percent from carrying

cargo and express mail, 4 percent from charter flights, and 1 percent from hauling US mail. Other revenue comes from providing maintenance, servicing, training, and reservations. Some airlines carry only cargo, using specially equipped planes. Some major airlines, including United, Northwest, and American, have large cargo operations that contribute 5 to 10 percent of revenue. For smaller passenger airlines, cargo may contribute more than 10 percent of revenue.

The basic operations of airlines include acquiring and maintaining airplanes, acquiring and operating airport facilities, acquiring passengers or freight, managing staff, and operating flights. The flight equipment (airplanes) that an airline uses is crucial to efficient operations. The cost, capacity, and fuel efficiency of airplanes vary substantially. The major airlines operate about 20 types of aircraft with a total of about 4,700 planes; of these, around 600 were made by Airbus and around 4,000 by Boeing. Manufacturers of smaller aircraft for regional airlines, with seating capacities of 30 to 90, include Bombardier, Air Transport Regional, and Embraer. The largest aircraft can hold 360 passengers or 70 tons of cargo, and are used for long flights with a "stage length" of more than 3,000 miles, but the major carriers operate mainly planes that hold from 130 to 175 passengers.

A large plane like the Boeing 747 consumes 3,500 gallons of fuel per hour, while a midsize one like the Boeing 737 consumes about 800 gallons. Larger planes require a larger crew. The operating cost of an airplane is often expressed in cents per seat mile, with typical values between 3 and 7 cents. The list price for a new Boeing 737-700 is close to \$50 million. A Boeing 747-400 lists for \$200 million. The actual price airlines pay for new planes can be substantially lower than the list price, especially if they place big orders. A large market exists for used aircraft, which can have a useful life of 20 years or more.

Airlines lease terminals; ticket counters; gates; cargo facilities; and maintenance facilities from airports, which are usually owned by local government authorities. In some cases, airlines can sublease their facilities to other airlines. About 340 airports have regular airline service in the US; close to 220 are served by the large carriers. American and Delta have service to virtually all 220, while Southwest serves about 60. In addition to paying for airport facilities, airlines pay landing fees for each flight, which average \$1 per 1,000 pounds of landing weight at a regional airport, or about \$100 for a Boeing 737. Landing fees at major airports can be more than twice as high. Routine aircraft maintenance is done at local airports, but the big carriers typically have

one or several large central maintenance facilities for major overhauls. Many smaller airlines contract maintenance out to the major carriers.

Because of the large number of flight departures - American, Delta, and Southwest each handle 1 million departures annually - scheduling staff and equipment is a major logistics problem.

Southwest operates its million departures with 365 aircraft and 30,000 employees; 10,000 are flight crew and 15,000 ground crew. Airlines measure in terms of departures, rather than flights, because a single flight may have several stops. Each airplane makes an average of 2,700 departures, about eight per day.

Airlines measure their performance using a number of metrics. Southwest carried 78 million revenue passengers in a recent year, about 75 per flight, and flew 60 billion revenue passenger miles (RPM). The average flight segment stage length was 600 miles. The full capacity of its flights in a recent year was 85 billion available seat miles (ASM). The load factor of its flights was 71 percent; that is, the average flight was 71 percent full (divide RPM by ASM). Operating revenue per ASM was 9 cents, while operating expense per ASM was 8 cents. The average passenger fare was \$94, which translates into average revenue of about \$7,000 per flight for this discount carrier. Carriers also use as a metric enplanements and deplanements, which is a revenue passenger boarding and/or deplaning an aircraft.

Sales and Marketing

Most ticket sales occur via computerized reservation systems (CRS) that show the various flight options between cities. Airlines pay fees to CRS operators for tickets bought through their system, such as Sabre, Worldspan, Amadeus, SystemOne, and Galileo, which are accessed by travel agents and online sites. Internet travel sites like Expedia, Travelocity, and Orbitz also feed reservations to the airlines. Airlines also operate their own reservation websites. Airline-operated sites are captive, in that they promote only one airline and its partners, and are an increasingly important source of passengers. Southwest, for example, receives the majority of its passengers through its own website, since it doesn't sell through other travel sites.

Major airlines use TV and magazine advertising, but smaller airlines often do no media advertising. Marketing alliances - for example, with other airlines, travel organizations, and destination sites --and code-sharing agreements have become common ways for airlines to effectively expand the number of markets they serve and passengers they can reach. Code-

sharing allows a ticketing airline to use the operating airline's flight code to book flights on that airline's planes.

Pricing systems vary considerably among airlines. Small airlines typically have set prices, but some large airlines have complicated computerized pricing schemes that attempt to maximize the revenue for a particular flight by offering different prices at different times, depending on how quickly a flight is filling. In addition to selling tickets individually, airlines may sell blocks of discounted tickets to wholesalers, such as Hotwire, Priceline, and Travelweb. Many airlines run loyalty programs in the form of mileage or point accumulation systems (frequent flyer programs) that entitle passengers to free tickets or upgraded service.

Finance and Regulation

Airlines experience uneven cash flow due to fluctuations in air travel and shipments. Capital spending and inventory are high, due to the initial and maintenance costs of airplanes. Airlines maintain a fleet of planes, regardless of use levels. The cost of owning or leasing aircraft and maintaining it accounts for about 20 percent of total airline expenses. Labor costs are 40 percent, and fuel costs are typically from around 15 percent to 20 percent. Various fees, commissions, insurance, and overhead account for the remainder.

Airline companies may buy or lease aircraft, depending on the prices and leasing terms of the aircraft manufacturers and leasing companies. Airlines often have a mix of owned and leased aircraft. For example, in a recent year, American owned 468 large aircraft and 213 smaller ones, with a combined gross book value of \$21 billion; it also leased 226 large aircraft and 65 smaller ones, for which it paid annual fees of \$840 million.

In normal economic times, the finances of airlines chiefly revolve around airplane acquisition. The decision of whether to buy or lease aircraft depends largely on the prices and leasing terms offered by airplane manufacturers and big airplane leasing companies like the Commercial Aviation Service division of GE. Boeing and Airbus offer their own lease financing to buyers. Most airlines also engage in financial hedging to protect themselves from increases in fuel costs. In recent years, the poor economy and reduced flying since 9/11 have forced airlines to focus on financial survival. Some have gone into bankruptcy or been acquired; some have applied for government loans.

The FAA regulates aircraft maintenance and operations, including training and licensing pilots and mechanics, and operates the national air traffic control system. The US DOT regulates

airline operations, approves routes and flights, and monitors the financial health of airlines and has jurisdiction over international pricing, computer reservation systems, code-sharing agreements, and consumer matters. Some airports are major sources of air pollution, and subject to EPA regulation.

Regional and International Issues

Airlines are impacted by local and regional economic circumstances that affect travel volume, including regional recessions and vacation travel to Southern states during the winter. Large regional airports, such as in Chicago, New York, Atlanta, and Los Angeles, are often bottlenecks. Concerns for airlines operating internationally include air carrier licensing, anti-competitive practices, alliances and code-sharing, and international agreements.

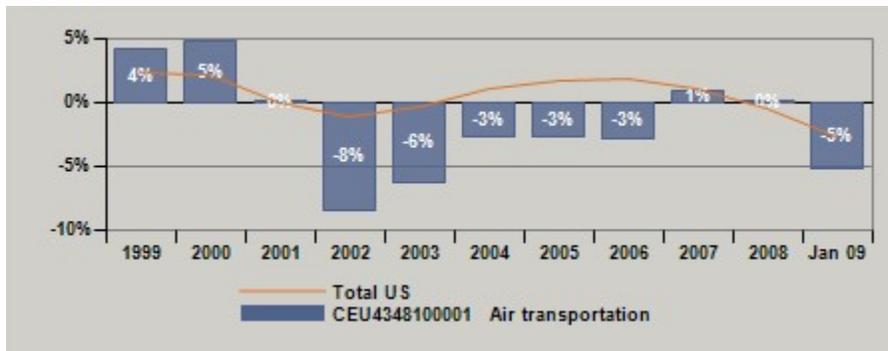
Unlike on US domestic routes, pricing on international routes is often determined by government authorities. In recent years, major US airlines have generally received higher prices on international than on domestic flights, and greater profitability. International revenue is substantial for some airlines, accounting for 30 percent of American Airlines' parent company AMR Corp.'s revenues in a recent year.

Human Resources

Annual personnel turnover is around 40 percent, lower than the national average of 46 percent for all private industry. The industry injury rate is very high, more than three times the national average, mainly due to handling baggage and freight. A third of accidents are serious enough to result in more than 30 days away from work. The employees of most airlines belong to unions that represent the various specialized functions in their company, including pilots, flight attendants, mechanics, and ground crew. Because labor is the largest single expense of airlines, wages and benefits are critical. Pilots and mechanics require special certification by the FAA. Pilots and other flight crew are limited, on average, to working no more than 20 hours per week.

