Using FAF2 Port Data to Model Freight in a Medium Sized Port City

Models for transportation, port, air, intermodal operation; impact analysis

Michael D. Anderson, Ph.D., P.E.
Associate Professor of Civil Engineering
Department of Civil and Environmental Engineering
The University of Alabama in Huntsville
Huntsville, AL 35899
256-824-5028
mikea@cee.uah.edu

Gregory A. Harris, Ph.D., P.E.
Director, Office for Freight, Logistics & Transportation
University of Alabama in Huntsville
Shelby Center for Science & Technology, Room 145
256-824-6060
harrisg@uah.edu

Kevin Harrison
Director, Transportation Planning
South Alabama Regional Planning Commission
110 Beauregard St. Suite 207
Mobile, AL 36602
251-706-4635
kharrison@sarpc.org

ABSTRACT

The ability to accurately incorporate freight moving to and from a port into an urban model is difficult in both small and large cities. To address this issue, this paper presents an application in which the Freight Analysis Framework Version 2.2 (FAF2) Port Data was incorporated into a traditional urban transportation planning model for a small/medium sized community (Mobile, AL). The paper discusses the application of the data integration steps and the issues encountered during the application. The paper concludes that port data can be incorporated into the traditional planning process, but special consideration must be made to understand the local shipping network.

INTRODUCTION

Transportation modeling activities focus on the development of travel demand models as a tool to support infrastructure investment decisions within an urbanized area. Typically, these models focus on passenger transportation, often peak hour levels of travel, to determine the existing and future roadway congestion to test roadway alternatives. The commonly used process is to develop the amount of travel or number of trips (trip generation), origin/destination pairs for the trips (trip distribution), mode for the trip, if alternate modes are available which is not the case in smaller urban areas, (mode choice), and finally the route for the trip (traffic assignment) [1]. A considerable amount of research has been performed into this process, as well as optimization within each step, and although there is more work to be done, this area of transportation modeling is relatively well understood.

Unfortunately, developing a travel demand model that only includes passenger car trips is omitting a significant number of vehicles on the roadways. The missing trips consist of heavy vehicles, or freight trips, which have the potential to account for 20-25 percent of the trips on major roadway facilities; especially in industrial/manufacturing sections of town (data verified using Alabama Department of Transportation Traffic data [2]). Additionally, this traffic consumes a significant amount of the roadway capacity and these trips are growing rapidly as freight movements are increasingly being transported by truck.

The need for the integration of freight traffic into the transportation modeling effort is evident by the publication of "NCHRP 570 - Guidebook for Freight Policy, Planning, and Programming in Small- and Medium-Sized Metropolitan Areas" [3] and ongoing research being performed by the National Cooperative Freight Research Program (NCFRP) [4]. However, even with a greater focus on the importance of freight transportation in the modeling environment, it is still difficult for transportation professionals to obtain accurate data for use in the models. This problem exists because freight data is proprietary, and as such, companies are reluctant to release this information. Often freight activities occur outside the study area, such that transportation professionals have no direct mechanism to collect freight trip information as they do with passenger trip information [3].

This paper describes methodologies developed to overcome these two limitations, the proprietary aspect and the external nature of the data, through the use of a publically available, highly aggregated commodity flow database within a travel demand model. The paper discusses some issues associated with the use of highly aggregated port freight data in a travel model, presents a multi-tiered mechanism to incorporate freight from a highly aggregated source into a travel model through a case-study of Mobile, AL, and presents issues associated when using the freight data in the model. The paper concludes that the highly aggregated port freight data can be successfully integrated into the travel demand model within an urbanized area by utilizing this methodology.

BACKGROUND

The application of freight within a travel demand model is not a new concept. There have been several attempts to collect and incorporate freight flow information into a community's travel model. NCHRP 570 contains a brief examination of 15 case studies performed in small and medium sized communities [3]. However, these model options often act as a stop-gap, or place-holder, for freight within the travel demand model and these applications are difficult to validate to actual travel patterns.

