Transportation Infrastructure in Alabama

Tools for Solutions

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The Center for Management and Economic Research
The University of Alabama in Huntsville

This research is the result of the professional efforts of the following team:

William R. Killingsworth, Ph.D.
Director, Center for Management and Economic Research

Gregory A. Harris, Ph.D., P.E.
Principle Research Engineer, Center for Management and Economic Research

Michael D. Anderson, Ph.D.
Associate Professor, Civil and Environmental Engineering, UAH

Phillip A. Farrington, Ph.D.
Professor, Industrial & Systems Engineering, Engineering Management, UAH

Lauren C. Jennings
Research Scientist, Office for Freight, Logistics and Transportation

Sharla A. Mondesir
Research Scientist, Office for Freight, Logistics and Transportation

Sarah M. Marcott
Student Assistant, Center for Management and Economic Research

Niles C. Schoening, Ph.D.
Professor, College of Administrative Science, Economics, UAH

Bernard J. Schroer, Ph.D.
Principal Research Scientist, Office for Freight, Logistics and Transportation

Heather R. Shar, EIT
Research Scientist, Office for Freight, Logistics and Transportation

Sherry Starling
Research Scientist, Center for Management and Economic Research

James J. Swain, Ph.D.
Professor, Industrial & Systems Engineering, Engineering Management, UAH

Jeff Thompson
Principal Research Scientist, Center for Management and Economic Research

Karen Yarbrough
Research Scientist, Center for Management and Economic Research

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Executive Summary

In the decade of the 90's the need to integrate freight into the policy, planning and programming activities of State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs) became very apparent as global manufacturing, outsourcing, and off shoring became more prominent in the global and US economy. Business and community leaders, as well as public sector officials, recognized that the effective and efficient movement of freight is key to a region's economic competitiveness. Using almost any metric, freight traffic is growing faster than passenger travel. Freight, by it nature, crosses modal boundaries, therefore any analysis method that does not consider multiple modes of transportation, such as truck and rail, are inadequate. However, by better understanding freight needs and issues, it is possible to design and conduct an economical and efficient freight planning process that can be integrated with conventional transportation planning.

More than 15 billion tons of freight valued at over $9 trillion traveled on the US transportation infrastructure in 1998. By 2020, freight will have grown by nearly 70 percent and the value of the goods moved will be almost $30 trillion, according to the Federal Highway Administration. This level of activity and growth demands the attention of transportation system planners.

Freight data is key to making informed decisions on infrastructure investment and policies issues that affect the effectiveness and efficiency of the freight transportation system. Freight data is critical to the evaluation of options to mitigate congestion, improve economic competitiveness, facilitate the effective use of land planning, optimization of modal activity, improve safety and security, reduce fuel consumption and enhance air quality. Although data by itself does not ensure good decision-making, it is not possible to make informed decisions without valid data.

A Transportation Research Board committee formed to investigate and make recommendations on freight data concluded that the present patchwork of uncoordinated and incomplete freight data sources should be reengineered in the context of a national freight data framework that provides for a more integrated approach to freight data collection and synthesis. The committee noted that this would be a multi-year effort and would involve many technical organizational challenges.

In response to this need to investigate freight from a multi-modal and comprehensive perspective, researchers at the University of Alabama in Huntsville (UAH) developed a Freight Planning Framework (FPF) shown in Figure ES.1. This framework is a direct freight forecast based upon industry economic activity that offers an improvement to the forecast based upon a percentage of overall traffic flow typically used by transportation planners throughout the U.S. The project research goal was to establish a more direct relationship between the major industry sectors in a region and the freight traffic generated as a result of that sector activity, formalizing the methodologies used in developing the forecasts used to operate the Infrastructure model developed in previous research. Total Value of Products Shipped, Income and Employment were investigated as indicators of sector economic activity in the relationships for forecasted freight traffic. The results of this research is a comprehensive framework for analysis, planning and forecasting based upon the industry sector composition of a region and the economic activity level.

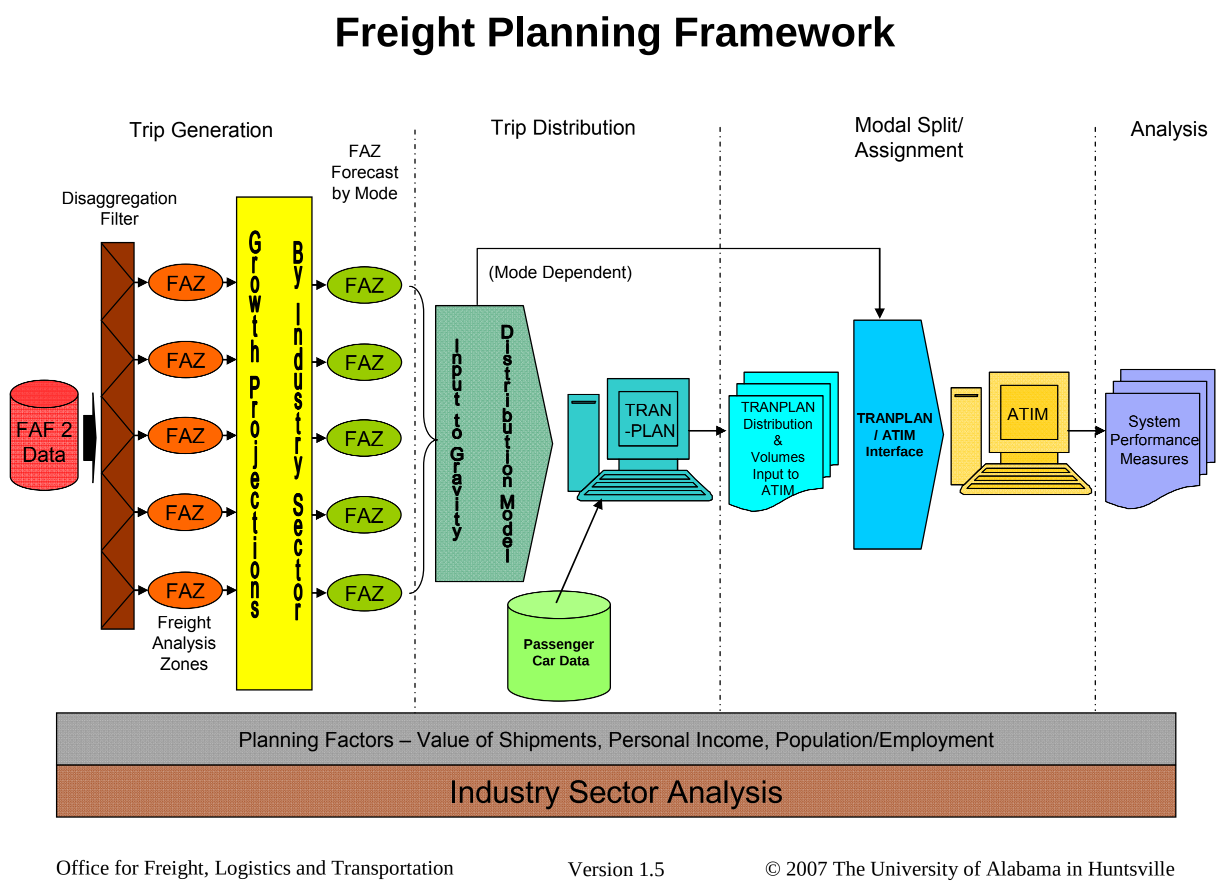


Figure ES.1 - Freight Planning Framework.

The FPF is a forward looking method and approach to freight planning. As such, the foundation of the framework is the use of industry sector analysis to establish the basic need for transportation infrastructure access. The concept is that if the underlying principles of freight demand generation can be discovered, the ability to accurately predict infrastructure requirements is improved. Once the freight generation principles of an industry sector are known, it is theoretically possible to apply those relationships anywhere the sector exists to estimate the demand for freight system requirements.

Freight Forecasting – Supply and Demand Factors

There is consensus from transportation planners that the availability of usable freight data is negligible. The Freight Data Committee of the Transportation Research Board is actively pursuing methods to generate usable freight data, but there is a great deal of dissatisfaction with the current state of freight data.

Previous research at UAH collected and tested several economic variables to be used in freight forecasting. It was concluded that the value of goods shipped by Alabama's manufacturing sectors was the best variable to predict the growth of freight traffic. Value of Shipments data is available through open databases and is a reasonable predictor of freight volumes arising from the supply side of the state's economy. Another variable selected was Personal Income. Personal income, a proxy for the consumer feeling of affluence, is a reasonable predictor of freight traffic originating from the sale of finished goods to Alabama's households.

A database of these variables was developed and used to predict future freight traffic in each of the state's 67 counties. This data did not exist upon the initiation of this research and had to be manually collected from multiple databases, disaggregated to the county level and sorted to create usable freight information. The original database, developed in 2006, included information on 17 of the state's manufacturing sectors. Thus, most of the effort in this research period of performance was focused on adding additional sectors to the original manufacturing-only database.

Figure ES.2 presents output of the forecasting methodology developed in terms of originating truckloads by industry sector for 2005, 2010 and 2015. The map in Figure ES.3 visually presents the 10 counties with the most truck originations in 2005.

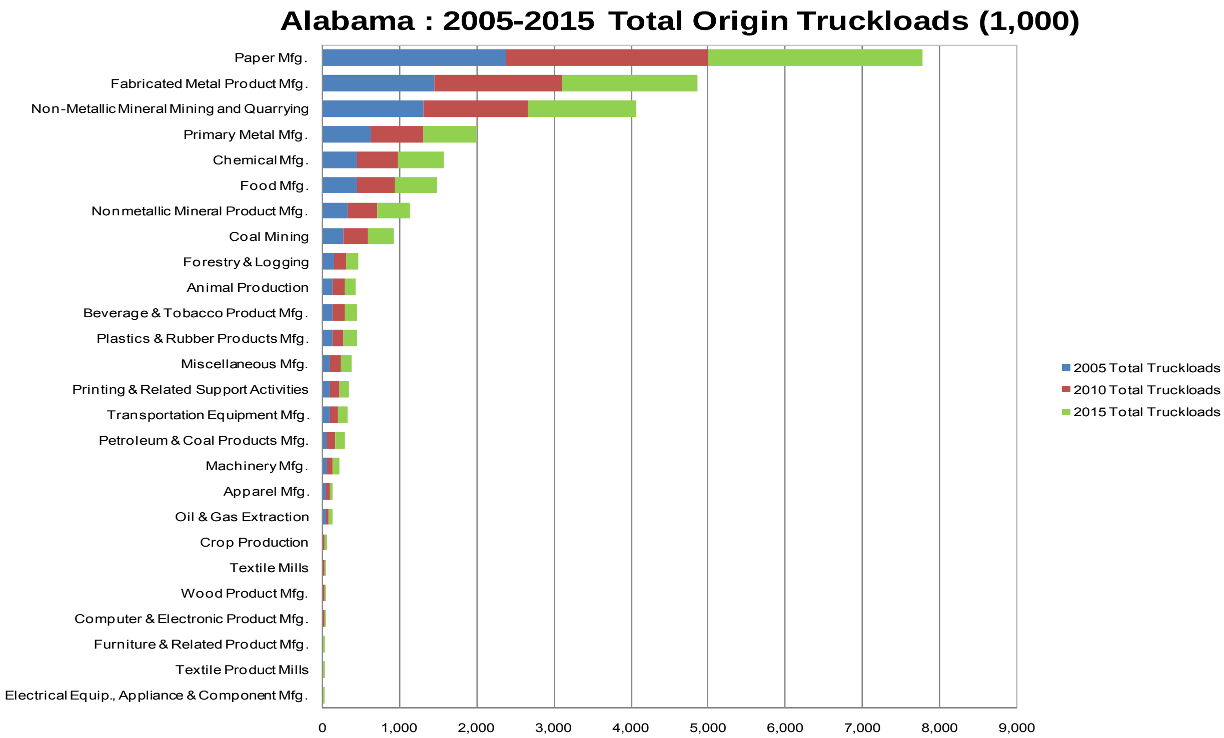


Figure ES.2 – Total Truckload Originations by Industry Sector

Figure ES.4 presents the counties in Alabama with more than 1,000 originating truckloads from the Transportation Equipment Manufacturing sector.

Figure ES.3 – Top Ten counties in 2005 Truckload Originations

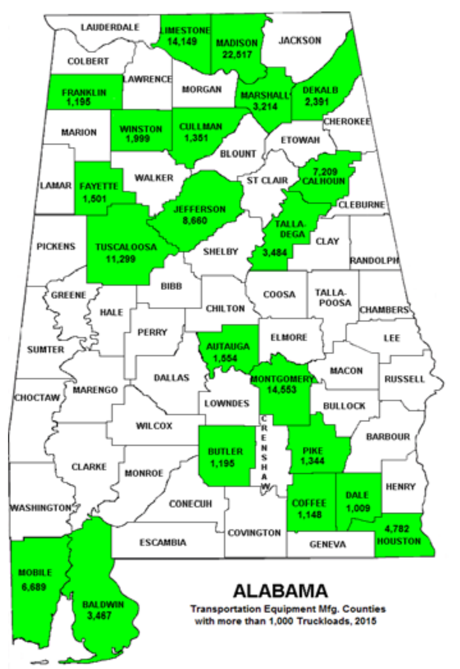


Figure ES.4 –Counties with more than 1000 Truckload Originations 2005 and 2015 for the Transportation Equipment Industry Sector

A substantial amount of freight traffic arises from the transport of finished goods, usually shipped from out-of-state, through warehouses and distribution centers to retailing locations serving the state's major population centers. It is important to include the demand side of freight activity by identifying the location and amount of freight traffic generated by distribution and major retailing centers. The locations of the state's major retail chains and distribution centers were identified as part of this research effort.