Industry Employment Growth

Bureau of Labor Statistics



Recent Developments

Industry Indicators

US corporate profits, an indicator of business demand for airline traffic, fell 9.2 percent in the third quarter of 2008 compared to the same period in 2007.

The spot price of crude oil, which affects airline fuel costs, dropped 30 percent in the week ending March 6, 2009, compared to the same period in 2008.

Quarterly Industry Update

Air Transportation Employment Declines - Employment in the air transportation industry fell 4.6 percent in December 2008 compared to December 2007. The overall unemployment rate in the US is the highest in nearly 16 years, which has reduced demand for air travel. Slumping revenue has caused airlines to cut employment and other operating costs.

Fare Reductions Not Following Fuel Price Drop - Jet fuel prices have declined since the summer of 2008, but fuel surcharges imposed during that time remain in effect at many US airlines. Surcharges initially attributed to fuel costs are being maintained, sometimes as components of base fares, because of increases in other costs, according to the *Boston Globe*. Despite customer protests, many airlines plan to keep the surcharges, which can help stabilize revenue in an unpredictable environment.

Air Traffic Down, But Flights Stay Full - US airline passenger traffic during the 2008-09 holiday travel season was expected to be 9 percent lower than the same period the year before. Flights were expected to be full or near-full, however, because of capacity reductions by airlines, according to the Air Transport Association of America. Capacity reductions should help North

American airlines post a small overall profit in 2009, according to the International Air Transport Association.

Business Challenges

Critical Issues

Profitability Depends on Business, Consumer Travel - Both business and tourist travel are reduced when the economy slows. Global aviation traffic rises and falls at twice the pace of economic output, so a change in the economy doubles the impact for airlines. Because of relatively high fixed-costs of airplanes, airport facilities, and labor, airlines can't easily adjust to reduced passenger traffic.

Fuel Costs can Vary Highly - Aviation fuel accounts for 15 to 20 percent of industry operating costs, relatively more for airlines with low labor costs. Fuel costs can change rapidly, making it difficult for airlines to adjust ticket prices. Some airlines use futures contracts to protect against cost increases. Newer planes have better fuel consumption.

High Labor Costs - Labor costs for many large airlines have remained high, despite lower ticket prices and reduced passenger volume. Wages, salaries, and benefits accounted for 32 percent of American Airlines parent company AMR's operating costs in 2005. The financial success of discount airlines has depended heavily on lower labor costs. A segment of the air transport industry known as low cost carriers (as compared to the traditional legacy carriers that have existed for some time) are typically low cost because they have lower labor costs at start up. However, as time progresses, the labor costs for low cost carriers rise while the legacy carriers have been seeking concessions from labor. Southwest Airlines is an example of a low cost carrier that is now starting to see costs on par with the restructure legacy carriers.

Capital-Intensive Industry - Airplanes are expensive to acquire and maintain. Most new airplanes typically cost between \$50 and \$200 million (with seating capacity for 130 to 360). Newer planes are usually more fuel-efficient, but the high prices deter many airlines from buying them.

Industry Widely Regulated - The FAA, DOT, and TSA impose various fees on the industry,

and can interfere with airline operations. To expand operations, airlines need to get route permission from DOT and gates from local airports.

Fatal Accidents Severely Damage Airline's Reputation - Although airplane accidents are rare, they can be financially damaging. Even though insurance coverage is usually adequate to cover the cost of liability lawsuits, a drop in consumer confidence can cripple an airline. The crash of one of its planes in the Everglades in 1996 eventually led to the demise of ValuJet.

Airlines Depend on Skilled Employees - Airlines can't fly without FAA-certified pilots and mechanics, whose training takes years. The unions that represent these employees at most airlines have an exceptionally important voice in labor issues.

Trends and Opportunities

Business Trends

Shift to Low-Cost Carriers - The high cost structure of traditional airlines, like American and United, coupled with tighter business travel budgets, has provided expansion opportunities for low-cost airlines in recent years. Low-cost national carrier Southwest ranked fourth in domestic market share in 2005. Southwest held 10 percent of the market, behind American, Delta, and United, which collectively held 42 percent. US Airways, once among the big four, fell to seventh.

Code-sharing, Marketing Alliances - Airlines that serve a limited number of airports can expand their network through code-sharing agreements with airlines that serve other airports. With code-sharing, connecting flights can be booked on the other airline's planes. Marketing alliances typically include code-sharing as well as frequent-flyer programs and common use of airport lounges. Revenue from code-shared tickets is split between the partners. Because of potential antitrust problems, code-sharing and marketing alliances have to be approved by the Department of Justice.

TSA - Following 9/11, passenger and property screening at airports was taken over by the newly created TSA using federal employees rather than private security companies. TSA activities

receive funding partly from a tax on tickets, but the agency can impose additional charges on the airlines, if necessary to cover federal aviation security costs. The TSA assessed a \$50 million Security Infrastructure Fee on Southwest for its share of costs in 2005.

Hub-and-Spoke Routes - Hub-and-spoke route structures are used both by small and large airlines. Small airlines use them to serve a central city that is the destination of regional customers, and large airlines, like American and United, take regional customers to a central hub, then fly them to other hubs. A steady supply of regional passengers from the spokes allows big airlines to fill large planes that fly between hubs, but the need for connecting flights can make trips long and undependable. Any fall-off in traffic also means that large planes may have to fly with low load factors.

Point-to-Point Routes - Point-to-point produces direct flights to final destinations, but the number of airports that can be served with a fleet of planes is smaller. Smaller aircraft are required and a falloff in traffic is more easily accommodated. Almost 80 percent of flyers on Southwest, the major point-to-point airline, flew nonstop to their destinations in 2005.

Frequent Flyer Loyalty Programs - Most airlines have loyalty programs, typically based on how many miles or trips a customer makes, that reward repeat customers by giving them free tickets, service upgrades, or merchandise. These plans don't cost the airlines much, as many flights have empty seats anyway. Usage of free travel awards equated to over 6 percent of Southwest's passenger revenue in 2005. However, as the airlines have drastically reduced capacity by parking aircraft over the last two years due to the economic conditions, fewer seats are available for frequent flyers. Several airlines have restructured their programs to increase the number of miles necessary for redemption, thereby trying to reduce their financial impact on the bottom line.

Industry Opportunities

Fuel-Efficient Aircraft - The fuel consumption of aircraft varies widely. An Airbus 319 that carries 122 may burn 758 gallons of fuel per hour, while a Boeing 747-400 that carries 369 may burn 3,500 gallons per hour. Because of high fuel costs, newer planes and engines have been designed to be as efficient as possible for a particular type of service.

Internet Ticket Sales - The convenience of buying airplane tickets over the Internet appeals to passengers and is an inexpensive source of customers for airlines. Internet sites allow customers to easily compare airline schedules and fares, buy tickets, reserve flights, and, in some cases, choose seats and generate their own boarding passes. Southwest's website handles about 65 percent of the company's passenger revenue.

Frequent Flyer Sales to Businesses - Some airlines sell frequent flyer miles or points, as if they were a product, to companies unrelated to the loyalty program. This practice is a way to further commercialize the frequent flyer asset beyond the traditional airline, hotel, and credit card partners. Businesses that buy the miles or points use them in their own incentive programs for customers or employees.

Efficiencies with Electronic Documents - Computer technology allows customers to board flights without paper tickets and to generate their own boarding passes. Bar coded baggage tags improve handling and identification for ticketless and self-serve travelers. Over 90 percent of Southwest's customers, and over half of AirTran's, chose not to receive a paper ticket for their flights in 2005.

Key Management Issues

Selecting Aircraft Mix- Planned operations and market position drive aircraft buying strategies. Southwest Airlines, which has a point-to-point route structure and strives to be the low-fare, no-frills provider, historically has contained costs by operating only Boeing 737s. Similarly, JetBlue Airways operates mostly Airbus 320s. Standardizing on a single aircraft gives management better leverage with the supplier, helps control maintenance and repair costs, and simplifies flight operations and training.

Establishing Routes - The airline selects cities and airports to reach a specific customer segment, targets underserved cities or secondary airports, or takes market share from high-priced incumbents. For example, Southwest entered Philadelphia in 2004 to compete with USAirways. A year later Southwest had captured 10 percent of that market, and then launched service in

Pittsburgh to counter USAirways' dominance there. In selecting airports, management also considers level of demand, cost of labor and maintenance, and direct versus hub-spoke route structure.

Selecting to Buy or Lease Aircraft - The cost of owning, leasing, and maintaining aircraft accounts for about 20 percent of total airline expenses. Financial management develops a capital strategy that includes aircraft acquisitions. The buy-or-lease decision hinges on the prices and lease terms of airplane manufacturers and leasing companies. Leases usually require at least a three year commitment and can apply to a single plane or many. Some airlines buy and lease, but others do exclusively one or the other.

