

King County International Airport Boeing Field



2003 Economic Impact Study

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King County
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Airport Division

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EXECUTIVE SUMMARY

“Boeing Field,” which is formally named King County International Airport (KCIA) is the subject of this study. It is located in south Seattle in the Duwamish River corridor on land that is primarily located in Tukwila. The airport is the site of final production activity associated with the assembly and delivery of Boeing 737 and 757 jetliners, testing of 777 jetliners, and the military AWACS program. It is also a major general aviation center, and the location of a significant share of the air cargo activity in the Puget Sound region. KCIA serves a diverse set of clients, ranging from private pilots to large corporate aircraft operations, as well as government organizations, retailers, wholesalers, and a variety of other services.

KCIA generated more than 10,000 jobs in King County in 2002, was responsible for sales by King County businesses of \$1.6 billion, and supported the earnings of \$0.5 billion in labor income. Over \$39 million in state and local taxes were generated as a result of economic activity at the airport. Directly, 3,900 people worked at the airport in 2002, earning \$261 million in labor income. Direct sales by businesses at the airport were \$1.04 billion in 2002, \$.68 billion of which were accounted for by aerospace activity. Most business activity at KCIA was sold outside the county economy, as some 82 percent of the gross volume of sales represented “new money” to the county economy. This activity would not be present in King County if KCIA were not operating here. Thus, the airport contributes significantly to the economic base of King County. New money revenues led to sales of \$1.4 billion in King County, generated almost 8,800 jobs, and created labor income of almost \$450 million. These estimates of economic impact were developed using an input-output model specific to King County that traces the indirect and induced economic impacts of the direct spending associated with production at the airport.

Most KCIA tenants have experienced a downturn in business activity over the past several years, but they are overwhelmingly optimistic about recovery of their business volume. Some tenants have had ongoing growth in business activity. The downturn in business activity at the airport is strongly related to the national economic recession and has not been fueled primarily by the Nisqually earthquake or the events of September 11, 2001. Activity at the Boeing facilities at the airport appears to have declined modestly.

Tenants offered many ideas about how King County could help their business; by providing better service and maintenance, promoting the airport to a greater extent to stimulate tenant business, and lowering their operating costs. Many specific ideas about airport operations were offered, such as a fuel-specific plan, movement of freight operations to the west side of the airport for safety reasons, and the need to complete the Master Plan.

The economic impacts associated with KCIA in 2002 were slightly smaller than found in a similar study benchmarked against the year 1998. The earlier study found that 10,596 jobs were supported in King County by the airport, while this study estimated these impacts to be 10,201 jobs. Both studies show that production at the airport contributes strongly to the regional economic base.

ACKNOWLEDGEMENTS

In undertaking this study, we have been almost entirely dependent upon the cooperation of various tenants at King County International Airport. The airport's administrative staff played a key role in helping us with tenants.

We would like to thank a number of people working at the airport for their assistance with this study. In many cases their help created a "snowball effect," as they provided insights about other tenants and subtenants, helping to fill in various pieces of the puzzle of business activity at the airport. Peter G. Anderson at Galvin Flying Service was a fountain of information about not only his business operations, but also about other activities at KCIA. Richard White of the Boeing Company was extremely helpful in gathering current information on Boeing Company activity and activity of Boeing clients and jet engine suppliers. We also thank Judy Galfano at Aviation Partners, Chief Richard Krough of the King County Sheriff's Office, Jeffrey McKinsey and Chris Kidwell at United Parcel Service, Rick Wolfer at Vulcan Flight Operations, Merle Davis at Nordstrom's, Greg Thompson at AirPac Airlines, Steve Lee at Wings Aloft, Clay Lacy at Clay Lacy Flight Center, Hal Tiffany at Shultz Distributing, Toni Long at Airlift Northwest, Clyde Carlson Jr. at San Juan Airlines, Howard Trott at the King County Jet Center, Ken Horwitz at Olde Thyme Aviation, Jerry Lennard at the FAA Tower, Ralph Bufano at the Museum of Flight, Rollie Grams at BAX Global, Lasse Nord at Guido Perla & Associates, Diane Newman at the King County Emergency Management office, Marie Campbell at the Aviation Training Center, Abdel Bellelli at the Cavu Café, Doug Stewart at Caliper Inspection, Tonya Harrison at Helijet, Richard Guinn at Western Metal Products, Jerry Rosso at Rosso Nursery, Jeff Sevela at the Washington National Guard, Karen Walling at Classic Helicopter Corp., Leo Mitchell at Aerocopters, Robert Kihlstrom at American Avionics, Lori Staples at King County Safety and Claims Management, Nancy Griffith at the Aviators Store and Aviator Book Company, Beverly Flores at Aviation Fuel Storage, Winston Marsh at Washington Audiology, John Brigham at Emerald Services, Rod Fichter at Ameriflight, and Bob Fairweather at DHL/Airborne. We hope that we have not omitted names of people who helped us with this study. We are particularly indebted to the tenants who helped us measure subtenant activity at KCIA.

The authors of this study accept the responsibility for any errors made in the use of information supplied by those interviewed in the course of this study.

I. Introduction

This report documents the economic impact of King County International Airport (KCIA) on the King County economy for the year 2002. It is a complete revision of a similar document completed in February 2000, which was benchmarked against the year 1998.¹ This report is organized as follows. Section I describes the study goals and methodology used to undertake the report. The categories of tenants found at KCIA are also described in this section. Section II of the report documents estimated direct economic impacts, as measured by sales, employment, and labor income of businesses located at KCIA. Section III presents results of the economic impact modeling, distinguishing between overall impacts and those associated with “new money”—impacts that would not occur if KCIA were not located here. Section IV presents results from a survey of tenants regarding historic trends in their business and their expectations about the future, and their opinions about how King County could provide them with better services. Section V compares the results from this study with results from the 2000 study. The report also includes three appendices. The first appendix is the questionnaire used for most tenants. The second is a technical appendix regarding the model used to estimate economic impacts. The third identifies the businesses that provided data for this report.

KCIA, which is popularly known as Boeing Field, is located in south Seattle and northern Tukwila near the Duwamish River. It serves as both the location for the completion and delivery of Boeing 737 and 757 product lines, as well as a myriad of general aviation uses. Along the edges of KCIA property there are many other businesses utilizing space on airport land. The Boeing Company also has activity located at KCIA related to the AWACS program, as well as the emerging Boeing Business Jets Division that sells aircraft to corporate customers.

There is another factor that contributes positively to the economic impact of KCIA, i.e., the economic value of KCIA to the National Airspace System². KCIA creates these impacts because of its proximity to Seattle Tacoma International Airport (SeaTac), which allows its use as a very close alternate in case SeaTac cannot be used for any reason, particularly weather. With an elevation about 400 feet lower than SeaTac's, weather is often better at KCIA, and it can often be used when SeaTac is below weather minimums. Road travel time to and from KCIA to SeaTac is short causing minimal impact when passengers, baggage and aircraft servicing is best accomplished from SeaTac. It is not unusual for Pacific weather systems to put airports below minimums in wide areas; airplanes arriving from Asia and Alaska could find that their closest acceptable alternate airport could be Boise or even the Salt Lake City area were it not for KCIA and its unique position. The effect is that airplanes use less fuel, less air time and have the ability to carry more payload than they could otherwise, and it takes less time for people, mail and packages to travel and less time to service, load and re-dispatch the

¹ William B. Beyers & Shaun McMullin. King County International Airport Economic Impact Study. February 2000.

² These impacts were identified by members of the KCIA Business Roundtable, in their review of this report.

airplanes using KCIA. All of these factors mean that the costs of operating at SeaTac are less because of KCIA. As a result all in the Puget Sound area who depend on air travel and air commerce benefit from this cost avoidance.

The factors just described are important, but they are beyond the scope of this study because of their complexity of analysis and because the savings play into the competitive ticket and air freight pricing structure and the way this fits into the business strategies of the airlines. Since these factors all represent increased value of KCIA the total impact figures derived in this study are conservative.

Study Goals

The principal goal in this study is to document the economic impact of tenants at KCIA. To accomplish this goal, we measured the current level of business activity at the airport. In approaching this project, we utilized a list of tenants supplied by KCIA and have supplemented this list with the names of businesses identified during the course of the study that were not included in KCIA's list of tenants and subtenants. In addition to this goal, we have also documented recent changes in business activity of tenants and their expected near-term changes in business activity. As discussed previously, we have also documented how King County might better serve their tenants. The estimation of economic impacts was achieved through the use of a version of the Washington State input-output model, whose coefficient structure was adjusted to approximate King County interindustry relationships. This model allows the estimation of indirect and induced impacts of the direct effects of business activity that take place at KCIA. We tracked several measures of impact in this study, which are commonly measured in impact studies utilizing input-output models. In particular, we have estimated sales (or output), employment, labor income, and selected tax revenue impacts associated with business at KCIA.

A major reason for undertaking this new study was the ongoing master planning process at KCIA and a presumption that since the study benchmarked against the year 1998 study was completed, that there have been major changes in the economic impacts of business activity at KCIA. As we undertook this study, the general expectation was that the combination of events during the past two years related to the Nisqually earthquake, the 9-11 catastrophe, and the national economic downturn, have significantly reduced economic impacts at KCIA. As we shall see in Section III of this report, these assumptions do not appear to be warranted. Business activity at the airport has changed, but overall economic impacts on the regional economy have not downsized significantly.

