FREIGHT ANALYSIS FRAMEWORK

Derivation of the FAF Database and Forecast

Office of Freight Management and Operations
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The Derivation of the Freight Analysis Framework Database and Forecast

In 1999, the Federal Highway Administration (FHWA) Office of Freight Management and Operations initiated the Freight Analysis Framework project, which sought to develop the first comprehensive database of transportation flows upon the Nation's infrastructure.

The FAF is a methodology to estimate trade flows on the Nation's infrastructure, seeking to understand the geographic relationships between local flows and the Nation's overall transportation system. The project will help identify areas of improvement to increase freight mobility, including highlighting regions with mismatched freight demand and system capacity, and encouraging the development of multistate and regional approaches to improving operations.

The FAF examines transportation for four key intermodal modes: highway, railroad, water, and air. A comprehensive database for different modes was developed from various government and private sector databases. To evaluate the effect of anticipated volumes upon the network, the FAF includes economic forecasts for the years 2010 and 2020, assigned to the network and linked to transportation infrastructure databases. The FAF will develop capacity estimates and shortfalls to support the Nation's freight transportation needs, considering operational efficiencies and anticipated investments by States and MPOs.

The Freight Analysis Framework database ("FAFD") features county-to-county freight transportation flows for truck, rail, water, and air modes at the four-digit Standard Transportation Commodity Classification Code (STCC) level. The database includes a historical data set of 1998 flows that is linked to WEFA long-term economic forecasts to develop estimates for both 2010 and 2020. This paper sets out to explain the development of the 1998 database, and the method used to prepare the 2010 and 2020 forecasts.

The Development of the 1998 Database

The foundation for freight flow information in the FAFD is Reebie Associates' TRANSEARCH Visual Database. TRANSEARCH draws from a wide variety of data sources covering commodity volume and modal flow, including a proprietary motor carrier traffic sample, the Bureau of Transportation Statistics (BTS) Commodity Flow Survey (CFS), and the Surface Transportation Board (STB) Railroad Waybill Sample. To compose the FAFD, additional data sources were introduced into the TRANSEARCH Visual Database and cast together in a single, consistent format.

Each annual version of the TRANSEARCH Visual Database begins by establishing state production volumes by industry or commodity. This information is drawn from the Census Bureau's Annual Survey of Manufactures and the Census of Manufactures. Both of these sources report production in dollars, which are converted to tons using commodity value/weight relationships maintained by Reebie. The FAFD is based on the 1998 TRANSEARCH Visual Database.

Once the production volumes are established, tonnages moving by rail, water, air, and pipeline[1] are netted from the totals (which serve as control totals), leaving the remaining freight volumes allocated to truck distribution patterns. Since the process begins with production data, which include items produced for both domestic and foreign consumption, export volumes were developed in the same manner. Import volumes, drawn from U.S. Department of Commerce data, are subsequently combined into the data set at the point of importation.

The Development of Domestic Production Statistics

As national, multimodal freight databases do not readily exist that depict detailed commodity flows on a county level, the data must be developed from many sources. The Reebie Associates' TRANSEARCH Visual Database estimates local production and consumption of domestic transportation. By linking production and consumption patterns and modal traffic flow, estimates of freight activity can be established.

Production and shipment estimates are developed from the Survey and Census of Manufacturers, which describe industrial activity by state. This information is updated to the base year (1998) through industrial production indices, and supplemented by trade association and industry reports. Shipments are localized to the level of counties using street-address employment and activity information, population data, and railroad rebill factors (which in a netting process affect the location of truck volumes). Relationships between industries are determined with input/output patterns. Localization and input factors also can be affected by industry reports and primary modal traffic data.

The chief sources of production and shipment estimates are shown in Table 1, along with the modes they influence. Some sources are used for certain modes of traffic and not for others; for example, port directories are employed exclusively to help localize waterway traffic patterns. Railroad data in the original source (the full STB Waybill sample) are highly localized and specific. Although some adjustment is made for through cargos, the majority of the Waybill sample does not require further processing for presentation in the database.

[1] Pipeline flows were excluded from the FAF database although some of the supporting databases do report information on pipeline flows.

Table 1. Data Elements Used in Developing Production\Consumption Patterns from Various Modes

Database	Used for Estimating Modal Flows
U.S. Department of Commerce Census/Survey of Manufacturers	*Truck, Water, Air*
DRI Industrial Production Indices	*Truck, Water, Air*
Trade Association Production & Shipment Reports	*Truck, Water, Air*
US Geological Survey Mineral Industry Reports	*Truck, Water*
Reebie Associates Freight Locater/InfoUSA Street-Address Industrial Employment & Activity	*Truck*
County Population Data	*Truck*
Inter-Industry Trade Patterns (Input/Output Table)	*Truck, Air*
Motor Carrier Industry Financial & Operating Statistics	*Truck*
Railroad Industry Proprietary Rebill Factors	*Truck*
Private Port Directories	*Water*

Development of Domestic Modal Database Flows

Reebie Associates constructed the 1998 TRANSEARCH Visual Database from the most recent set of publicly available freight traffic flow information. The result is a database of county-level origin-to-destination flows by commodities for seven modes of transportation: for-hire truckload, less-than-truckload, private truck, conventional rail, rail/truck intermodal, air, and water. Volume is presented in terms of tonnage, then translated to value and ton miles using conversion tables and route distances.

Appendix Exhibit 1 shows the basic data sources for TRANSEARCH, including non-standard[2] elements that have been incorporated in the data set delivered to FHWA. These data sources are not uniform in terms of the geographic areas used, commodity definitions, units of measure, and the base years presented. The development process draws these disparate sources together, checking their completeness and basic validity, assigning commodity, geography and mode descriptions and then putting them into a common format. Each mode will be explained in turn.

Railroad Traffic Activities

FAFD rail traffic is taken from the fully detailed (and confidential) version of the annual Railroad Waybill Sample of the DOT Surface Transportation Board (STB). The Waybill Sample is a statistically based stratified sample of shipments terminated by U.S. rail carriers. All carriers terminating 4,000 or more carloads per year are required to report to the STB. Thus, 62 railroad systems are captured, encompassing all Class I and II roads and the more prominent short lines. (Carriers smaller than 4,000 annual loads may be sampled when they act as haulage agents for larger railroads, and the latter appears as the carrier of record on a shipment.) The full Waybill Sample file

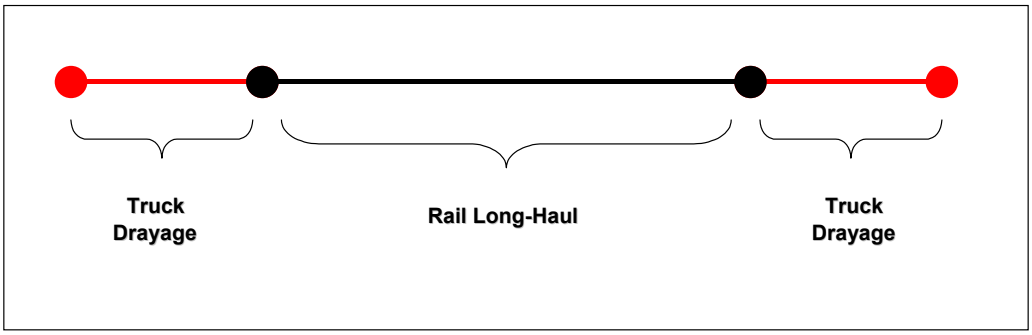
[2] Aspects of the 1998 FAFD that are not normally part of commercial TRANSEARCH databases are 1) domestic truck traffic of ores and non-metallic minerals 2) border crossing points for NAFTA trade 3) U.S. county allocations of U.S./Mexico traffic; and 4) Latin American Trade and Transportation Study (LATTS) seatrade traffic. All of these aspects are discussed elsewhere in this document.

contains detailed information on the origin, destination, commodity, and volume of each sampled movement.