Mitigating Effects of Rising Fuel Prices - Fuel accounts for about 20 percent of operating expenses. Airlines may try to pass increases to consumers, but unless all airlines do this simultaneously, those that do are at a competitive disadvantage. To minimize the impact of fuel price increases, airlines may cancel low-capacity routes, consolidate routes, and use one-engine taxiing at airports. Proactively, most airlines engage in financial hedging to protect against fuel cost increases, and may buy newer planes and engines that are more fuel-efficient for a particular type of service.

Automating Flight Operations - An airline may have up to 1 million departures a year involving hundreds of aircraft and thousands of flight and ground crew personnel. To support its flight operations, the airline IT group must implement a system to schedule the aircrafts and crews available, including backups, and assure that each is in the right place. This detailed scheduling requires interfacing with other systems, such as passenger sales and airframe maintenance, to assure that data is entered only once, but is available to all systems.

Enhancing Internet-based Passenger Reservation Systems - As Internet use has become popular, airlines have recognized that the potential for savings is great when travelers make their own reservations online. Online reservations can reduce the number of reservation staff required, travel agent fees, and the amount paid for postage to mail tickets. The airline IT group must implement and maintain a user-friendly, non-intimidating system that the traveling public will

use, and tie it to other internal systems.

Dealing with Union Employee Issues - The industry is labor-intensive and most airline employees are members of unions that represent various job functions, such as pilots, flight attendants, mechanics, and ground crew. Unions that represent FAA-certified pilots and mechanics have a significant voice in labor issues, due to these employees' importance to airlines. Wages and benefits are top issues for employees and airline management, and represent an airline's largest single expense. To minimize labor issues, HR departments are generally positioned to act as an intermediary between airline operations management and the unions about compliance with union contract terms.

Training for Regulatory Compliance - The airline industry is highly regulated, particularly with regard to maintenance and safety. Compliance curricula are complex and affect many job functions and employees. The HR group oversees the establishment of training programs for employees to reach and retain certification in their area of specialty. HR schedules individuals for classes, monitors attendance and certification status, and assures that the requisite number of certified specialists is available at each location.

Expanding Marketing Alliances - Management uses alliances with domestic or international airlines, travel organizations, and destination sites as an economical way to reach a greater customer base. Marketing alliances include frequent-flyer programs, joint travel packages, shared use of airport lounges, code-sharing, and full destination travel packages, including hotel, local transportation, and entertainment. Marketing teams must assure that programs don't violate antitrust laws; some submit theirs to the Department of Justice for review.

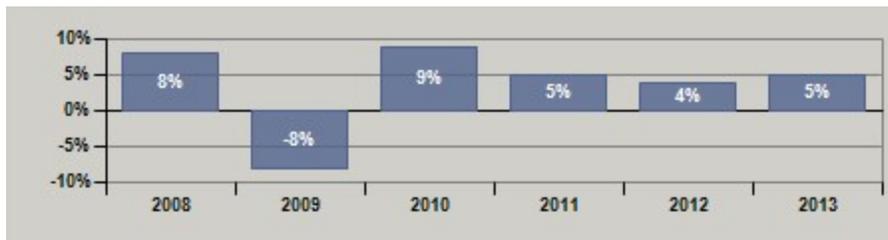
Selling Specialized Services - Many airlines carry passengers, cargo, and mail for the general public, but others specialize by customer industry, such as transporting hospital patients (Mayo MedAir) or servicing oil rigs (Petroleum Helicopters, Inc.). Some airlines exclusively carry cargo (FedEx Express); specialize in operating charter flights (Regal Aviation); or fly regionally (Northwest Airlink). Airlines also earn revenue by providing maintenance, special services, training, and reservations to other carriers. Salespeople calling on retail travel operations or

special industries require different knowledge and face different challenges than those selling services to other, usually smaller, airlines.

Industry Forecast

US personal consumption expenditures for US airlines are forecast to grow at an annual compounded rate of 3 percent between 2008 and 2013. Data Sourced: Aviation Week, December 2008

Consumer Spending on Airline Travel Growth Improves and Levels



Web Links and Acronyms

Industry Web Sites

Air Transport Association

News, economics, government affairs, and publications.

<http://www.airlines.org/>

Air Transport World

News. Other information by subscription.

<http://www.atwonline.com/>

AirWise.com

International industry news.

<http://news.airwise.com/>

Aviation Week

US industry news.

<http://www.aviationweek.com/aw/>

Boeing - Aircraft List Prices

Current list prices for new aircraft.

<http://www.boeing.com/commercial/prices/>

Boeing - Current Market Outlook

Boeing strategic airline market assessment.

<http://www.boeing.com/commercial/cmo/>

Bureau of Transportation Statistics (BTS)

Industry operating and financial statistics.

<http://www.bts.gov>

DOT Office of the Assistant Secretary for Aviation and International Affairs

Quarterly financial and operating statistics for all major airlines. Policy and regulatory issues.

<http://ostpxweb.dot.gov/aviation/index.html>

EIA - Jet Fuel

Spot prices for jet fuel from the Energy Information Administration.

<http://tonto.eia.doe.gov/dnav/pet/hist/rjetnyhM.htm>

International Air Transport Association (IATA)

News, statistics, and articles on opening page.

<http://www.iata.org>

Regional Airline Association

Regional statistics.

<http://www.raa.org>

Glossary of Acronyms

ASM - available seat miles

BTS - Bureau of Travel Statistics

CRS - computerized reservation system

LCC - low-cost carrier

OEM - original equipment manufacturer

PMA - parts manufacturing authorities

RPM - revenue passenger miles

VI. FREIGHT SHIPPING SERVICES

Industry Definition

Freight shipping services is defined as SIC Code 4731 or NAICS Code 4885.

Industry Overview

The freight shipping service industry includes about 17,000 companies with combined annual revenue of \$34 billion. Major companies include CH Robinson Worldwide, UPS Supply Chain Solutions, and BAX Global, a US subsidiary of Deutsche Bahn. The industry is fragmented: the top 50 companies account for 45 percent of total industry revenue.

Freight shipping service providers, commonly known as freight forwarders and customs brokers, are companies that arrange the transportation of goods from shippers to receivers. The industry doesn't include carriers that directly handle cargo, logistics management consultants, or supply chain management software manufacturers.

Competitive Landscape

Demand is driven by domestic manufacturing output and levels of international trade. The profitability of individual companies depends on efficient operations, extensive relationships in shipper and carrier networks, and industry expertise. Large companies have advantages in account relationships and access to advanced logistics technologies. Small operations can compete effectively by serving a local market, specializing in cargo transfer with specific countries, and facilitating the transport of unusual goods. The industry is somewhat labor-intensive: average annual revenue per employee is \$170,000.

Products, Operations and Technology

Major services are freight forwarding and customs brokering. Unlike fully integrated carriers that own truck, rail, air, or ocean assets and transport cargo, freight forwarders arrange the transportation of goods without owning any transportation equipment or handling

("fingerprinting") the cargo. Customs brokers add another layer of expertise by facilitating the clearing of goods through international customs barriers. Most companies specialize in either freight forwarding or customs brokering, though companies and individuals can provide both. Forwarders are well-versed in the schedules, rates, and availability of cargo carriers. They use this expertise to solve logistics challenges, lower expenses, and minimize delays for companies that ship or receive goods. Forwarders book cargo space with carriers; negotiate rates; arrange insurance; calculate the weight, volume, and cost of goods to be moved; prepare quotations, invoices, bills of lading, and letters of credit; and keep extensive records of all transported products. Forwarders may also act as freight consolidators, buying bulk cargo space on trucks, ships, and airlines only to resell it at a higher rate. Many forwarders specialize in a particular region, industry, or mode of transportation.

Customs brokers 'clear' goods through international customs on behalf of an importing or exporting business. Key responsibilities include preparing documents; submitting information electronically; paying taxes, duties, and excises on behalf of the client; and facilitating communication among the shipper, receiver, and government agencies. Government entities can be both international and domestic, as many goods require clearance and inspection from agencies like the FDA, USDA, or the US Fish and Wildlife Service. Just as forwarders tend to specialize, many customs brokers specialize in certain types of transactions, such as clothing, perishables, or obtaining clearance for the crew and manifest of large ocean vessels.

Shipping service providers can range from a sole, independent proprietor working out of a local office to large corporations with a network of hundreds of small offices and agents. Forwarding companies can also be a part of a freight services franchise. Local offices are largely autonomous: they serve local customers and are responsible for local marketing and for dealing with local contract carriers. In addition to their own offices, forwarders also may maintain a network of agents, especially in foreign locations.

Major technological advances center around proprietary computer systems that find the best routes for a shipment, present alternative fares and schedules, consolidate loads, confirm and bill orders, track and trace shipments, produce management reports, and allow logistics analysis. Some firms allow orders to be placed over the Internet, and by phone, fax, and electronic data interchange (EDI) with large customers. Customs brokers can be connected to the US Customs

Automated Export System (AES), which allows shippers to electronically file a Shipper's Export Declaration and Ocean Manifest.

Sales and Marketing

Typical customers are shippers and receivers that need to move cargo within the US or internationally. Shippers include chemical companies, construction firms and building manufacturers, commodity importers and exporters, consumer products companies, food suppliers, and vehicle manufacturers.