KCIA is set within the larger production systems of the Central Puget Sound and Washington State economies. Some activity at the airport is related to production that takes place in other parts of the regional economy, such as at Paine Field in Snohomish County. Suppliers to producers located in these other regions bring product to KCIA. The largest activity undertaken at KCIA is the final work on Boeing 737 and 757 product lines, which are manufactured in Renton and flown to KCIA for final testing, painting, and delivery. There is insufficient space in Renton to undertake this activity so aircraft are flown to KCIA for work prior to delivery. KCIA is also a major player in the

regional air cargo business. Businesses such as BAX, UPS, and DHL have operations there, and they coordinate the movement of cargo from locations within the region and from around the Pacific Northwest to clients located elsewhere in the United States and abroad. Niche market players such as Ameriflight also operate at KCIA, feeding cargo to major air cargo shippers such as UPS, and transferring billions of dollars each day of canceled checks to banks across the country. While this study focuses on King County, KCIA is clearly embedded in a much larger regional production system.

Study Methodology

This section provides a general description of the methodology used in this study.

Tenant and subtenant identification

KCIA provided a list of current tenants. The airport sent notices to their tenants that we were undertaking this study and asked them to cooperate with the study team. In a number of cases, tenants had changed or key contacts had changed as we undertook interviews. We relied heavily on KCIA staff to track new tenants and provide us information on tenant characteristics.

Interviews with tenants and some subtenants

We developed the information used in this study principally from interviews with tenants at KCIA. These interviews were conducted from July through November of 2003, with a combination of personal and telephone interviews. Appendix A contains the brief interview form used for this project. The interview information related to economic impacts was interfaced with a model of the King County economy that was developed for the purposes of this study which allowed the estimation of indirect and induced economic impacts. Technical notes on the input-output model are provided in Appendix B. In addition to the use of this model, information on other aspects of the study were tallied and analyzed to provide the results reported in Section IV. In conducting these interviews, we have tried to include activity that is specifically tied to work undertaken at KCIA. Many tenants have offices at KCIA that are also involved with production in other locations, which is intimately tied to what they do at KCIA. We have tried to exclude those portions of their business that are not undertaken at KCIA, or in the case of several service businesses where work is undertaken in the region, but the organization has its headquarters at KCIA.

Appendix C lists the names of businesses that we included in this study. This list is divided into two categories: businesses that we interviewed directly and businesses for which we had information that was included in the study. In most cases, information on the businesses that we included in the study that were not interviewed was derived from interviews with other businesses at KCIA. Most of these are subtenants of businesses that we interviewed, although some are tenants who either refused to provide us with information or could not be reached in the course of the study.

Overview of Tenant Categories

Seven broad categories of tenants are identified at KCIA. They are (1) aerospace manufacturing businesses, (2) fixed base operators (FBOs), and corporate air businesses, (3) air passenger and air cargo businesses, (4) retailers and wholesalers, (5) government agencies, (6) service industry and other tenants, and (7) general aviation. A brief description of each of these categories of tenants is now provided.

(1) Aerospace Manufacturing This category is dominated by the Boeing Company, which has major facilities located on the west side of KCIA associated with the delivery of the 737 and 757 product lines. The airport also serves as the test facility for 777 aircraft. Boeing flies these aircraft to KCIA and completes painting and some aspects of final assembly there. Boeing's clients and engine suppliers also have a major presence at KCIA. The sale process separates engine sales from the sale of the rest of the aircraft, so engine manufacturers are also present in relation to final sales. The airlines that are making purchases of these aircraft also have staffs located at KCIA who are involved with the inspections and other documentation related to the transfers of title and sale of these aircraft to customers of the Boeing Company. It is our understanding that some military/defense activities of the company are also conducted at KCIA, but in interviews with the Boeing Company the nature of these activities were not identified specifically. In addition, Boeing Business Jets has a presence at the airport; this division is involved in selling Boeing jet aircraft to non-airline customers. While the Boeing Company is by far the largest employer within this category, on the east side of the field there are also several companies engaged in the manufacture of parts or components sold to the aerospace trade.

(2) FBOs and Corporate Air and Training Along the east side of the field there are a number of establishments serving largely business markets for private and corporate aircraft. This industry segment at the airport is complex; each enterprise has a somewhat different market focus. Some establishments primarily service jet aircraft either owned locally by wealthy individuals or businesses that they control, while others cater to a diversified set of clients who fly in and out of KCIA. These establishments provide a variety of services to their clients. They service the aircraft that are permanently based or temporarily located at their site. They provide support services such as limousine services, taxis, or car rental and hotel accommodations for people who fly into KCIA and are attending meetings or attending other business functions in the local area. They arrange food services for on-the-ground or in-flight needs. They refuel aircraft. They provide service on aircraft visiting and housed at KCIA. They also provide training to people learning to become pilots. Businesses only providing training are included with the services sector in this study. There are a number of businesses that also sell aircraft. In some cases, these are establishments servicing a particular corporate client or they are engaged in the myriad of activities just described.

(3) Passenger Transportation and Air Cargo KCIA is also the site for a portion of the scheduled (and charter) air transportation market in the Central Puget Sound region. It has several regional passenger carriers who fly to largely western Washington or British Columbia destinations. More important than passenger airline activity at KCIA are the air cargo carriers. Several of these are major enterprises in the global air cargo

industry, but KCIA also has several smaller air cargo companies that serve niche markets such as bank-check clearing operations. Our interviews indicate that billions of dollars in canceled checks are moved through KCIA every day, on their way to being cleared through the banks on which they have been written. KCIA is also the base for the transportation of people within the region for emergency medical care; Seattle serves as a hub for such care, and KCIA serves as the inbound location for people being transported into the Seattle area from outlying regions for movement into area hospitals. In some cases this movement from KCIA to local hospitals is undertaken by helicopter.

(4) Retail and Wholesale KCIA has a number of businesses that are engaged in retail and wholesale activity. They are heterogeneous in nature. Some establishments are clearly focused on selling to the small-aircraft or corporate-aircraft trade located on the east side of KCIA. Others are simply renting inexpensive space on the periphery of the airport. One establishment serves food to passengers using the terminal building for scheduled flights and to airport employees.

(5) Government There is a sizeable public sector presence at KCIA, related to a variety of functions performed by Federal agencies, the State of Washington, and King County. The federal presence at the airport is related to the FAA that operates the control tower, NOAA that maintains an unmanned instrumentation station for weather, and the Department of Homeland Security that handles functions similar to those previously lodged in the Immigration Service and the Customs Service. The State of Washington rents space at the north end of the airport for a local National Guard unit at \$1 per year. King County uses a number of spaces at the airport for functions clearly related to the airport itself (such as airport administration or emergency transport), and to functions taking advantage of low-cost office space (such as a special sheriff's office facility).

(6) Services and Other Activity KCIA is also the location of a number of other business activities. Some of these are located on the west side of the field, while others are on the east side. They are extremely diverse in their nature. These businesses include the Museum of Flight at the southwest corner of the field. Although technically, the Museum of Flight is not an airport tenant, KCIA staff and the museum consider themselves part of the airport "family." The Museum of Flight also abuts the runway and makes use of some KCIA space. Several producer service businesses with no relationship to the airport simply rent office space through KCIA tenants. There are also firms providing services to people interested in training to be pilots which are unrelated to the FBOs and businesses included in group (2) above. Several firms that provide repair service work for the aircraft industry are located at KCIA. A consulting proprietor rents an office there, as does a construction company that is doing some work locally. This is a heterogeneous collection of tenants, most of whom are tightly tied to the airport for their business activity, but there are some "outliers" who are airport tenants largely due to low cost of space for their business activity.

(7) General Aviation KCIA is the home base for more than 500 aircraft, some of which rent space from King County, while others rent space from FBOs or other establishments serving the corporate air community. We did not survey the owners of

these aircraft. However, the expenditures that they make in relation to operating their planes from KCIA, such as fuel and maintenance, would be included in the revenues of the FBOs and others providing services to aircraft at the field. A part of the revenue stream to King County comes from these tenants and the county has some costs associated with servicing these general aviation tenants. The expenses incurred by the county in relation to these general aviation tenants is included with the overall operating costs estimated for the King County Airport Administration establishment. We recognize that general aviation is an important activity at KCIA and we believe that our survey has captured on-site expenditures made by those owning these aircraft.

II. Direct Impacts

Economic impacts are calculated by relating direct economic impacts to the input-output model. Given the formulation that we are using in this study, we needed to estimate sales, employment, labor income, other value added, and regional purchases by all of the tenants covered in this study. These estimates were made as follows.

Through our survey of tenants (see Appendix A), we sought information on sales and employment. In many cases, we obtained both, but in a number of cases tenants could only provide us with the number of employees that they had and their estimated labor costs for these employees. We obtained employment estimates for all tenants included in the study. Where we did not have labor income information, we utilized Washington State Department of Employment Security average annual earnings per worker within the industry in which a particular establishment was classified³. The latest data available from the Department of Employment Security was for the year 2001. Estimates of sales for establishments that did not provide an estimate were derived as follows. The Washington State Department of Revenue makes available detailed estimates of sales by four-digit SIC code annually. We used the most recent file of data (for the year 2001) to estimate sales per employee (or sales per dollar of labor income) and applied the relevant coefficient to the number of employees or labor income to estimate sales⁴.

By far the most important statistic resulting from this process is the aerospace figure. Boeing provided an estimate of the number of their employees working at KCIA, as well as an estimate of the number of airline and engine manufacturer representatives located at KCIA. Boeing was unable to separate the value of their KCIA activity from their overall Puget Sound area business activity and could not estimate the effective sales per person employed by the airlines and engine manufacturers. Therefore, an average value of revenue per employee in aerospace was used to estimate sales by manufacturers in this sector (there were several small aerospace manufacturers besides Boeing included with this sector).

³We used the file named 01aastat.xls available on the Washington State Employment Security Department website (labor market information-download tab).