One unique feature of the FAFD rail data set is that international rail traffic port and border crossing points have been incorporated. For NAFTA traffic moving to and from the United States, this information has been taken from BTS border crossing statistics and from routings suggested in the Waybill, interpreted with a rail network routing model. For traffic through ports, the port identification forms part of the LATTS data set, and ultimately derives from customs documents. (LATTS is described in more detail in a following section.)

Throughout the development process, carload and intermodal trailer-on-flat-car/container-on-flat-car (TOFC/COFC) traffic are maintained as separate[3] volumes. The identification of which shipments utilized TOFC/COFC services was based on intermodal record flags in the Waybill file. As illustrated in Figure 1, intermodal freight movements consist of both truck and rail portions. For the long-haul portion of the trip, the goods are carried by rail. The shorter, drayage portion of the trip occurs on truck.

Figure 1. Designation of the Rail Portion of Freight Movement as Intermodal



Traffic that is classified as "Intermodal" represents the rail portion of a truck-rail shipment. The origin corresponds to the point at which the shipment is put on a rail car, and the destination is the point at which a shipment is taken off the rail car. The commodities carried on rail are identified by a STCC code; while the STCC normally corresponds to a specific product, for much of the intermodal traffic the commodity is identified only by the general classification FAK (Freight All Kinds) in the primary source data (the STB Waybill Sample).

The FAFD also captures the truck portion of rail-truck intermodal shipments. This traffic is shown in the "truckload" mode and is identified by STCC 5020. The truck portion shows both the movement from ultimate origin (producing) point to the railroad, and from the railroad destination to the ultimate destination point. On a tonnage basis, each intermodal shipment appears in the data set as three separate records: first as a "truckload" mode movement of STCC 5020 from true origin to the railhead, then as an "Intermodal" mode movement from one railhead to another, and finally as an additional "truckload" mode movement from the terminating railhead to the final destination point. When modal volumes are totaled by tons, the separate segments will cause the shipment to be "triple counted" in a sense. However, when volumes are totaled on a ton-mile basis, the miles in each truck or rail segment appear just one time, so the shipment in ton-mile terms is counted only once.

[3] The separation of carload from intermodal traffic is not possible for some NAFTA freight, due to limitations in the source data.

Waterborne Commerce Activities

The U.S. Army Corps of Engineers (ACE) annually collects information on all shipments moving on the nation's waterways to support its management and planning activities. TRANSEARCH uses various components of the data issued by the Corps to develop its waterborne flow data. While the raw information collected is comprehensive, that released to the public is summarized in ways that mask the details of traffic flows; the data development process in TRANSEARCH aims to reestablish some of this detail. The primary data set employed is the annual ACE file of waterborne commerce. This source provides state-to-state annual volumes of broad commodity groupings. Complementing these flow data are originating and terminating volumes by port and more specific commodity type, which are also provided by the ACE. The less detailed state-to state flow data are disaggregated to the port level using the more detailed origination and termination information, supplemented by directories profiling public and private port facilities.[4] Thus for example, the general flow of goods from Pennsylvania to Louisiana is refined to steel products from Pittsburgh-area counties to counties in South Louisiana by comparison of sources. Commodity descriptions adopted by the Corps are transformed to STCC codes through data bridges that Reebie Associates developed and maintains.

Air Cargo Activities

Air cargo represents by far the smallest portion, on a tonnage basis, of the TRANSEARCH Database. Air activity is constructed using BTS Airport Activity Statistics.

The BTS enplanement data reports the total tonnage originating at each airport. In addition, a separate data series, BTS T-100, reports cover airport-to-airport flow volumes. The origin tonnage is then disaggregated into flows to the destination airport based on this second set of data. The data are then translated from airports to counties, based on airport location information that is maintained by the Federal Aviation Administration (FAA). In some cases, where there is more than one airport in a county, data are subject to a further aggregation. Because the data are meant to portray domestic freight between origin and destination markets, adjustments are made to account for international traffic and the use of intermediate airport hubs. Consequently, air traffic is captured from source airport market to consuming market, and any use of hub facilities enroute is not depicted.

Commodity identification is then introduced. The Commodity Flow Survey (CFS) provides a broad level identification of commodity types. This broader detail is further refined based on the origin at the production region, and consumption at the destination region, by using full detail commodity information for each market.

Finally, the FAFD also captures the dray portions of air freight shipments, which are the segments moved over the road to and from airports. This traffic is shown in the truck mode, and is identified by STCC 5030. This truck portion shows both the movement from ultimate origin (producing) point to the airport, and from the airport destination to the ultimate destination point. As with rail intermodal shipments (discussed above), each air shipment appears in the data set as three separate records: origin truck dray, aircraft linehaul, and destination truck dray. When modal volumes are totaled by tons, each shipment's tonnage will be counted three times; however, when volumes are totaled by ton-miles, each shipment mile segment is counted only once.

[4] Drayage for marine ports is captured in the FAFD, through its treatment of import and export traffic. Drayage for inland waterway ports is not captured – it isn't a standard part of the TRANSEARCH database, and was not selected for addition to the FAFD.

Truck Flow Activities

Truck traffic remains the most challenging mode to estimate because of its broader market areas and a lack of unified databases. As mentioned earlier, the truck portion of the FAFD begins as the share of total freight not identified on other modal shipments, derived through a netting process. To develop truck estimates, Reebie Associates allocates the remaining freight (truck) volumes between the for-hire and private sectors of the industry based on relative volumes reported in the CFS. The for-hire segment is then split between truckload and Less Than Truckload (LTL) components using industry data on the level of LTL shipments, and prior TRANSEARCH patterns.

At this point, the data are ready to be split into origin to destination flow volumes. The sources used for this processing step consist of a combination of proprietary data collected and compiled by Reebie Associates, and information collected and disseminated by government sources. The information from Reebie includes the Motor Carrier Data Exchange and the Freight Locater database of shipping establishments. TRANSEARCH Visual Database elements from prior years are considered as a repository of historical patterns. The government sources are the BTS CFS and the Bureau of Economic Analysis (BEA) Industrial Input/Output (I/O) tables.

The TRANSEARCH database uses its proprietary Motor Carrier Data Exchange as the starting point for developing domestic truck flows. Carriers that participate in the Exchange program submit a summary of their annual traffic flows that includes origin, destination, and volume. Commodity indications are captured through Standard Industrial Codes (SICs), carrier commodity codes, or equipment types. Traffic is reported by 3-digit zip code, with a large subset reported by county or 5-digit zip code. All of this information is provided on an origin-to-destination basis. Zip codes are converted to counties as part of the database preparation process.

There is some variation in the sample achieved each year through this program, but in recent years the sample has included about 70 million[5] individual truck shipments, covering both the truckload and LTL segments of the industry. Participating carriers are primarily large truckload and LTL operators with haul distances that are, on average, more than 500 miles. However, the sample also takes in owner-operator business, portions of private carriage and dray activity, and significant amounts of regional (under 500-mile) traffic. Because the program depends on cooperation and carriers' business interests, it is does not create a stratified random sample; to offset this, coverage is pursued and obtained for a broad cross section of the trucking market, including diverse industrial and geographic segments.