The state's major retail distribution centers were identified from data supplied by the Alabama Development Office and from a national market research database entitled *2006 High-Volume Retailers* compiled by TradeDimensions International. Major retail store locations were identified from a national internet research database – *Reference USA*. This data was supplemented by telephone directory listings to verify the locations. Petroleum product distributors were identified through the Alabama Department of Revenue Wholesale Licensed Distributors list. The completed list will be used to develop a survey and interview plan to complete the demand side freight data for the aggregate freight volumes utilizing Alabama transportation infrastructure.

The Alabama Transportation Infrastructure Model (ATIM)

The transportation model developed in earlier research calculated a deterministic "snapshot" of average traffic flow during a day. Peak traffic flows were estimated based upon ratios to average flow. The model incorporated no interrelationships between modes of shipping, i.e., truck, rail, or water.

The Alabama Transportation Infrastructure Model (ATIM) developed at UAH in 2005 overcame many of the limitations of the earlier model. The ATIM is a discrete simulation that will create and display traffic flows over a twenty-four hour day. Automobile traffic and truck traffic are independently calculated and used to simulate overall traffic flows. The model also incorporates dynamics between modes of shipping. The ATIM incorporates the random variation inherent in transportation systems as well as the complex interactions of freight moving over the transportation network and through intermodal connector points. In 2005/06 the model network and loading of initial data was completed and validation of the highway mode initiated. To validate the rail and waterway modes it is necessary to collect and analyze additional data.

The ATIM can provide estimates of how changes in the network or changes in utilization of network components will impact the performance of the overall transportation system and, consequently, indicate the expected performance of system investment alternatives.

The ability to make reasonable decisions regarding transportation investment is limited by the quality and quantity of data and information available on the transportation infrastructure. The ability to communicate with diverse audiences about transportation issues and the source of congestion is key to creating consensus on potential solutions. Visual representations allow for open discussion and debate on the underlying issues and the merits of the potential solutions. This was the purpose behind the development of the Alabama Transportation Infrastructure Model (ATIM), and it has proved to be a valuable communication and analysis tool over the last year and a half. In 2006/07 the model network and data was expanded and enhanced.

The ATIM includes 20 Class III rail lines currently operating in the state, which service specific companies or communities. The Class III rail lines provide connections between the areas they serve and the Class I railroads; essentially, they serve as the "farm-to-market" pathways for the rail industry.

Railroads are increasingly being considered as a possible solution to congestion in many areas of the country, including Alabama, but that may not be realistic. Like roadways, rail has a limited capacity for moving freight along specific routes. Contrary to popular opinion, rail companies may not have access to the capital necessary to increase capacity. For planning purposes, more information is needed on how the railroads operate, schedule train movements, and calculate capacity. This information will not be obtained without strengthened relationships and cooperation with the decision makers within private railway companies.

Until recently, researchers at UAH have experienced limited success with engaging representatives of the Class I railroad transportation community in the research. Recent opportunities have arisen from relationships developed with the research departments of Norfolk Southern railroad. The researchers at UAH will continue to develop this relationship.

The waterway simulation in the ATIM is developed from data on Alabama's inland waterways provided by the Army Corps of Engineers. The Corps provided the most recent data available (2004) on freight movement volumes on Alabama's inland waterways. This data was used to update the origin-destination pairs already in use in the ATIM. Current freight activity on Alabama's inland waterways consists primarily of the transport of bulk commodities that are not time-sensitive delivery such as coal, chemicals, forest products, petroleum, and grain. The image of waterborne transport as slow and inflexible to shipper's needs has negatively affected the mode's competitive standing relative to rail and truck shipments. However, transport by barge remains the most fuel-efficient mode of freight transportation.

Waterborne freight transport, especially Container-on-Barge transport, represents an untapped opportunity for reducing congestion due to freight growth in key sections of Alabama's Freight-Significant Corridors (Interstates 10 and 65). However, without up-to-date information on the capacity of the locks and dams, maintenance and dredging needs of the waterway system and levels of recreational water vehicle demand on the inland waterway system, this key mode of freight transportation cannot be included in comprehensive freight plans and modeling efforts.

Validation of the ATIM is being conducted by comparing model output with the Alabama Department of Transportation (ALDOT) traffic counts. ALDOT supplied UAH researchers with their statewide traffic count data for the roadway system. The traffic count data contains an estimate of the truck count for each roadway segment. The lack of reliable truck count data for model verification and validation purposes continues to be an obstacle in model development.

A System Dynamics Model of the Alabama Transportation Infrastructure

The models discussed above do not have the capability of examining the long-term interaction between a state's economy and its transportation infrastructure. The economy and infrastructure are influenced by several long-term feedback loops that interact, influence, and determine the evolution of the system. Another set of dynamic interrelationships involve growth, tax revenues, and future infrastructure improvements to ease congestion. In 2005, UAH researchers developed a preliminary system dynamics model that illustrated these interrelationships. During this period of performance the researchers at UAH expanded and enhanced the system dynamics model to offer more fidelity and analysis capability of the Alabama economy and transportation infrastructure. The focus of the model is on the relationships between population, education, workforce, congestion, and infrastructure.

The population in Alabama has increased from 3,444,354 in 1970 to approximately 4,525,375 in 2004. Alabama has lagged behind in population growth when compared to Florida, Georgia, and Tennessee. These neighboring states all exceeded the national average for percentage population growth over the 34-year period. Figure ES.5 shows the percentage change in population for these four states. The drivers for population growth are the state's economic development activity, the age composition of the state's residents, and net migration.

Increased investment and expansion leads to net immigration and population growth. The neighboring states of Florida, Georgia, and Tennessee have experienced an increase as a result of the factors mentioned here but Alabama has not experienced the same level of growth in population and jobs.

The gradual aging of the state's population along with relatively weak immigration has contributed to the decline in population. The continuation of this population trend will result in a society that is unable to effectively sustain economic growth. Reduced economic growth decreases the attractiveness of the state to skilled and educated workers.

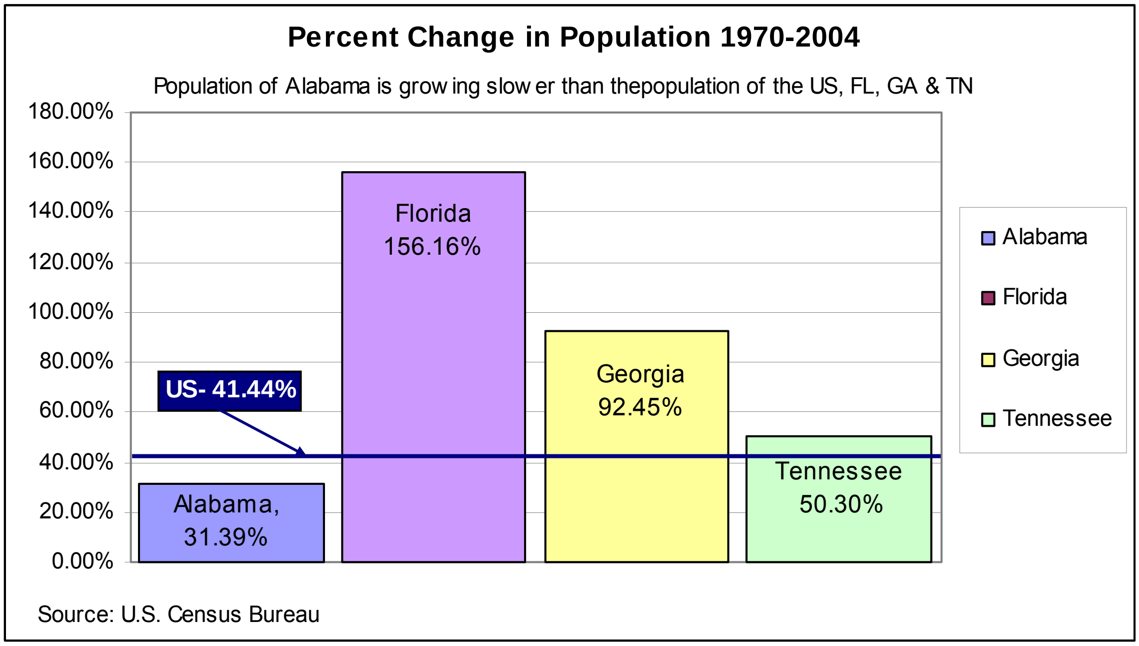


Figure ES.5 - Percent Change in Population 1970 – 2004

Elementary education (grades 1 through 8) in Alabama experienced decreasing enrollment by 100,929 students from 1970 to 2004. Comparatively, the national average for elementary education enrollment decreased but by a smaller margin. Secondary education (grades 9 through 12) experienced a decrease in enrollment of 29,751 over the same period. During the years 1970 to 2004, national enrollment in secondary education increased nationally. The loss of school-aged population in Alabama could be related to a decrease in the state's birth rate. A comparison of the decline in Alabama's elementary and secondary enrollment as well as the national averages can be seen in Figure ES.6.

Post-secondary education in Alabama (both 2 and 4 year colleges) increased significantly in Alabama from 1970 to 2004. This increase exceeds the national growth rate. 2-year college enrollment in Alabama more than doubled over the same period. The population of Alabama between ages 18-34 increased by 31% from 1970 to 2004 and could explain some of the increase in post secondary education enrollment. Another factor that could have lead to such an increase in enrollment is the addition of 15 post secondary schools to the Alabama education system since 1980, providing easier access to many Alabamians.

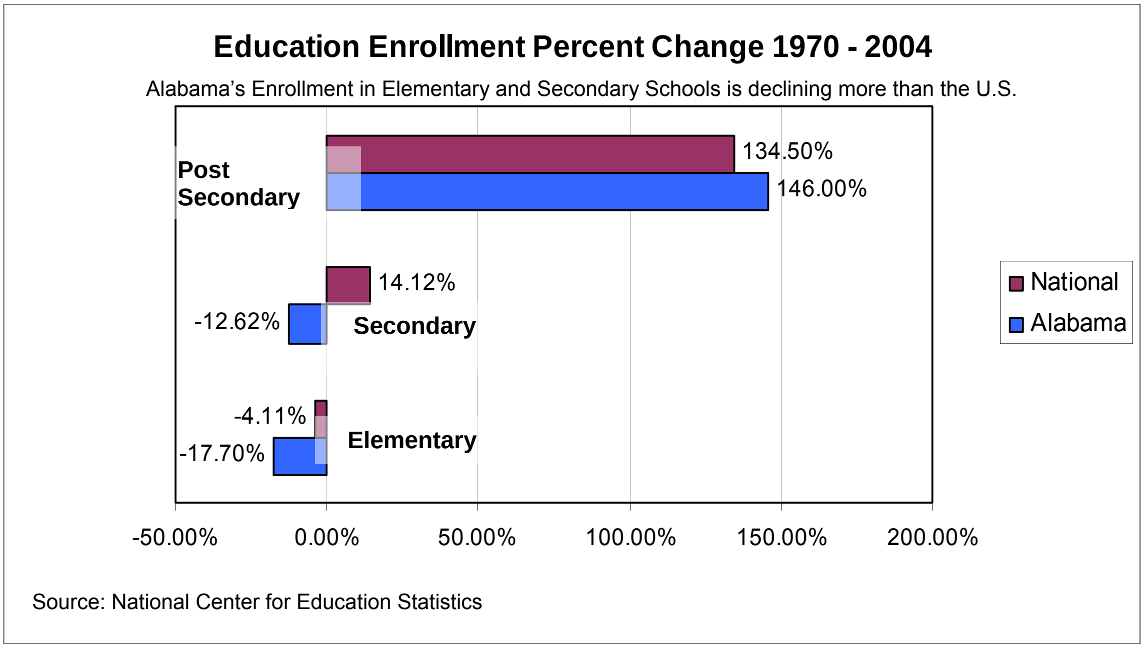


Figure ES.6 – Percent Change in Education Enrollment from 1970 - 2004

The economy of Alabama has made a dramatic transition from predominantly Agriculture & Natural Resources and Basic Manufacturing industries to Service, Advanced Manufacturing, and Knowledge industries. This dramatic transition is evident in the employment changes for these various industry groupings. For model analysis purposes, industries in the state of Alabama were divided into five broad industry groupings: (1) Agriculture & Natural Resources, (2) Basic Manufacturing, (3) Advanced Manufacturing, (4) Services, and (5) Knowledge. Figure ES.7 presents the jobs gained and lost by industry grouping from 1970 to 2004.