This paper focuses on using the Federal Highway Administration's Freight Analysis Framework Database, Version 2.2 (FAF2) for application within an urban area. The FAF2 is a commodity flow database that contains 114 internal zones and 17 ports of entry for the United States [5]. The geographic location for the zones is presented in figure 1. The flow information is given for 43 specific commodities, for 7 transport modes, in either kilotons transported annually or value of shipment transported annually [5].

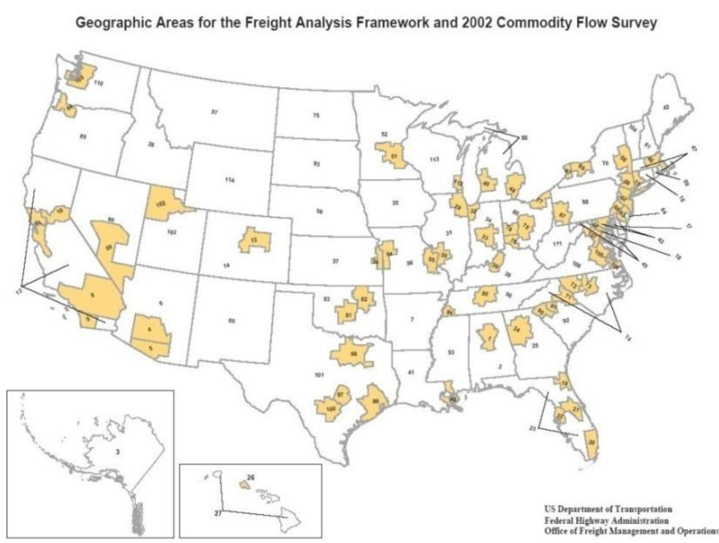

FIGURE 1 FAF2 Geographic Areas

Often, using the freight flow information contained in FAF2 is questionable because of limitations associated with the data due to the scale for the zones and the lack of empty vehicles being included in the database. There have been studies performed to disaggregate the FAF2 data to smaller geographic regions [6, 7, 8]. Additionally, the empty vehicles can be accounted through the conversion of kilotons to vehicles by selecting the appropriate weight per vehicle that will take into account the portion of empty vehicles [9].

With these adaptations included, it is theorized that the aggregated data can be used to support freight transportation in a travel demand model.

METHODOLOGY/CASE STUDY

The methodology is presented through the case study used to test the application of the federal freight flow database for travel modeling. The case study location selected was Mobile, AL. The case study community has an area population of approximately 350,000, an international port for bulk and container freight, and is positioned at the intersection of Interstate 10 and Interstate 65 – two important freight corridors within the nation (see figure 2).

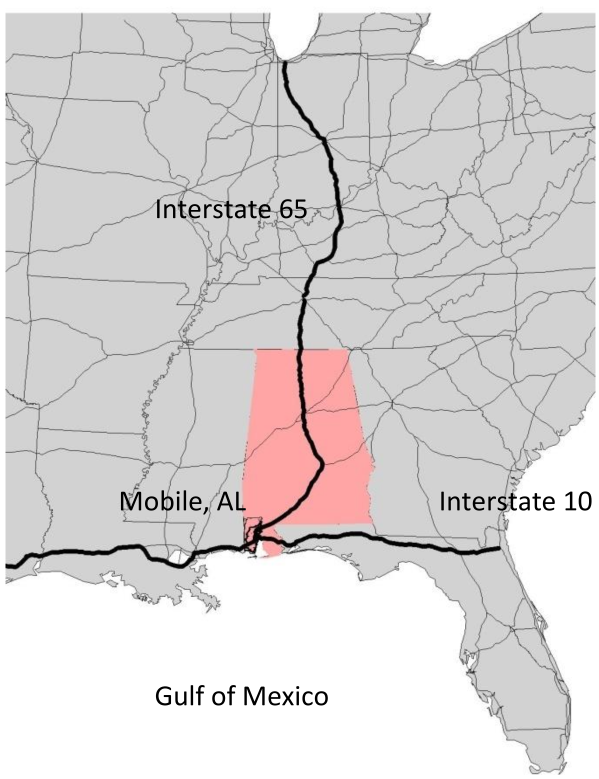

FIGURE 2 Mobile, AL in relation to the United States

The existing travel demand model for the Mobile area is developed in TRANPLAN and models trucks implicitly. The trucks passing through the area are accounted for through the use of the traffic count at the study boundary. The external-external trips are preloaded in the model and these trips are constrained to selected roadways in the networks. The internal truck trips are assumed to be a portion of the non-home-based trips in the study area. These trips are distributed through a gravity model and assigned to the network using an equilibrium assignment.