Major types of marketing include online ads and rate quotes, telemarketing, and face-to-face visits with potential customers. Large shippers may negotiate national contracts with national or regional customers who are served through local offices.

Internet sales are common, especially for less-than-truckload (LTL) cargo. Potential customers can quickly get rate quotes and compare fees online. For specialized goods and heavier cargo, forwarders and brokers often use online forms to collect information and call back the prospect to discuss terms.

Prices vary depending on route, weight, volume, and demand. Freight shipping service providers make their money on the spread between the rates charged to customers and the rates they pay carriers. To get the most favorable rates, forwarders typically agree to provide a carrier with a minimum number of shipments. The forwarder and the carrier may also agree on general payment terms, but specific rates are negotiated at the time of service. Most sales are to repeat customers with whom the forwarder has long-term relationships. Customer contracts may call for discounts in return for a specific volume of business.

Finance and Regulation

Cash flow for most freight shipping services is fairly steady throughout the year, though cash flow demands are higher in the third and fourth quarters in advance of the Christmas season.

Inventories are at or near zero, as forwarders and brokers are service providers that don't handle product. Freight forwarders have few assets except for local offices and proprietary software systems. Receivables are typically about 30 days, but can extend to 180. Companies must establish and maintain firm collection policies to lower the days of sales outstanding.

Insurance coverage is a critical expense for freight shipping service providers. Forwarders typically obtain "errors and omissions" insurance to protect the shipper in case of delays or errors

on documentation. Insurance expenses can run 10 to 20 percent of sales. Gross margins range from 30 to 40 percent.

Forwarders and brokers are regulated and licensed according to their specialty. An ocean transportation intermediary that forwards freight on a Non-Vessel Operating Common Carrier (NVOCC) must be licensed by the Federal Maritime Commission (FMC). Forwarders that handle air freight are typically accredited with the International Air Transport Association (IATA) as cargo agents. Many states require additional freight forwarding licenses, particularly for alcoholic beverages or other heavily regulated consumer goods.

Customs brokers are regulated by the US Customs and Border Protection, a division of Homeland Security. All brokers must pass an exam and background check. Current federal employees are ineligible to serve as customs brokers.

Regional and International Issues

California, New York, Illinois, and Florida are the leading states for freight shipping services. Forwarders and brokers tend to maintain offices near major transportation nodes: ports, rail terminals, and intermodal transfer stations.

Both forwarders and customs brokers depend highly on the international trade climate. The US, a net importer of goods, has imports of \$2 trillion annually and exports of \$1.2 trillion. Imports have doubled in the past 10 years. Leading import sources include China, Canada, Mexico, and Japan. Top export partners include Canada, Mexico, China, and Japan. As specialists in efficient global trade, brokers and forwarders must have extensive knowledge in international trade, tariffs, and the current regulatory climate.

Human Resources

Wages average more than \$18 an hour, slightly higher than the national average. Freight forwarding firms that are a part of a larger integrated carrier network may require many low-skilled material handlers and drivers. While background checks are required for customs brokers, a past criminal record doesn't preclude an individual from becoming licensed.

Since asset-less forwarders do not handle cargo, the annual injury rate in the freight shipping industry is quite low: 60 percent below the national average. Most injuries involve sprains, strains, soreness, fractures, and bruises.

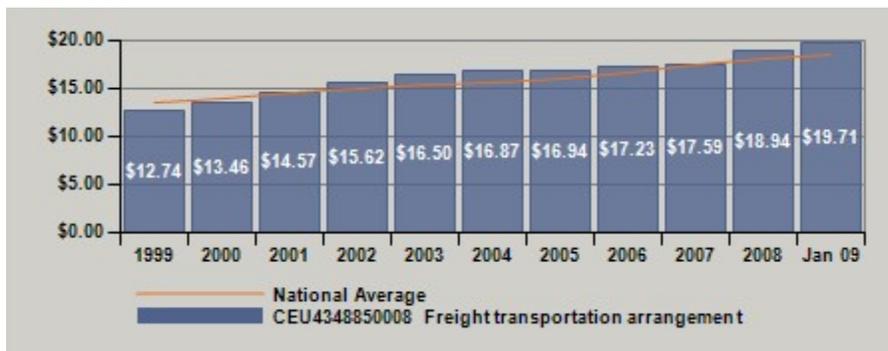
Industry Employment Growth

Bureau of Labor Statistics



Average Hourly Earnings & Annual Wage Increase

Bureau of Labor Statistics



Recent Developments

Industry Indicators

The average US retail price for diesel and regular gas, a major operating cost for freight shipping fleets, dropped 49.3 percent and 41.8 percent respectively in the week ending March 16, 2009, compared to the same period in 2008.

Total US durable goods manufacturers' shipments, an indicator of the volume of goods shipped by freight shipping services, fell 17.1 percent in January 2009 compared to the same period in 2008.

Quarterly Industry Update

New TSA Rules Drive Screening Work - New air cargo screening rules could mean more work for freight forwarders. Beginning February 2009, a new rule mandates that 50 percent of cargo on passenger airlines must be screened by a facility certified by the Transportation Security Administration. By August 2010, 100 percent of cargo on passenger airlines must be screened by TSA-certified screeners. Freight forwarders certified by the TSA will be able to pick up

additional screening business.

Pirate Attacks Plague Ships - More than 100 ships have been attacked by pirates off the coast of Somalia in the past year, and more attacks are expected in 2009. Special insurance costs for ships traveling the dangerous route are 40 times above the normal costs. Freight shipping service companies have to account for the potential of a pirate attack when arranging transportation of customers' cargo.

Airline Cargo Traffic Falls Sharply - US airline cargo traffic, an indicator of demand for freight shipping services, took a nosedive in December 2008, falling 17 percent from the same month in 2007, according to the Air Transport Association of America (ATAA). Trans-Pacific cargo traffic fell nearly 30 percent in December 2008 compared to the previous month, the worst monthly drop ATAA has reported. ATAA called 2008 the worst year for US cargo traffic since the downturn that followed the September 11, 2001, terrorist attacks.

Business Challenges

Critical Issues

Demand Tied to Economic Cycles - Freight shipping services depend highly on the volume of domestic and international trade. Economic slowdowns or a drop in consumer confidence typically results in less products being manufactured and shipped; thus, less business for companies that specialize in the efficient transfer of cargo. Shipping volume falls faster than manufacturing activity during an economic slowdown, as distributors and retailers have less inventory turnover.

Dependence on Free Trade - Forwarders and customs brokers are highly dependent on the free flow of goods among nations. Embargoes, protectionist policies, and trade sanctions can limit or completely halt commerce among nations. Customs brokers that specialize in specific nations can see opportunities shut off entirely when free trade is blocked. Too much free trade can also harm the industry: the free flow of goods with limited customs barriers can reduce the need for experts to deftly navigate customs, tariffs, and filings.

Increased Competition - The giants of the small package business, FedEx and UPS, have expanded operations to move heavy cargo. Both now maintain internal divisions focused on cargo forwarding. Excellent brand recognition and a network of existing customers have given these larger firms an immediate advantage. Some truck, rail, ship, and air carriers have used Internet technologies to develop internal forwarding and customs capabilities, and have eliminated relationships with third-party forwarders and brokers.

Expensive Information Systems - Advanced computer information systems select the best routes and rates for a shipment and allow customers to track and trace loads in real time. Most systems rely on bar coders, scanners, and other devices to make them function properly. Comprehensive systems are costly; only fairly large shippers can afford the investment. The competitive advantage of these systems has increased industry consolidation in recent years.

Perishable and Fragile Goods - Forwarders often arrange the delivery of perishable and fragile goods, which can be complex and unpredictable. Temperature control from harvest to delivery is essential, especially for products like seafood, produce, and flowers. Delivery timing is critical to reduce the risk of spoilage. To comply with a country's regulations on specific perishables, companies may be challenged by international import and export authorities. Forwarders and customs brokers typically maintain expensive insurance policies to protect them against delivery mishaps.

Security Concerns Increase Costs - Insurance premiums for air freight companies have increased sharply because of terrorism concerns. Tighter screening requirements cause delays and increase costs. Depending on the route or type of cargo, shippers may impose war or terrorism risk surcharges.

Customer, Industry Concentration - Although large freight shipping service providers typically receive no more than 5 percent of business from any single customer, local forwarders often rely on just a few large accounts for the bulk of revenue. Many independent forwarders specialize in shipping goods for a particular industry, such as electronics or fresh produce, leaving them vulnerable to a slowdown in that industry. Customs brokers that specialize in a

particular country are subject to the economic strength of that country and its major trading partners.

Trends and Opportunities

Business Trends

Technology Improves Tracking - Custom brokers and forwarders can rely on sophisticated software and hardware to monitor the flow of cargo. Companies have developed advanced proprietary systems that can reduce delivery times, lower loss rates, and track cargo as it moves. RFID tags and scanners can automatically detect a shipment and enter the information into a centralized computer system.