⁴ This file is named cal_2001.csv, and can be downloaded from the publications tab of the Washington State Department of Revenue website.

We approached the sales and direct outlays of the engine manufacturers and the airline representatives as follows. We assumed that they were not engaged in manufacturing, but rather were largely involved with services associated with delivery, inspection, legal work, etc. We estimated the value of engine manufacturer and airline services would be overstated if their output per worker was valued at the same level as used for aerospace manufacturing. We examined average earnings in seven service industries identified as comparable to the work undertaken by the airline representatives and engine manufacturers: legal services, engineering services, architectural services, management services, management consulting services, public relations services, and miscellaneous consulting services. The average revenue per employee for these services was \$175,932, somewhat less than half of the average revenue per aerospace employee (\$407,549).

Table 1 reports the results of the estimation of sales and labor income, as well as the estimated employment at KCIA and the labor income per employee by industry group. Over 3,900 people worked at KCIA in the year 2002, earning an estimated \$261 million in labor income. Sales of \$1.04 billion occurred, the bulk of which originated in the aerospace sector. There is a considerable variation in labor income per worker across the different industries included in this table. In general, labor income of people working at KCIA is well above the Washington State average of \$37,457 in wage and salary income in the year 2001.

Table 1 Sales, Employment, and Labor Income

	Sales		Labor Income	
	(\$ millions)	Employment	(\$ millions)	Labor Income Per Employee
Aerospace	\$680.748	2,239	174.416	\$77,899
FBO/Corp. Air	101.645	497	25.071	\$50,445
Airlines & Air Cargo	106.725	554	21.005	\$37,949
Retail & Wholesale	40.925	91	3.6	\$39,560
Government	41.212	227	21.35	\$94,053
Other	<u>67.959</u>	<u>326</u>	<u>15.542</u>	<u>\$47,675</u>
Total	\$1039.214	3,934	260.984	Average \$66,349

The direct requirements of businesses located at KCIA were estimated in two ways. First, some establishments provided us with an accounting of their purchases. Second, we used the direct requirements coefficients in the input-output model for the appropriate sectors to estimate direct purchases, but utilized the estimates of labor income that came from the survey of tenants rather than the input-output coefficients. This procedure was used to estimate purchases of each of the groups of tenants identified in Table 1, and then a composite purchases vector was derived, as shown in Table 2.

Table 2 indicates that KCIA business establishments purchased almost \$183 million within King County in the year 2002, with the strongest purchases being made from service industries. Strong purchases are made from other regions, dominated by the imports of components to the aerospace sector from elsewhere in the United States and abroad. Labor income payments are the largest outlays made in the regional economy and form a principal basis for indirect and induced effects that are captured by the input-output model. Other value added includes profits, capital consumption allowances, tax obligations, retained earnings, and other components of value added except labor income.

Table 2 Direct Requirements (\$ millions)

1 Agriculture	\$0.011
2 Forestry and Fishing	0.013
3 Mining	0.251
4 Food Products	2.993
5 Apparel	0.004
6 Wood Products	0.102
7 Paper Products	0.712
8 Printing	2.818
9 Chemical Products	1.255
10 Petroleum	12.098
11 Stone, Clay, and Glass	0.046
12 Primary Metals	0.040
13 Fabricated Metals	1.047
14 Nonelectrical Machinery	1.804
15 Electrical Machinery	1.288
16 Aerospace	17.420
17 Ship and Boat Building	0.001
18 Other Transportation Equipment	0.133
19 Other Manufacturing	3.187
20 Construction	8.929
21 Transport Services	28.429
22 Communications	7.770
23 Utilities	7.353
24 Wholesale and Retail Trade	18.851
25 Finance, Insurance, and Real Estate	15.878
26 Business Services	31.186
27 Health Services	0.000
28 Other Services	19.225
<i>Subtotal, King County Purchases</i>	182.844
Imports from other regions	505.953
29 Labor Income	260.984
30 Other Value Added	89.433
Total Purchases	\$1039.214

III. Direct, Indirect and Induced Impacts

The input-output model calculates estimates of indirect and induced effects, which are added to the direct impacts to obtain estimates of total impacts, as presented in Table 3. The \$183 million in direct purchases made from industries in King County and the \$260 million in value added stimulate the regional economy, produced levels of output, employment, and labor income well above direct impacts reported in Tables 1 and 2. Table 3 indicates that total sales in King County related to activity at KCIA were more

Table 3 Direct, Indirect and Induced Impacts

	Output Mils. \$2002	Employment	Labor Income Mils. \$2002
1 Agriculture	\$0.361	7	\$0.172
2 Forestry and Fishing	0.980	7	0.186
3 Mining	0.646	4	0.164
4 Food Products	17.439	76	2.454
5 Apparel	0.645	11	0.238
6 Wood Products	1.555	6	0.361
7 Paper Products	1.708	7	0.336
8 Printing	13.295	93	4.289
9 Chemical Products	2.842	11	0.845
10 Petroleum	13.044	9	0.492
11 Stone, Clay, and Glass	2.079	13	0.632
12 Primary Metals	0.178	1	0.041
13 Fabricated Metals	2.728	18	0.834
14 Nonelectrical Machinery	2.527	16	1.409
15 Electrical Machinery	1.585	13	0.853
16 Aerospace	696.954	2,278	179.977
17 Ship and Boat Building	0.402	3	0.182
18 Other Transportation Equipment	0.334	2	0.111
19 Other Manufacturing	6.502	57	2.314
20 Construction	47.433	258	15.149
21 Transport Services	251.270	1,480	66.012
22 Communications	23.032	94	9.696
23 Utilities	15.827	23	2.547
24 Wholesale and Retail Trade	158.057	1,879	58.152
25 Finance, Insurance, and Real Estate	79.241	526	17.889
26 Business Services	124.754	729	44.634
27 Health Services	54.120	696	23.699
28 Other Services	128.074	1,884	69.823

Total	\$1647.613	10,201	\$503.494
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than \$1.6 billion in 2002 and more than 10,000 people were employed due to the airport, and over \$0.5 billion in labor income was earned as a result of activity at KCIA.

The strongest impacts are felt in various service industries. A comparison of the direct impacts reported in Table 2 with the total impacts reported in Table 3 shows strong impacts within transportation services; retail trade; finance, insurance, and real estate; business services; health services; and other services. Impacts within the aerospace sector are very small, reflecting the relatively weak interindustry linkage within this sector in the regional economy.

The input-output model has a different multiplier for each sector. It is possible to develop summary or aggregate multipliers for the three measures of impact reported in this study. Table 4 reports these aggregate multipliers. They were calculated by dividing the total impacts for each category of impact by the direct impact measures. For example, the 3,934 people directly employed at KCIA support a total of 10,201 jobs in the regional economy, or 2.59 jobs for each direct job at KCIA. The same computational process was used to derive the output and labor income multipliers contained in Table 4.

Table 4 Aggregate Multipliers

Output Multiplier	1.59
Employment Multiplier	2.59
Labor Income Multiplier	1.93

A more compact version of Table 3 is reported in Table 5. This table distinguishes between manufacturing and non-manufacturing impacts, and also separates non-manufacturing into two service industry components and a non-services grouping. Impacts of KCIA are distributed broadly across each of these aggregate groupings of sectors in the input-output model.

Table 5 Summary of Direct, Indirect, and Induced Impacts

Output (Mils. \$2002)	\$1647.613
Manufacturing	763.816
Nonmanufacturing	883.797
Wholesale and Retail Trade	158.057
Services	306.949
Other	418.791
Employment	10,201
Manufacturing	2,613
Nonmanufacturing	7,587
Wholesale and Retail Trade	1,879
Services	3,309
Other	2399
Labor Income (Mils. \$2002)	\$503.494
Manufacturing	195.371
Nonmanufacturing	308.123
Wholesale and Retail Trade	58.152
Services	138.155
Other	111.816

Tax Revenues

Business activity in King County related to KCIA leads to collections of state B&O taxes, while the spending of labor income yields sales tax revenues to the State of Washington and local governments. Table 6 presents estimates of these tax collections for the year 2002. The B&O tax revenues were calculated by multiplying the sales of each sector by estimated collections per dollar of output and summed across the sectors to yield the total reported in Table 6. State and local sales tax impacts were estimated as a function of labor income and personal income.

Table 6 Selected Tax Impacts (\$ millions)

	<u>State</u>	<u>Local Governments</u>
Sales Taxes	\$23.99	\$6.24
State B&O Tax	\$9.18	
Total	\$39.41	

New Money Impacts

A second measure of economic impact is referred to as “new money.” The previous section presented estimates of economic impacts for all spending taking place at KCIA in 2002. Some of this was spending made by local residents or businesses for goods and services that could be produced someplace else in the region if the airport were not sited here. However, a significant proportion of the activity at the airport involves non-local demand and is production taking place locally that would not occur in the region if the airport were not located here. Table 7 presents estimates of the new money or export share of activity by major industry category at KCIA. The share of markets of KCIA tenants that were made in King County was ascertained in the survey of tenants; this survey is the basis for estimating the level of new money activity taking place at the airport. Clearly, across all the sectors located at KCIA, new money accounts for the bulk of revenues and jobs.

