



# Exploration of Data Sources for Air Cargo Studies



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# **Exploration of Data Sources for Air Cargo Studies**

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## **Exploration of Data Sources for Air Cargo Studies**

### **1. Introduction**

There is no doubt that air cargo plays an important role in the economy of California and the United States. But there are few studies of air cargo activity at a state level. The need to improve the infrastructure and reform the policy for the air cargo industry in California calls for more in-depth analysis of the role of air cargo and the relationships between air cargo, economic development, infrastructure investment, and employment growth at the state level.

There are two important reasons that account for the lack of in-depth research on air cargo at the state level: 1) comparing with passenger traffic, there are no sufficient, accurate and consistent data available in the air cargo industry, although there are multiple resources; 2) there are many agents involved in the air cargo industry, including shippers, carriers, airports, ground transportation agents, and various levels of governments; and the inter-relationship between air cargo and other economic indicators is complicated.

The Aeronautics Division of the California Department of Transportation is very interested in research proposals leading to quantify the role of air cargo in California's goods movement, and strategies to improve the infrastructure and reform the policy for the air cargo industry in California. This project is trying to explore the available data sources and databases related to air cargo studies, so as to investigate what data are available in various sources, and what analysis can be made based on current data sources to study air cargo activity at a state level, specifically in California.

The rest of this report is organized as follows. Section 2 describes in detail the major data sources for air cargo studies; section 3 summarizes the data sources; section 4 discusses the general uses of these data sources for air cargo studies, and points out the limitations of the current data sources; and section 5 summarizes the findings and suggests possible research topics based on the current data sources for Caltrans.

## **2. Description of major data sources for air cargo studies**

This section describes the major data sources that have been often used, or can be used, to study air cargo activity at the state level.

### **1) Air Carrier Statistics (Form 41Traffic)**

This database is available in the website of Bureau of Transportation Statistics (BTS): <http://www.transtats.bts.gov/>.

The Large Air Carrier Statistics database, also known as the T-100 data bank, contains domestic and international airline market and segment data. This database includes monthly data reported by large certificated U.S. and foreign air carriers (having at least one point of service in the United States or one of its territories) on passengers, freight and mail transported, and also includes aircraft type, service class, available capacity and seats, and aircraft hours (including ramp-to-ramp and airborne). This database is the original data source of both domestic and international data for air cargo reported by large carriers. Currently, it covers the time period from 1990 to 2005. (BTS, 2006)

There are four major tables in this database, which respectively provide domestic market, domestic segment, international market, and international segment data. T-100 Domestic Market table contains domestic market data by air carriers, origin and destination airports and service class for passengers, freight and mail enplaned; T-100 Domestic Segment table contains domestic non-stop segment data by aircraft type and service class for passengers, freight and mail transported, available capacity, scheduled departures, departures performed and aircraft hours; T-100 International Market table contains international market data by air carriers, origin and destination airports for passengers, freight and mail enplaned; and T-100 International Segment table contains international non-stop segment data by aircraft type, seats, scheduled departures, departures performed, payload, service class, freight and mail transported, aircraft hours and aircraft configuration. There are also two summary tables: T-100 Market table combines domestic and international market data by U.S. and foreign air carriers; and T-100 Segment table combines domestic and international T-100 segment data by U.S. and foreign air carriers. (BTS, 2006)

In this database, air freight is defined as “property, other than express and passenger baggage transported by air”. Air carriers report two different categories of air cargo: air freight and air mail. The “market” tables contains the information of the weight of air mail and air freight enplaned at the origin airport and deplaned at the destination airport; and the “segment” tables contains the information of the weight of air mail and air freight transported from the beginning to the end of the segment. (BTS, 2006)

The value of the air freight and the production places of the goods are not specified in this database.

## 2) Small Air Carrier Statistics (Form 298C Traffic Data)

As a complementary to the database for large carriers (Air Carrier Statistics), this database includes information on small carrier flights performed in scheduled, non-scheduled, and charter service, which contains data on scheduled departures, completed departures, revenue passenger miles, revenue ton miles, available seat miles, and available ton miles. Data includes small certificated air carriers and commuter air carriers from 1969 to 2002. This database is also available in the website of Bureau of Transportation Statistics: <http://www.transtats.bts.gov/>.