To supplement the Data Exchange data, Reebie Associates draws on the proprietary Freight Locater data set, which provides information on the specific locations of manufacturing and distribution facilities, along with profiles of their industrial output, employment and sales level. This information, in conjunction with that gathered through the Motor Carrier Data Exchange, guides the establishment of origination volumes at the county level, and is relied on particularly in markets where the Data Exchange sample is small.

This location information is employed further in the procedure that translates the raw Data Exchange submissions from a zip code to a county basis. Where the zip codes submitted by carriers overlap county boundaries, the relative activity levels as estimated in the Freight Locater dataset are used in the translation process.

Just as the Freight Locater information is used to supplement origination data, it is also used, in conjunction with the BEA Industrial I/O tables, in a similar manner to enhance the destination or consumption volumes by county. Based on the production volumes by industry derived from Freight

[5] As a point of comparison, the 1993 CFS sampled 12 million shipments and the 1997 CFS 6 million, and these samples were addressed to all of the modes, not just to truck.

Locater, the I/O relationships are analyzed to develop necessary input commodities and volumes that would be needed to satisfy production demands.

An initial screening and analysis of the Data Exchange information adjusts and eliminates any discrepancies in reporting formats or procedures by various participants. Summary results are also tabulated, and statistical analyses are conducted to judge the reasonableness of the data. The most important numbers that are developed are the sample rates at both the national and state levels.

The sample rates are calculated by dividing the amount of traffic reported by Data Exchange carriers by the amount of relevant truck traffic determined in earlier processing. These sample rates are then used to determine the degree to which flow pattern development will rely on either the carrier–reported patterns or those from the CFS. Where the Data Exchange sample rates are most robust, the flow patterns reported by the carriers are adopted almost in their entirety. This typically covers longer-haul shipments and commodities that are moved in dry-van type trailers, as this segment of the trucking industry is best represented amongst the participating carriers.

Where Data Exchange coverage is thin, CFS data (also used to distinguish the for-hire and private sectors of the trucking industry) are used. The 1993 CFS data were applied in the standard construction of the TRANSEARCH database. The data volumes were extrapolated to 1998 levels to ensure compatibility with the other sources of information. Top line comparisons of broad level totals from the 1997 CFS data were also utilized, but the more detailed flow information required by the development procedures was not available in time to be incorporated in the process. Shorter haul truck volumes and patterns in the FAFD are chiefly a reflection of the CFS, due to lesser coverage of this type of traffic in Data Exchange. In addition, translations of FAFD traffic volumes from tons to dollar value are based on CFS commodity value relationships.[6]

The standard TRANSEARCH database covers only some kinds of non-manufactured goods transported by truck. To fill one gap in commodity coverage for the FAFD, the 1997 CFS was used as the starting point for developing truck movements of ores and non-metallic minerals. County-level detail was introduced into this segment of the data through identification of specific mining locations, and local distribution patterns were modeled from CFS data that profiled the lengths of haul for these commodities. Volumes were updated to 1998 levels through industrial production indices.

Two other key segments of truck activity in non-manufactured goods are captured in the standard TRANSEARCH database and appear in the FAFD: fresh produce and coal. Traffic of fresh produce is modeled using production data and distribution patterns gathered by the USDA. The coal movements are based on those reported by the Department of Energy. Other coverage gaps in non-manufactured goods were elected not to be filled, because of Freight Analysis Framework project constraints. The FAFD does not treat truck shipments of waste, nor of bulk agricultural goods such as grain; all of these are outside the sampling scope of the CFS as well.

The Development of Domestic Flows of International Movements

International data in the FAFD largely derive from independent information sources and overlap partially with the domestic database. Export traffic is embedded in the domestic FAFD because of its use of production statistics, and maritime imports explicitly are added. To the extent possible, NAFTA overland trade was separated from the domestic data set. No overland imports from Mexico and Canada appear, and modal volume that clearly moves for NAFTA export also has been eliminated – but most remains embedded in border state traffic patterns.[7] Thus, between the domestic and

[6] Both 1993 and 1997 CFS commodity values per pound were used, but the primarily reliance was placed on an adjusted version of the 1993 values, because of their better correspondence to FAFD commodity codes.

[7] International traffic contained in the U.S. database is used in the analysis of production and consumption patterns; other international traffic is treated in a separate process in the parallel databases.

international FAF data sets, there is some double counting of international traffic flows moving to and from inland markets.

Based on independent information sources, three international data sets were developed to parallel to the domestic shipments: inland maritime, U.S./Mexico, and U.S./Canada. Each data set portrays commodity modal movements internal to the U.S., traveling between counties and international gateways, and beyond those gateways to and from foreign points.

In the FAF, International flows were set to regions: Canada, Mexico, Europe, Latin America, Asia, Rest of World. The discussion will examine how international maritime trade was developed, followed by discussions on U.S.-Mexican surface flows, U.S.-Canadian flows and international air traffic flows.

International Maritime Freight Movements

Import and Export traffic flows are identified in the FAFD based on information assembled for the Latin American Trade & Transportation Study (LATTS). These data were originally developed by Wilbur Smith Associates and Standard & Poor's DRI, utilizing information from PIERS (Port Import Export Reporting Service) and TRANSEARCH. A consortium of southeastern U.S. states funded this initial effort examining international trade patterns.

LATTS was the first known attempt to link international trade data with domestic production and consumption data on a nationwide bases. This process involved allocating international trade passing through international gateways (while the full LATTS database focused on ports, airports, and border posts, only the port data set was fed into the FAFD) to individual U.S. states and Bureau of Economic Analysis (BEA) zones. An example would be the tracing of the trade route of a widget exported through a Florida port to Brazil from Tennessee.

Different commodity and trade databases address different components of the commodity flow path. Some address the international segment – from a U.S. port to a foreign country – while others address the domestic portion – from Tennessee to Florida. To assemble a master database that actually addresses the entire trade path required matching a variety of databases.

The major challenge was to link international trade databases with the domestic commodity flow databases. At the very least, the databases and models used for this task are all similar in the sense that they contain economic and trade indicators for specific jurisdictions – states, counties, BEA's, countries – by industry and commodity group – for different modes of transportation. But that is where the commonality ends. The data characteristics vary from database to database. For example, some databases report data at a state level while others report at a BEA or county level. They also report data at different commodity detail levels. And a certain commodity/industry grouping in one database may not include the same mix of industries as a similar grouping in another database. Also, some of the databases used to define the domestic routing of commodities contained both international and domestic flows in an aggregate form, hence requiring alternative methods of identifying the international component within aggregate domestic flows.

There are three international trade components for which data were collected, each from different sources:

- International seaborne trade; Source: Journal of Commerce's Port Import Export Reporting Service ("PIERS").

- International cross-border trade with Mexico; Source: Bureau of Transportation Statistics' Transborder Surface Freight Database.

- International air cargo trade; Sources: U.S. imports and exports for selected airport codes, Department of Commerce, Bureau of the Census; and Trade with U.S. Possessions, Annual EA695, Department of Commerce, Bureau of the Census.

Again, only the seaborne component was fed into the FAFD.