Table 7 New Money Estimates of Sales and Employment

	Sales (\$ millions)	% New Money	Employment
Aerospace	\$679.123	99.8%	2,234
FBO/Corp. Air	23.093	22.7%	113
Airlines & Air Cargo	61.610	57.7%	320
Retail & Wholesale	14.056	34.3%	31
Government	15.019	36.4%	83
Other	54.133	79.7%	260
Total	\$847.033	81.5%	3,040

Through the use of the same methodology as described above for total sales, estimates were made of the economic impact of new money demands and direct requirements. Table 8 presents summary impacts from these new money estimates, which are proportionally similar to approximately 86% of the impacts reported in Table 4. However, these impacts are not exactly proportional due to the variation in the share of sales of the different sectors included in this study that are new money and the varying distributions of direct requirements across the sectors included in this study. New money output impacts are approximately 86% of the total output impacts, while for employment and labor income the comparable percentages are 86% and 89% respectively. This new money analysis indicates that King County’s economy has nearly 9,000 jobs that would not exist if KCIA was not located here.

Table 8 New Money Summary Impacts

Output (Millions \$2002)	\$1414.058
Manufacturing	749.446
Nonmanufacturing	664.612
Wholesale and Retail Trade	145.362
Services	258.592
Other	260.658
Employment	8,793
Manufacturing	2,584
Nonmanufacturing	6,209
Wholesale and Retail Trade	1,665
Services	3,016
Other	1,528
Labor Income (Millions \$2002)	\$446.617
Manufacturing	203.722
Nonmanufacturing	242.895
Wholesale and Retail Trade	53.130
Services	117.276
Other	72.489

The new money impacts are similar in their distribution to the overall impacts of KCIA. The domination of aerospace in the new money impact scenario is even greater than in the baseline impact estimate. However, the indirect and induced impacts of both scenarios are largely felt in the services related to the consumption-related impacts associated with the spending of labor income.

A final perspective on new money is given in Table 9, which contains tax revenue impacts associated with the new money scenario. This table indicates that tax revenue impacts are approximately 88% of the values reported in Table 6.

Table 9 New Money Tax Impacts (\$ millions)

	<u>State</u>	<u>Local Governments</u>
Sales Taxes	21.28	5.53
State B&O Tax	7.79	
Total	34.60	

In summary, KCIA supported almost 8,800 jobs in King County in 2002 that would not have been located here if the airport were not present. It generated \$1.4 billion in sales, \$.45 billion in labor income, and \$35 million in tax revenues to state and local governments that represented net gains to the regional economy due to the presence of the airport.

It should be noted that these economic impact estimates are limited to producers located in King County. Spending by users of the airport also lead to production elsewhere in the regional and state economy, such that there are other economic impacts regionally that are not captured in this study. For example, fuel sold at the airport is not refined in King County, but much of it is refined at petroleum refineries located in north Puget Sound. It was not possible in this study to document the larger economic impacts of KCIA on the Central Puget Sound region or Washington State economies. If measures of spending related to production elsewhere in the state economy had been measured, the economic impacts would be higher than documented in this report.

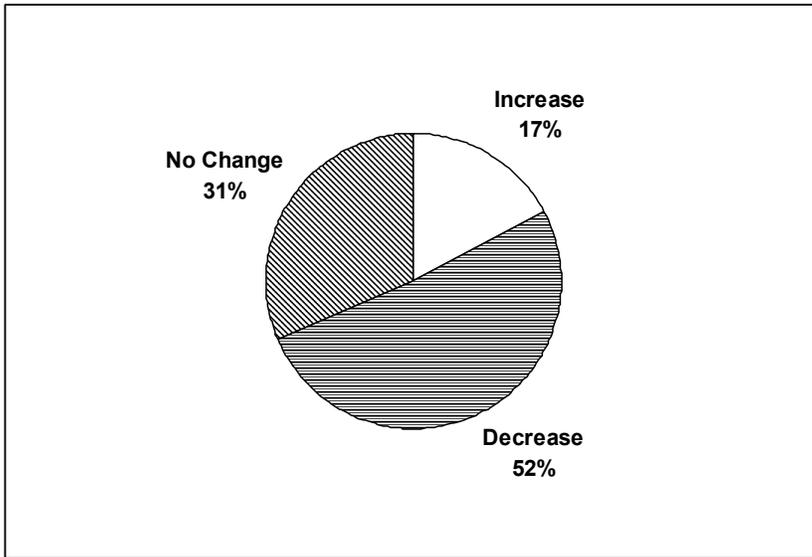
IV. Changes in Business Activity and Opportunities for KCIA to Better Serve Tenants

Several questions were included in our interviews that were aimed at better understanding changes in business activity at KCIA during the last several years and providing a perspective on where tenants thought that their businesses were headed in the next several years. The tenants were asked for ideas on how King County could better serve them. In this section the results of these interviews are summarized.

Recent Trends in Business Activity

Figure 1 summarizes the answers received to a question asking how sales/revenue had changed since the Nisqually Earthquake, the terrorist attacks of September 11, 2001, and through the recent economic downturn. Most tenants have experienced a decrease in revenues, although roughly half of them have not had a downturn in revenues. We asked respondents to explain why their revenues changed (if they did). The most common response with regard to a decrease in revenues was related to the recession that the national economy has experienced. However, the events of 9-11 are also creating significant difficulty for some tenants. These difficulties are demonstrated in vastly increased insurance costs that create more costly services or in decreased revenues to the public sector that translate into more slender budgets for government services. The Nisqually Earthquake was discounted as a long-term source of negative impact, although many businesses noted that for a short period of time it was very disruptive. Information was sought on the percentage change in business activity from these tenants; some of those selling commodities such as aircraft have had double-digit downturns in sales, while those engaged in services experienced more modest downturns in the 5-15 percent range.

Figure 1 Change in Sales (Revenue) During the Past Two Years



N=35

Increases in business activity were related to the growth of the underlying business activity of the tenants. In some cases this was related to the development of new product lines and in other cases due to general business growth. The latter was noted by a number of major corporate air tenants. There was also an undercurrent of growth in business due to the events of 9-11 and people seeking to travel outside of general commercial passenger airlines. Increases in business activity were recorded in a moderate range, such as 5-20 percent.

Establishments not reporting any change in economic activity were not always asked why their business had been stable. Our questionnaire was designed to probe those with losses or increases in business as to why they experienced change. However, some businesses that indicated no change in their business activity did provide some explanation. Some literally had not experienced any changes in their business volume (“stagnant”), while one noted a 70 to 80 percent drop in business after 9-11 and now a rebound to pre 9-11 business volume.

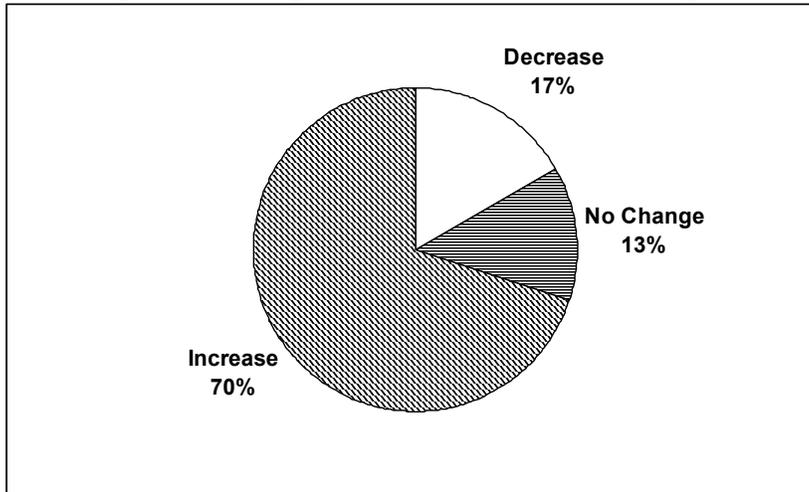
In retrospect we might have asked the tenants about changes in their business since 1998, the year against which an earlier economic impact study was benchmarked. We may have found many tenants reporting downturns over the past two years had experienced growth in the 1998-2001 time frame.

Expectations For The Near Future

Businesses at KCIA have very different opinions about their future, compared to their responses regarding their experiences during the past several years. As Figure 2 clearly indicates, 70 percent anticipate an increase in their revenues. In many cases, they sense that this is going to occur as a result of the economy’s recovery, but some are operating in industries already experiencing growth and they expect that growth to

continue. Many expecting an increase in sales or revenue were cautiously optimistic. Passenger air and air cargo tenants, and service industry tenants were the most likely to expect an increase in sales, while relatively few government and FBO/corporate air tenants expected an increase in revenues. Comments such as “return of tourism, recovering economy” were frequent. The experiences of the past two years are driving business to some tenants at KCIA, as indicated by these quotes: “constraints due to public travel,” “operations are up: homeland security money.”

Figure 2 Expected Change in Sales or Revenue During the Next Two Years



N=30

Businesses indicating that they expected business to decrease cited a variety of reasons for their pessimistic views. These quotations are indicative of the types of comments made: “9-11 charter has not recovered, economic downturn (not optimistic)”, “smaller companies will be hurting,” “economic downturn,” and “depends on the turbulent economy.” Unfortunately, not enough comments were obtained from those indicating no change in their business to characterize why they thought their business would be stable.

Opportunities for King County

Tenants were asked if King County could do anything to help their business (besides reducing rents and fees). Responses to this question were quite varied, but fall into five broad categories: (1) doing nothing, (2) providing better service and maintenance, (3) promoting the airport to a greater extent to stimulate tenant business, (4) gripes about costs of operating, and (5) specific suggestions for planning and operations.

Approximately one third of the tenants felt that the County could do nothing to help their business. Some of these people were complimentary to the airport administration for their recent efforts. Comments such as “airport has been supportive,” and “management is better than it used to be,” and “staff and maintenance have been very helpful over the years” epitomize these comments.