Port Freight Trip Purposes

Initial examination of the Mobile, AL area and the aggregation levels and geography of the FAF2 database identified three possible freight movements in the area attributable to the port. The freight movements identified are:

1. Port to the US (non Alabama)
2. Port to Alabama (non Mobile)
3. Port to Mobile, AL

Port – US (non-Alabama)

The truck trips from the Port of Mobile to anywhere in the US, non Alabama, were developed using a national network and a subset of the FAF2 database. The network used to model the FAF2 database was a national level roadway network developed in TRANPLAN (see figure 3). The network was developed to include the interstate system links and a few US Highways in close proximity to Mobile, the case study city. The decision to use the interstates in the national network is logical because most trips traveling between states are assumed to take the major interstates while the trips close to the case study city might choose to use some additional local roadways. Additionally, trips between locations that do not impact the case study are not if great importance.

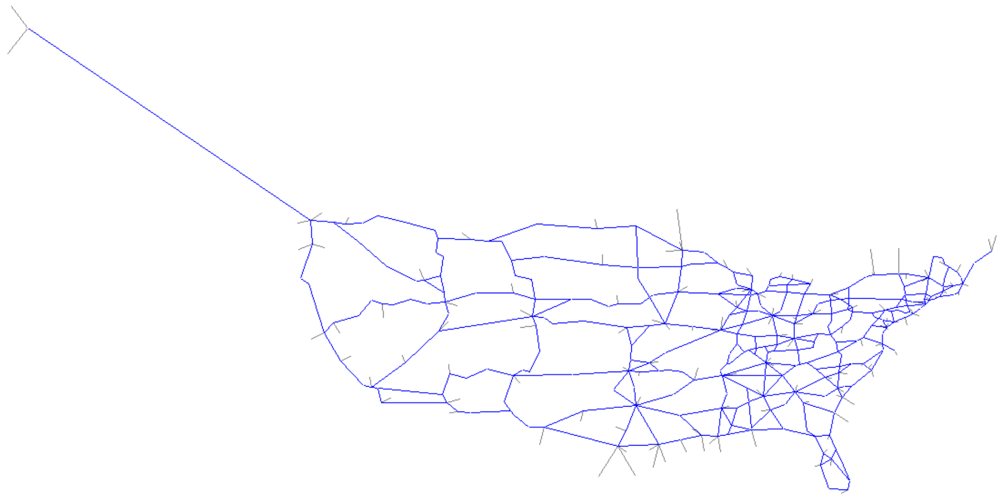

FIGURE 3 National Network

The truck trip table assigned to the network is obtained from the FAF2 database, using the actual origins and destinations entered in the database and converted into truck volumes from the original truck weights. Empty trucks are included in the process by manipulation of the study truck weight as described earlier. The trips are determined by adding five trip types from the FAF2 Database (Domestic Trips, Border Crossing into the US, Boarder Crossing out of the US, and Port trips into the US, and Port trips out of the US). A Matrix Manipulate function in TRANPLAN is used to aggregate the data into one table for assignment. A Matrix Update function in TRANPLAN is used to remove trips originating or terminating from Alabama zones (FAF2 zone 1 & FAF2 zone 2) that were not the port. The assignment step again used selected link loading options for only the centroid connector that served as the port. The trip volumes were manually renumbered to match the external stations used in Mobile.