Fees Flat - The fees charged by forwarders and brokers to manage cargo have remained relatively flat over the past decade. In the last 10 years, railroads have increased fees nearly 50 percent, air cargo companies 30 percent, and ocean carriers and trucking companies, 25 percent; forwarders and brokers have raised fees only 7 percent. Most carrier fees have increased due to rising fuel costs; forwarders don't incur shipping fees, but rising carrier costs can increase their spread.

International Trade Expands - The ease of global importing and exporting has fueled the growth of the freight shipping services industry. The rapid expansion of electronics and clothing factories in China and India has resulted in volumes of new business to companies specializing in air and sea freight services. The annual volume of US international trade in goods (imports plus exports) has doubled over the past decade.

Wages Rise - Average wages in freight shipping services have increased 50 percent in the past 10 years, but overall employment has remained relatively unchanged. Productivity levels have steadily risen due to advancements in logistics software and the proliferation of global trade.

Industry Opportunities

Deregulation Opens Markets - Deregulation of the trucking, rail, and airline industries has resulted in complex rates and a competitive free market. Instead of the federally mandated flat fees common in decades past, rates vary due to carrier supply and demand, volume, weight, and

the type of materials transported. Shippers generally prefer to hand the responsibility of navigating this free market to forwarders and brokers who can aggressively source the best deal.

Logistics Consulting, Analysis - Forwarders can take advantage of customers' greater logistics needs to provide services beyond basic freight scheduling. Consulting opportunities include supply chain management, logistics analysis, and just-in-time (JIT) inventory management. Large companies are developing logistics consulting divisions; individual forwarders often take on work as project consultants.

International Expansion - Domestic forwarders and customs brokers are in high demand in nations experiencing high growth. Cities like Dubai and countries like China and India need international freight forwarders (IFF) that understand the import and export business, tariffs, and international trade. Forwarders and brokers that can navigate through increased inspections and heightened security may have opportunities that extend well beyond domestic freight services.

Branding - Despite the growth of the freight shipping service industry, it remains a fragmented market led by independent agents and small offices; the industry has no market leader. Large corporations like FedEx and UPS are getting into the game, but their core expertise and brand is in parcel delivery. A large integrated forwarder and broker may be able to establish a strong brand and reputation, potentially consolidating the market.

Key Management Issues

Forecasting Customer Demand - To provide adequate personnel and equipment to serve customers, forwarders must anticipate customer demand. Shipping volume is highly sensitive to national and local economic conditions and may be seasonal for individual customers. Excess or insufficient resources are costly.

Establishing Shipper Relationships - To keep large customers, forwarders offer contracts that provide discounts for a specific volume of business. Many companies rely on repeat customers. Contracts specify a level of discount rather than fixed prices because prices change with market

conditions.

Negotiating Contracts with Carriers - Freight forwarders negotiate contracts with land, sea, and air carriers to transport customer goods. These contracts generally don't specify prices, which depend on market conditions at the time of service. Large shippers can impose special requirements on carriers, while small shippers typically use standard contracts that describe performance, billing, and payment terms. To expand their capabilities, even integrated shippers have contracts with other carriers.

Setting and Comparing Rates - Forwarders and brokers must be keenly aware of the rates offered by competitors. Companies establish rates by adding a premium to carrier fees, tariffs, and taxes. As service providers, the barriers to entry for competition are very low. Rates typically fall within an industry-accepted norm.

Improving Rate and Scheduling Systems - To route customer shipments by the fastest or lowest-cost route, forwarders and brokers must juggle a variety of schedules and fare rates for truck, rail, air, and sea carriers. Some large companies have proprietary computer systems that integrate information from many carriers, but the large number of carriers makes tight integration difficult.

Improving Integration with Customer Information Systems - Carriers and shippers are developing Internet-based tracking for customers. Freight forwarders can have difficulty providing such information because they may need to receive and post information from a variety of shippers and carriers. Integrating logistics software can be complex for these third-party intermediaries.

Providing Specialized Training - Workers may need special training in computer systems, shipping schedules, export/import regulations, and logistics. Because most business is from existing customers, workers may need education about specific customers or customer industries. Independent forwarders and brokers tend to keep their knowledge of the industry "in their head": very little of it is documented for future employees.

Complying With Licensing Requirements - Freight shipping service providers must obtain appropriate licenses and certification from federal authorities. Depending on their product expertise and cargo specialization, forwarders and brokers need to comply with federal air, sea, and highway administrations. Customs brokers must be licensed by the US Customs and Border Protection.

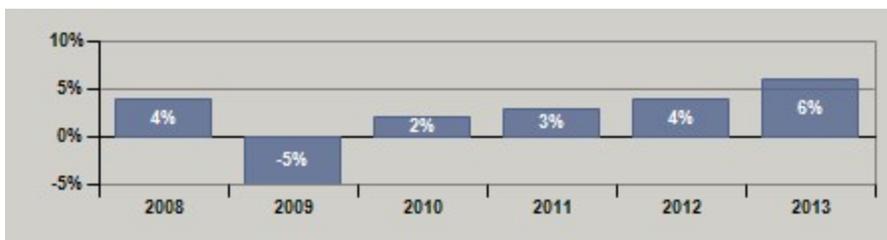
Expanding Internet Marketing Programs - Many forwarders have Internet marketing programs, including search engine advertising and websites that allow customers to view sample prices and track shipments. Companies can often expand their customer base by demystifying the purpose and advantages of freight forwarding.

Increasing Sales of Logistics Services - Because of the greater complexity of transportation, companies may be able to handle all of the logistics needs of their customers, including raw material supply, inventory management, and final product distribution. Such services have higher margins than simple cargo forwarding, and can increase the retention of large customers.

Industry Forecast

The output of US railroads, trucking, and water transportation services, all major indicators for freight shipping, is forecast to grow at an annual compounded rate of 2 percent between 2008 and 2013. Data Sourced: National Customs Brokers & Forwarders Association of America December 2008

Trucking, Railroads, Water Transport Growth Steadily Improves



Web Links and Acronyms

[Industry Web Sites](#)

Airforwarders Association

Industry association representing the interest of air cargo forwarders.

<http://www.airforwarders.org>

American Association of Port Authorities

Port reports and news.

<http://www.aapa-ports.org>

American Trucking Associations

News for the trucking industry.

<http://www.truckline.com>

Intermodal Association of North America (IANA)

Trade association promoting the interests of intermodal transport.

<http://www.intermodal.org/>

International Federation of Customs Brokers Associations

Worldwide industry group representing customs brokers associations.

<http://ifcba.org>

National Customs Brokers & Forwarders Association of America (NCBFAA)

Industry association for customs brokers and freight forwarders.

<http://www.ncbfaa.org>

NCBFAA Shippers Association (NCBFAASA)

Offshoot of the NCBFAA with a special focus on ocean shipping and forwarding.

<http://www.ncbfaasa.org>

Packaging Strategies

News and analysis on the world of packaging.

<http://www.packagingstrategies.com/>

US Customs and Border Protection (CBP)

Division of Homeland Security that regulates and inspects US trade.

<http://www.customs.gov>

Glossary of Acronyms

AES - Automated Export System

EDI - electronic data interchange

FMC - Federal Maritime Commission

IANA - Intermodal Association of North America

IATA - International Air Transport Association

IFF - International freight forwarders

JIT - just-in-time

LTL - less than truckload

NCBFAA - National Customs Brokers & Forwarders Association of America

NVOCC - Non-Vessel Operating Common Carrier

VII. SPACE/AEROSPACE

A. Space Industry

This industry overview summary is based upon a 2008 space industry study by the National Defense University, which prepares annual studies of strategic industries important to US defense and security.

Structure and Markets: The U.S. space industry is comprised of individual businesses and several national and intergovernmental organizations. The industry is segmented into three distinct areas: space, control, and user. The space segment deals with launch and platform components, usually a satellite or scientific experiment. The control segment addresses infrastructure required to operate platforms, while the user segment enables the user to access the platform for the designed capability, such as television or telephone signals. To address these segments, the industry deals with two primary markets and one secondary market. Satellite production or manufacturing and launch services, including booster development and infrastructure, represent the two primary markets. These markets are organized in terms of support for commercial, civil, and military (including intelligence) clients.

A Cold War acquisition mentality, where schedule and cost are tradeoffs to performance, still permeates the space industry. Rapidly changing technology, coupled with a desire to produce decisively superior capability, has led to large cost overruns and unacceptable delays in system fielding. As payloads get larger, more capable, and significantly more expensive, launch vehicle performance has become paramount and economic aspects are ignored in favor of reliability.