Specific comments on planning and management were offered by the next largest share of tenants. These people offered up a potpourri of ideas and comments. These comments were simply recorded, in a somewhat edited manner:

- “Would like a building where (we) can control our fuel costs.”
- “New terminal is too spread out; it is not efficient to operate in.”
- “County does not know how to deal with security; rules and regulations don’t make sense.”
- “County has been working on Master Plan for twenty years. What gives?”
- “County should have a plan for how fuel goes through the airport, that is petroleum specific.”
- “Freight should be on the west side of the field to ease access to long runway.”

Some tenants sought better service and maintenance from the County. They made comments such as these:

- “(County) needs to be more business friendly. Response time is too slow.”
- “Property guys are slow to reply.”
- “Replace ramp (concrete) surface on time.”
- “Could have a good maintenance schedule.”

Several tenants thought that the County could be more proactive in promoting businesses at the airport:

- “Advertise for us, provide a shuttle service between Sea Tac and Boeing Field. This would bring more revenue.”
- “People need to know the airport is open for business. People think Boeing Field is limited to aircraft manufacturing and not open to the public. The administration needs to engage in an advertising campaign to help businesses.”
- “KC should help with education, need help with promotion.”
- “We’d really like to see a quarterly celebration. Why no 100 year celebration? County should pay for newspaper ads promoting the airport.”

And, even though we asked tenants to ignore costs to them from King County, a number did gripe about costs:

- (We need) “financial assistance, 15 percent rent increase does not help”
- “Roll back recent rent increase to pre 9-11 levels.”
- “Costs driven up by County hurt businesses. Billionaires club may hurt more than help.”
- “Curtail maintenance costs.”
- “Raising the rent really hurt us.”

The airport noted that landing fees have not been increased since 1972, and that the fuel fee has not increased in twelve years. Aircraft based at KCIA do not pay landing fees. The airport does limited advertising in the Pacific Northwest Aviation and Business Journal and in Robinson Newspapers. The airport held a 75th anniversary celebration and airfield rededication.

These comments provide food for thought for airport management staff. They do not include responses from the Boeing Company to these questions. We felt that influences guiding Boeing's decisions at KCIA are affected more by global market forces, rather than KCIA policies. It should be noted that the Boeing Company has very long-term leases on KCIA spaces compared to other tenants, and would be less sensitive to questions related to relatively short-term management strategies developed by KCIA.

V. Comparison with 1998 Economic Impact Study

This study has been conducted through the utilization of a methodology almost identical to that used in the 1998 KCIA Economic Impact Study⁵. We purposefully tried to use measurement procedures so that we could compare results obtained in the current study with the one benchmarked against the year 1998. Although this was our approach, there are some differences in procedure that have influenced impact analysis outcomes and direct impact measurements.

Key inputs common to both studies are:

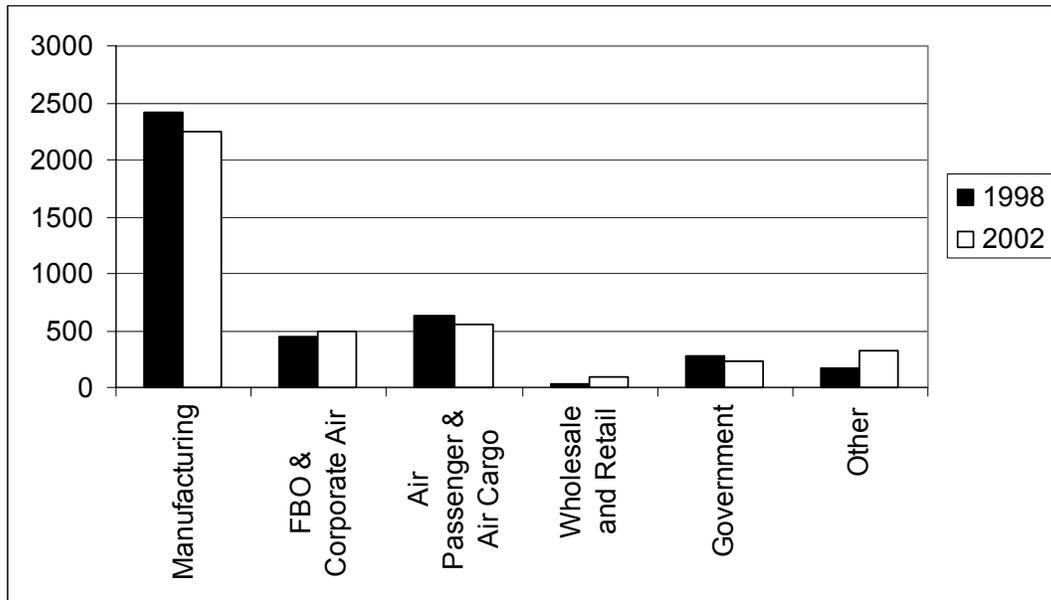
(1) Employment, labor income, and sales of tenants and subtenants at the airport, as reported by them to the study team. This study and the 1998 study are essentially benchmarked against what tenants have reported to us. We have assumed that they have provided us with accurate estimates of their business activity.

(2) A model of the regional economy with similar multiplier structures, based on the 1987 Washington State input-output model. There are slight differences in the multiplier structure in the current study and in the model used in the 1998 study, based on minor differences in the series of location quotients used to adjust the Washington State input-output model coefficients to a King County structure.

Figures 3, 4, and 5 portray the relative importance of broad industry groups for the year 1998 and 2002. Employment is estimated to have declined from 4,078 in 1998 to 3,934 in 2002. Figure 3 indicates that most of this decline is in manufacturing, although FBO & corporate air, wholesale and retail, and the "other" category also had employment growth.

⁵ William B. Beyers & Shaun McMullin. King County International Airport Economic Impact Study. February 2000.

Figure 3 Employment at KCIA in 1998 and 2002



Figures 4 and 5 portray the shares of employment accounted for by various tenant categories in 1998 and 2002. These two pie charts are not dramatically different. However, it is evident that manufacturing and government accounted for a smaller share of employment, while the other categories of employment had relative expansion.

Figure 4

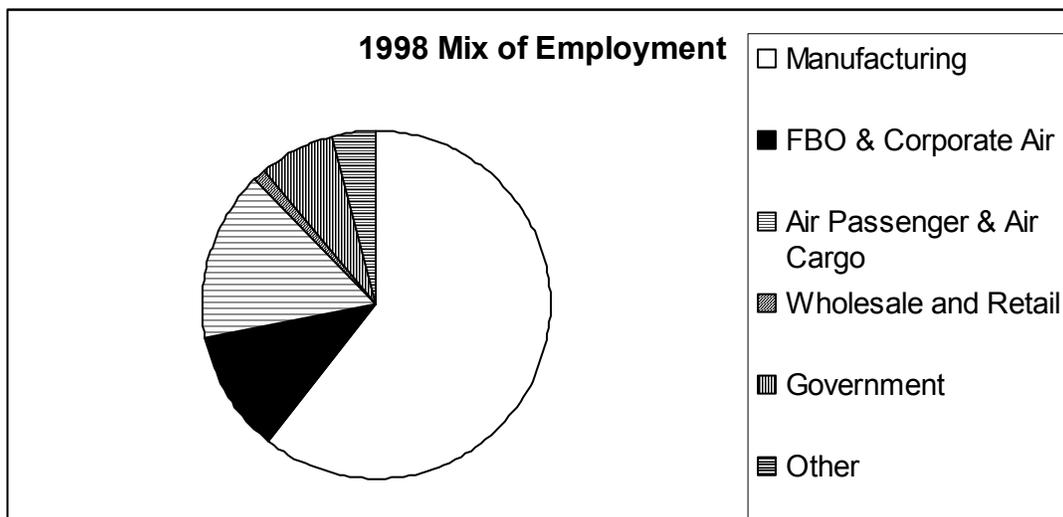
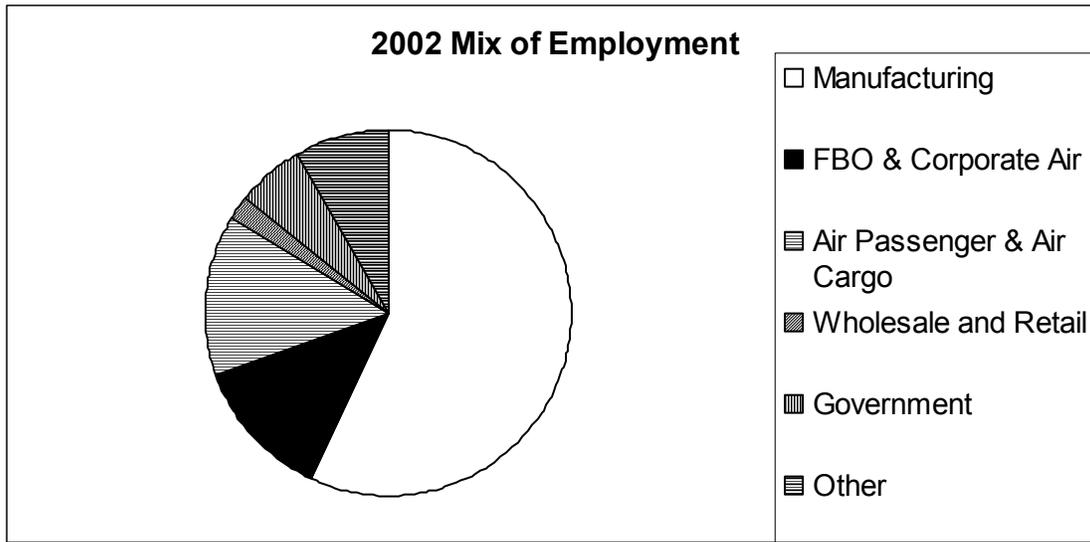


Figure 5



Multipliers used in the two studies were very similar. Table 10 presents these multiplier estimates. The small difference in multipliers is likely accounted for by small variations in the input-output direct, indirect, and induced requirements matrices used in the two studies and is related to changes in the mix of industries located at KCIA.