There are three major tables in this database: Schedule A-1 table provides a summary of commuter air carrier activity, by quarter, for such information as scheduled departures, completed departures, revenue passenger miles, revenue ton miles, available seat miles, and available ton miles; Schedule E-1 table summarizes non-scheduled commuter charter activity on a quarterly basis, and includes information on the carrier, origin airport, and number of passengers; Schedule T-1 table provides quarterly information by commuter air carriers, by origin and destination airports, for such items as freight, mail, and the number of passengers. (BTS, 2006)

Therefore, this database contains the quarterly information of the weight of air mail and air freight enplaned at the origin airport and deplaned at the destination airport, which are transported by commuter air carriers.

But the value and production places of the goods are not specified in this database either.

### 3) The Air Carrier Summary Database (Form 41 and 298C Summary Data)

This database contains the summary information of the previous two databases, Air Carrier Statistics and Small Air Carrier Statistics, which include non-stop segment and on-flight market data reported by air carriers on Form 41 and Form 298C, which includes three tables: Schedules T1, T2, and T3. This database covers all U.S. carriers and foreign carriers (with at least one point of service in the United States or one of its territories) from 1974 to 2005. Pre-1990 data exists only in the Air Carrier Summary Data. This database is also available in the website of Bureau of Transportation Statistics: <http://www.transtats.bts.gov/>.

It has three major tables: Schedule T-1, T-2 and T-3. Of particular interest is Schedule T-3 table, which contains quarterly scheduled and non-scheduled passenger and freight information by carrier and airport, and provides such items as scheduled departures, departures performed, passengers, freight, U.S. mail tons, and a domestic/foreign airport indicator. Similar to the previous data sources, only the weight, neither the value nor the production place, is specified in this database. (BTS, 2006)

### 4) ONBOARD by Data Base Products, INC.

This database is produced by an information vendor Data Base Products based on the data collected through schedule T-100, including tables of Schedule T-100 market, T-100 segment and Schedule T-3.

It has better interfaces than the original T-100 tables, but doesn't provide any additional information beyond the data acquired from schedule T-100. The T-100 database is described in section of "Air Carrier Statistics (Form 41Traffic)" above.

The website of the Data Base Products Inc. is:

<http://www.airlinedata.com/products.htm>.

### 5) Airport traffic report

Most of the large hub U.S. airports provide a report of the data for their monthly traffic activity. And most of these reports are available in the airports' websites on the internet. For example, LAX publishes the report of Traffic Comparison, which is compiled from over one hundred airline traffic reports, and the reports from U.S.

Customers and the FAA. This report is published monthly, and it is available at: <http://www.lawa.org/lax/volTraffic.cfm>. It has the information of departure and arrival tonnage of “mail” and “freight” in both “international” and “domestic” markets. SFO publishes Air Traffic Report, which provides a summary as well as detailed accounts for the air cargo activities at the airport. SFO publishes “Comparative Traffic Report” of summaries of air cargo activities for consecutive periods for comparison purpose. The information is available in the website of <http://www.flysfo.com/about/stat/>. For each month, it provides the weight information for loaded and unloaded “mail” and “cargo” in both “domestic” and “international” markets. Another major airport in California, Oakland International Airport (OAK), publishes Monthly Activity Report summarizing passenger activities at the airport, and publishes “year-end airport statistics summary” summarizing the yearly weight (tonnage) of inbound and outbound freight at the airport. The information is available in its website:

[http://www.oaklandairport.com/airport\\_stats\\_yearend\\_stats.shtml](http://www.oaklandairport.com/airport_stats_yearend_stats.shtml).

To our knowledge, not all airports in California publish such reports for external distribution and how the data are derived is not very clear to the public. The main air cargo activity information provided by these airports’ air traffic reports is the weight of loaded and unloaded cargo at the airport, without any information regarding the value or OD (Origin and Destination) of the cargo.