The primary markets for satellite production services are concentrated within a narrow range of companies producing a majority of the systems and services in these markets. Satellite production is centered on Lockheed Martin, Boeing, Northrop Grumman, Space Systems/Loral, Alcatel Alenia, and EADS Astrium Space Systems. Launch is likewise concentrated. Booster production is focused on United Launch Alliance (ULA), which combines the Boeing and Lockheed Martin Evolved Expendable Launch Vehicles (EELV) under a single management structure. Arianespace produces the Ariane 5 booster. Sea Launch is a joint venture between Boeing, Energia, Aker Kvaerner, and SDO Yuzhnoye/PO Yuzhmash. The Ukrainian Zenit booster, a former ICBM and the Soyuz rocket are also strong competitors in launch, as well. SpaceX, a new entrant to the launch market, was founded as an alternative to higher cost launch. SpaceX is taking an innovative approach to the design and production of an entirely new booster vehicle.

The secondary market for ground services and infrastructure is more difficult to define. Aspects of this market, such as launch facilities and range control, represent a direct tie to the use of space. Major launch control and ranges in the U.S. are Kennedy Space Center and the Cape Canaveral Air Force Station in Florida, along with Vandenberg Air Force Base (AFB) in California. Arianespace, the marketing commercial launch component of the European Ariane rocket, is located in French Guiana, South America. The Russian component launches from the aging Baikonur Cosmodrome in Kazakhstan. Sea Launch, an international consortium, modified a mobile oil platform to launch rockets from an equatorial location in the Central Pacific. The ground control segment is fairly robust, with major facilities for communications at Intelsat in the U.S. and the European Space Operations Center at Darmstadt. Governments with robust space programs generally provide control for their own assets on orbit. The United States controls its military and intelligence assets through the U.S. Air Force Satellite Control Network,

located at the 50th Space Wing at Shriever AFB, and in Cheyenne Mountain. U.S. Civil spacecraft are controlled through a number of different facilities across the country, including the Johnson Space Center which controls the space shuttle and the International Space Station.

Industry Conditions

Mature Industry and Entry Barriers: Characterized as mature within the industry life cycle, the space industry experiences few emerging markets and little opportunity for growth. High barriers to entry include: (a) a significant capital investment to support land, plant, technology, and labor; (b) a highly skilled workforce that can provide both for current needs and also adapt to evolving technologies; (c) a reliance on government contracts and acquisition systems for the majority of industry revenues; (d) the use of governmental grants and subsidies, which provides an unfair advantage to incumbent producers; and (e) stringent regulations, such as the International Traffic in Arms Regulations (ITAR), which limit the ability of industry to compete in the global market.

These barriers support the large scale, vertical integration that characterizes the industry. Boeing's earlier mergers with North American Rockwell, McDonnell Douglas, and Hughes Electronics, are representative of the consolidation throughout the industry. Similar industry consolidation took place on the other side of the Atlantic, resulting in the creation of European Aeronautic Defense and Space Corporation (EADS) from the merger of a number of European aerospace giants including Dassault, Aerospatiale, Fokker, Vereinigte Flugtechnische Werke, Messerschmitt Bölkow-Blohm, Construcciones Aeronauticas Sociedad Anónima, and Aeronautica Industrial SA. This merger was significant because it crossed a number of national borders to create a dominant regional company capable of competing with similarly realigned Lockheed Martin and Boeing.

Government Reliance: The industry's heavy reliance on government contracts and support comes with some concern. When access to space is characterized as a national security issue, the industry becomes a fertile ground for governmental regulations. Barriers to trade, such as the ITAR, significantly reduce free and open exchanges of information, leading to diminished

innovation and competition in the market. Heavy use of grants and subsidies distorts market conditions, increases government costs, and lowers competition by raising barriers for would-be entrants.

The Nature of the Market

Market Size: The global space industry is a growing and strategic component of the world economy, though industry observers see the industry as mature in the U.S. The Space Foundation estimates that global space industry revenues were just over \$250 billion in 2007 with annual growth of 11%. Of this total, US Government space spending accounts for 25%. Other international government space budgets were only 6% combined. Commercial satellite services accounted for the lion's share of 2008 revenues at 55% of the total. The other 16% comes from commercial infrastructure (14%), space commercial transportation services (1%), and infrastructure support industries (1%).

Segments: The two major markets within the space industry are satellite development and production and booster manufacturing/launch services. The North American Industry Classification System, or NAICS, defines these two sectors as 336414, Guided Missile and Space Vehicle Manufacturing and 334220, Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.

While these two sectors include the majority of the space industry, they do not include all of it. For example, booster propulsion falls under NAICS code 336415 and portions of the launch and manufacturing infrastructure falls under 336416. While a good deal of the space industry falls outside the two primary codes, several elements within these two codes are not related to space. As a consequence, accurate data relating specifically to the space industry is obfuscated, resulting in a chronic degree of uncertainty as to the industry's fiscal condition and developments. Since reliable economic data is required for complex budgeting processes, to provide valid cost estimates, to accurately account for research and development spending, and to better understand the role of government within the market, there is a need to improve the economic data analysis of the industry.

According to the NDU report, Nascent industries are marked by growth, innovation, and competition among a large number of companies, which was representative of the space industry fifty years ago. Today the industry reflects lower levels of innovation, little competition, low capacity, and high cost. As U.S. reliance on space continues to increase, these industry conditions become cause for concern. It is certainly worth asking why newer technologies have not emerged in the last forty years. In part, this may be due to the very small market for space capabilities. Until new and different technologies are developed, which is not likely to occur without an interest and investment by government, the current dynamic will sustain a condition of limited innovation and capacity.

B. Aerospace Industry

Industry Definition

The aerospace sector is defined as SIC Codes 3721, 3724, 3728, 3761, 3764, 3769, or NAICS Code 3364.

Industry Overview

The US aerospace industry includes about 1,500 companies with combined annual revenue of \$125 billion. Large companies include Boeing, Northrop Grumman, Lockheed Martin, Raytheon, and General Dynamics. The industry is highly concentrated: the 20 largest companies account for more than 90 percent of industry revenue. Many companies work primarily as subcontractors to the five largest manufacturers. Later in section VII an overview of the space market is provided.

Competitive Landscape

Demand is driven by the US military budget and the overall economic climate, which affects airline traffic and demand for new commercial aircraft. The profitability of individual companies depends on technical expertise and the ability to accurately price long-term contracts. Large companies enjoy economies of scale in design, manufacturing, and purchasing. Small companies can compete effectively by concentrating on selected components and parts manufacturing for particular prime contractors. Increasingly, small companies are developing system integration capabilities as large firms outsource more aspects of contracts. Production of aircraft and major aircraft components is highly automated: average revenue per employee is over \$300,000.

Products, Operations and Technology

Major products are aircraft, including commercial, military, private and business planes; aircraft components, including engines, fuselages, interiors, and avionics; missiles and satellites; and space vehicles. Aircraft manufacturing accounts for over 50 percent of industry revenue, aircraft components for about 30 percent, missiles and satellites for about 10 percent, and space vehicles for less than 5 percent.

Boeing is the only US manufacturer for commercial aircraft, but outsources portions of its business to numerous subcontractors. Private and business aircraft are made by companies such as General Dynamics, through its Gulfstream subsidiary, and Cessna. Subcontractors specialize in producing assemblies for various systems, such as engines, fuselages, interiors, rotors, electronic and hydraulic control systems, avionics, and guidance systems.

The manufacturing process involves forming, forging, metal fabricating, painting, and finishing activities. These activities require greater precision and higher grade materials such as aluminum, titanium, and special steel alloys, than in general manufacturing. Assemblies and systems are manufactured according to designs specified by the prime contractor, and often developed in tandem by the prime and subcontractor. Small contractors generally work for a specific prime contractor.

Manufacturing costs are dominated by the costs of materials and supplies, especially aluminum, titanium, and carbon and boron composites. Some materials are available from only a few suppliers. As such, the timing and pricing of some materials and commodities can fluctuate widely.

Technology is constantly changing in the industry. R&D expenses approximate 2 percent of company revenues. Systems development is especially important in the manufacture of guidance systems, communications, and space vehicles. Lockheed Martin and Raytheon both have business units devoted solely to electronic systems development. Aircraft are designed through CAD that allows companies to design an entire aircraft, including its components, by computer. Investment in computer-aided manufacturing (CAM) is common. Computer systems are critical for designing, testing, and operating aerospace products.

Sales and Marketing

The federal government, primarily the Department of Defense, is by far the largest customer. For example, 75 percent of Raytheon's revenue is from the federal government. Other end-customers

include private airline and cargo transportation companies worldwide and telecommunication companies.

Commercial aircraft are generally sold fixed-price with indexed price escalation clauses. List prices for Boeing commercial aircraft can range from \$50 to \$200 million. Private jets list for \$6 to \$45 million depending on size.

Commercial airplanes are built and then modified by customer request. Airlines specify requirements for their needs including range, size, cargo, and seating arrangements, then invite manufacturers to submit bids. The winning bid is generally based on cost and favorable financing. The testing and prototype stages can take years. Once in production, the manufacturing line can be active for years, with modifications made depending on changing specifications.