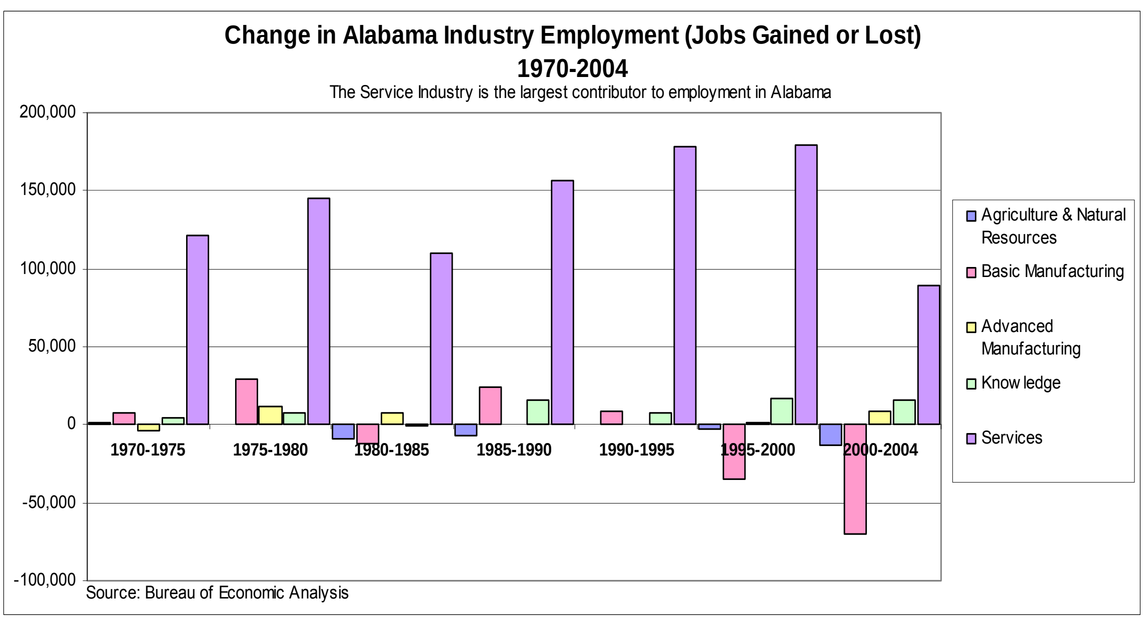


Figure ES.7 - Change in Alabama Industry Employment 1970 - 2004

The number of jobs in Alabama that require skilled and/or college-educated individuals continue to increase. Education and training of the labor force and immigration are failing to keep up with this growth. If Alabama is unable to educate, attract, and retain the talent required for its expanding Advanced Manufacturing, Services, and Knowledge industries, then economic growth in Alabama would eventually be constrained.

Congestion is often measured in terms of delay. Figure ES.8 shows the growth in hours of delay for travelers in urban areas from 1982 to 2003 for 11 U.S. cities, including Birmingham, AL. which has a relatively low level of delay caused from congestion compared to other cities with the same size population. This is a positive attribute for Birmingham and other major Alabama cities.

The purpose of the transportation infrastructure system is to permit and enhance the efficient and effective movement of people and commerce from origins to destinations. Historical data for interstate lane miles obtained from the Alabama Department of Transportation data indicates that the rate of increase in Interstate lane miles is essentially the same as the rate of deterioration, about 5% per year.

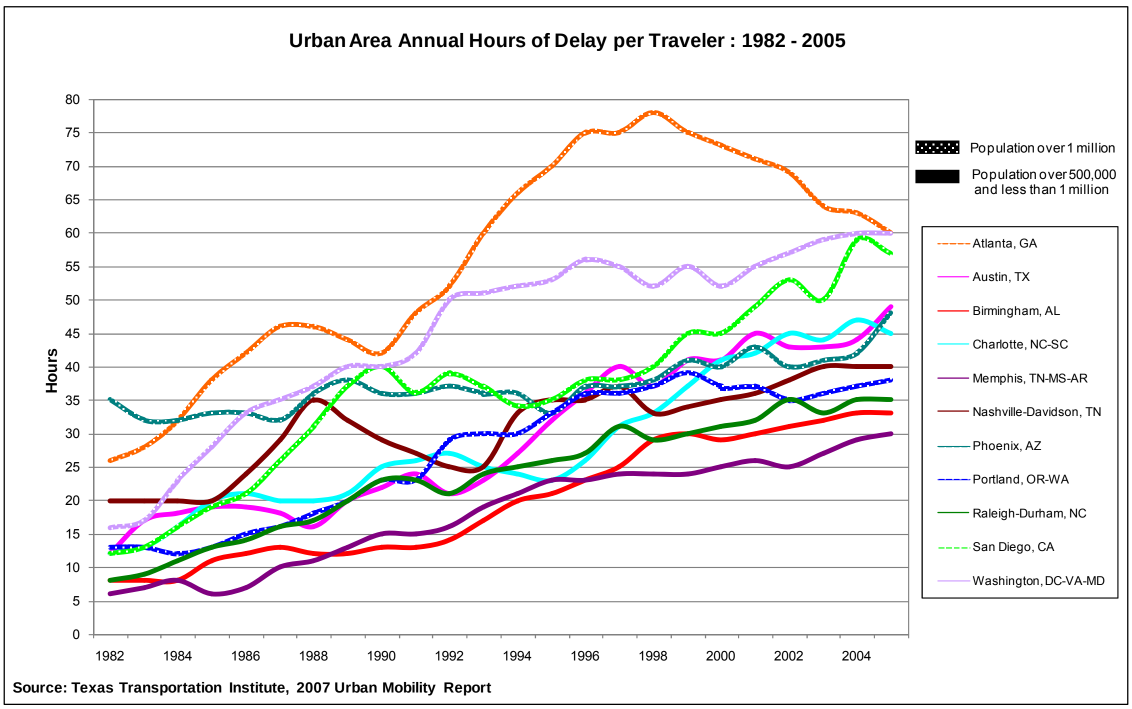


Figure ES.8 - Urban Area Annual Hours of Delay per Traveler 1982-2005

The ability of the model to reproduce the past is a method of model verification. Statistics were collected from 1970 through 2004 for the different sectors of the model. Figure ES.9 is an example of the reproducibility of the model.

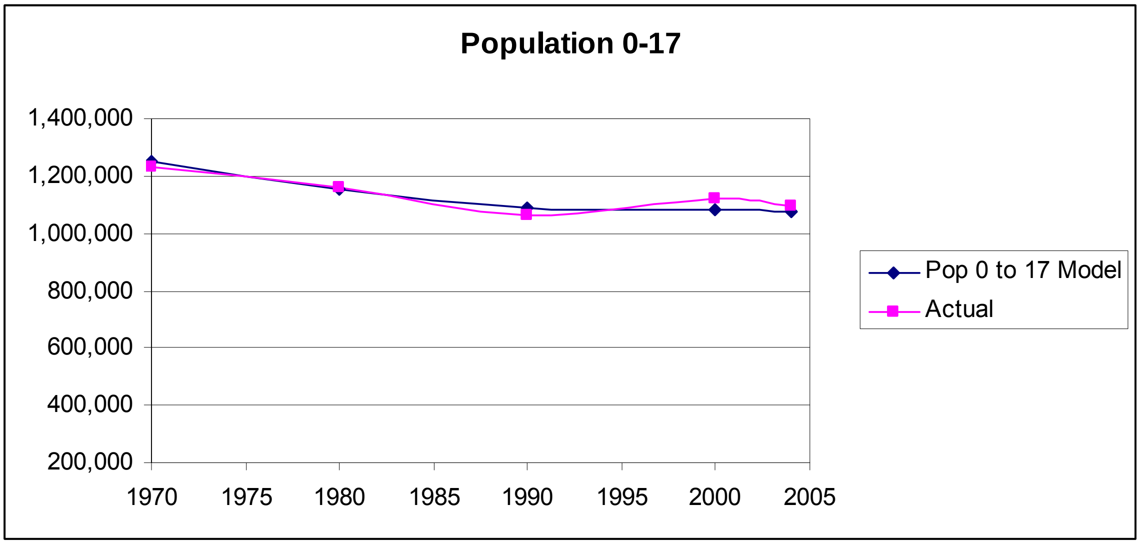


Figure ES.9 - Population 0-17 Actual vs. Model

Figure ES.10 is an example of the projection capabilities of the model. The chart shows employment over time of the five industry groupings.

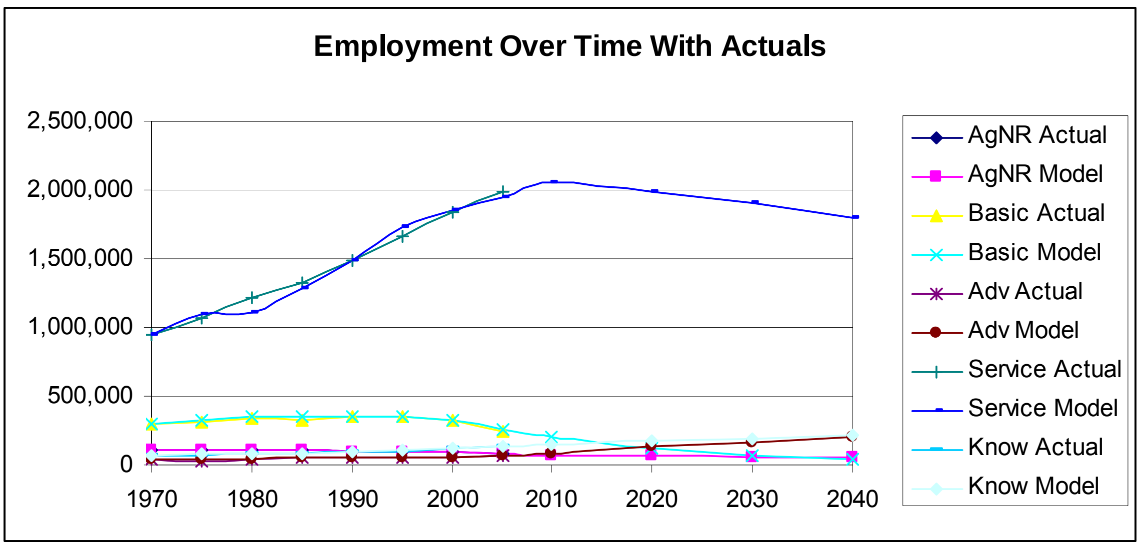


Figure ES.10 - Employment Model Outlook With Actuals

At present, there is more workforce available for Basic Manufacturing than is needed, while Advanced Manufacturing and Knowledge industries fall short of their desired workforce. This puts a strain on the existing and future workforce. Both growing congestion and workforce issues will be potential constraints to investment in Advanced Manufacturing and Knowledge industries. However, growth in Advanced Manufacturing and Knowledge industries can provide an opportunity for Alabama to offer higher paying jobs and possibly attract a workforce from other parts of the country. This growth could also force Alabama school systems and Alabama training programs to step up and provide the state with more individuals trained for high skill jobs.

Investments in Basic Manufacturing assets are declining, and will continue to decline, especially in economic centers, as congestion grows. Once congestion reaches a level where the cost of travel exceeds the ability to attract workers, the Basic Manufacturing industry plants will relocate, either in a more rural, accessible area or to a lower wage environment. Congestion and the availability of workforce are two main factors that will act as constraints to a thriving economy.

Congestion continues to grow, even though each year the interstate lane miles are increasing slightly. Alabama's workforce is and will continue to be strained to fill needed positions. The available workforce in Basic Manufacturing is being used to keep Advanced Manufacturing and Service where they need to be. A switch from a Basic Manufacturing job to an Advanced Manufacturing job cannot be accomplished, in most cases, without going through additional training. It is important that the Alabama school system and training centers teach the skills necessary to perform at a minimum Advanced Manufacturing jobs. However, the state will need more than just better training to get the workforce where it needs to be; the state needs additional population.