For all three of these categories, the data addresses the flow for trade through U.S. gateways (seaports, border posts, and airports) where international shipments are cleared. During the clearance process, a range of information about the shipments is collected, the most useful and accurate of which is information about the nature of the shipment as well as the international origin/destination. This information was used to trace the international trade patterns for individual industry sectors.

Also collected during the clearance process, specifically for the seatrade and cross-border trade, is information about the U.S. shipper/receiver, including their domestic location. Conceptually, this information about the domestic origin/destination could be useful in tracing international trade domestically, to and from U.S. locations of origin and destination. However, this domestic data component was found to have a significantly high level of error. For example, shippers commonly identify the address of the respective company headquarters as the point of origin/destination, rather than the actual production plant. Grain from Iowa shipped down the Mississippi River system through the port of New Orleans to Brazil may actually be shown as being shipped from New York where the shipper is headquartered. In other cases, no domestic address is provided in this database. Although this problem of arbitrary reporting was not universal to all industry sectors, it was found that these international databases could not be used alone to accurately trace the domestic routing of international trade. Hence, an approach was undertaken which involved supplementing domestic reporting components of the international trade databases with other data sources, namely:

- Reebie Associates' TRANSEARCH data.
- 1993 Commodity Flow Survey, Department of Commerce/Bureau of the Census.
- Standard & Poor's DRI U.S. Regional Economic Service.

All three of these data sources were used to help define the domestic production and consumption and related flow patterns for commodities which were characteristic of trade.

Therefore, while the international trade routing portion (between ports/airports/border posts and foreign origin/destinations) was based primarily upon shipper declarations (PIERS), the domestic routing portion, though somewhat based upon declarations where available, was supplemented by other data sources and models (TRANSEARCH, CFS, DRI). The method of supplementing the declarations of domestic origins/destinations identified the most plausible domestic routing and allocation of international trade. To accomplish this, the domestic allocation process went through a series of progressive adjustments and refinements. For example, one of the early observations made during internal reviews was that the domestic allocation process had a bias toward the gateway states. In other words, the gateway states were shown to produce/consume an unusually high percentage of the trade passing through them. For some sectors like petroleum (crude and refined), which is shipped primarily through ports in Texas and Louisiana, the largest share was shown to be predominantly produced and consumed in those two states. This is actually plausible since these two states have a strong local base in those industries. However, in general, especially for merchandise and industrial goods, the gateway state bias was beyond reason. Hence, DRI's U.S. Regional Economic Service was used in combination with Reebie Associates' TRANSEARCH database and the 1993 Commodity Flow Survey data, to adjust for the bias.

One of the challenges of undertaking a study of this nature was the sheer magnitude of data set which was analyzed. At the database level, LATTS studied trade between 112 specific U.S. entities (76 Alliance state BEA's, Puerto Rico, and 35 non-Alliance states) and 23 foreign entities (19 Latin

American, and 4 other world regions), through 101 gateways (ports/border-posts/states), for 32 different commodity groups, by 3 international modes and 6 domestic modes, over a space of 5 previous years (1992-1996). From a mathematical standpoint, the combinations ran into the millions, making it very impractical to report findings at this level of detail.

Hence, for purposes of discussing trade patterns in this report, the U.S. was broken into five major regions: the Alliance, the Southwest, the Northwest, the Central, and the North Atlantic states. The states included in each region are shown in Exhibit B1-2. The non-Alliance states were addressed on a regional basis, while the trade patterns for each of the Alliance states and Puerto Rico were identified individually.

In a similar manner, Latin America was grouped into 19 individual entities, the majority of which are individual countries, while several of the smaller countries were combined into groups, as shown in Exhibit B1-3.

In addition to the 19 Latin American data regions shown above, there are four international data regions for which the database identified trade with the U.S.: Asia, Europe, Canada, and the Rest of World. However, in this report, to simplify the task of reporting non-Latin American international trade, these four regions were combined into a single Rest of World category.

The Standard Transportation Commodity Code (STCC) classification system was used, specifically at the 2-digit level. Exhibit B1-4 lists the commodities and their associated codes. In addition, for presentation purposes broader classifications are shown below. These classifications are intended to simulate material handling needs.

The standard TRANSEARCH data set includes import and export volumes, but inland flow patterns of these international movements largely "mimic" the supply chain of domestic goods. By using the import/export data assembled by PIERS, plus Industrial I/O relationships, the LATTS effort enhanced the inland movement data for international flows by developing a set of distribution patterns through a process similar to that used for establishing domestic freight patterns. LATTS modeling also distinguished inland modes, using STB rail and COE water information to establish railroad, inland waterway, and net truck activity. For the FAF database, 1996 LATTS volumes of international trade were updated to 1998 levels.

Mexico/U.S. Surface Freight Movements

The central source of the FAFD U.S./Mexican database is TRANSEARCH international products, augmented with border crossing points from U.S./Mexico transborder statistics produced by the U.S. Census Bureau, under contract to the U.S. Department of Transportation Bureau of Transportation Statistics. This source provides information on transborder shipments by truck and rail, in terms of declared value (U.S. dollars) at customs inspection points on the border. (Air and water shipments are described elsewhere.) Information on southbound shipments includes U.S. state of origin and Mexican state of destination. For northbound shipments, U.S. state of destination is shown, but origins are shown simply as Mexico; however, physical volume (tons) is reported for these shipments, along with their value. Commodities are indicated by the Mexican version of the "harmonized" coding system.

Processing the data involves allocating the northbound traffic to Mexican State of origin. In addition, the data are converted from the Harmonized Code to STCC commodity codes and from volume units (dollars) into tons. This is done by means of a bridge table. After a review, some further checks are made during the process of converting volume units from dollars to tons. This conversion relies on a table of product values; however, adjustments are made in some instances where a dollar value is deemed more appropriate for import/export trade in a given STCC category.

The database includes both production and consumption regions in Mexico and the United States. To determine the Mexican state of origin for northbound shipments, source data are processed further. The method employed hinges on a set of tables produced by Reebie Associates from a variety of Mexican sources. These tables give a quantified breakdown of all 32 states within Mexico as origin areas for world exports from Mexico. Further, each table represents an industrial group, approximating a two-digit STCC code. It is assumed that Mexican exports to the United States are proportionately in the same source patterns as exports to the rest of the world.

U.S. state volumes of imports from and exports to Mexico are further allocated down to the county-level. This procedure utilizes domestic U.S. production and consumption levels within counties, by specific commodity types. The relative weighting of each county's inbound and outbound volumes, as a percent of a state's total volumes by specific commodity type, are used to create disaggregation factors, which are then applied to Mexican traffic flows. Caution should be exercised, as assignment to the county-level was undertaken in order to maintain uniformity within the data base, and for the purpose of developing flow routing assignments. It has limited reliability as a localized picture of U.S./Mexico traffic. It should be noted that in the FAF Database, all flows are on a county to county basis, which includes the border crossing (and all other international transportation flows) data also. In counties were multiple crossing exist, the database does not contain information on specific border crossing activities. Regarding the flow maps, the traffic flows through these multiple border crossings within the same county become routed based upon the shortest flow, not necessarily through the specific gateway facility itself.

A final enhancement to the data set was the assignment of border crossing points to each of the flows, based on BTS reports of crossing volumes. Thus, the gateway is linked to the flow of traffic into or from the United States.

Canada/U.S. Freight Movements

This FAFDInternational database is based upon the Transearch International database, which draws from original customs data obtained from Statistics Canada, using a combination of 1997 and 1998 reports. In this source, all origins and destinations are defined as U.S. states or Canadian provinces. Commodities are coded in accordance with the Harmonized Commodity Description and Coding System (HS). Canada/U.S. freight flow data have been translated into equivalent four-digit STCC definitions.