#### 6) ACI 2004 Annual Worldwide Airport Traffic Report (WATR)

The Airports Council International (ACI) bases this report on a survey of large airports in the world. The data in the report are in a higher level and are in less detail compared with the air traffic report from each individual airport. The major data in the WATR report are cargo tonnage loaded and unloaded at large airports. This report is available free of charge to ACI members and also available with charges to non-ACI members. The website of ACI is: [www.airports.org](http://www.airports.org).

For each year, airport rankings and annual statistics for passenger, cargo (freight and mail) and aircraft operations are included in this report. The total annual weight of air cargo at each airport is divided into three categories: international freight, domestic freight and mail. According to the information on the ACI’s website, this report includes

data back to the year of 1991, and the most recent year in which the report was published is 2004. For a most recent month, such as March 2006, it also publishes “Cargo Traffic Monthly Ranking” with the data of total cargo volume (loaded and unloaded freight and mail in metric tones) reported by airports.

#### 7) Airport Activity Statistics of Certified Route Air Carrier (AAS)

This report is published by the US Department of Transportation. It is available on-line at [http://www.faa.gov/data\\_statistics/](http://www.faa.gov/data_statistics/). This report has high-level cargo traffic at major U.S. airports.

The data summarized in this report are compiled from information reported to the US DOT by large certified air carriers on Schedules T-100 and T-3. It has five summary tables: table 1 is a summary of aircraft departures and enplaned passengers, freight, and mail by carrier group, air carrier, and type of service; table 2 is summary of aircraft departures and enplaned passengers, freight, and mail by state or U.S. area and type of service; table 3 contains aircraft departures and enplaned passengers, freight, and mail in total operations, all services at large air traffic hubs; table 4 contains aircraft departures and enplaned passengers, freight, and mail in total operations, all services at medium air traffic hubs; and table 5 contains aircraft departures and enplaned passengers, freight, and mail in total operations, all services at small air traffic hubs. (BTS, 2006)

Tsao (1998) claims that, based on the T-100 databanks, US DOT also publishes the report of U.S. International Air Passenger and Freight Statistics, which contains 12 tables.

Since the data contained in this report are purely derived from the T-100 and T-3 databases, there is no new information added to the original information in T-100 and T-3 databases.

#### 8) Commodity Flow Survey (CFS)

A Commodity Flow Survey (CFS) is conducted about every five years (1993, 1997 and 2002) as part of the economic census by the U.S. Census Bureau in partnership with Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation. CFS obtains data based on a sample questionnaire survey of shipments by domestic

establishments in manufacturing, wholesale, mining, and selected other industries. It is for freight transportation only, not including passenger transportation. The data of flow of goods and materials are classified by mode of transport. Most of the survey results are available online at its website: [http://www.bts.gov/programs/commodity\\_flow\\_survey/](http://www.bts.gov/programs/commodity_flow_survey/).

The 1993, 1997 and 2002 CFS are a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1997, and includes major improvements in methodology, sample size and scope. The 1993, 1997 and 2002 CFS differ from previous surveys in their greatly expanded coverage of intermodalism. Earlier surveys reported only the principal mode. The 1993 survey reported all modes used for the shipment (for-hire truck, private truck, rail, inland water, deep sea water, pipeline, air, parcel delivery or U.S. Postal Service, other mode, unknown). Route distance for each mode and shipment was input from a Mode-Distance table developed by Oak Ridge National Laboratory. Distance, in turn, was used to compute ton-mileage by mode of transport. (CFS, 2006)

The 1993 CFS CD-ROM contains the same data and information on domestic commodities as in previous years. It has data on the individual 50 states, and the 89 National Transportation Analysis Regions (NTARs), which are based on the Bureau of Economic Analysis regions. The survey was based on a sample of 200,000 domestic establishments randomly selected from a universe of approximately 800,000 establishments engaged in manufacturing, mining, wholesale, and some selected activities in retail and service. For the 1997 CFS, samples of 100,000 domestic establishments randomly selected from a universe of about 800,000 establishments engaged in mining, manufacturing, wholesale, auxiliary establishments (warehouses) of multi-establishment companies, and some selected activities in retail and service were used. Each selected establishment reported a sample of about 25 outbound shipments for a one-week period in each of four calendar quarters in 1997. This produced a total sample of over 5 million shipments. For each sampled 1997 CFS shipment, zip code of origin and destination, 5-digit Standard Classification of Transported Goods (SCTG) code, weight, value, and modes of transport, have been provided. Check box information on whether the shipment was containerized, a hazardous material, or an export was also obtained. The 1997 CFS CD-ROM provides information on commodities shipped, their

value, weight, size, and mode of transportation, as well as, the origin and destination of shipments. It has data on the whole United States, individual 50 states, and selected metropolitan areas and the remainder-of-state. The CD-ROM also has publications in PDF format, including special reports on hazardous materials transportation and exports. (CFS, 2006)