Online Data and Information Warehouse

The Center for Management and Economic Research has embarked upon a project to create an online warehouse for transportation related data and information for Alabama and the Tennessee Valley Region. This centralized database is expected to facilitate the effective and efficient retrieval of data and information pertinent to the research process. Access to the repository would be through two links on the UAH CMER website, namely:

1. Population, Infrastructure, and Economic Activity Data
2. Presentations, Papers, and Reports

Population, Infrastructure, and Economic Activity Data

A brief explanation of its contents

- This section consists of data obtained from various non-proprietary databases and/or documents which have been used in research efforts conducted by CMER

A searchable feature

- This feature will allow the user to perform data searches by keywords and/or data sources.
- The result of this search will be a list of available data that falls under the search criteria. Each item in the list will be a link to the PDF data file. Researchers will also have the option of obtaining certain data in Microsoft Excel format by submitting an emailed request for data

A list feature

- This feature will allow the user to view a list of all data categorized under the following headings : Population, Infrastructure, and Economic Activity
- The result will be a list of ten data items per webpage. To facilitate navigation, each webpage will contain a next-and-previous page button

Presentations, Papers, and Reports

The main page for the presentations, papers, and reports section of the online warehouse will contain the following:

A brief explanation of its contents

- This section consists of presentations, papers, and reports published and/or delivered by faculty and staff of the University of Alabama in Huntsville

A searchable feature

- This feature will allow the user to perform searches by author's name, title/keywords, and/or date
- The result of this search will be a list of available data that falls under the search criteria. Each item in the list will be a link to the PDF document and additional information about the item, namely: title, publication year/presentation date/report date, author, and abstract

Conclusions and Next Steps

Research on transportation infrastructure in Alabama completed by UAH since 2003 has created significant awareness of the tie between infrastructure and economic growth in the state. The Office for Freight, Logistics and Transportation (OFLT) at UAH has developed an excellent working relationship with the Alabama Department of Transportation (ALDOT) and is considered a valuable transportation planning information resource by the department. The OFLT research team consists of full time research staff and faculty from the Colleges of Engineering and Business Administration. Expertise in specific areas of research has led the team to focus on four research streams:

- *Freight Forecasting, Planning, and Analysis*

The research completed last year at UAH in developing a comprehensive approach to freight forecasting, planning and analysis is one of the first efforts to provide transportation planners with tools adequate to perform the required tasks of integrating freight into the transportation planning process. The Freight Planning Framework developed at UAH provides a foundation and guide for needed research that will bring freight planning to the level of planning expertise for passenger car travel. Research into the comprehensive approach to freight planning will be a main focus of the research at UAH in the future.

- *Transportation Systems Modeling & Simulation*

In 2005/06 the model network and loading of highway data and expansion of the highway, rail and waterway networks was completed and validation of the highway mode initiated. The validation process included a preliminary qualitative validation of the highway infrastructure system based on Extreme World Scenarios. The validation effort brought to light needed model modifications and led to a more robust model. Still, the data needed to bring the rail and water modes of freight transport up to the level of the highway data is still underway. New and growing relationships are opening access to the data required from these other modes of transport.

- *Interrelationships between Infrastructure, Economic Activity, and Population*

The system dynamics modeling has evolved to a level of complexity of which transportation and congestion are a small part. The workforce, population and education issues bring much more weight to the issues facing Alabama than the transportation infrastructure at this time. Research into the relationships between population, infrastructure and economic activity will continue as it relates to the development of freight forecasting, planning and analysis tool development.

- *Productivity Enhancements in Transportation, Logistics, and Supply Chain*

Personnel from the Alabama Technology Network Center at UAH, working with the OFLT, have been engaged with the Alabama State Docks in Mobile, Alabama to introduce lean enterprise principles and help create a culture of continuous improvement. The throughput of coal at the McDuffie Island Coal Terminal has almost doubled since the UAH experts began training the workforce and facilitating improvement events. Results such as these indicate that there is much to be gained in the flow of freight through improving operational efficiency and effectiveness at ports and other logistics hubs.

The next steps for transportation research at UAH will build on previous OFLT successes and will expand the body of knowledge within each of the four strategic research initiatives including:

- *Development of Freight Analysis Zones*

Researchers at UAH will continue the development of freight analysis zones to determine optimal levels at which freight analysis, planning and forecasting should be undertaken in Alabama. Specific tasks to be performed include developing the methodology for the establishment of Freight Analysis Zones in Alabama, applying the FAZ methodology to freight in Alabama through the development of various freight flow models using the different zone structures, and performing analysis to compare different FAZ structures to county level freight planning zones to determine the benefits and costs.

- *Expansion and Enhancement of the Alabama Transportation Infrastructure Model (ATIM)*

In 2006 the model network and loading of data was completed and validation of the highway mode began. Validation and calibration of the model is ongoing with alternative data sets needed. To validate the rail and waterway modes it is necessary to collect and analyze additional data. Access to this data is being pursued and headway should be made in the near future.

- *Modeling Intermodal Operations Using Discrete Event Simulation*

Conceptual simulation models of intermodal facilities can be used to identify needed improvements and the potential benefits of continuous improvement activities. The use of simulation for intermodal operations can be used to establish performance targets for planning future process improvement activities. UAH is focusing on developing models that will evaluate the effect of increasing freight volume on the immediate egresses to and from each facility and the resulting volumes on connector facilities in the region.

- *Continuous Improvement in Logistics & Transportation Systems*

A study of best practice logistics operations is needed to better understand the opportunities Alabama has in the transportation and logistics industry sector identified in the 2005 report to U.S. DOT “Transportation Infrastructure in Alabama – Meeting the Needs for Economic Growth” produced with the support of the Office of the Secretary, U.S. Department of Transportation Grant No. DTTS59-03-G-00008. Some areas for research include:

- What are the best performing logistics companies?
- What are the characteristics of the best performing companies?
- How do their activities relate to lean thinking?
- Development of lean logistics & transportation principles.

- *Support the Online Information Warehouse for Alabama and the Tennessee Valley Region*

State level economic data is a major component of the Freight Planning Framework being developed by OFLT. It is important to document the data and information used in previous research and add to the data and information as updated versions are available. The online information warehouse should continue to be a focus of the effort in transportation research. The data warehouse is expected to accessible via the Internet with links to various datasets and research reports developed and compiled by OFLT.

1. Development of a Freight Forecasting Methodology Utilizing Industry Sector Analysis

Since the mid 1990's, the integration of freight issues into the policy, planning and programming activities of State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs) has become a significant concern. Business and community leaders, as well as public sector officials, recognize that the effective and efficient movement of freight is key to a region's economic competitiveness. Freight traffic is growing faster than passenger travel by almost any measure chosen. Freight cannot be addressed in individual modal segments due to the nature of freight to utilize several modes of transport. However, by better understanding freight needs and issues, it is possible to design and conduct an economical and efficient freight planning process that can be integrated with conventional transportation planning.

Recent changes in the global economy have highlighted freight and transportation system issues and the pattern of freight movement has changed dramatically. The transportation infrastructure in the U.S. was constructed, in large part, to accommodate passenger and freight travel that is much different today from what it was 50 years ago. Products and goods spend significantly more time in the transportation system than ever before due to extended supply chains and the distance products now travel from where they are produced to the location of the product demand.

Decisions on freight issues require data on items such as the origin and destination of shipments, the commodities involved, shipment mode, the type of vehicle or vessel, routes taken, and time of day. Timeliness of the data is critical to allow decisions to be made on current information.

1.1 The State of Freight Data [1]

In 1998, more than 15 billion tons of goods valued at more than $9 trillion moved over the nation's transportation system accessing all modes of transport. Estimates from the Federal Highway Administration state that by 2020, freight tonnage will have grown by nearly 70 percent and the value of the goods moved will be almost $30 trillion. This level of activity and growth demands the attention of transportation system planners to provide data for making informed decisions.

The foundation for any reasonable predictor of freight activity in a region is the availability of accurate and verifiable data. Data availability and validity are issues that have plagued the transportation community for many years. Participants in a 2001 conference on "Data Needs in the Changing World of Logistics and Freight Transportation" determined that currently available regional and national data are inadequate to support the requirements of analysis and that the market area data are not readily available. It was also agreed that freight data collection, storage and distribution are expensive activities, so any effort to collect new freight data should be preceded by an understanding of why such data are needed.

Freight data is a key to making informed decisions on infrastructure investment and policy issues that affect the effectiveness and efficiency of the freight transportation system. Freight data is critical to the evaluation of options to mitigate congestion, improve economic competitiveness, facilitate the effective use of land planning, optimize modal activity, improve safety and security, reduce fuel consumption and enhance air quality. Although data by itself does not ensure good decision-making, it is impossible to make informed decisions without valid data.

Freight data is collected by agencies of the federal government, other public sector agencies and private sector entities that observe and document transportation activity at the regional, state, national or international levels. These data collection entities are not coordinated, thus the quality of the data varies significantly and typically does not provide a complete picture of freight movement. Combining data from the diverse sources results in limited usefulness for freight transportation analyses. Most of these data collection efforts were not designed for the purposes of freight transportation analyses, and the resulting data are less than ideal for such applications.

Much of the US freight transportation system is privately owned with goods transported by private companies. The private sector use freight data to identify underserved and emerging markets and to identify needed improvements to enhance productivity and efficiency. The uncoordinated data collection efforts currently in place do not provide decision makers with the information they require.

Some large efforts to collect information covering all modes of freight movement do exist. These generally, however, do not provide analysts and researchers with the data required. Every five years the Bureau of Transportation Statistics and the Census Bureau produce the Commodity Flow Survey (CFS), which is a comprehensive effort to gather the flow of goods by mode throughout the U.S. It is thought by some, however, that gaps in the coverage limit the usefulness of the CFS data. Shortcomings of the CFS data include the fact that survey samples are from domestic shipping companies, which do not provide and accurate estimate on the flow of goods into the U.S. This shortcoming is critical based upon the global growth of supply chains and the flow of goods. Modal information from shippers that is collected through the CFS process is often incomplete. The CFS does not provide the level of geographic detail required by transportation planners and engineers, who need this information to appropriately assign commodity and vehicle flows to corridors and major highways and rail lines. The CFS does not provide needed information concerning the existing capacity in the freight system. The CFS data are often supplemented by data from other sources for use in analysis and modeling.

This data fusion is frequently riddled with problems that create inaccuracies. Most sources of freight data were developed for specific applications and needs, varying greatly in modal coverage, approaches to collection, and the underlying meanings used to define the data. Use of existing data with these limitations is a source of concern regarding the quality and usefulness of combining data from multiple sources. In addition to the limitation mentioned above, there is a problem in that some of the information, such as time of day, vehicle type, routes traveled and commodities trapped in congestion events, is rarely collected.

Some national freight data programs, such as the Vehicle Inventory and USE Survey (VIUS), provided data on the physical and operational characteristics of the nation's private and commercial truck population. The primary goal of VIUS was to produce national and state-level estimates of the total number of trucks. This survey was conducted every 5 years, until it was discontinued due to the cost of the program in 2002.

A Transportation Research Board committee formed to investigate and make recommendations on freight data concluded that the present patchwork of uncoordinated and incomplete freight data sources should be reengineered in the context of a national freight data framework that provides for a more integrated approach to freight data collection and synthesis. The committee noted that this would be a multi-year effort and would involve many technical organizational challenges.

1.2 A Freight Planning Framework

The forecasting of freight traffic is commonly performed by estimating truck traffic as a percentage of a forecast for overall traffic flow. The percentage of truck traffic used in the forecast is calculated by randomly sampling a segment of overall highway traffic. This is a very indirect method for forecasting freight and essentially separates the forecast from the specifics of the underlying industry and any specific changes or growth in the industry mix of a region or area. A direct freight forecast based upon industry economic activity offers potential improvement to the forecast based upon a percentage of overall traffic flow as has been shown in the research performed over the last two years by the University of Alabama in Huntsville (UAH). The research goal for this task was to establish a more direct relationship between the major industry sectors in a region and the freight traffic generated as a result of that sector activity, formalizing the methodologies used in developing the forecasts used to operate the Infrastructure model developed in previous research. Total Value of Products Shipped, Income and Employment were investigated as indicators of sector economic activity in the relationships for forecasted freight traffic. The results of this research are a framework for building a forecast based upon the traded sector makeup of the region and the ability to more accurately forecast demand on the infrastructure created by economic growth and industry recruitment.

1.2.1 Traditional Transportation Planning

Transportation planning activities performed in essentially all metropolitan planning organizations (MPOs) in the U.S., and many statewide planning efforts, follow the traditional sequential four-step methodology. The four steps are (see Figure 1.1):

- trip generation
- trip distribution

- modal split
- traffic assignment

Socio-economic characteristics of population and employment aggregated to the traffic analysis zone level, and the available infrastructure (roadways with defined speeds and capacities) are the typical inputs to the sequential modeling process [2]. A trip generation methodology is applied to determine the quantity of trips that are expected to enter and exit each zone throughout the day. Trip exchanges between zones are developed through the application of a trip distribution methodology. The exchange of trips is generally formulated using a gravity model that attempts to balance trips produced to locations where trips are attracted, while factoring the distance between the potential origin and destination zones, and sometimes, extraneous factors such as income and ethnicity [2]. Once the trip exchange is determined, a mode split methodology is employed to determine which transportation mode will be utilized. This typically involves the examination of availability, costs and travel times to determine the number of trips made between origin and destination pairs by each mode. In most smaller applications, the mode split methodology is not included. Finally, the trip exchange by mode is assigned to the available infrastructure network. For passenger car trips assignment is made to the roadway network through one of several methodologies intending to reduce the travel-time for all drivers [2]. The output from the assignment step is the anticipated, or forecasted, traffic volume (or Annual Average Daily Traffic (AADT)) for each roadway segment in the model.