Five separate modes are reported: truck, rail, water, air, and other. Where the mode of transport is unknown or not clearly specified on the customs documents, the shipment is included in the "other" grouping, which is overwhelmingly dominated by pipeline shipments of crude petroleum and natural gas.[8]

For U.S. origins and destinations, domestic traffic volumes at the county-level are used to allocate the international origins and destinations. This process uses the same U.S. domestic data and processing techniques that are used with the Mexican data, although the greater dispersion of Canadian shipping activity renders the resulting patterns more robust. Canadian origins and destinations are disaggregated to the metropolitan market level based on patterns of Canadian domestic truck traffic, reported by Statistics Canada. Reports identify commodities and Canadian Metropolitan Areas (CMAs); still, significant portions of traffic appear in non-CMA, "remainder of Province" territories, and these residual geographic classifications also are carried forward into the international data set.

[8] While the movements of these flows from/to Canada are incorporated into the forecast, intra U.S. flows are not – the Reebie Associates' baseline database does not include pipelines as a transport mode.

The STB Railroad Waybill sample reports U.S. import traffic from Canada, but not exports, because it captures traffic from U.S. terminating railroads. Waybill data have been used in place of the customs information for Southbound (import) traffic, because of the superior detail in the original information source. In the Northbound direction, customs data are employed.

A final enhancement to the current FAF dataset was the assignment of border crossing points to each of the flows, again using BTS reports of crossing volumes. The Canadian-United States data was supplemented with additional data. The Eastern Border Transportation Coalition (EBTC), in cooperation with the Canadian Motor Carrier Association, collected cross-border truck flow data by origin/destination, routing, and commodity. This data set was added to the FAFD to better illustrate US/Canadian cross border trucking. In 2001, EBTC began collecting rail freight data, which was then added to complete the enhancement of border crossing components of the database.

International Air Flows

International air traffic between the U.S. and Canada is captured in the customs data organized by Statistics Canada. It appears in the FAFD by commodity in the same format as other U.S./Canada traffic information, and it has been forecast. Similarly detailed information is not available for U.S./Mexico and overseas trade; instead, air freight traffic in other international lanes has been compiled from BTS data, which show weight volume between U.S. and foreign airports. In the FAFD, this traffic appears as air tonnage flows for U.S. counties and foreign points.

However, commodity information is not presented in this data source for any international shipments. Separate customs data exist that depict commodity imports and exports by air; these could be linked to the BTS information to estimate the flow of goods. While estimates of this type were not undertaken for the FAFD, they are scheduled to be added for future editions. The absence of commodity information has meant that most international traffic by air has not been forecast.

How Were Freight Flows Mapped

Once the linkages between production and transportation flows were developed, they were mapped across geocoded modal networks for GIS display. The highway network was developed by the Oak Ridge National Laboratory (ORNL), and adapted by them for the county unit structure of the TRANSEARCH Visual Database (and FAF) database. Highway routes are determined by an ORNL algorithm that selects a single, lowest impedance path between any pair of counties.[9] Impedances reflect distance, class of highway and travel speed, and tolls. The algorithm follows the same principles that guide dispatch software used by motor carriers to manage their drivers. The resulting routes are a practical representation of the path favored by trucks operating in any given county-to-county lane.[10]

Rail routes are established by a routing model developed by Reebie Associates that considers carrier and junction information contained in the Waybill traffic data, and contains regional and short line as well as Class I railroad track in its network. Impedances take account of line ownership, trackage and haulage rights, track types, and the operating preferences of railroads for dispatching particular classes

[9] One consequence of the county unit is that artificial connections are used at origin and destination, to link county centroids to the nearest network point. This causes the routes for intra-county traffic, and for traffic originating and terminating between adjacent counties, to be not really meaningful.

[10] The traffic captured in the FAFD is U.S. domestic and international volume. Highway and rail traffic between points in Canada can use U.S. infrastructure, and traffic between Canada and Mexico certainly will; neither appears in the FAFD.

of traffic. The routing for a given county pair may follow a variety of rail paths, each with specific, associated commodity volumes.

Inland waterway routes follow patterns established in a network table, prepared by Reebie Associates for a waterway service and costing model supplied to ACE. The waterway network has few path alternatives, so a least-miles routing is adequate.[11] Mile posts in the table were associated with counties to create alignment with the traffic database; but only one path is used for any pair of counties for highway and waterway flows. ACE publishes data showing directional traffic volume on river segments; these data were not employed in the FAF routing process, though they are available as cross-checks for future development.

County-to-county flows of freight by air are not routed on detailed routing networks. Because the data reflect travel between origin and destination markets, flows are represented as straight-line county-to-county connections in the GIS displays. However, the use of hubs in air travel is not captured in this way, so the GIS does not depict operating routes for volumes that are subject to intermediate rehandling.

The forecast is consistent in using current routing options, moving both present and forecast volumes over current facilities. No adjustment was made for facilities under construction.

Commodity Groupings Used

Standard Transportation Commodity Codes are used in the FAFD to organize and present commodity information for a variety for reasons. These reasons include 1) the suitability of STCC codes to transportation and their general adequacy of nested detail, 2) comparability to codes used in production and consumption data, 3) convertibility from international codes, 4) continuity with historical information, and 5) use in the STB Waybill data.

STCCs at the 4-digit level[12] of detail are employed in the FAFD; thus, in the general category of Transportation Equipment, transportation of new motor vehicles (code 3711) is distinguished from auto parts (code 3714). In addition, non-standard codes have been added by Reebie Associates to represent various forms of secondary[13] truck traffic as follows: traffic from wholesalers, warehouses, and distribution centers (code 5010), and drayage for rail terminals and airports (codes 5020 and 5030). Commodity codes 4200 and above (chiefly describing miscellaneous categories) appear in domestic data but not in international; this is because the customs documentation that is the primary international information source routinely requires specific commodity identification, in order to apply appropriate duties.

For convenience in handling and display, STCCs at the 2-digit level have been employed for summaries and reports constructed from the FAFD (Appendix Table 3). More significantly, freight forecasts were prepared by 2-digit STCCs, for the sake of economical alignment with the commodity conventions maintained by WEFA. (A table of 2-digit STCCs and their descriptions is presented in the Appendix.) In preparing the commodity time series inputs to the forecasts, several definitional issues arose. Prior to 1995, STCC code 48 (hazardous materials) was included in the data for STCC code 28 (chemicals). For this analysis, STCC code 48 was ignored and a dummy variable representing its inclusion in chemicals was added to the equation for chemicals for the time period from 1985 to 1995.

[11] The really significant alternative route is the Tennessesee-Tombigbee waterway – but this typically is a high-cost operation. For the FAFD, only points physically located along the Tenn-Tom system were assigned that route.

[12] U.S./Mexico commodity data are restricted to a two-to-three digit STCC by limitations in the source information.

[13] Primary traffic is that from original points of production or importation; secondary traffic is that through an intermediate staging point.

In 1995, data collection coverage in TRANSEARCH was expanded to include STCC code 50 (secondary traffic moving from warehouses and distribution centers). In 1996, the definition used by Reebie Associates for secondary traffic was expanded to include the truck portion of rail intermodal activity, and the truck portion of air freight. Despite the fact that only a few years of data were available for secondary traffic, it was included in the forecast, due to its size and expected future growth.