Government contracts are fixed-price, fixed-price incentive, or cost reimbursement. In the fixed-price incentive contract, the manufacturer shares with the government any savings or additional costs from the original contract price. A cost reimbursement contract allows costs plus a fee. Government contracts begin with an announced need for military aircraft, satellites, or missile systems, and specify various requirements. Aerospace companies submit bids detailing their solutions and designs as well as cost estimates. Firms may undergo substantial R&D to enhance their bid. Following negotiation, a contractor is selected and a prototype developed, built, and tested.

Once won, a government contract is conditional upon continuing availability of Congressional funding. Funds are appropriated on a fiscal year basis even though contract performance may extend over several years. If a contract is terminated due to lack of continued funding, the contractor is entitled to the purchase price for delivered items, reimbursement from the costs of work in progress, and a profit allowance.

Sales cycles can be long, so relationship building is important, as is having a voice on Capitol Hill. Though they're subcontractors, aircraft component manufacturers may also sell directly to airlines and the military to have their products specified in orders for new planes. Marketing consists primarily of establishing and using personal contacts with the relatively small number of customers. Aerospace companies advertise in aviation and defense publications and journals.

Finance and Regulation

Revenues are generally higher in the second half of the year after the new federal budget is approved. Industry inventories are over 15 percent of total assets. Cash flow isn't generally an issue as contracts are paid based on percentage completion and cost plus. Manufacturers are paid as work is completed and final products are delivered on an agreed-upon schedule. Industry profit margins lag the manufacturing sector as a whole.

The aerospace manufacturing industry is highly regulated. The industry deals with numerous US agencies including all branches of the military, NASA, Homeland Security, and the FAA. The FAA regulates the manufacture and operation of commercial and business aircraft. Companies doing business with the Department of Defense are subject to government oversight and audits. The industry must contend with many government policies regarding security, export controls, technology transfer, and market access that may limit its ability to compete globally.

Regional and International Issues

The industry is concentrated in California, Washington, Arizona, Texas, and Florida.

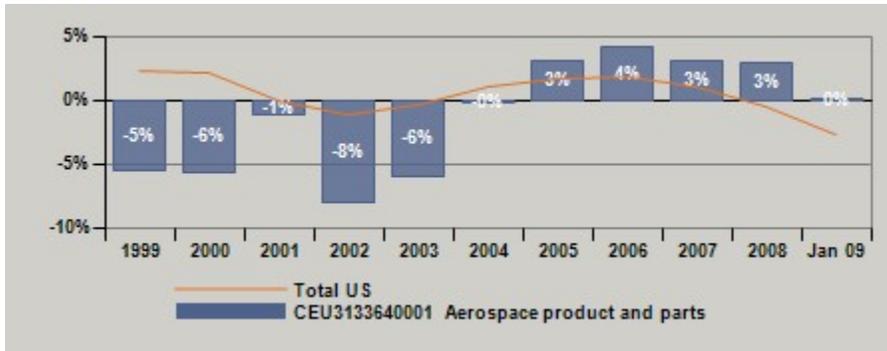
The US aerospace industry exports about half its output and is the single-largest net exporter among all US manufacturing sectors. The countries receiving the largest amount of US exports include Japan, France, the UK, Singapore, and Canada. The US aerospace manufacturing industry faces increasing competition in global markets from state-supported firms such as Airbus, which is the only competitor of Boeing for commercial aircraft. Imports come largely from Canada, France, the UK, Brazil, and Germany.

Human Resources

Production workers are highly skilled and include a large number of unionized workers and many engineers and scientists. Average hourly earnings for production workers are about 50 percent higher than the national average. About 30 percent of all workers in the aircraft and parts sector are unionized.

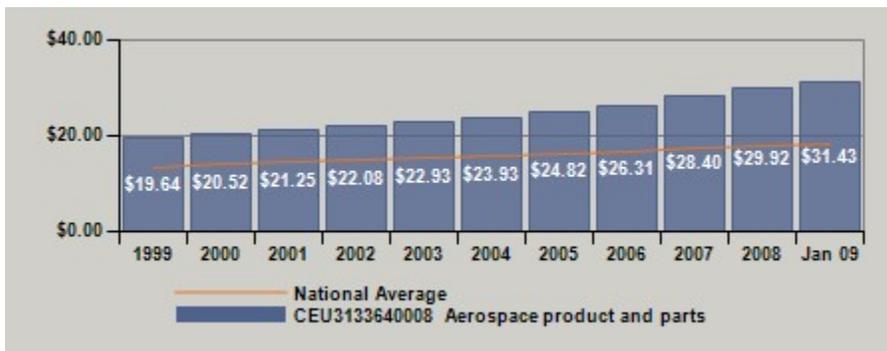
Industry Employment Growth

Bureau of Labor Statistics



Average Hourly Earnings & Annual Wage Increase

Bureau of Labor Statistics



Recent Developments

Industry Indicators

US corporate profits, which affects airline traffic and demand for new commercial aircraft, fell 9.2 percent in the third quarter of 2008 compared to the same period in 2007.

US steel mill product prices, an indicator of commodity steel costs for aerospace products, fell 9.8 percent in February 2009 compared to the same period in 2008.

Quarterly Industry Update

Number of Idle Aircraft Increases - More aircraft belonging to the world's airlines sat idle in 2008 than at any time since the industry downturn that followed the terrorist attacks of September 11, 2001, according to airline consulting firm Ascend. About 11 percent of the global fleet of more than 20,000 aircraft is sitting in storage. Of the 2,300 aircraft sitting idle, about half are scheduled to be decommissioned. Airlines are idling aircraft to save cash as consumers curtail travel and the recession reduces demand for air cargo transportation.

Aerospace, Defense Sector Downgraded - The outlook for the US aerospace and defense sector was recently downgraded from positive to stable by Moody's Investor Services. The downgrade is in response to a number of challenges facing the industry through 2010, such as diminished access to financing, falling air travel demand, and uncertainty over the Obama administration's defense budget plans. Moody's suggests companies with a good balance of civil and defense aerospace offerings would be best suited to weather the current economic climate.

Boeing's Commercial Orders Fall - Orders for Boeing commercial aircraft decreased in January 2009 compared to a year earlier. Boeing received 18 orders for new aircraft in January 2009 compared to 65 in January 2007. More than 30 orders for the company's upcoming 787 Dreamliner jet have been canceled, as the widening global economic slowdown has reduced airline traffic. Although Boeing has seen a slump in demand, the company has a backlog of orders that will take many years to complete.

Business Challenges

Critical Issues

Volatility of Government Spending - Dependent in large part on federal government spending, the aerospace industry is cyclical by nature and unpredictable, due to uncertainty of the annual government budgeting process, election cycles, and the ebb and flow of spending levels. In five of the last 15 years, annual production of aerospace products and parts fluctuated over 10 percent from the previous year.

Dependence on Air Travel - Commercial aircraft and parts production, which is twice as large as military aircraft production, depends highly on worldwide air travel. Air travel, in turn, depends greatly on general economic activity and security issues. Consumers reduce pleasure travel as prices rise, and business travel falls as security measures lengthen how long it takes to get to destinations. Reduced air travel decreases the need for new aircraft and changes existing orders from developed planes to newer, more efficient aircraft.

Access to Foreign Markets Depends on Government Policy - Sales outside the US are influenced by US government relationships and trade policies with specific foreign countries. Federal law prohibits US manufacturers from paying foreign officials to win contracts. Sales cycles can last many years, during which the domestic political environment can change,

affecting US foreign relations and trade policies.

Difficulty Attracting Qualified Workforce - According to the Commission on the Future of the US Aerospace Industry, over a quarter of all aerospace workers will be eligible to retire by 2008. Of aerospace workers, 80 percent of aerospace workers say they wouldn't recommend the industry as a profession for their children. The lack of skilled workers could jeopardize the leadership position of the US industry in the global marketplace.

Increasing Foreign Competition - The European aerospace manufacturing industry has consolidated into a few companies supported by multiple governments. Airbus' parent EADS is the leading pan-European company and is developing the world's largest jetliner. Pan-European companies are offering solutions for European and developing countries' military needs that compete against US products. The Korean and Israeli aerospace industries are undergoing extensive consolidation and are expanding their marketing to other countries.

Long Procurement Cycles - Aerospace companies constantly invest in technology and systems development in hopes of winning future contract bids. While upfront investment is no guarantee that companies will win particular contracts, it may help position the company for the future. Contract bidding is long and involved, and even if a contract bid is won, the contract may not continue to completion. Government contracts are subject to potential annual budget cuts and commercial airlines change existing orders based on economic conditions.

Trends and Opportunities

Business Trends

Emergence of "Micro Jet" Airplanes - Several companies are introducing smaller, more affordable planes designed to provide passengers more efficient travel. This emerging market is driven primarily by business travelers' dissatisfaction with flying conditions, large airports, and increased security. Several new aerospace companies have introduced air taxi services that transport travelers from point to point, avoiding commercial aviation's hub-and-spoke system. Eclipse Aviation, Honda Motor Company, and Safire Aircraft have all tested micro jets that seat four to eight and two crew members and are more affordable than commercially available jets.