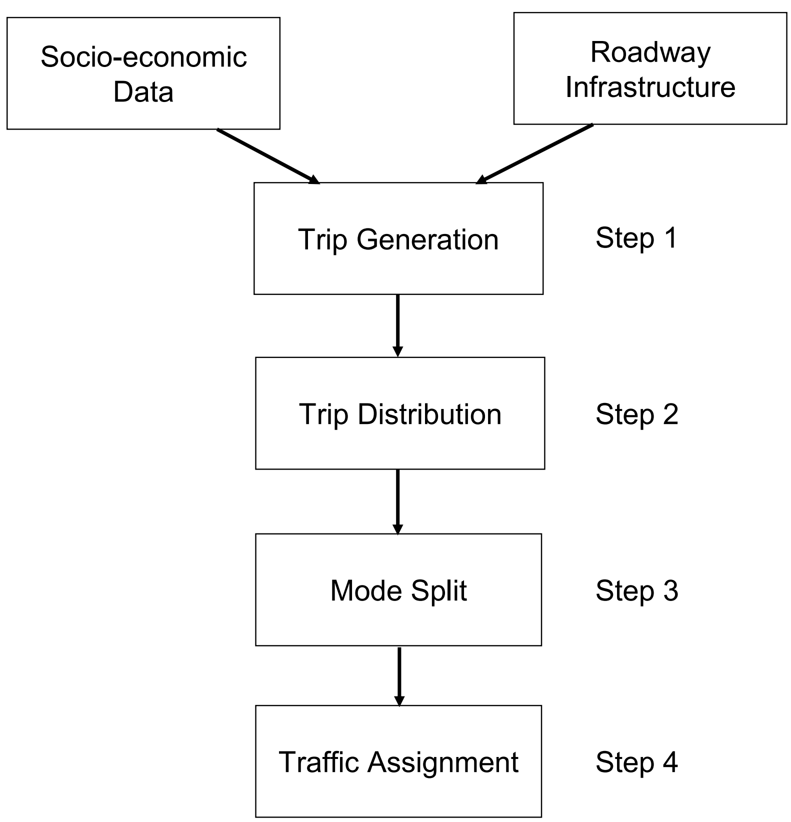


Figure 1.1 - Traditional four-step process.

Researchers have recently made attempts to optimize the transportation planning process and improve forecasting results. Major areas of study include the addition of feedback loops to incorporate congestion effects, and the detailed examination of each step to reduce potential error [3]. However, even as these improvements are shown to be successful, the underlying notion of the sequential, four-step model has remained.

Some MPOs have switched their efforts to activity-based or tour-based modeling systems that change the focus from the traditional four-step process to one where the household activities are modeled as a series of transportation needs to support daily life. However, in all cases where efforts to improve the traditional planning process are made, the focus of the planning activity remains on the individual, specifically understanding and responding to the needs of the passenger. The focus on passenger transportation is evident in Alabama, for example, where the MPOs perform their trip generation using only household automobile ownership statistics and employment levels to develop the number of trips being produced or attracted. The freight levels associated with the activity in the area are applied as a function of total trip production [4]. In addition, NCHRP Report 365, which contains transferable parameters and is used by many MPOs as the basis for transportation planning activities, does not incorporate freight into the modeling equations [5]. Thus, traditional transportation planning activities often ignore freight transportation in the modeling process or add them as an afterthought to the model. Freight planning applications, if included in the process, often rely on projections that cannot account for major changes in the workforce or economy of the area. The implications of this underestimation of freight traffic leads to higher than expected maintenance cost, congestion levels greater than expected and negative effect on economic development, etc. Therefore, an approach to freight modeling that accounts for economic activity and can be incorporated into the transportation planning process, or used on its own, is needed to better allocate resources to transportation infrastructure.

The idea of using a freight planning methodology based upon industry sectors was developed during the research into the relationship of transportation infrastructure and the economic growth in Alabama [6]. A forward-looking industry sector based analysis is being developed as a more encompassing methodology than the backward looking trend line forecasting used to date. Michael Porter at the Institute for Strategy and Competitiveness at the Harvard Business School developed the industry clusters concept [7]. An industry cluster refers to a group of interrelated companies and organizations engaged in a specific market, located within the same economic region or geographic area. Clusters overlap with other clusters in areas where there are similar products, services and skills. Industry sectors cut across traditional industry classifications [8]. The freight data is available in either NACIS or SCTG codes, which are both based on industry types and not easily combined into clusters since a sector such as manufactured goods may be a participant in many clusters. Some sectors, such as the paper industry, are aligned closely with the cluster concept due to the vertical nature of the industry. This research uses sectors as the basis, knowing that many of the cluster concepts apply, to align with the available data.

Using industry sectors for freight planning is a relatively straightforward concept. By developing the understanding of how an industry sector creates freight and the need to access transportation infrastructure, it is possible to develop the interrelationships that can then be used to predict freight requirements anywhere that industry sector is located. Aggregation of the known freight behaviors for the industry sectors in a region can produce a better prediction of the freight needs in the region than random sampling and roadside interviews. These concepts have resulted in the creation of a Freight Planning Framework, which provides an insightful new methodology for obtaining freight volumes. The methodology is built upon publicly available federal databases and is intended to be applied at the state or regional level. A more detailed look at the UAH Freight Planning Framework follows.

1.2.2 A New Approach to Freight Forecasting

Figure 1.2 presents an overview of the UAH approach to the analysis, planning and forecasting of freight. The initial action is the development of the level at which the freight planning will take place. This is called the “Freight Analysis Zone” (FAZ) in the figure. The freight analysis zone can be at the county level or Metropolitan Planning Organization (MPO) level or an aggregation of several counties based upon the freight activity in the area. Once the FAZs are established, a database of freight activity by commodity and mode is employed. The figure below indicates that the Freight Analysis Framework 2 (FAF2) is used in the UAH model. Though there may be issues with the completeness of this database, there is nothing publicly available at this time that is better or more reliable. The FAF2 data is disaggregated through a filter utilizing industry sectors, value of shipments, personal income, population and employment to the appropriate FAZ level. This becomes the current state of freight in terms of origin and destination pairings by commodity by transport mode.

After the current state is established, a projection of growth by industry sector is applied to the data to establish the forecasts to be used in the analysis and planning activities. Each scenario, current state and individual forecasts, are then run through the transportation network in TRANPLAN/CUBE, a gravity distribution model, to create the routes that each O-D pairing will take through the state. The O-D pairings and routes are input to the Alabama Transportation Infrastructure Model (ATIM) where a simulation of the traffic flows over a 24 hour period can be observed and metrics as to the performance of the system can be collected.

This approach to freight analysis, forecasting and planning is comprehensive in its employment of the best currently available freight data and a multi-modal transportation network. It also provides stakeholders with multiple views of the transportation issues in the state. It is this comprehensive approach that has been missing from the national freight conversation. A more detailed look at the UAH Freight Planning Framework follows.

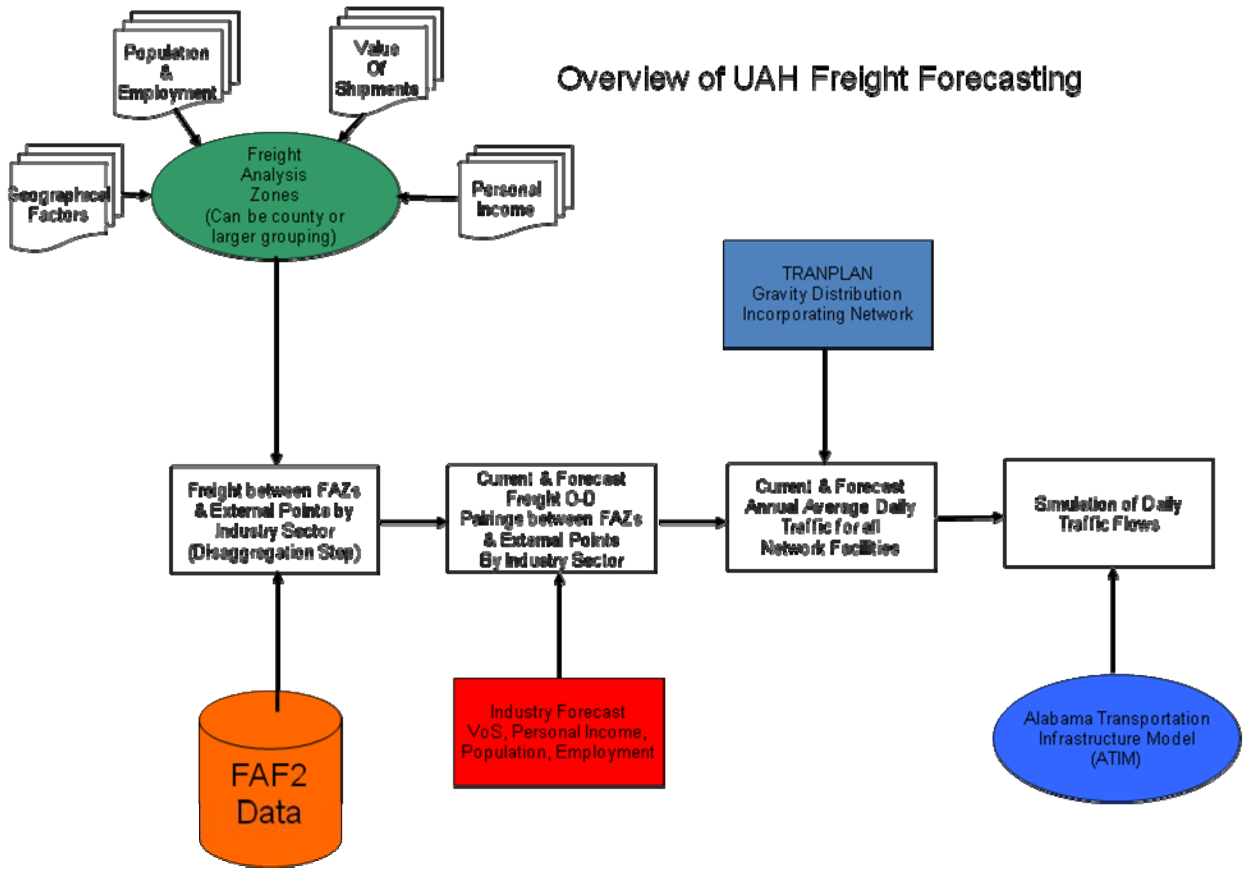


Figure 1.2 – UAH Freight Forecasting Overview

The Freight Planning Framework (FPF) builds upon the traditional four-step transportation planning process by establishing a forward looking approach to trip generation. Figure 1.3 provides a graphic depiction of the FPF. The following sections will present the approach and methodology proposed to overcome the problems with the traditional four-step process, and the interrelationships of the systems approach.

The FPF is a forward looking method and approach to freight planning. As such, the foundation of the framework is the use of industry sector analysis to establish the basic need for transportation infrastructure access. The concept is that if the underlying principles of freight demand generation can be revealed, the ability to accurately predict infrastructure requirements is enhanced. Once the freight generation principles of an industry sector are known, it is theoretically possible to apply those principles anywhere the sector exists to estimate the demand for freight system requirements. The following description of the FPF framework first defines the underlying planning factors used, and then reviews the process sequentially from initial data to final system performance.

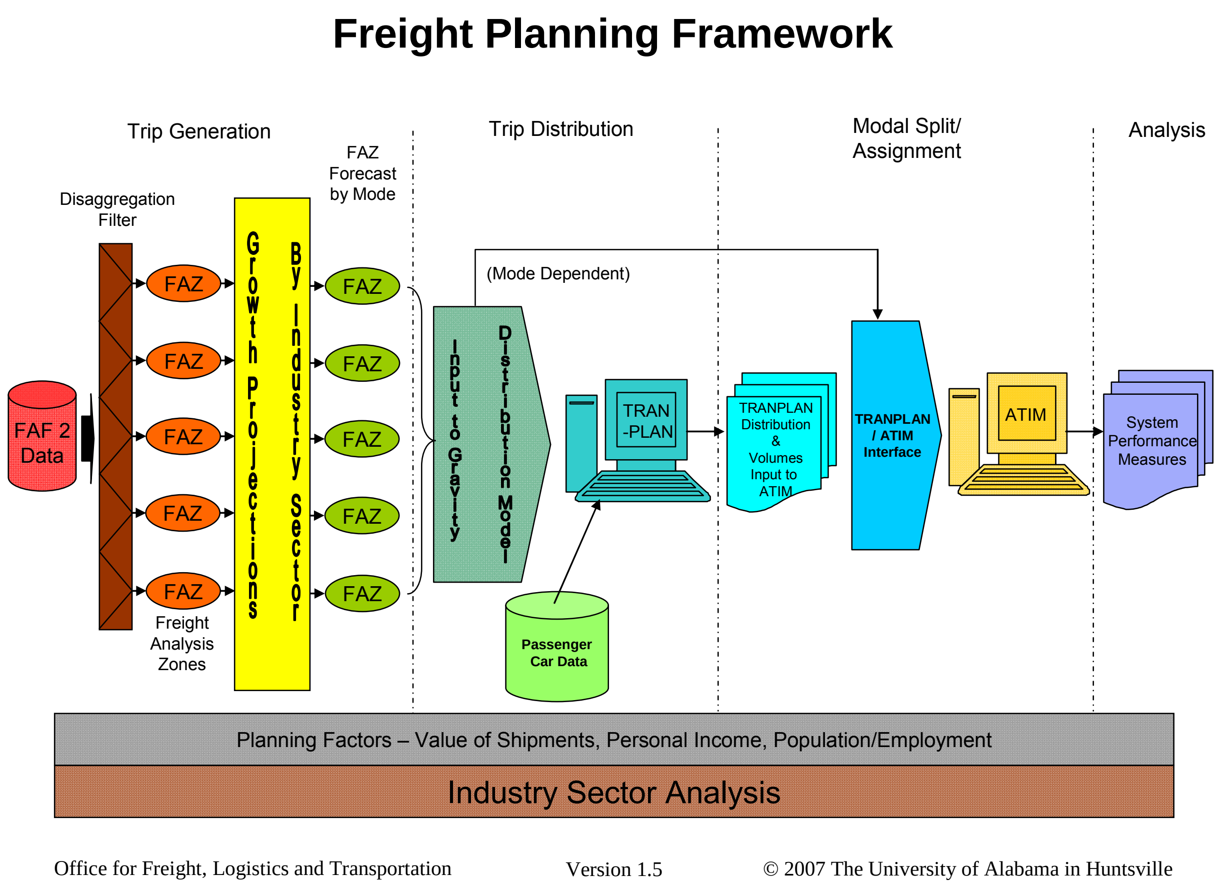


Figure 1.3 - Freight Planning Framework.