The Development of the 2010 and 2020 Forecasts

The objective of this project is to create a forecast through 2020 for domestic and international freight flows, by origin, destination, and STCC. After developing the 1998 base year data, origin and destination data were linked to WEFA's econometric forecasts to provide additional information regarding future traffic flow estimates. WEFA's economic assumptions and the methodology used to link the WEFA forecast to the 1998 base year data set are discussed below.

Summary of WEFA's Economic Assumptions

WEFA's Macroeconomic Service Long-Term Trend Scenario from the second quarter of 2000 served as the basis for estimating and forecasting the national freight flow equations by STCC code. WEFA's Macroeconomic Service High Growth and Low Growth alternatives from the second quarter of 2000 were used to create the alternative forecasts. The baseline international forecasts were supplied by WEFA's World Trade Monitor forecast, while the alternatives were calculated from WEFA's Global Risk Scenario of Slower Growth from the third quarter of 2000 and the Global Scenario of Stronger Growth from the second quarter of 2000.[14]

The forecast is a long-term forecast out to the year 2020. The long-term analysis is concerned with the expansion of potential output or aggregate supply. The growth of aggregate supply or potential output is the fundamental constraint on the long-run level of economic activity. Two additional forecasts were developed: one assuming higher long-term growth, and a second assuming lower economic growth.

In the long-term forecast, potential GDP is a measure of the economy's ability to produce goods and services, and what economic growth could be achieved if resources were fully utilized. In an environment free of exogenous shocks, one can assume that economic output will converge to its potential or fully utilized level. The long-range outlook is dominated by supply factors, such as population growth and demographics, labor force participation rates, average weekly hours worked, national saving and capital stock accumulation, productivity growth, fiscal and monetary policies, foreign developments, and internationally determined prices. The forecast assumes that no exogenous shocks occur to the economy and that the economy expands at its long-run potential path in the absence of any business cycles, which are difficult to predict over the long term. Table 2 lists WEFA's long-term economic assumptions for the base forecast.

[14] WEFA's economic assumptions are posted on the Office of Freight Management and Operations Website (http://www.ops.fhwa.dot.gov/freight/adfrmwrk/index.htm).

Table 2. The WEFA Long-Term Baseline Forecast Assumptions

Population and Labor Force	Population growth will slow from 1% to 0.8% annually, slowing civilian labor force growth.
Employment and Unemployment	Manufacturing employment will continue to decline as a share of total employment, while service sectors will generate an increasing share of employment growth.
Productivity and Aggregate Supply	Potential GDP growth will slow relative to historical rates due to slower growth in the labor force, while productivity growth will remain steady.
Government Policy	The government sector share of GDP will decline due to slower growth in defense spending and a reduction in the share of interest payments relative to the federal budget.
Monetary and Financial	The Federal Reserve Board will remain watchful of inflation while ensuring growth in output consistent with potential output.
Consumption	The share of real consumption devoted to services and durable goods will rise, while it falls for nondurable goods, such as energy.
Business Investment	The investment share of structures will decline, while equipment's share will rise. The fastest growing sector of the economy for investment will be producers' durable equipment.
International Trade	Real export growth will slow growth in the trade deficit due to a decline in the value of the dollar and the a reduction in US real unit labor costs relative to the rest of the industrialized world.
Industrial Production	Manufacturing of durable goods, particularly non-electrical machinery such as computers, will grow faster than nondurable goods. Plastics and paper will lead nondurable goods production.

Methodology Used in Linking the Forecast to the FAF Database

The general methodology involved taking benchmark values for 1998, and growing these values into the future based on WEFA's forecasted growth rates. The result represented either shipments or purchases for a SIC code in a particular region of the country. The shipments growth rate was determined based on the growth rate in output in a particular region of the country and SIC code, from WEFA's Business Demographic Model (BDM). The purchases growth rate was determined based on WEFA's Business Transactions Matrix (BTM), which measures the purchases of a product made in one industry by industries in all other SIC codes, as well as the retail sector, in a particular region of the country. A national constraint was used to ensure shipments and purchases for each STCC and region combination were matched.

For the international freight flows, a similar methodology was applied for freight movements within the United States. The World Trade Monitor (WTM) forecast was used to estimate flows outside of the United States. The international freight flows were constrained to the WTM forecast by STCC code, world region, U.S. gateway, and domestic region.

The development of the forecasts involved ten overall steps. First, 1998 TRANSEARCH data were geographically aggregated to a combination of 20 metropolitan BEAs and 9 Census Divisions (Appendix Tables 1 and 2). The BEAs were selected for a number of reasons including modal regional importance, however time and costs limited the forecast to the 20 areas. (These 20 metropolitan BEAs accounted for approximately 35 to 40% of domestic freight flows in the U.S. in 1998.) Second, historical data from earlier years (and versions) of TRANSEARCH were assembled in time series back to 1985, in a format parallel to the 1998 database. Third, domestic origin/destination freight flows in 1998 were increased to 2010 and 2020 levels based on WEFA forecasts of growth in real output at the two-digit STCC commodity level for the specified regions. Fourth, utilizing the WEFA input-output system to capture regional purchases, a supply/demand balance was enforced to ensure consistency on a national level. This step provided a method of allowing shipments of a particular commodity from all regions to a particular region (supply) will equal purchases of that commodity by that particular region (demand.)

The fifth step in the forecasting process involved the application of a specially designed WEFA national freight model to the initial regional freight flow forecasts. The national freight model by two-digit STCC code was developed to serve as a top-level constraint for the freight flows by region. Equations were estimated for the total freight flows and 36 two-digit STCC codes at a national level, using time series data from Reebie Associates' TRANSEARCH database as the dependent variables. All equations included an index of industrial production as the primary independent variable. In some cases, a trend variable or price variable was also included. A dummy variable was added in cases where a specific problem with the data was identified. Again, these forecasts served as a top-down national constraint on the regional freight flow forecasts developed in step three. It is important to note that the incorporation of the national model as a top-down constraint reduces any bias associated with the generation of forecasts from one point in time (1998). The national freight model is not tied to a particular year and therefore provides an unbiased perspective in terms of national freight flow estimates developed for 2010 and 2020.

There were four additional steps related to the development of the international traffic flow forecasts. First, export and import freight flows by commodity from/to US gateways to/from specified world regions in 1998 (taken from TRANSEARCH /LATTS) were estimated on the basis of forecasts from WEFA's World Trade Service. Second, shipments to gateways from ultimate US origins (exports) were estimated utilizing WEFA's forecast of real output by commodity at the regional level. Third, shipments from gateways to ultimate US destinations (imports) were developed on the basis of WEFA's input-output system capturing future regional purchases. Finally, the internal export/import flows to/from the gateways were constrained by those established by the WEFA World Trade Service forecast in terms of STCC, world region of origin or destination, and gateway combination.

The last step in the forecast development process was the breakdown of forecasted traffic into both component counties and four-digit STCC commodity codes. This was done by applying two-digit commodity growth rates observed in a given origin/destination geographic set to all four-digit commodities observed in the base year in the corresponding counties within the same two-digit commodity class. The current 1998 routing programs and network were used in the forecasted database also.

It should be noted that the forecasts are commodity-based demand driven.[15] As a result, modal distributions over time are jointly determined by the differential growth in commodity flows and changes in the pattern of origin and destination. The advantage of this approach is that it supplies a baseline against which modal diversion – including changes in input costs and service competitiveness – can be separately assessed.