Major tables provided in CFS 1993 and 1997 include: Table 1a. Shipment characteristics by mode of transportation for state of origin: 1997; Table 1b. Shipment characteristics by mode of transportation for state of origin: 1997 and 1993; Table 1c. Shipment characteristics by mode of transportation for state of origin: percent of total for 1997 and 1993; Table 2. Shipment characteristics by total modal activity for state of origin: 1997; Table 3. Shipment characteristics by mode of transportation and distance shipped for state of origin: 1997; Table 4. Shipment characteristics by mode of transportation and shipment size for state of origin: 1997; Table 5. Shipment characteristics by two - digit commodity for state of origin: 1997; Table 6. Shipment characteristics by two - digit commodity and mode of transportation for state of origin: 1997; Table 7. Shipment characteristics by state of destination for state of origin: 1997; Table 8. Inbound shipment characteristics by state of origin for state of destination: 1997 (CFS, 2006).

The major shortcoming of the CFS data for air cargo analysis is it is only for domestic transportation of goods, and it does not isolate the mode of air transportation from other modes of transportation. The mode of air includes the intermode of truck and air. It has information for export by origin of state, but doesn't have any information on imports.

Based on the 2002 Commodity Flow Survey, for the state of California, the following information is provided in table format: value of commodity flows for selected mode of transportation by state of origin in millions of dollars; value of commodity flows for selected mode of transportation by state of destination in millions of dollars; weight of commodity flows for selected mode of transportation by state of origin in thousands of tons; weight of commodity flows for selected mode of transportation by state of destination in thousands of tons; ton-miles of commodity flows for selected mode of transportation by state of origin in millions of ton-miles; ton-miles of commodity flows

for selected mode of transportation by state of destination in millions of ton-miles; coefficient of variation for value of outbound commodity flows for selected mode of transportation by state of origin. For example, the value of commodity flows for selected mode of transportation by state of origin in millions of dollars for California in year 2002 is:

State	Total	Truck	Rail	Water	Air (including truck and air)
California	923,669	625,530	9,718	1,789	51,996

The value per ton or ton-mile for each mode can also be calculated, since tonnage is also available in the CFS.

#### 9) Other sources

Searches for many other sources of databases to study air cargo activity at the state level yielded no or little information that can be added to the databases listed above. Therefore, those databases are not listed. For example, Airline Origin and Destination Survey (DB1B) is a 10% OD-survey sample of airline tickets from reporting carriers, including data of origin, destination and other itinerary details of passengers transported. It has the fare information for passengers in the flight, but it doesn't have any cargo information.

### 3. Summary of data sources

Based on the review of the major databases listed above and other information related to air cargo activity at the state level, in this section, the survey of all these data sources is summarized:

1) The data sources for the air cargo databases can be divided into three categories: (i) the data are collected by airlines. For example, both T-100 and T-3 are based on the data collected by airlines and reported to the department of transportation; Onboard is based on the data sources available in the department of transportation, such as T-100 and T-3, and is compiled by a commercial database company; and Airport Activity Statistics of Certified Route Air Carrier (AAS) published by the U.S. Department of Transportation (DOT) is also compiled from information reported to the DOT by large certified air carriers on Schedules T-100 and T-3 ; (ii) The data are collected by individual airport.

For example, major airports, such as SFO, OAK, and LAX, publish a monthly or annually report on cargo statistics; and based on a survey of large airports in the world, Airports Council International (ACI) publishes the Annual Worldwide Airport Traffic Report (WATR); iii) the data are collected from shippers and other logistics company. For example, Commodity Flow Survey (CFS) obtains data based on a survey of shipments by domestic establishments in manufacturing, wholesale, mining, and selected other industries. Not surprisingly, the data from the above three different resources are not necessarily consistent.