1.2.3 Planning Factors

The planning factors used for the FPF approach are Value of Shipments, Personal Income, Population, and Employment. One factor does not adequately define the demand for freight system access or needs. The factors employed must be capable of describing the freight generation characteristics of a region and the freight attraction characteristics of that region. The reasoning for the inclusion of each factor is described below.

Value of Shipments

If freight is included in the transportation planning process at all, most traditional freight forecasting methods depend on employment as the primary factor in developing forecasts. The time when industries in the United States could compete based on labor costs alone is long past. Developing countries constantly outbid U.S. industries on labor costs. Today, U.S. industries compete on productivity. Employment as a freight planning factor does not take into account the productivity improvements by which U.S. companies compete in the world marketplace. If employment were the sole factor used in freight planning, the increase in production due to productivity improvements would be missed as the output per employee improves and the amount of freight increases. Moreover, if the same amount of production is achieved using fewer employees due to technology or productivity improvements, traditional freight planning methods would actually forecast a decrease in the demand for freight requirements.

The factor *Value of Shipments (VoS)* is included to alleviate the issues raised above. As productivity improvements increase the output of a plant, the VoS factor captures this information. With knowledge of the relationships between value and vehicle loads acquired on a particular industry sector, the freight system requirements can be calculated from the VoS (# of vehicles = VoS/Average VoS per vehicle). VoS provides a more consistent factor to use in the generation of freight from industries within the region.

<u>Personal Income</u>

If VoS is a proxy factor for the generation of freight generation, Personal Income (PI) can be used as a proxy for the attraction of freight to a region. The perceived affluence of an area increases as PI increases. As the perceived affluence of a region increases, the willingness of the population to spend creates more demand for products, thus increasing the need for freight to the area to provide the desired consumer goods. As PI decreases in a region, the population perceives a loss of affluence and spending tends to slow. This reduced demand for products in the region causes a decrease in freight destined for the region.

<u>Population/Employment</u>

Population is a traditional factor in transportation planning. The population of a region is a proxy for the volume of vehicles in the region, from which the number of trips and distances can be derived. Employment has traditionally been used as a proxy factor for freight. It is assumed that as employment increases, the amount of freight shipped into an area also increases and vice versa. However, these two factors alone do not provide an adequate predictor of freight activity, but combined with VoS and PI they can potentially improve the accuracy of the planning factors.

1.2.4 Freight Data

As discussed earlier in this report, the state of freight data leaves much to be desired. The limitations on analysis of freight activity are a direct result of the limitations and gaps in existing freight data sources, such as the CFS. The Federal Highway Administration's Freight Analysis Framework (FAF) database is an attempt to fill some of the gaps in the CFS and deal with some of the confidentiality issues that arise from reporting entities in very sparse geographic locations where it would be easy to determine the owner origin of the data. The second generation of the Freight Analysis Framework, known as FAF2, is a continuation of the original Freight Analysis Framework developed by the U.S. Department of Transportation, Federal Highway Administration (FHWA). Whereas the original FAF provided transportation planners with generalized freight movement and highway congestion maps without disclosing the underlying data, FAF2 provides commodity flow origin-destination (O-D) data and freight movement information on the FAF2 multi-modal transportation network. The O-D data includes the base year (2002) and future years between 2010 and 2035 in 5-year intervals [9]. The Freight Analysis Framework is designed to enable the FHWA to conduct investment and policy analysis and to support legislative activities.

Industry knowledge gathered through strategically performed surveys and interviews is used by researchers at UAH to supplement the information provided by the FAF2. The surveys provide a clearer understanding of the activity of particular industries in a region and the factors that affect freight generation and attraction. Conversion factors to determine the number of shipments by mode that the data represents are necessary to use the FAF2 and survey data successfully.

1.2.5 Disaggregation Filter

The data in the FAF2 database is presented in a format of 114 origins and destinations, graphically depicted in Figure 1.4 [9]. Alabama is included in the database as two zones: the Birmingham area and the rest of Alabama. The Birmingham zone includes Bibb, Blount, Chilton, Cullman, Jefferson, St. Clair, Shelby and Walker counties. The highest number of FAF2 zones in a state is five, but 14 states have just one zone. The high level of aggregation limits the usefulness of the FAF2 data for local and sub-state planning.

It is important to derive the potential freight volume that is destined for, originating from, passing through, and internal to Alabama. The FAF2 is a large database and attempting to perform the derivation of Alabama-specific data manually would be tedious and consume significant resources. Alabama destined and generated freight can be obtained through a data sort of the existing FAF2 database. The freight that passes through Alabama because the destination or origin of the freight is located such that Alabama is simply part of the route is a more difficult task. To establish what freight passes through Alabama on the way to its destination, the origin and destinations that do not include one of the Alabama points must be determined. The next step is to determine the most likely route that freight would take as it passes through Alabama. This is a large assignment and computational ability is necessary to accomplish the task efficiently.

Once the Alabama related freight is compiled, the data must be disaggregated to predict what segments of that freight will be destined for, passing through or originating from particular points within Alabama. This disaggregation could be performed at a county level, a metropolitan planning area level or in configured Freight Analysis Zones (FAZs). In a state such as Alabama, it might be feasible to perform the disaggregation at a county level since there are only 67 counties. This would result in a 67 by 67 matrix of freight data for each mode and 42 commodities. The main issue with using counties as the proposed disaggregation level is that states with significantly more counties would end up with a freight matrix that could easily become unmanageable. Additionally, there are many counties where the level of freight activity is so low that the cost to include them in an analysis as an independent entity is not justifiable. The use of metropolitan areas as the planning level leaves out significant portions of state infrastructure that need to be included in a state-wide analysis of freight traffic.

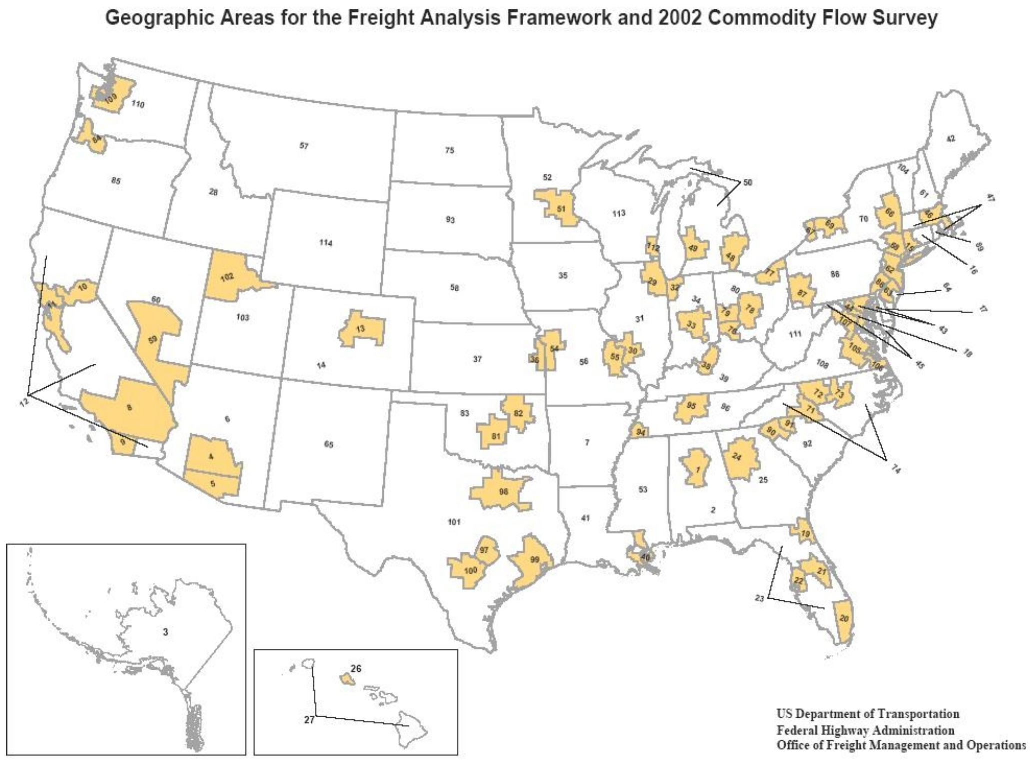


Figure 1.4 - Geographic locations for FAF2 data.
(http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/cfs_faf_areas.htm)

Preliminary analysis indicates that the appropriate approach seems to be the development of Freight Analysis Zones sized to contain approximately equal proportions of freight activity. Industry sector analysis is a part of the process to determine the configuration of each FAZ. This could mean that an industrialized metropolitan area may be a FAZ while another FAZ would be an aggregation of several rural counties. Once the FAZs are defined, the planning factors, Value of Shipments, Personal Income, Employment and Population, can be used to allocate the appropriate volume of freight to each FAZ.

During this period of performance, researchers made an initial investigation into the development of freight analysis zones for the purpose of efficiently utilizing scarce resources for the planning, analysis and forecasting of freight. The researchers employed hierarchical cluster analysis using the Ward's method [10]. Economic variables used for this cluster analysis were Value of Shipments, Personal Income and Employment. Geographic data used included longitude, latitude and the distance from an interstate. The initial clusters were developed using the interstate highways in the state as zonal boundaries and revised based upon industry sector analysis and growth projections. The results of this investigation are shown in Figure 1.5. The map on the left presents the output of the cluster analysis, which resulted in 26 FAZs instead of 67 counties. The map on the right of Figure 1.5 overlays the industry sectors by county on the 26 FAZ map.

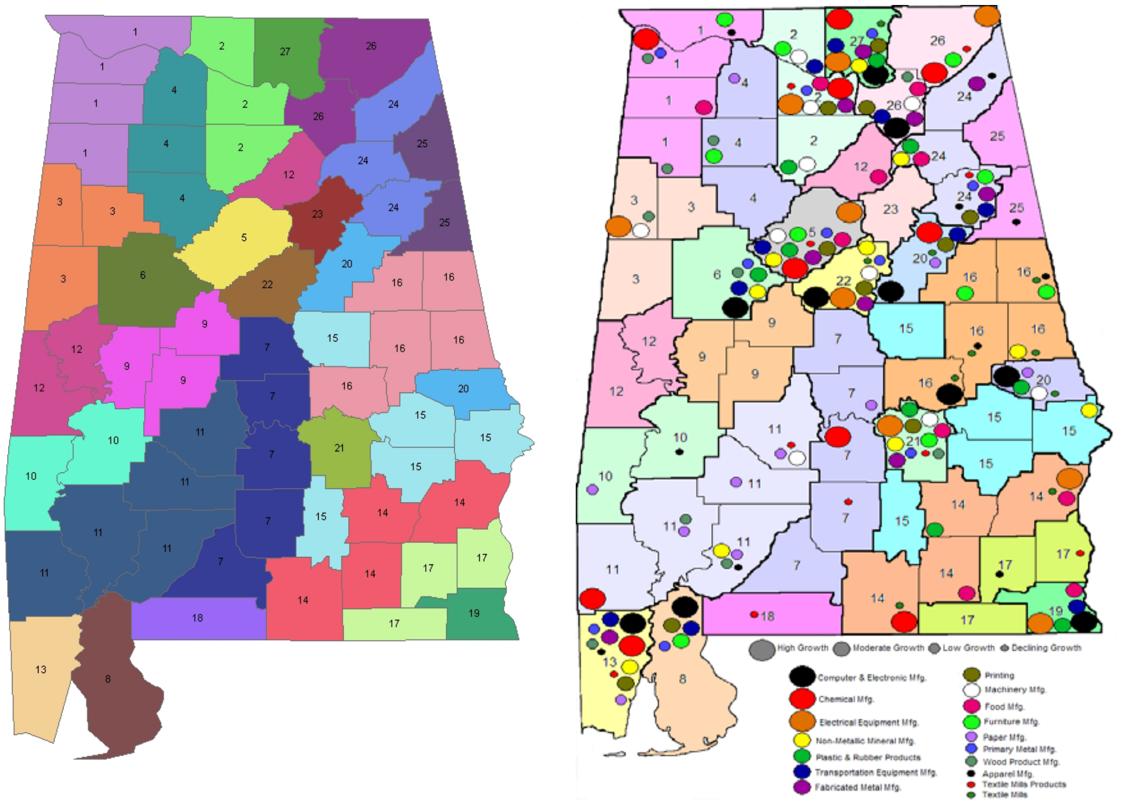


Figure 1.5 – Example of Cluster Analysis Output and Industry Sector Analysis

Future plans for the research team are to evaluate the approach utilizing freight models developed by UAH researchers to determine the effectiveness of using FAZs to distribute freight and traffic loads across the state. The team will also evaluate other partitioning approaches to consider alternate ways to partition counties around interstates (i.e., use counties on both sides of interstate) and consider alternative clustering approaches such as nonhierarchical methods based on starting clusters.