Summarized Forecast Information

The results show that total domestic freight flows are expected to grow an average of 3.4% from 1998-2010, and 2.4% from 2010-2020. Fifteen of the thirty-seven STCC codes are expected to grow faster than the average for 1998-2010, while twelve are expected to grow faster than average for 2010-2020. The fastest growing sectors in the first half of the forecast (1998-2010) are STCC 47 (small packaged freight shipments), and STCC 43 (mail or contract traffic). This supports the anecdotal evidence that small, light packages will comprise a larger share of total freight in the future. STCC 45 (shipper association traffic) and STCC 9 (fresh fish or marine products) show the sharpest decline in the first half of the forecast. Both sectors have been declining steadily since 1985. Mail or contract traffic remains the fastest growing sector in the second half of the forecast.

The WEFA forecast also included two alternative forecasts regarding assumptions of stronger economic growth and lower economic growth. Regarding total domestic freight flows, shipments are expected to grow an average of 3.7 from 1998-2010 in the high alternative scenario and 3.1 in the low alternative scenario. After 2010, slower growth is expected for both forecasts, with average growth rates of 2.7 from 2010-2020 in the high alternative scenario and 2.0 in the low alternative scenario. The relative ranking by STCC code based on compound annual growth rates does not change from the base case to the alternatives.

Summary Points on Content and Use of the FAF Database

The Use of the FAF Database

The foundation of the FAF database (FAFD) is the Reebie Associates' TRANSEARCH Visual Database, a proprietary data set. This places limits upon its public release and its availability for non-Federal government projects. The FAFD is available for utilization by Federal agencies for projects that are wholly financed by the Federal Government. Further, detailed guidelines governing the access, application, and release of the FAFD should be obtained by prospective U.S. agency users from the FHWA in Washington, D.C. Because of the propriety nature of the database, the detailed data set is not available for non-Federal Government use, although some summary information will be publicly available.

[15] In common economic practice, long-term forecasts implicitly assume that the necessary infrastructure and productivity gains will become available in order to handle projected freight volumes. The Office of Freight Management is conducting other analyses to examine the linkage between long-term economic growth and increased congestion

Summary of Inclusions and Exclusions

The FAFD covers the following forms of freight traffic, in base year 1998 and in forecast years 2010 and 2020:

- *Rail:* All U.S. domestic and inland international traffic moved by rail is captured.
- *Inland Water:* All U.S. domestic and inland international traffic moved on internal waterways is captured.
- *Air:* All U.S. domestic and international traffic is captured; commodity identification and forecasts are available for U.S.-Canada traffic, but not for other international flows.
- *Truck:* U.S. domestic traffic of manufactured goods, and inland international traffic of all goods are captured. Coverage of non-manufactured goods moved by truck extends to produce, coal, ores, and non-metallic minerals. Intermodal truck drayage is captured for international marine, domestic air and all railroad TOFC/COFC business. Drayage for inland waterways, pipelines, international air, and rail carload transfers is not captured. Other forms of excluded domestic truck traffic are:
  - Non-manufactured goods – other farm products (grain, raw fibers, livestock, horticultural); primary (raw) products from fisheries and logging camps, and waste.
  - Small package and mail shipments moved entirely over-the-road, as (truck drayage is captures movements of for such shipments moved by air and rail shipments).
  - Military and other government trucks.
  - Household goods and local service trucks (e.g., utilities, repair).
- *Pipeline:* Traffic of products moved in pipelines is not captured.

Summary of Caveats

The following are caveats affecting the character of FAF data:

- The traffic depicted consists of goods carried by various modes of freight transportation. The non-revenue empty movement of vehicles is not part of the database, though it can constitute a material portion of the demand for infrastructure.
- There is overlap between the U.S. and the international databases: inland movement of seatrade traffic is covered by both, as are most overland Nafta exports. However, this traffic is embedded in the U.S. dataset, while the foreign trade datasets have it explicitly identified and described. International air, and overland Nafta imports appear only in the foreign trade data.
- Commodity codes above STCC 40 are employed for some (chiefly U.S. domestic) traffic and describe miscellaneous categories of goods.
- County identification of U.S./Mexico traffic beyond its gateways is supplied as an aid to network assignment, and should not be relied upon for other purposes.

- Modal network assignments are applied to traffic to and from counties, the closest representation of geographic location. Sub-county routes at the origins and destinations of traffic and at international gateways are not meaningful, nor are routes for traffic originated and terminated in adjacent counties.

- County-to-county pairs are assigned one route for the highway and inland water modes, but multiple routes for railroad traffic.

Appendix Tables

Appendix Table 1. WEFA Regions and State Codes

Region	States (including District of Columbia)
Mountain	AZ, CO, ID, MT, NV, NM, UT, WY
New England	CT, ME, MA, NH, RI, VT
South Atlantic	DE, DC, FL, GA, MD, NC, SC, VA,WV
West North Central	IA, KS, MN, MO, NE, ND, SD
West South Central	AR, LA, OK, TX
Pacific	AK, CA, HI, OR, WA
East North Central	IL, IN, MI, OH, WI
East South Central	AL, KY, MS, TN
Middle Atlantic	NJ, NY, PA

Appendix Table 2. 20 BEA Areas and Region

BEA Area	Region
Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	New England
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	Middle Atlantic
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	Middle Atlantic
Washington-Baltimore, DC-MD-VA-WV-PA	Middle Atlantic
Charlotte-Gastonia-Rock Hill, NC-SC	South Atlantic
Miami-Fort Lauderdale, FL	South Atlantic
Atlanta, GA-AL-NC	South Atlantic
Cleveland-Akron, OH-PA	East North Central
Detroit-Ann Arbor-Flint, MI	East North Central
Chicago-Gary-Kenosha, IL-IN-WI	East North Central
New Orleans, LA-MS	West South Central
St. Louis, MO-IL	West North Central
Minneapolis-St. Paul, MN-WI-IA	West North Central
Dallas-Fort Worth, TX-AR-OK	West South Central
Houston-Galveston-Brazoria, TX	West South Central
Denver-Boulder-Greeley, CO-KS-NE	Mountain
Los Angeles-Riverside-Orange County, CA-AZ	Pacific
San Francisco-Oakland-San Jose, CA	Pacific
Portland-Salem, OR-WA	Pacific
Seattle-Tacoma-Bremerton, WA	Pacific

*Note: Freight flows for each of the BEAs were forecast separately from the rest of the region (Census Division) in which they are located.