2) There are two important indices describing the properties of the goods to study the air cargo activity: weight and value. Most of databases in this survey contain the information of the weight, not the value. In this search to date, the only database that contains the value information is the Commodity Flow Survey (CFS).

3). The important features that are often used to describe the movement of air cargo include: i) the origin (or place of production) of the good; ii) the destination of the good; iii) transportation routing or any transferring airports involved; and iv) any other transportation modes involved in completing the travel tour. Some databases contain the information of origin and destination of the movement, such as T-100 market database, but don't provide information of the complete travel tour. The data collected by the airport, such as those in airport traffic reports and Annual Worldwide Airport Traffic Report (WATR), only contain the information of loaded and unloaded volumes of the cargo, but don't specify the origin, destination or value of the goods. The report based on the sample data in Commodity Flow Survey (CFS) contains origin, destination and value of the goods, but doesn't provide the information of the travel tour. It specifies the transportation mode and intermodalism, but unfortunately, the data combine the mode of "air only" and mode of "air and trucking" together into one category.

4). Based on this survey of the databases for air cargo, specifically for the purpose of studying the air cargo activity at the state level, major problems in the current databases exist in the following areas: i) The data from different sources (airlines and airport) are not consistent, since the data reported by either airlines or airport are collected from their own perspectives; ii) There are some very important features missing from most of the databases, such as the value of the goods, the complete travel tour of the

movement, the production place of the goods, and etc.; iii) Some databases, such as CFS, are not based on the most recent data. CFS is done every five years since 1997. And the most recent survey was completed in 2002. CFS is also very limited in the type of goods moved.

5). For the purpose of studying air cargo activity at the state level, the most “useful” database is the Commodity Flow Survey (CFS). However, CFS excludes import data.

#### **4. Use of data sources and limitations**

Since there is not much literature published in the field of studying air cargo activity at the state level, and the purpose of this project is to investigate whether and how the existing databases can support any in-depth analysis for air cargo studies at the state level, such as an industry wide determination of air cargo value and quantifying the role of the transportation infrastructure in California’s air cargo activity, this section briefly discusses what questions can be answered and what research can be completed in this field based on current databases.

First, it is not difficult to estimate the weight of air cargo loaded and weight of air cargo unloaded at all major airports in California, although there could be large differences between results in the studies based on different data sources. The data can be obtained directly from three different sources: the first source is the worldwide airport traffic report (WATR); the second source is the air traffic report (ATR) by individual airport in California, such as LAX, OAK, Ontario, Sacramento, San Diego, SFO, SJC, Burbank-Glendale-Pasadena, orange county (John Wayne), Long Beach, and etc. Most of these airports publish data online in their websites, and a full hard-copy report could also be found in the public library; and the third source is the group of databases based on T-100, such as Onboard, and AAS from Department of Transportation. The first two sources are similar, since they are both based on the data reported by airports, though the data from ATR is in more detail. But there is a drastic difference between the third resource (i.e., data reported by airlines) and the first two resources (i.e., data reported by airports). Therefore, it is possible to “estimate” the loaded weight and unloaded weight of

air cargo at major airports in California based on data either from airlines or from airports, but the numbers might be quite different.

It is clear that all the three sources above provide the data for all major airports in California, but it is not confirmed that any of the three sources cover the information for all airlines (including regional and other smaller airlines) operating at all airports (including regional and other smaller airports) in California, which may also have an effect on the accuracy of the estimation of the weights of enplaned and deplaned cargo.