Table 10 Multiplier Comparison

	<u>1998 study</u>	<u>Current study</u>
Output Multiplier	1.47	1.59
Employment Multiplier	2.59	2.59
Labor Income Multiplier	1.94	1.93

Direct measures of sales and labor income are higher in the current study than in the 1998 study, while labor income levels per job are sharply higher. Differences in prices and productivity are likely contributors to these differences. Table 11 reports sales and labor income per worker for the two studies. It should be noted that this table has a slightly different scheme for grouping businesses than used in the 1998 study, and the authors have adjusted data in the 1998 database to make them comparable to the industry definitions used in the current study. The 1998 study counted a number of the reservists at the National Guard station as employees in the government sector, while in this study we did not include these people as employees. Non-reservist employment at this establishment has been counted in both studies. The dramatic difference in labor incomes between the two studies appears in the government sector. Outside of this significant upward shift in government employee earnings, the magnitude of earnings in the other sectors are relatively comparable.

Table 11 Sales and Labor Income Comparison

	1998 Sales <u>\$ millions</u>	2002 Sales <u>\$ millions</u>	1998 Labor Income <u>Per Job</u>	2002 Labor Income <u>Per Job</u>
Manufacturing	\$778.29	\$680.748	\$52,623	\$77,899
FBO & Corporate Air	67.34	101.645	\$44,044	\$50,445
Air Passenger & Air Cargo	81.03	68.025	\$30,381	\$37,949
Wholesale and Retail	2.79	40.925	\$26,944	\$39,560
Government	26.52	41.212	\$44,007	\$94,053
Other	<u>20.06</u>	<u>67.959</u>	\$45,244	\$47,675
Total	\$976.03	\$1,039.214	x	x

A final comparison between the two studies is made in Table 12. This table presents estimates of the share of sales that were new money in the two studies. As with the other comparisons in this section, this table is not directly comparable to the percentages of new money shown in the 1998 study, due to slight differences in industry groupings. Table 12 has particular establishments classified in the same industry groupings for the purpose of this comparison. The overall orientation of businesses at KCIA remains strongly tied to export markets, with a nearly identical aggregate percentage of new money in the two studies. The “other” sector shows a strong increase in export orientation, as is the case more modestly for government, and passenger air and air cargo.

Table 12 New Money Comparison

	1998 Study	Current Study
Manufacturing	99.3%	99.8%
FBO & Corporate Air	27.6%	22.7%
Air Passenger & Air Cargo	52.4%	57.7%
Wholesale and Retail	45.8%	34.3%
Government	29.5%	36.4%
Other	31.7%	79.7%
Total	87.0%	81.5%

VI. Concluding Comments

This study has documented the economic impact of KCIA on the King County economy for the year 2002. It was based on a survey of nearly 100 percent of the principal tenants at KCIA and on information that they provided us with regarding their subtenants. We believe that tenants in this study have provided us with reasonably accurate information, and that the impact estimates developed in this study are a good approximation of the economic impact of KCIA for the year 2002.

The project has clearly measured the diverse economic activity that takes place at KCIA, a busy general aviation airport in the middle of one of the nation's largest metropolitan areas. The airport makes a significant contribution to the economic base of King County. The nature of this contribution has changed somewhat since the conduct of the Economic Impact Study benchmarked against the year 1998. Clearly, the recent recession has had a negative impact on some sectors, but tenants on the east side of the field express optimism regarding their future development opportunities as the economy recovers. This includes expectations by FBOs and corporate air businesses, as well as air cargo and passenger air carriers that their businesses will expand. This optimism is based not only on the recovery from the recession, but also because of a growing desire by air passengers to use alternatives to traditional commercial airlines. The development of a dramatically expanded market for winglets by Aviation Partners could increase engineering activity, although manufacturing of the product line by this company would not be at Boeing Field.

The major cause for uncertainty regarding future impacts revolves around the Boeing Company, which has dramatically downsized its employment and production levels in the Puget Sound region since the late 1990's. Boeing's announcement that it will terminate production of the 757 line could have adverse impacts on KCIA aerospace activity if there are no compensating increases in orders for the 737 product line. The future of this product line is also the subject of speculation, as Boeing moves towards the production of the new 7E7 jetliner.

There is some dynamism in the tenant base at KCIA, such as the movement of some King County offices out of the airport, the movement of South Seattle Community College out of the airport, and the assumption of a major FBO by a new operator--Clay Lacy--who is emphasizing services to corporate jet aircraft. This dynamism will continue and will render studies such as this one obsolete as the airport milieu evolves in ways that are impossible to forecast.

Appendix A. Survey Questionnaire
King County International Airport Economic Impact Study

Responses to this survey will be treated as confidential information. Responses from individual businesses will be combined with information from other respondents to preserve the confidentiality of your response.

Establishment Name _____

Interviewer _____ Date of Interview _____

Person Interviewed _____

1. Description of products or services: _____

2. Sales or Budget (most recent fiscal year) \$ _____

3. Market Composition (% of sales or budget):

	% of Total	% from King County sources
Industry Markets	%	%
Household Markets	%	%
Governments – Local or State	%	%
Government – Federal	%	%
Total	100.0%	

4. How many employees on average do you have that are: _____ Full time _____ Part time

5. What was your total level of employee compensation in your most recent fiscal year?
 (E.g. wages & salaries as well as fringe benefits)
 \$ _____

6. How has your sales (budget) changed since the year Nisqually earthquake, the events of 9-11, and the downturn in the national economy?

No Change Has Decreased Has Increased

a. If their sales (budget) has changed, by what % _____
 b. Why has this change occurred?

7. How do you anticipate you sales (budget) will change over the next 2 years (to 2005)?

No Change Will Decrease Will Increase

a. If they think their sales will change, by what % _____
 b. Why do you expect this change?

8. What could the airport do to help their business (besides reducing rents and/or lease excise tax?)

9.. (Ask this only to those with no recorded subtenants). Do you have tenants or subtenants? If yes, who are they, how many people do they employ, what is their business, and how much of it is sold in King County?

Appendix B. Technical Notes on the Input-Output Model⁶

The impact estimates developed in this study stem from the utilization of an “input-output model.” Models of this type are based on static, cross-sectional measures of trade relationships in regional or national economies. They document how industries procure their inputs and where they sell their outputs. Pioneered by Wassily Leontief, who won the Nobel Prize in Economic Science for his insights into the development of input-output models at the national level, these models have become “workhorses” in regional economic impact analysis in recent decades.

Washington State is fortunate to have a rich legacy of research developing input-output models. Led by the late Philip J. Bourque of the University of Washington Graduate School of Business, along with the late Charles M. Tiebout, input-output models have been estimated in Washington State for the years 1963, 1967, 1972, 1982, and 1987. No other state in the United States has this rich historical legacy of survey-based regional input-output models.

Input-output models decompose regional economies into “sectors”--groups of industries with a common industrial structure. The heart of these models are “Leontief production functions,” which are distributions of the cost of producing the output of sectors. Leontief augmented the national accounts schema developed by Kuznets (also a Nobel laureate in economics) to take into account the significant levels of intermediate transactions that occur in economic systems in the process of transforming raw materials and services into “finished products,” or “final products.” Sales distributions among intermediate and final sources of demand are used as the accounting bases for the development the core innovation of Leontief: that these relationships can be used to link levels of final demand to total industrial output by way of a system of “multipliers” that are linked through the channels of purchase in every industry to the production of output for final demand.

This system of relationships is based on accounting identities for sales. Mathematically, this system of relationships may be represented as follows. For each industry we have two balance equations:

$$(1) X_i = x_{i,1} + x_{i,2} + \dots + x_{i,n} + Y_i$$

$$(2) X_j = x_{1,j} + x_{2,j} + \dots + x_{n,j} + V_j + M_j$$

where: X_i = total sales in industry i,
 X_j = total purchases in industry j
 $x_{i,j}$ = intermediate sales from industry i to industry j
 Y_i = final sales in industry i
 M_j = imports to sector j
 V_j = value added in sector j.

⁶ This section was taken from: W. Beyers & D. Lindahl. The Economic Impact of Technology -Based Industries in Washington State in 2000. June 2001.

For any given sector, there is equality in total sales and total purchases:

$$(3) X_i = X_j \text{ when } i=j.$$

This system of transactions is generalized through the articulation of Leontief production functions, which are constructed around the columns of the regional input-output model. They are defined in the following manner.

Let us define a regional purchase coefficient:

$$r_{i,j} = x_{i,j}/X_j.$$

Rearranging,

$$x_{i,j} = r_{i,j}X_j$$

Substituting this relationship into equation (1) we have:

$$(4) X_i = r_{i,1}X_1 + r_{i,2}X_2 + \dots + r_{i,n}X_n + Y_i$$

Each sector in the regional model has this equation structure, and since the values of X_i equal X_j when $i=j$, it is possible to set this system of equations into matrix notation as:

$$(5) X = RX + Y$$

This system of equations can then be manipulated to derive a relationship between final demand (Y) and total output (X). The resulting formulation is:

$$(6) X = (I-R)^{-1}Y$$

where the $(I-R)^{-1}$ matrix captures the direct and indirect impacts of linkages in the input-output model system. The input-output model utilized in the modeling for this research project was developed by aggregating the 1987 Washington State input-output model from its original specification at the level of 62 sectors to 28 sectors, and adjusting the direct requirements coefficients to simulate the structure of the King County economy⁷.