Port – AL (non-Mobile)

The truck trips between the Port of Mobile and locations in Alabama, non Mobile, were determined using a statewide level network and disaggregation of the two FAF2 zones for Alabama to the county level and the port data from FAF2. The statewide network was developed to contain all Interstate facilities, US Highways and some Alabama Highways within the state. Again, these roadways were selected as they represented the main routes truck would travel through the state, assuming long distance truck trips would avoid using county roadways, see figure 4.

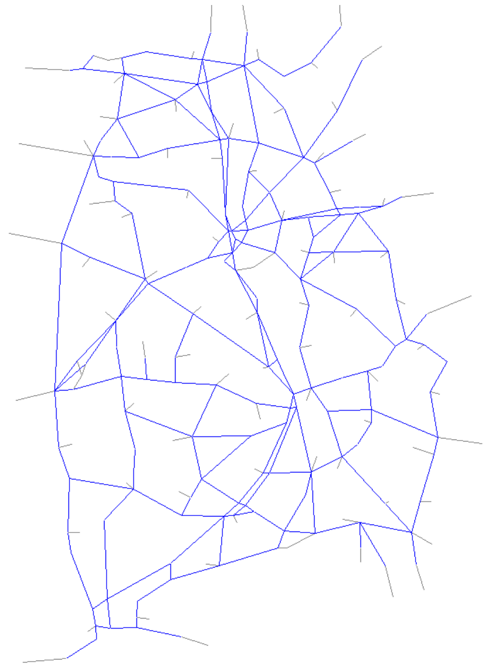

FIGURE 4 Statewide Network

These truck trips were determined using a disaggregation of the FAF2 data for zones 1 and 2 using the county population, personal income and value of shipment allocation factors [10]. The disaggregation was performed in Microsoft Excel and only the trips to and from the Port of Mobile was distributed to the 67 counties in Alabama. It is important to note that trips were distributed to Mobile County, these trips will be used as the basis for the Port to Mobile trip purpose.

The assignment to the statewide network provided the number of truck trips on US Highway 43, US Highway 45, Interstate 65, and Interstate 10, the four main roadways leading out of Mobile. The trip volumes were then manually renumbered to match the external stations used in Mobile.

Port – Mobile

The truck trips between the Port of Mobile and locations within Mobile were developed during the step where the port trips were disaggregated to the 67 counties of Alabama. However, in this trip purpose, since the truck trips were specifically associated with Mobile, it was necessary to develop a mechanism to further disaggregate the trips into the urban area of Mobile.

The disaggregation of trips within Mobile was performed using Freight Analysis Zones (FAZs) within Mobile. The concept behind the development of the FAZ is that there are so many traffic analysis zones (TAZs) within the urbanized area, the disaggregation to that level would become extremely fine, and there would be several zones with fractions of trips. The FAZ allowed for an aggregation of TAZs with similar household, employment and income characteristics to be grouped into a larger region. Statistical tests and an analysis of freight characteristics associated with each FAZ were used to determine the appropriate grouping levels and over 300 internal TAZs were converted into 28 FAZs [11].

The final disaggregation of trips into FAZs was performed using the number of manufacturing employees that were considered working in freight related industries. Originally, the total employment was used for disaggregation to the FAZs, however, this led to an over-estimation of truck trips because of retail and manufacturing locations where the manufacturing consisted of software and pharmaceuticals. Once the FAZs were determined, the assignment of trips was made to the local area network, see figure 5.