1.2.6 Growth Projections

Once the industry sectors in a FAZ are known and sized, the conversion factors developed for converting gross value or volume quantities into shipping vehicles for those sectors can be applied to determine the freight volume in the FAZ by transportation mode. An economic forecast by industry sector is used to predict the total freight value or volume in a FAZ for periods in the future. To make a reasonable projection, a forecast for the state is needed that can be segmented using the North American Industrial Classification System (NAICS) to allocate growth by sector. This industry sector forecast can then be used to develop the forecast for an individual FAZ.

1.2.7 The Gravity Distribution Model

The freight projections by FAZ are then distributed into origin/destination pairs for modeling purposes. Distribution of the freight volume across the network is accomplished through the use of a gravity model, such as TRANPLAN/CUBE. Travel time between zone pairs is determined using a transportation network created using Interstate and primary highways, rail and waterways. A traditional gravity model distribution can be performed using the quantity of freight, segregated by commodity, produced and attracted for each FAZ along with friction factor values associated with the distance the specific commodity would likely be transported. The result of the gravity model is then arranged into an Origin/Destination (O/D) matrix for the state.

The freight O/D matrix is assigned to the transportation infrastructure network developed to determine the travel paths for validation. In this fashion, it is possible to test the base year O/D patterns through a comparison of actual freight volumes on the existing infrastructure. Passenger car volume is introduced to the Interstate and highway network as a separate travel model and is produced using traditional transportation planning techniques. The freight forecast developed using projected industry sectors for the study area is routed through the gravity model to develop future year O/D patterns.

1.2.8 Statewide Multi-Modal Discrete Event Simulation

With freight volume distribution completed based upon the gravity distribution model, the next step is to understand how the freight distribution affects, and is affected by, the transportation network and built in constraints of the system. This is accomplished by employing simulation resources. The tool used in the FPF is the Alabama Transportation Infrastructure Model (ATIM), developed by researchers at the University of Alabama in Huntsville. The ATIM is a discrete event simulation used to evaluate the impact of changing freight patterns in order to more accurately plan for future transportation infrastructure needs [10]. The ATIM is a statewide multi-modal freight transportation model with the ability to quickly evaluate the impact of system decisions on the statewide freight transportation system including highway, rail, and water routes. The transportation network includes intermodal transfers between truck, rail, and water at the transfer points in Huntsville, Birmingham, Montgomery, and Mobile, Alabama.

The ATIM is based on the framework of the Virtual Intermodal Transportation System (VITS) model developed at the National Center for Intermodal Transportation at Mississippi State University [11]. The VITS was a first attempt to use discrete-event simulation to model multiple modes of transportation infrastructure in a single simulation. The ATIM expands and enhances the VITS in the manner and complexity in which it is employed to simulate the Alabama transportation network currently at the county level, eventually at the FAZ level.

The result generated by the gravity distribution model is input to the ATIM through an interface designed to translate the data into the appropriate format for use in the simulation. The coordination of gravity distribution modal networks and the modal networks within the statewide multi-modal simulation are critical for the load volumes to be accurately distributed.

1.2.9 System Performance Measures

The final piece of the FPF is the ability to measure the performance of the transportation system. The FPF is designed as a tool used for continuously improving the ability of the transportation system to efficiently, effectively, and safely move people and freight. Improvement cannot take place if a measurement system is not in place to quantify the performance.

There are many years of performance data that has been collected on the highway systems across the U.S. for multiple purposes. This data is point specific in nature and does not provide managers and planners of transportation systems with a measurement of how the system as a whole is performing. Metrics that accurately portray the performance of the system is a missing tool for transportation system planners and managers to optimize system performance.

Access to an efficient transportation system is a key element to economic growth and development within a region. It is essential that the performance measures used by Alabama be chosen with that goal in mind. It is also important to choose metrics appropriate to the needs of the intended audience: the state government, the state legislature, DOT management and staff, other agencies, elected officials, and the public at large. An optimal set of performance metrics will provide the ability to determine the impact of improvements to the transportation system performance over time, and compare the results to short-term and long-term goals and objectives.

1.2.10 FPF Summary

The FPF methodology discussed here takes freight flow data at the national level and structures it in a format usable for freight planning purposes at a variety of levels. This methodology is expected to be a valuable piece of the overall transportation planning toolbox in the future. As with all new ideas, significant research is needed within each component of the FPF to ensure the final product provides value added information and data to transportation planners in Alabama and throughout the nation.

1.3 Supply Side and Demand Side Freight Data Development

There is consensus from transportation planners that the availability of usable freight data is negligible. The Freight Data Committee of the transportation Research Board is actively pursuing methods to generate usable freight data, but there is a great deal of dissatisfaction with the current state of freight data.

As stated earlier, historically freight forecasting was the result of sampling, roadside interviews of truckers, and the application of trend line methodologies. Freight forecasts have typically been based on the historical growth of traffic or on socioeconomic variables such as employment or population. Rather than tweaking existing approaches, the UAH research team chose to forge out and examine the possibilities of establishing a new methodology based upon economic variables that are more closely aligned to economic growth.

Previous research collected and tested several economic variables and resulted in the conclusion that the value of goods shipped by Alabama's manufacturing sectors was the best variable to predict the growth of freight traffic. Value of Shipments data is available through open databases and is a reasonable predictor of freight volumes arising from the supply side of the state's economy. Another variable selected was Personal Income. Personal income, a proxy for the consumer feeling of affluence, is a reasonable predictor of freight traffic originating from the sale of finished goods to Alabama's households. These variables are then used to create a disaggregation filter through which the freight data, provided in aggregate form through the FAF2 database, is disaggregated to each county, or FAZ, in Alabama.

1.3.1 Analysis of Supply Side Freight

Data assembled for each of the sectors listed in Table 1.2 comes from a variety of published and unpublished sources. For manufacturing sectors, the initial estimate of freight traffic generated was based on personal interviews of representative companies in each of the three-digit NAICS manufacturing codes listed in Table 1.2. Value of shipments for each of these sectors was estimated from data found in the *2002 US Census of Manufacturing* for Alabama published by the US Bureau of Census in 2006. The 2002 figures were then projected forward to 2005 to allow a comparison of value of shipments to the truckload figures found through the interviews conducted in that year.

A national projection of the value of production arising in each US manufacturing sector was provided by Global Insight in their publication entitled, *The US Economy – The 30-Year Focus,* published in 2005. Rates of change calculated from these National projections were then applied to each of Alabama's manufacturing sectors to generate a projection of freight shipments from 2005 to 2010 and 2015.

Creating a projection of freight traffic generated by Alabama's mining and agricultural sectors was somewhat more complicated. Value of shipments data was not available for important agricultural commodities such as poultry and forest products or minerals such as sand, gravel and coal. Some of these production data could not be found at the county level so a method had to be developed to take state production figures and disaggregate them to the county level.

Agricultural production data were found in the *2002 Census of Agriculture* for Alabama. They were reported in physical units such as bushels of wheat or numbers of chickens at the county level. Freight shipments from each county were based on this data instead of value of sales. Freight shipments were then projected to 2005, 2010 and 2015 using the same sources and methods that were used for manufacturing.

Data on the forestry industry came from the Alabama Forestry Commission. The Commission publishes information on the trees harvested each year in each county of the state. Data from 2005 were used to determine logging shipments originating from each Alabama County in that year.

The US Geological Survey publishes annual figures for non-fuel raw mineral production in Alabama. Included are production figures for sand, gravel, crushed stone, cement, lime, clay and gemstones. The data are not available at the county level so a method had to be developed to appropriately disaggregate the state production figures to the county level. *County Business Patterns*, a publication of the US Census Bureau, lists the number, size and type of each mining operation found in each Alabama County. Using 2002 as the base year, the researchers allocated non-fuel mineral production to each county according to its share of total mining employment for each type of non-fuel mineral. These figures were then projected forward using the same methodology as in the other economic sectors.

The US Department of Energy publishes a state energy profile each year which includes coal production figures for Alabama Counties. The figures for 2005 were used to estimate total freight shipments arising from surface and underground coal mining in the state.

A summary of all the data sources used to compile the freight forecasting database can be found in Table 1.2. All of these data are routinely collected and published by either the state or federal government thereby allowing for a complete update of the economic database at least every five years. This update can be accomplished with minimal additional survey work.

A database of these variables was developed and used to predict future freight traffic in each of the state's 67 counties. The cumulative data by industry sector for the state is shown in Table 1.1. The detailed data for each county by commodity can be found in Appendix A. This data did not exist upon the initiation of this research and had to be manually collected from multiple databases, disaggregated to the county level and sorted to create usable freight information. It has proven to be very difficult to find usable data for the crop production and animal production industries. The research team is actively pursuing these categories to make sure the data used in the forecasting and modeling efforts are as complete as possible.

The original database included information on 17 of the state's manufacturing sectors. Three relatively small manufacturing sectors (Fuel oils/gasoline/other oils, Instruments, and miscellaneous manufacturing) and several major non-manufacturing sectors (animals, grains, other agricultural products, alcohol, tobacco, stone, sand, gravel, non-metallic minerals, metal ores, coal, crude oil, logs, waste & scrap, and mixed freight), which are known to generate high volumes of freight traffic in the state, were not included. Thus, most of the effort in this research period of performance was focused on adding these additional sectors to the original manufacturing-only database. A list of the economic sectors that can now be found in the Alabama freight forecasting database is provided in Table 1.2. The additional sectors, manufacturing and non-manufacturing, which were included in the database during this research effort are shown in bold. Each sector is related both to the sectors in the Freight Analysis Framework, Version 2.2 (FAF2), adopted by the US Department of Transportation, and to the North American Industry Classification System (NAICS) adopted by the US Office of Management and Budget. The appropriate Standard Classification of Transported Goods (SCTG) number from FAF2 is shown in the left-hand column of Table 1.2 and the corresponding NAICS code is shown in the right-hand column. Organizing the database in this way will allow researchers to cross reference the data from the 2002 Commodity Flow Survey to economic projections based on the NAICS classifications.