A major issue that surrounds the estimation of the $(I-R)^{-1}$ matrix is the level of “closure” with regard to regional final demand components, which are personal consumption expenditures, state and local government outlays, and capital investment. It is common practice to include the impacts of labor income and the disposition of this income in the form of personal consumption expenditures in the multiplier structure of regional input-output models. The additional leveraging impact of these outlays are

⁷ Chase, R., P.J. Bourque, & R.S. Conway Jr. (1993) Washington State Input-Output 1987 Study. Olympia: Washington State Office of Financial Management Forecasting Division.

referred to as “induced” effects in the literature on models of this type. It is less common to include state and local government expenditures in the induced effects impacts, but it can be argued that demands on state and local governments are proportional to the general level of business activity and related demographics. In contrast, investment is classically argued to be responsive to more exogenous forces, and is not a simple function of local business volume⁸.

In the model which we developed for this impact study we have included personal consumption expenditures and state and local government expenditures as a part of the induced-demand linkages system. We have considered personal consumption expenditures to be a function of labor income. We have considered state and local government expenditures to be a function of other components of value added. The location quotient approach to adjusting the direct requirements coefficients was used to adjust the Washington State structure to an estimated King County structure. The resultant Leontief inverse matrix is displayed in Table B-1.

The 1987 Washington State input-output model, which forms the benchmark for the analyses conducted in this study, was estimated at the level of 62 sectors⁹. For the purposes of this impact study the model was aggregated to 28 industrial sectors and had personal consumption plus state and local government expenditures included in the model to capture the induced impacts related to these two “final demand” categories. Estimates of demand, employment, income, and direct expenditures for the year 2002 were used to calculate the impact estimates. The specific form of the model used in this analysis takes into account price and labor productivity changes between 1987 and 2002 for each sector.¹⁰ Other models which have been used for various impact studies in Washington State include the Washington Policy and Simulation Model (WPSM) developed by Conway, and IMPLAN models developed by the U.S. Forest Service. The WPSM model is an integrated econometric and input-output model; it has a more inclusive structure than the Washington input-output model used here, leading to higher and time-distributed multipliers.¹¹ The IMPLAN models have a structure which is

⁸ For a discussion of these modeling issues see G.J.D. Hewings. (1985) Regional Input-Output Analysis. Beverly Hills: Sage Publications.

⁹ See Chase, R., Bourque, P., and Conway, R., op.cit.

¹⁰ Conway, R. & W. Beyers (1996) Seattle Seahawks Economic Impact. For HOK Sports and King County.

¹¹ Conway, R. (1990) “The Washington Projection and Simulation Model: A Regional Interindustry Model,” International Regional Science Review, Vol. 13, pp. 141-65.

similar to the Washington input-output model; they are based on the benchmark US model, and have been used for analyses of issues such as the impact of old growth forest conservation strategies.¹² For the purposes of this impact analysis, the Washington input-output model provides an excellent basis for calculating impacts. Utilization of these other models would yield similar, but not identical, levels of impact as presented in this report.

¹² Carroll, A., D. Holland, D. Hughes, K. Johnson, R.G. Lee, J. Machlis, C. Nasser, R. Scott, P. Sommers, H. Birss, and K. Warren. (1991) Revitalizing Timber Dependent Regions of Washington. University of Washington, Northwest Policy Center.

Table B.1

Direct, Indirect, and Induced Requirements Table

(Columns show final demand sector)

	1	2	3	4	5	6	7	8	9	10
1 Agriculture	1.01065	0.00061	0.00042	0.01325	0.00074	0.00048	0.00040	0.00051	0.00049	0.00010
2 Forestry and Fishing	0.00195	1.01914	0.00135	0.01450	0.00092	0.15302	0.01472	0.00137	0.00135	0.00028
3 Mining	0.00092	0.00050	1.01144	0.00095	0.00036	0.00045	0.00075	0.00042	0.00114	0.00031
4 Food Products	0.05644	0.02521	0.01821	1.06102	0.01662	0.02138	0.01875	0.02231	0.02192	0.00426
5 Apparel	0.00147	0.00094	0.00092	0.00090	1.00761	0.00167	0.00089	0.00111	0.00200	0.00020
6 Wood Products	0.00415	0.00448	0.00441	0.00250	0.00163	1.14551	0.10526	0.00322	0.00330	0.00076
7 Paper Products	0.00205	0.00125	0.00116	0.00741	0.00243	0.00165	1.02319	0.01628	0.00322	0.00055
8 Printing	0.01231	0.01192	0.01091	0.01146	0.00934	0.01195	0.00983	1.02205	0.01377	0.00257
9 Chemical Products	0.02808	0.00807	0.01030	0.00440	0.00147	0.00764	0.04175	0.00611	1.05007	0.00101
10 Petroleum	0.00297	0.00213	0.00167	0.00108	0.00091	0.00193	0.00258	0.00126	0.00156	1.00176
11 Stone, Clay, and Glass	0.00333	0.00396	0.01234	0.01631	0.00268	0.00382	0.00322	0.00292	0.00450	0.00237
12 Primary Metals	0.00020	0.00058	0.00025	0.00031	0.00017	0.00047	0.00022	0.00021	0.00027	0.00012
13 Fabricated Metals	0.00386	0.00508	0.00687	0.01762	0.00198	0.00962	0.00442	0.00440	0.00577	0.00134
14 Nonelectrical Machinery	0.00192	0.00169	0.00502	0.00197	0.00093	0.00512	0.00262	0.00134	0.00190	0.00058
15 Electrical Machinery	0.00045	0.00218	0.00160	0.00047	0.00039	0.00238	0.00059	0.00052	0.00091	0.00035
16 Aerospace	0.00021	0.00019	0.00014	0.00017	0.00010	0.00033	0.00027	0.00013	0.00284	0.00004
17 Ship and Boat Building	0.00054	0.00840	0.00044	0.00041	0.00040	0.00173	0.00051	0.00052	0.00049	0.00010
18 Other Transportation Equipment	0.00073	0.00027	0.00026	0.00035	0.00022	0.00080	0.00028	0.00029	0.00029	0.00006
19 Other Manufacturing	0.00591	0.00980	0.00438	0.00869	0.00360	0.01088	0.00850	0.01722	0.00882	0.00243
20 Construction	0.06143	0.09021	0.06888	0.04464	0.06163	0.06613	0.05848	0.06284	0.08507	0.02028
21 Transport Services	0.03195	0.02549	0.02457	0.02896	0.02492	0.07171	0.03963	0.02797	0.02688	0.00983
22 Communications	0.02765	0.02171	0.02548	0.01702	0.03025	0.02491	0.01996	0.03440	0.02561	0.00510
23 Utilities	0.01793	0.00954	0.01410	0.01221	0.01103	0.01434	0.03097	0.01253	0.02160	0.00882
24 Wholesale and Retail Trade	0.21227	0.15609	0.15220	0.14707	0.15245	0.19255	0.16998	0.20285	0.20087	0.04261
25 Finance, Insurance, and Real Estate	0.07542	0.06556	0.08023	0.04714	0.06390	0.07911	0.06153	0.07736	0.07165	0.01368
26 Business Services	0.03043	0.03626	0.03986	0.04233	0.04576	0.03420	0.03340	0.06916	0.03952	0.00770
27 Health Services	0.05975	0.04835	0.04937	0.03191	0.04440	0.05201	0.04215	0.05912	0.05561	0.01035
28 Other Services	0.08902	0.07583	0.10144	0.05370	0.07203	0.08799	0.06870	0.10152	0.09464	0.01603
29 Labor Income	0.72870	0.56421	0.59525	0.38265	0.54284	0.63122	0.50642	0.71655	0.66673	0.12041
30 Other Value Added	0.46566	0.88877	0.52214	0.37955	0.31762	0.46572	0.48130	0.55098	0.66300	0.19828