Appendix Exhibit 1: SOURCES OF TRAFFIC DATA BY MODE

DATA SOURCE	MODES INFLUENCED T=TRUCK, R=RAIL, A=AIR, W=WATER				PRODUCER	BASIS
PRODUCTION AND SHIPMENTS						
US DEPT. OF COMMERCE SURVEY/CENSUS OF ANNUAL MANUFACTURES	T		A	W	US DEPARTMENT OF COMMERCE	SURVEY/CENSUS OF MANUFACTURING ESTABLISHMENTS WITH ONE OR MORE EMPLOYEE
DRI INDUSTRIAL PRODUCTION INDICES	T		A	W	STANDARD & POOR'S DRI	HISTORICAL ECONOMETRIC TREND DATA FROM FEDERAL, STATE, LOCAL GOVERNMENT, OTHER SOURCES
TRADE ASSOCIATION PRODUCTION AND SHIPMENT REPORTS	T		A	W	VARIOUS TRADE ASSOCIATONS	MEMBER, GOVERNMENT, MANUFACTURER INFORMATION ON PRODUCTION, CONSUMPTION, SHIPMENTS
US GEOLOGICAL SURVEY MINERAL INDUSTRY REPORTS	T			W	US DEPT OF THE INTERIOR, US GEOLOGICAL SURVEY	QUESTIONNAIRES SENT TO PRODUCERS, PLANTS, DISTRIBUTORS, IMPORT TERMINALS
MOTOR CARRIER INDUSTRY FINANCIAL AND OPERATING STATISTICS	T				TRANSPORTATION TECHNICAL SERVICES	COMPILED M-1 MOTOR CARRIER ANNUAL REPORTS, SUBMITTED TO FEDERAL & STATE GOVERNMENT
RA Freight Locater/InfoUSA STREET ADDRESS INDUSTRIAL ACTIVITY	T				InfoUSA/REEBIE ASSOCIATES	PHONE-SURVEY CENSUS OF BUSINESS; 2NDARY FORTUNE 500 DATA; RA BIENNIAL SURVEY
RAILROAD INDUSTRY PROPRIETARY REBILL FACTORS	T				RAILROADS	RAILROAD TRAFFIC RECORDS & GATE SURVEYS
COUNTY POPULATION DATA	T				US DEPT OF COMMERCE, CENSUS BUREAU	CENSUS OF POPULATION COLLECTED EVERY 10 YEARS AND ESTIMATED ANNUALLY
INTER-INDUSTRY TRADE PATTERNS (INPUT/OUTPUT TABLE)	T		A		US DEPT OF COMMERCE, BUREAU OF ECONOMIC ANALYSIS	INPUT-OUTPUT (IO) ACCOUNTS, BASED ON ECONOMIC CENSUS DATA
PRIVATE PORT DIRECTORIES				W	VARIOUS BARGE LINES, PORTS	PROPRIETARY INFORMATION ABOUT WATERWAY FACILITIES, COMPILED BY SURVEY

DATA SOURCE	MODES INFLUENCED T=TRUCK, R=RAIL, A=AIR, W=WATER				PRODUCER	BASIS
TRAFFIC FLOW						
RA MOTOR CARRIER INDUSTRY DATA EXCHANGE	T				REEBIE ASSOCIATES, MOTOR CARRIERS	ANNUAL COMPILATIONS OF BILLS OF LADING, DISPATCH RECORDS (VOLUNTARY, TARGETED)
DEPT. OF ENERGY COAL MOVEMENT STATISTICS	T				US DEPT OF ENERGY	MONTHLY, QUARTERLY, ANNUAL SURVEYS OF ELECTRIC UTILITIES; EXIM CUSTOMS DATA
DEPT. OF AGRICULTURE PRODUCE MOVEMENT DATA	T				US DEPT OF AGRICULTURE	COLLECTED FROM JOBBERS, CARLOT RECEIVERS, CHAIN STORE EMPLOYEES, & STATE DEPTS.
BTS COMMODITY FLOW SURVEY	T		A		BUREAU OF TRANSPORTATION STATISTICS	COMPULSORY, STARTIFIED SURVEY: MANUFACTURERS, WHOLESALERS, SOME RESOURCE PRODUCERS
RA PRIOR YEAR TRANSEARCH DATABASES	T	R	A	W	REEBIE ASSOCIATES	HISTORICAL, MULTI-SOURCE DATABASES
STATISTICS CANADA INTERNATIONAL TRADE DATA	T	R	A	W	STATISTICS CANADA INTERNATIONAL TRADE DIVISION	COLLECTED FROM CUSTOMS DECLARATIONS, IMPORT ENTRY FORMS
STATISTICS CANADA ANNUAL SURVEY OF TRUCKING IN CANADA	T				STATISTICS CANADA TRANSPORTATION DIVISION	SAMPLE OF INTERCITY COMMODITY MOVEMENTS OF FOR-HIRE TRUCK COMPANIES
BTS TRANS-BORDER STATISTICS	T	R			BUREAU OF TRANSPORTATION STATISTICS	SHIPPER EXPORT DECLARATIONS, IMPORT ENTRY FORMS
LATIN AMERICA TRADE & TRANSPORTATION STUDY DATABASE (LATTS)	T	R		W	STATES:MS, AL, LA, TX, AR; WILBUR SMITH ASSC; DRI	COMPILATION OF TRADE DATA; BASE 1996 WITH 2000 FORECAST, EXTRAPOLATED TO 1998
COE WATERBORNE COMMERCE STATISTICS - STATE TO STATE SERIES				W	US ARMY CORPS OF ENGINEERS	COMPULSORY SURVEY OF OWNERS, AGENTS, MASTERS, CLERKS OF VESSELS ON NAVIGABLE WATERS
COE WATERBORNE COMMERCE STATISTICS - PORT SERIES				W	US ARMY CORPS OF ENGINEERS	COMPULSORY SURVEY OF OWNERS, AGENTS, MASTERS, CLERKS OF VESSELS ON NAVIGABLE WATERS
BTS T-100 DOMESTIC & INTERNATIONAL TRAFFIC DATA			A		BTS, OFFICE OF AIRLINE INFORMATION	REPORTS OF US AND FOREIGN CARRIERS OF FREIGHT AND/OR MAIL
BTS FORM 41 T-3 ENPLANEMENT STATISTICS			A		BTS, OFFICE OF AIRLINE INFORMATION	REPORTS OF CERTIFICATED AIR CARRIERS BY ORIGIN AIRPORT
FAA 5010 AIRPORT DATABASE			A		US DEPT OF TRANSPORTATION, FEDERAL AVIATION ADMIN	COMPILATON OF CERTIFICATED LANDING FACILITIES
STB PRIVATE RAILROAD WAYBILL SAMPLE		R			SURFACE TRANSPORTATION BOARD	STRATIFIED, COMPULSORY WAYILL SAMPLE FOR RAILROADS TERMINATING 4000+ LOADS/YEAR

Appendix Exhibit 2. TABLE OF STCC 2Digit Codes

STCC2	DESCRIPTION
1	Agricultural Production-Livestock
8	Forest Products
9	Fresh Fish Or Marine Products
10	Metallic Ores
11	Coal
13	Crude Petroleum Or Natural Gas
14	Nonmetallic Minerals
19	Ordnance Or Accessories
20	Food Or Kindred Products
21	Tobacco Products
22	Textile Mill Products
23	Apparel Or Related Products
24	Lumber Or Wood Products
25	Furniture Or Fixtures
26	Pulp, Paper Or Allied Products
27	Printed Matter
28	Chemicals Or Allied Products
29	Petroleum Or Coal Products
30	Rubber Or Misc Plastics
31	Leather Or Leather Products
32	Clay, Concrete,Glass Or Stone
33	Primary Metal Products
34	Fabricated Metal Products
35	Machinery
36	Electrical Equipment
37	Transportation Equipment
38	Instrum, Photo Equip, Optical Eq
39	Misc Manufacturing Products
40	Waste Or Scrap Materials
41	Misc Freight Shipments
42	Shipping Containers
43	Mail Or Contract Traffic
44	Freight Forwarder Traffic
45	Shipper Association Traffic
46	Misc Mixed Shipments
47	Small Packaged Freight Shipments
48	Waste Hazardous Materials
49	Hazardous Materials Or Substances
50	Secondary Traffic

Note: STCC codes higher than 41 are not included in international freight flow data.