Increased Emphasis on Operational Efficiency - Continued oil price rises and increased competition from discount and new airlines has led to greater focus on efficiencies. US carriers have demanded a more fuel-efficient plane. Boeing responded by developing the 7E7, scheduled for delivery in 2008. Eclipse, a small jet manufacturer, has introduced friction stir welding that eliminates the need for rivets and creates stronger and lighter joints, making jets more fuel-efficient.

Outsourcing Development, Manufacturing - Similar to what happened in the auto industry, the aerospace industry is developing partnerships and alliances to outsource significant components of both development and manufacturing. Boeing is introducing the 7E7, a smaller but more efficient commercial aircraft. Boeing will outsource development and assembly of the 7E7 to several of its partners and suppliers, in hopes that these components will be produced just-in-time and faster than Boeing could internally, creating greater efficiencies.

Industry Consolidation, Partnerships - Since the 1990s, the aerospace industry has consolidated into five major firms that dominate, with several hundred suppliers competing for subcontracts. Much partnering with suppliers exists, and even the Big Five are suppliers to each other. Boeing and Lockheed Martin each have a 50 percent partnership responsible for all ground processing of the space shuttle fleet.

Growth of Business Jets - The business jet segment is growing faster than other industry segments, due in part to the greater connectivity to more than 5,300 US airports as opposed to the 550 airports serving commercial aircraft. Forecast growth is driven largely by fractional ownership, where an aircraft has multiple owners. More than half of back orders are due to fractional ownership companies.

Increasing Use of Automated Controls - Operations of commercial, military, and business aircraft are becoming more automated through advances in avionics. New computerized controls and software systems are allowing planes to "fly themselves" without continual pilot involvement. Avionics and related parts suppliers must keep pace with this technological innovation to remain competitive.

Industry Opportunities

Unmanned Combat Aerial Vehicles (UCAV) - Future generations of fighter jets will be robotic and pilotless vehicles that transmit signals through satellite relays to ground stations and piloted aircraft. These unmanned aircraft will be cheaper to produce, since they won't require the same level of redundancy and safety requirements as manned aircraft, and will be safer to operate since no human pilot is at risk. The Department of Defense plans to spend \$4 billion over the next 10 years to develop UCAV technologies, and expects that one-third of US military combat planes will be robotic by 2020. Potential applications outside the military include robotic cargo planes, weather monitoring, and border patrol surveillance.

After-Market Industry Growth - As existing fleets age, emphasis is on maintenance and modernization, which are increasingly being outsourced. Service and maintenance programs can generate revenues and help contractors secure their position as a preferred partner. Delta Airlines outsourced its aircraft maintenance to save \$250 million over five years. Timco Aviation Services expanded its facilities to service aging commercial airplanes. As the market for micro jets grows, the need for after-market services, including modifications and maintenance, will grow.

Defense Focus on Quick-Strike Capability - As the US shifts defense spending to quick-strike capability, emphasis will be on rotorcraft and other mobile transport carriers and on missiles. Demand for helicopters in both the US and Europe is increasing as existing fleets age. Raytheon is the leading supplier of missiles, making both air-to-air and land combat. Lockheed Martin is the leader in fleet missiles for the US Navy.

Moon, Mars Initiative - The federal government's current Vision for Space Exploration outlines US plans for establishing an outpost on the moon as a stepping stone to explore Mars. This goal will be NASA's focal point for the near future, including building an international space station scheduled for completion in 2010. Boeing, the leading US contractor for the space station, is also working on the crew exploration vehicle, which is to be developed and tested by 2008, with its first manned mission by 2014.

Updating Air Force Fleet - The Secretary of the US Air Force believes that the largest challenge facing it is to recapitalize its fleet. Nearly all aircraft will have to be replaced in the next 15 to 20 years; the F-15 fighter is 30, and the average age of Air Force tankers is 45. The F/A-22 Raptor program is aimed at providing next generation planes for updating the fighter fleet.

Key Management Issues

Forming International Business Alliances - The size of the Department of Defense (DoD) and NASA contracts has forced industry consolidation. For large contracts where only one or two prime contractors are eligible, qualified subcontractors are forced to seek foreign partners. Northrop is partnering with EADSC for a \$20 billion Air Force tanker contract; Lockheed-Martin is partnering with British Aerospace to develop a Joint Strike Force Fighter.

Managing Growth in Uncertain Government Spending Environment - Aerospace companies depend largely on government programs funded annually and tied to budget priorities. Careful strategic planning is required because supporting major programs can require substantial intellectual and capital resources. New program bids can contend for the same resources and, if awarded, worsen staff and capital problems. Accidents, political control changes, and national priorities shifts can slow or cancel programs, leaving the company with staff surpluses and committed capital.

Managing Working Capital - The industry is highly capital-intensive and contractors are under constant government audit scrutiny. Most of General Dynamics' business with the government is cost plus contracts structured to fund capital requirements, allowing it to use cash and credit for acquisitions. Boeing has eliminated most long-term debt associated with plant and equipment to preserve its credit rating for financing aircraft sales.

Performing Accurate Proposal Financial Analyses - Large contracts are for billions over five to 20 years; a third are fixed-price. While the government tries to level the playing field by mandating common bidding assumptions, errors and/or omissions in competitive contracts often occur and are problems to contractors. As EDS discovered in its Navy base networking, such

omissions can result in multi-million dollar losses.

Developing Commercial Markets for Technology Products - Meeting the Department of Defense (DoD) and NASA contract requirements has resulted in developing and implementing technologically advanced hardware and software. Leading aerospace companies are packaging the technology for commercial and government service sales. Northrop had \$5.1 billion in such revenue in 2004; Lockheed-Martin had \$3.8 billion, of which \$1.7 billion was commercial IT product revenue.

Creating Network-centric Operations - The Pentagon's strategy of a common digital communication network is driving huge technical upgrades. While no single integrated network is in place, the military is structuring its long-range planning around such network capabilities. Northrop won a \$1 billion contract for surveillance jets due to its ability to link surveillance information to a common point for control.

Attracting New Talent to the Industry - The industry workforce is aging: 30 percent are eligible to retire in 2008. Absent the allure of an ambitious space development program, many engineering and technology graduates are opting for jobs in other industries rather than aerospace. To revitalize the industry, NASA has begun discussing bases on the moon and a manned mission to Mars, but these plans clearly lack funding commitments.

Evaluating Pension and Healthcare Plans - As the airline industry continues to operate in distress, airlines are considering defaulting on some pension obligations and transferring them to the government Pension Benefit Guarantee Corporation. Congress has held hearings and is considering a moratorium on pension defaults while it develops legislation. Healthcare and pension plans will be very important in the next round of labor negotiations.

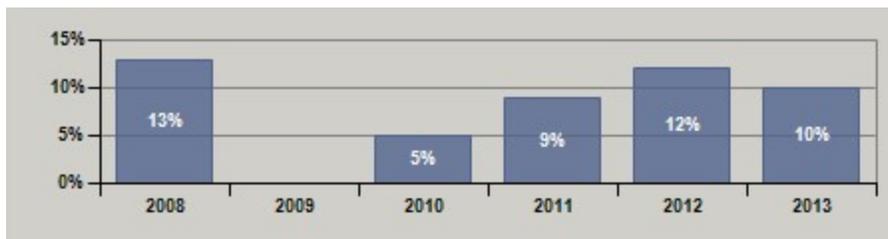
Positioning Sales Teams - The sales cycle can take several years, might require a large onsite presence, and can cost millions. Getting market intelligence about the timing and structure of bids is important. Boeing aggressively offered several discounts to Northwest, an Airbus customer, to win a contract for its new 787 aircraft.

Developing Foreign Sales - Foreign sales can be extremely lucrative, but require domestic sales savvy plus knowledge of foreign business cultures and practices. Sales and Marketing teams usually consist of both US and indigenous staff and can include an intermediary sales consultant to facilitate deals. Boeing's revenues depend in large part on foreign sales and the company recently had success with Singapore Airlines and Air India.

Industry Forecast

The output of US aerospace products is forecast to grow at an annual compounded rate of 7 percent between 2008 and 2013. Data Sourced: Aerospace Industry Association, January 2009

Aerospace Manufacturing Growth Climbs



Web Links and Acronyms

Industry Web Sites

Aerospace Industries Association

Industry news, links, events, press releases, government issues.

<http://www.aia-aerospace.org/>

Assembly Magazine

Industry news, product news, links.

<http://www.assemblymag.com/>

Aviation Week

Industry news, homeland security news and issues, links.

<http://www.aviationweek.com/aw/awhome.jsp>

General Aviation Manufacturers Association

Industry news.

<http://www.gama.aero/home.php>

The Manufacturer

Information about manufacturing in the US and UK.

<http://www.themanufacturer.com/>

US Department of Defense

Military news.

<http://www.defenselink.mil/>

Glossary of Acronyms

CAD - computer-aided design

CAM - computer-aided manufacturing

DoD - Department of Defense

UCAV - Unmanned Combat Aerial Vehicle