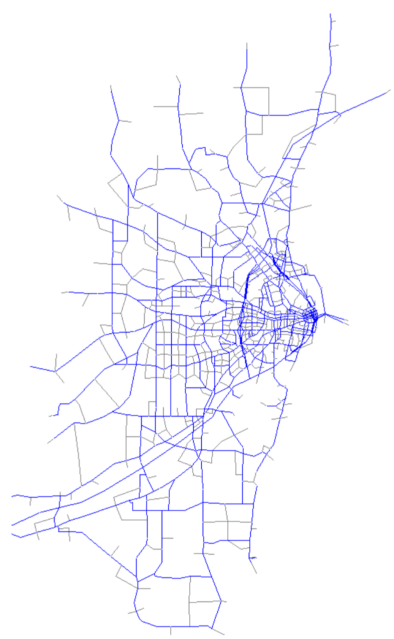

FIGURE 5 Mobile, AL Network

Modeling Port Trips

The aggregation of the three trip purposes described form a single truck origin/destination matrix for Mobile, specifically targeting the Port. To incorporate this new matrix into the model, the model structure was altered such that the truck matrix was assigned through a preload to the network as a separate mode which was constrained to selected roadways in the network. The selected roadways in the networks for truck traffic were carefully identified examining locations that contained limited turning radii and existing traffic calming devices.

"Freight Handlers"

After examining the assignment of the truck trips, it was determined that the impact of "freight handlers" needs to be explicitly model. The freight handlers in Mobile are responsible for moving freight in/out of the port property, but not for the entire shipment. A large number of these freight handlers were located on a parallel roadway to the main interstate path north out of town, and originally, the model assigned the freight trips directly out of town on the interstate. A subsequent model was developed, after surveys were performed, that indicated that the truck trips from the port were being held in Mobile while waiting for final processing to the ultimate destination.

CONCLUSIONS

This study examined the use of a publically available, highly aggregated freight flow database to incorporate freight into an urban model. The process required a multi-tiered modeling approach with many trip purposes to complete the endeavor. Additionally, the process requires some local knowledge to complete the process to ensure the results are accurate. The issue with "freight handlers" is one that would not have been easily identified without local surveys. Overall, as a transportation planning tool, the model developed can be used with the FAF2 2035 forecast as a tool for developing future truck forecasts. These future forecast can be used model future scenarios and examine freight impacts.

REFERENCES

1. Dickey, J., *Metropolitan Transportation Planning.* Second Edition. Hemisphere Publishing Corporation, Bristol, PA, 1983.
2. ALDOT. Alabama Traffic Data. http://aldotgis.dot.state.al.us/atd/default.aspx. Accessed June 30, 2009.
3. NCHRP 570. Guidebook for Freight Policy, Planning, and Programming in Small- and Medium-Sized Metropolitan Areas. 2007.

4. TRB. National Cooperative Freight Research Program. http://www.trb.org/crp/ncfrp/ncfrp.asp. Accessed June 30, 2009.
5. Federal Highway Administration, *Freight Analysis Framework (FAF), Version 2.2 User Guide*, Nov. 20, 2006.
6. Opie, K., J. Rowinski and L. N. Spasovic. Commodity Specific Disaggregation of the 2002 FAF2 Data to the County Level for New Jersey. In *Proceedings of the Transportation Research Board Annual Meeting, TRB 88th Annual Meeting Compendium of Papers DVD*. Washington, D.C., January 11-15, 2009.
7. Krishnan Viswanathan, K. Daniel Beagan, V. Mysore, and N. Srinivasan. *Disaggregating FAF^2 Data for Florida: Methodology and Results*, Submitted to the 2008 Transportation Research Board Annual Meeting, 2008.
8. Rowinski, J., K. Opie, and L. N. Spasovic. *Development of a Method to Disaggregate the 2002 FAF2 Data down to the County Level for New Jersey*, Proceedings of the 87th Annual Meeting of the Transportation Research Board, 2008.
9. Federal Highway Administration, *Development of Truck Payload Equivalent Factor (TPEF), Final Report*, 2007.
10. Anderson, M., G. Harris, S. Jeereddy, S. Gholston, J. Swain and N. Schoening. Using a Federal Database and New Factors for Disaggregation of Freight to a Local Level. *Proceedings of the 10th International Conference on Application of Advanced Technologies in Transportation*, Athens, Greece, May 2008.
11. Harris, G.A., P. Farrington, M. Anderson, N. Schoening, J. Swain, and N. Sharma. Developing Freight Analysis Zones at a State Level: A Cluster Analysis Approach. In *Proceedings of the Transportation Research Board Annual Meeting, TRB 88th Annual Meeting Compendium of Papers DVD*. Washington, D.C., January 11-15, 2009.