Commodity Flow Survey (CFS) is a very useful and valuable database to study the air cargo activity, since it contains such important information as value and origin and destination of the goods that other databases don't have, and also considers different modes and intermodalism of transportation. To quantify the role of air cargo at the state level (i.e. for the state of California), Tsao (1998) listed the four major quantities that can be estimated based on the CFS data: i) Trucking-for-Air-Cargo Percentage: the percentage, by value and weight, of goods moved via air-truck combination with respect to all goods whose movement involves trucking; ii) Commodity-Weight-Moved-by-Air Percentage: percentage of commodity weight, for individual commodity categories, that is moved by air; iii) Commodity-Value-Moved-by-Air Percentage: percentage of commodity value, for individual commodity categories, that is moved by air; and iv) Commodity-Movement-Mode Distribution: the distribution of transportation modes for each of the commodity categories for which air cargo plays an important role. Due to the drawbacks of the CFS data discussed in previous section, the estimates of the quantities list above are not necessarily accurate and are difficult to confirm.

Therefore, estimates of such quantities as the enplaned and deplaned weight of air cargo at California airports can be derived directly and easily from the databases surveyed in this project, potentially with some errors. It is not easy or straightforward to define and quantify the value or role of air cargo market (both domestically and internationally) for California, due to the limitations of the databases. Nevertheless, the air cargo industry plays a very important role in the economy of California. Research might include a literature review and analysis of the relationship between the air cargo activity and other economic indicators such as GDP, employment, and trade, and propose strategies to Caltrans to improve the transportation infrastructure and possibly reform the

air cargo related financing policies in order to promote air cargo activity in California, considering the air cargo competition from other states.

## **5. Summary and conclusions**

This project is trying to explore the available data sources and databases related to air cargo studies, so as to investigate what data are available in various sources, and what analysis can be made based on current data sources to study the air cargo activity at a state level, specifically in California.

Eight major data sources are investigated in this project. Since the data used in different databases may come from different sources: airlines, or airports, or shippers, the data in different databases may not be consistent. Most of these databases contain the information of the weight, not the value, of the goods (only the data derived from the Commodity Flow Survey contains the value information). It is not difficult to estimate the weight of air cargo loaded and weight of air cargo unloaded at major airports in California, although there could be large differences between results based on different data sources, and it is not easy to find out which database is more accurate.

Commodity Flow Survey (CFS) is a useful database to study the air cargo activity at the state level, since it contains such important information as the value and origin and destination of the goods, and also considers different modes of transportation and intermodalism. But CFS is not based on the most recent data (the most recent CFS survey was completed in 2002), and it is difficult to validate the accuracy of estimates based on the data from CFS.

Although it is not seemingly easy or straightforward to quantify the value and role of air cargo industry (both domestically and internationally) for California, it's not hard to show that the air cargo industry plays a very important role in the economy of California, based on such simple statistics as the weight or volume of air cargo enplaned and deplaned at the airport in California. California is an important and major state for production of agriculture goods and hi-tech products (computer, electronics, bi-tech and etc.). A significant proportion of these products are consumed by customers in other states of the U.S. or exported to foreign countries in the world. Therefore, there is no doubt that air cargo plays an important role in trading and economy in California. While

it is difficult or impossible to quantify the value of air cargo industry directly based on the data in the air cargo industry (i.e., the eight major databases investigated in this project), the importance of the air cargo industry and infrastructure to the economy of California could be demonstrated by the magnitude and role of such specific industries as agriculture and hi-tech in California. Therefore, it is reasonable and necessary that there should be a higher level of public investment in supporting infrastructure for the air cargo industry in California.

Further research in these two areas is important:

1) Although, it is difficult to find the values of all goods shipped by air, the “value” and importance of the air cargo industry could be also demonstrated by the employment of the air cargo and logistics industry. The need for more public investment in infrastructure for the air cargo industry can be justified not only by the magnitude of the air cargo industry itself but also from the perspectives of the customers of the air cargo industry, i.e., the hi-tech and agriculture industries. There is a need for additional literature review and analysis of the relationship between the air cargo industry and other economic activity in California, such as GDP growth, employment rate, and trade development, especially in the hi-tech and agriculture industries.

2) The deficiencies in the current air cargo industry and the need to improve the infrastructure in California should be investigated through the survey of airlines, airport and shippers. Considering the continuous growth in the demand for air cargo in California and also competition from other states, comparison studies should be taken based on the survey of the policies and projects that have been implemented in other states. Research should identify and propose strategies and reforming policies to Caltrans to improve the transportation infrastructure in order to facilitate air cargo activities in the state of California.

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