**Table B.1, continued
Direct, Indirect, and Induced
Requirements Table**

	11	12	13	14	15	16	17	18	19	20
1 Agriculture	0.00046	0.00030	0.00038	0.00047	0.00048	0.00030	0.00046	0.00040	0.00049	0.00063
2 Forestry and Fishing	0.00131	0.00078	0.00100	0.00117	0.00126	0.00069	0.00223	0.00108	0.00220	0.00373
3 Mining	0.02575	0.00188	0.00037	0.00039	0.00042	0.00026	0.00047	0.00035	0.00040	0.00377
4 Food Products	0.02103	0.01331	0.01694	0.02105	0.02139	0.01300	0.02010	0.01780	0.02029	0.02126
5 Apparel	0.00096	0.00102	0.00082	0.00102	0.00104	0.00066	0.00229	0.00086	0.00173	0.00101
6 Wood Products	0.00344	0.00158	0.00207	0.00202	0.00254	0.00101	0.01025	0.00243	0.01023	0.02118
7 Paper Products	0.00490	0.00115	0.00250	0.00185	0.00245	0.00103	0.00116	0.00184	0.00255	0.00172
8 Printing	0.01149	0.00753	0.00962	0.01265	0.01186	0.00705	0.01152	0.01182	0.01215	0.01234
9 Chemical Products	0.00477	0.00687	0.00909	0.00518	0.00365	0.00156	0.00487	0.00555	0.01429	0.00392
10 Petroleum	0.00446	0.00138	0.00107	0.00119	0.00116	0.00072	0.00124	0.00099	0.00110	0.00195
11 Stone, Clay, and Glass	1.03244	0.00195	0.00276	0.00279	0.00280	0.00142	0.00375	0.00249	0.00322	0.03858
12 Primary Metals	0.00050	1.02272	0.01063	0.00225	0.00071	0.00017	0.00101	0.00057	0.00095	0.00254
13 Fabricated Metals	0.00481	0.00282	1.01615	0.01053	0.02510	0.00262	0.00706	0.00700	0.00576	0.02053
14 Nonelectrical Machinery	0.00337	0.00275	0.00832	1.03108	0.00681	0.00371	0.00560	0.00210	0.00485	0.00281
15 Electrical Machinery	0.00059	0.00098	0.00045	0.00593	1.01138	0.00110	0.00195	0.00104	0.00374	0.00336
16 Aerospace	0.00021	0.00015	0.00292	0.00017	0.00419	1.01384	0.00662	0.00676	0.00017	0.00019
17 Ship and Boat Building	0.00049	0.00032	0.00039	0.00048	0.00049	0.00031	1.00254	0.00039	0.00046	0.00049
18 Other Transportation Equipment	0.00029	0.00019	0.00090	0.00154	0.00029	0.00017	0.00106	1.00535	0.00026	0.00056
19 Other Manufacturing	0.00743	0.00677	0.01216	0.01101	0.02510	0.00571	0.01143	0.01584	1.03959	0.00953
20 Construction	0.09182	0.04292	0.05654	0.06087	0.06103	0.02913	0.08398	0.05464	0.05763	1.05475
21 Transport Services	0.05002	0.03282	0.02191	0.02522	0.02421	0.01403	0.02070	0.01807	0.02770	0.02885
22 Communications	0.02773	0.01533	0.02350	0.02822	0.02852	0.01620	0.02317	0.02200	0.02665	0.02622
23 Utilities	0.03422	0.05209	0.01108	0.01180	0.01687	0.00731	0.01460	0.01059	0.01195	0.01197
24 Wholesale and Retail Trade	0.18451	0.13576	0.17085	0.20658	0.21132	0.11012	0.18958	0.17736	0.18526	0.22666
25 Finance, Insurance, and Real Estate	0.07821	0.04440	0.06232	0.07111	0.07680	0.04317	0.06353	0.05710	0.06898	0.07805
26 Business Services	0.05772	0.02323	0.03720	0.04139	0.04665	0.03248	0.03322	0.03203	0.03738	0.03242
27 Health Services	0.05110	0.03352	0.04348	0.05452	0.05572	0.03628	0.05442	0.04552	0.05073	0.05313
28 Other Services	0.08767	0.05378	0.08097	0.08864	0.09366	0.06686	0.07745	0.07119	0.08278	0.13285
29 Labor Income	0.61890	0.40498	0.52966	0.66210	0.68194	0.44874	0.67650	0.54950	0.61419	0.64943
30 Other Value Added	0.48446	0.33757	0.34976	0.47980	0.38651	0.15644	0.16743	0.46756	0.48612	0.38315

Table B.1, continued
Direct, Indirect, and Induced Requirements
Table

	21	22	23	24	25	26	27	28	29	30
1 Agriculture	0.00060	0.00052	0.00033	0.00099	0.00054	0.00073	0.00077	0.00081	0.00096	0.00029
2 Forestry and Fishing	0.00135	0.00121	0.00080	0.00294	0.00139	0.00153	0.00174	0.00179	0.00211	0.00071
3 Mining	0.00056	0.00048	0.00679	0.00057	0.00071	0.00049	0.00056	0.00060	0.00061	0.00041
4 Food Products	0.02747	0.02260	0.01405	0.05412	0.02311	0.02930	0.03403	0.03413	0.04224	0.01215
5 Apparel	0.00145	0.00113	0.00070	0.00138	0.00116	0.00145	0.00213	0.00182	0.00216	0.00060
6 Wood Products	0.00208	0.00200	0.00160	0.00244	0.00317	0.00225	0.00216	0.00271	0.00231	0.00169
7 Paper Products	0.00175	0.00181	0.00122	0.00418	0.00229	0.00306	0.00193	0.00251	0.00217	0.00086
8 Printing	0.01525	0.01471	0.01053	0.03017	0.04304	0.02462	0.02059	0.02860	0.02089	0.00838
9 Chemical Products	0.00247	0.00218	0.00215	0.00311	0.00309	0.00381	0.00996	0.00365	0.00315	0.00144
10 Petroleum	0.00729	0.00128	0.00084	0.00159	0.00139	0.00193	0.00203	0.00238	0.00206	0.00076
11 Stone, Clay, and Glass	0.00335	0.00357	0.00289	0.00427	0.00559	0.00343	0.00444	0.00439	0.00421	0.00318
12 Primary Metals	0.00037	0.00023	0.00022	0.00025	0.00036	0.00022	0.00024	0.00028	0.00026	0.00020
13 Fabricated Metals	0.00372	0.00275	0.00234	0.00361	0.00384	0.00288	0.00346	0.00395	0.00360	0.00224
14 Nonelectrical Machinery	0.00466	0.00134	0.00231	0.00194	0.00208	0.00307	0.00180	0.00525	0.00178	0.00098
15 Electrical Machinery	0.00087	0.00144	0.00069	0.00067	0.00076	0.00140	0.00085	0.00125	0.00065	0.00042
16 Aerospace	0.00385	0.00010	0.00007	0.00015	0.00012	0.00014	0.00016	0.00015	0.00015	0.00006
17 Ship and Boat Building	0.00235	0.00052	0.00032	0.00063	0.00054	0.00068	0.00070	0.00077	0.00101	0.00026
18 Other Transportation Equipment	0.00150	0.00030	0.00019	0.00038	0.00033	0.00037	0.00038	0.00095	0.00049	0.00018
19 Other Manufacturing	0.00688	0.00669	0.00495	0.00776	0.00754	0.01157	0.02140	0.01268	0.00783	0.00362
20 Construction	0.06760	0.07991	0.06597	0.08434	0.13578	0.07288	0.07802	0.09016	0.08638	0.07445
21 Transport Services	1.07254	0.02077	0.01481	0.03350	0.02497	0.02954	0.03204	0.03321	0.03296	0.01253
22 Communications	0.03355	1.02750	0.02018	0.04109	0.06288	0.04916	0.04224	0.04848	0.04344	0.01387
23 Utilities	0.01312	0.01175	1.07410	0.01965	0.01878	0.01534	0.01991	0.02081	0.01919	0.00618
24 Wholesale and Retail Trade	0.21822	0.18584	0.11524	1.23311	0.19350	0.24979	0.25565	0.29952	0.34509	0.08642
25 Finance, Insurance, and Real Estate	0.09918	0.08211	0.05756	0.11475	1.23003	0.11365	0.15827	0.15416	0.12885	0.03926
26 Business Services	0.04951	0.03804	0.02829	0.07043	0.07573	1.07912	0.05824	0.08732	0.04621	0.02493
27 Health Services	0.06557	0.06097	0.03734	0.06689	0.06232	0.07910	1.13779	0.08994	0.12003	0.03064
28 Other Services	0.11790	0.10493	0.06067	0.12414	0.12567	0.13445	0.14642	1.17693	0.15173	0.04488
29 Labor Income	0.80353	0.72628	0.43895	0.81077	0.74760	0.96872	0.99426	1.10326	1.48739	0.32816
30 Other Value Added	0.43315	0.82188	0.62199	0.62120	0.73524	0.53513	0.46561	0.57168	0.46146	1.15330

Appendix C List Of Establishments Included In This Study.

<p><i>Manufacturing – Interviewed</i></p> <p>The Boeing Company Western Metals</p>	<p><i>Manufacturing Included in Study</i></p> <p>Lindean Aircraft Interiors</p>
<p><i>FBO's and Corporate Air Interviewed</i></p> <p>Clay Lacy Flight Center Vulcan King County Jet Center Nordstrom Classic Helicopter Galvin Flying Service Wings Aloft Airwest Sales</p>	<p><i>FBO's and Corporate Air Included in Study</i></p> <p>Orca Bay Aeroflight KTC Aviation Miami Aircraft Support Puget Sound Aviators Systems Aviation Group Valkyrie Leasing Corporation Charter Seattle Flight CJ Helicopter Systems Costco Aviation Department Service Group of America Ashton Corporation Mariner Air Executive Jet Dessault Corporation</p>
<p><i>Air Freight and Passenger Air Interviewed</i></p> <p>Airlift Northwest Ameriflight Old Thyme Aviation San Juan Airlines United Parcel Service Airpac Airlines Aerocoverters BAX Global Helijet International Airborne Express/DHL</p>	<p><i>Air Freight and Passenger Air Included in Study</i></p> <p>BFI Executive Flight Clay Lacy subtenants not named Cowboy Copters King Air Four Transbox Systems Aviation Methods</p>
<p><i>Retail and Wholesale Interviewed</i></p> <p>Aviation Fuel Storage Aviator Book Company / Aviators Store Shultz Distributing American Avionics Cavu Cafe Rosso Nursery</p>	<p><i>Retail and Wholesale Included in Study</i></p> <p>National Aviation Washington Avionics</p>
<p><i>Government Interviewed</i></p> <p>King County Airport Administration Office King County Dept. of Safety & Claims King County Sheriff King County Dept. of Public Safety & Sheriff Air Support</p>	<p><i>Government Included in Study</i></p> <p>U.S. Dept. of Customs U.S. Immigration Service</p>

Appendix C, Continued

Government Interviewed, continued

FAA Control Tower
King County Dept. of Emergency Management
Washington National Guard

Other Businesses Interviewed

Aviation Partners (engineering)
Emerald Services (waste management)
Washington Audiology (hearing tests)
Museum of Flight (cultural services & education)
Aviation Training Center (training)
Caliper Inspection (testing)
Guido Perla & Associates (consulting)

Other Businesses Included in Study

Airtech Instruments (repair services)
Northwest Boring (construction)
Tristate Construction (construction)
Cascade Airframe Repair (services)
Duncan Avionics (repair services)
AeroSA Limited (consulting)
National Air Insurance (insurance)