Alabama Industries

NAICS	Industry	2002 Employment	2002 Annual Payroll ($1000)	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
111	Crop Production	17,829	90,469	563,844	21,309	*	21,309	*	21,309	*	21,309
112	Animal Production	17,829	90,469	2,472,774	148,746	*	148,746	*	148,746	*	148,746
113	Forestry & Logging **	5,728	35,772	1,345,032	158,579	*	164,922	*	153,444	*	157,924
211	Oil & Gas Extraction	831	55,449	1,068,472	44,520	1,100,526	45,855	1,074,444	44,768	1,053,385	43,891
2121	Coal Mining	3,258	171,234	680,383	279,120	687,187	281,911	753,913	309,285	824,253	338,141
2123	Stone, gravel, sand, and clay	2,284	86,140	387,004	1,228,584	417,152	1,324,291	423,909	1,345,744	439,001	1,393,653
311	Food Manufacturing	36,393	854,315	7,150,635	440,356	7,308,664	450,088	8,061,483	496,449	8,883,091	547,046
312	Beverage & Tobacco Product Manufacturing	2,092	65,068	750,456	127,848	827,378	140,835	897,291	152,861	967,549	164,829
313	Textile Mills	15,195	406,399	2,765,120	21,121	2,491,443	19,030	1,972,376	15,066	1,384,083	11,137
314	Textile Product Mills	7,203	179,341	1,389,825	10,012	1,252,246	9,021	991,353	7,142	732,878	5,280
315	Apparel Manufacturing	13,775	289,002	1,639,448	61,988	1,532,884	57,958	1,236,308	46,745	1,033,787	39,088
321	Wood Product Manufacturing	21,053	585,407	3,614,791	16,833	3,720,412	17,325	3,437,145	16,006	3,772,024	17,565
322	Paper Manufacturing	14,178	799,943	5,780,741	2,126,680	6,489,460	2,387,411	7,122,393	2,620,261	7,515,368	2,764,833
323	Printing & Related Support Activities	5,580	170,485	740,178	109,264	713,398	105,311	797,638	117,746	875,490	129,239
324	Petroleum & Coal Products Mfg.	2,174	109,699	2,150,392	90,731	2,325,864	75,573	2,454,252	103,555	2,620,159	110,555
325	Chemical Manufacturing	14,201	689,432	6,796,111	389,107	8,097,226	463,602	9,169,585	524,999	10,354,283	592,828
326	Plastics & Rubber Products Manufacturing	18,202	672,869	3,096,027	123,774	3,406,156	136,172	3,749,413	149,895	4,180,410	167,126
327	Nonmetallic Mineral Product Manufacturing	8,690	320,273	1,899,181	329,353	1,953,460	338,766	2,186,071	379,105	2,397,013	415,686
331	Primary Metal Mfg.	17,054	738,759	5,030,806	645,994	4,872,688	625,690	5,372,247	689,837	5,398,659	693,229
332	Fabricated Metal Product Manufacturing	26,976	903,601	3,925,728	1,486,005	3,847,135	1,456,255	4,351,198	1,647,058	4,655,168	1,762,120
333	Machinery Manufacturing	13,367	450,549	2,505,670	63,622	2,667,010	67,719	2,867,664	72,813	3,228,656	81,979
334	Computer & Electronic Product Manufacturing	12,360	484,647	3,586,630	13,562	4,052,892	15,325	4,701,355	17,777	5,735,653	21,688
335	Electrical Equip., Appliance & Component Manufacturing	7,300	234,808	1,723,266	8,030	1,717,286	8,002	1,974,983	9,203	2,223,634	10,362
336	Transportation Equipment Manufacturing	26,423	1,219,951	9,262,593	81,911	10,160,694	99,639	11,697,914	114,713	12,390,108	121,502
337	Furniture & Related Product Manufacturing	14,198	339,487	1,746,486	11,358	1,735,780	11,289	1,897,714	12,342	2,062,565	13,414
339	Miscellaneous Manufacturing	6,798	195,275	1,107,676	103,997	1,192,635	111,974	1,374,034	129,005	1,618,887	151,994

* Calculations for these areas are being researched

** The Alabama Forestry Commission has indicated that their 2002 values are currently being reviewed. These revisions may affect the current values for Forestry and Logging

Sources: U.S. Census Bureau - County Business Patterns and 2002 Economic Census
U.S. Department of Agriculture -2002 Census of Agriculture
Alabama Forestry Commission
Global Insight, First Quarter, 2005

Table 1.1 – Annual Freight Volumes and Forecast Value of Shipments by Industries; Total for All Counties

The freight forecast shown in Table 1.1 was used to develop a current level of trucks accessing the Alabama transportation infrastructure and forecast for 2010 and 2015.

Alabama: Preliminary, Estimated Value per Origin Truckload ($1,000)		
NAICS	Industry	Preliminary, Estimated Value per Origin Truckload ($1,000)
111	Crop Production	26.46
112	Animal Production	16.62
113	Forestry & Logging	8.48
211	Oil & Gas Extraction	24.00
2121	Coal Mining	2.44
2123	Stone, gravel, sand, and clay	0.31
311	Food Manufacturing	16.24
312	Beverage & Tobacco Product Manufacturing	5.87
313	Textile Mills	130.92
314	Textile Product Mills	138.81
315	Apparel Manufacturing	26.45
321	Wood Manufacturing	214.74
322	Paper Manufacturing	2.72
323	Printing & Related Support Activity	6.77
324	Petroleum & Coal Products Mfg.	30.78
325	Chemical Manufacturing	17.47
326	Plastics & Rubber Products Manufacturing	25.01
327	Non-Metallic Mineral Product Manufacturing	5.77
331	Primary Metal Manufacturing	7.79
332	Fabricated Metal Product Manufacturing	2.64
333	Machinery Manufacturing	39.38
334	Computer & Electronic Product Manufacturing	264.46
335	Electrical Equipment, Appliance & Component Manufacturing	214.60
336	Transportation Equipment Manufacturing	101.98
337	Furniture and Related Product Manufacturing	153.76
339	Miscellaneous Manufacturing	10.65

Table 1.2 – Alabama: Preliminary, Estimated Value per Origin Truckload ($1,000)

Table 1.2 illustrates preliminary, estimated value per origin truckload for industries in Alabama examined under the current report. These numbers were obtained through interviews with representatives of each industry. Since a small sample size was used to derive these estimated values it is pertinent for researchers to further study the conversion of value of shipments to truckloads for each industry. Steps that can be taken to achieve this goal includes: increasing the sample size for each industry, updating data received from previous interviews, and examining industry trends in other states.

Figure 1.6 presents the information on total origin truckloads by industry sector for 2005, 2010 and 2015. The map in Figure 1.7 visually presents the 10 counties with the most truck traffic in 2005.

Commodity Code		Data Sources	NAICS Code
SCTG #	Name		
1	**Animals**	2002 Census of Agriculture- Alabama Report	111
2	**Grains**	2002 Census of Agriculture- Alabama Report	112
3	**Other**	2002 Census of Agriculture- Alabama Report	112
4	Animal Feed	2002 Census of Manufacturing- Alabama	311
5	Meat, Seafood	2002 Census of Manufacturing- Alabama	311
6	Bakery Goods	2002 Census of Manufacturing- Alabama	311
7	Other Foods	2002 Census of Manufacturing- Alabama	311
8	**Alcohol**	2002 Census of Manufacturing- Alabama	312
9	**Tobacco**	2002 Census of Manufacturing- Alabama	312
10	**Stone**	US Geological Survey- Alabama Report	212
11	**Sand**	US Geological Survey- Alabama Report	212
12	**Gravel**	US Geological Survey- Alabama Report	212
13	**Non-metallic Minerals**	US Geological Survey- Alabama Report	212
14	**Metallic Ores**	US Geological Survey- Alabama Report	212
15	**Coal**	US Department of Energy - Alabama Profile	212
16	**Crude Oil**	US Department of Energy - Alabama Profile	211
17	**Gasoline**	2002 Census of Manufacturing- Alabama	324
18	**Fuel Oils**	2002 Census of Manufacturing- Alabama	324
19	**Other Oil Products**	2002 Census of Manufacturing- Alabama	324
20	Basic Chemicals	2002 Census of Manufacturing- Alabama	325
21	Pharmaceuticals	2002 Census of Manufacturing- Alabama	325
22	Fertilizers	2002 Census of Manufacturing- Alabama	325
23	Other Chemicals	2002 Census of Manufacturing- Alabama	325
24	Rubber and Plastics	2002 Census of Manufacturing- Alabama	326
25	**Logs**	Alabama Forestry Commission - 2005 Report	113
26	Wood Products	2002 Census of Manufacturing- Alabama	321
27	Pulp, Newsprint	2002 Census of Manufacturing- Alabama	322
28	Paper	2002 Census of Manufacturing- Alabama	322
29	Printed Products	2002 Census of Manufacturing- Alabama	323
30	Textiles & Apparel	2002 Census of Manufacturing- Alabama	313-15
31	Nonmetallic Mineral Products	2002 Census of Manufacturing- Alabama	327
32	Primary Metals	2002 Census of Manufacturing- Alabama	331
33	Fabricated Metals	2002 Census of Manufacturing- Alabama	332
34	Machinery	2002 Census of Manufacturing- Alabama	333
35	Electrical Equipment	2002 Census of Manufacturing- Alabama	334-35
36	Motor Vehicles	2002 Census of Manufacturing- Alabama	3361-63
37	Transportation Equip	2002 Census of Manufacturing- Alabama	3364-69
38	**Instruments**	2002 Census of Manufacturing- Alabama	339
39	Furniture	2002 Census of Manufacturing- Alabama	337
40	**Misc. Manufacturing**	2002 Census of Manufacturing- Alabama	339
41	**Waste & Scrap**	2005 Manufacturing Surveys	NA
42	**Mixed Freight**	2007 Distribution Center Surveys*	NA

Table 1.3 - Data Sources, Commodity and NAICS Codes for Each Economic Sector (Bold Type Sectors were added in 2006-07)

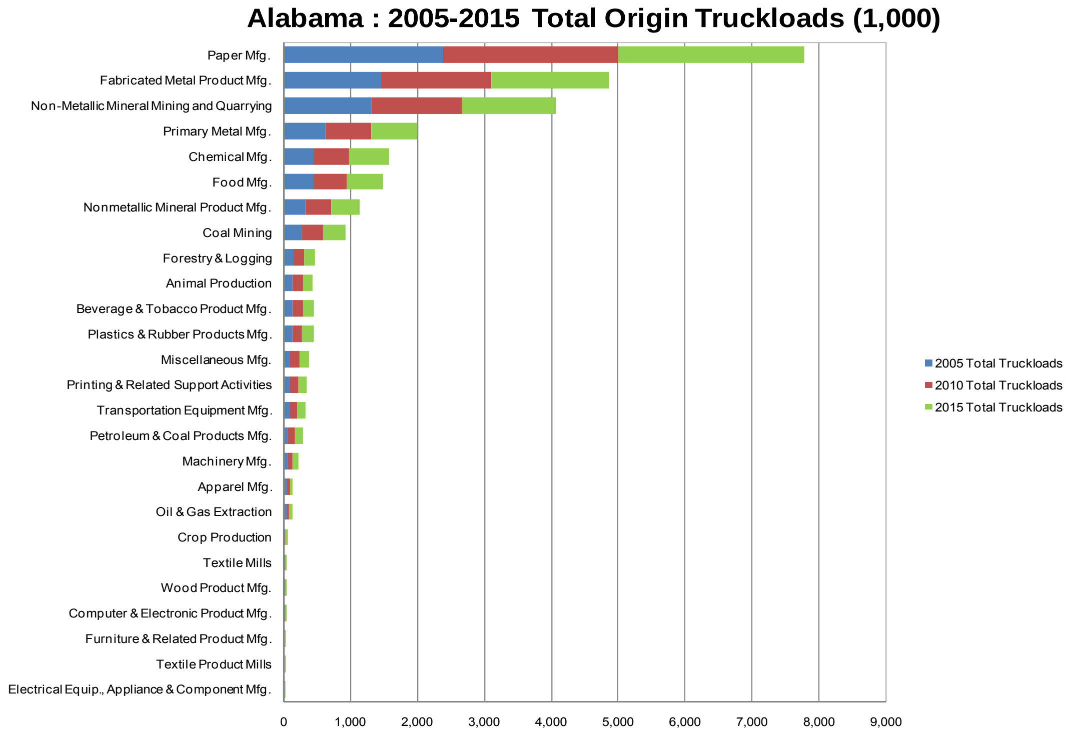


Figure 1.6 – Total Origin Truckloads by Industry Sector

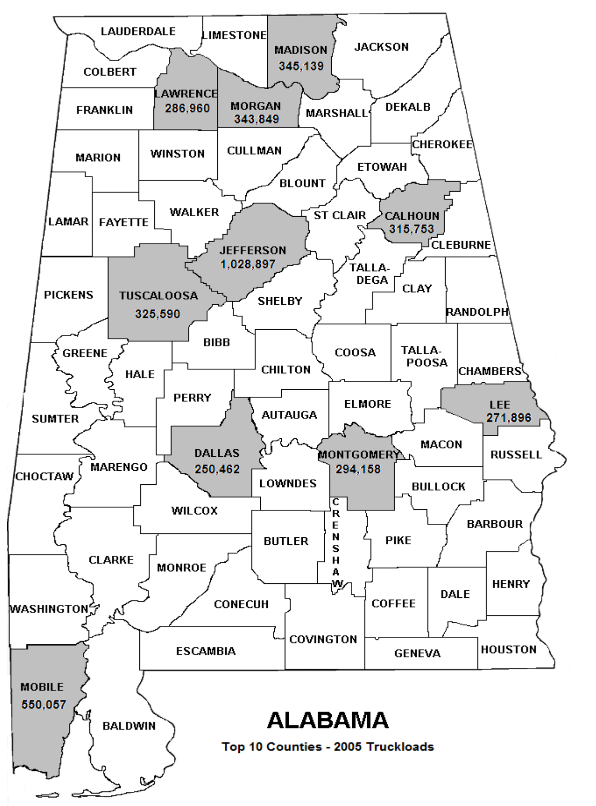


Figure 1.7 – Top Ten counties in 2005 Origin Truckloads

Figure 1.8 presents the percentage change in truckloads for the industry sectors investigated in Alabama from 2005 to 2010. Figure 1.9 presents the percentage change in truckloads for the industry sectors investigated in Alabama from 2010 to 2015.

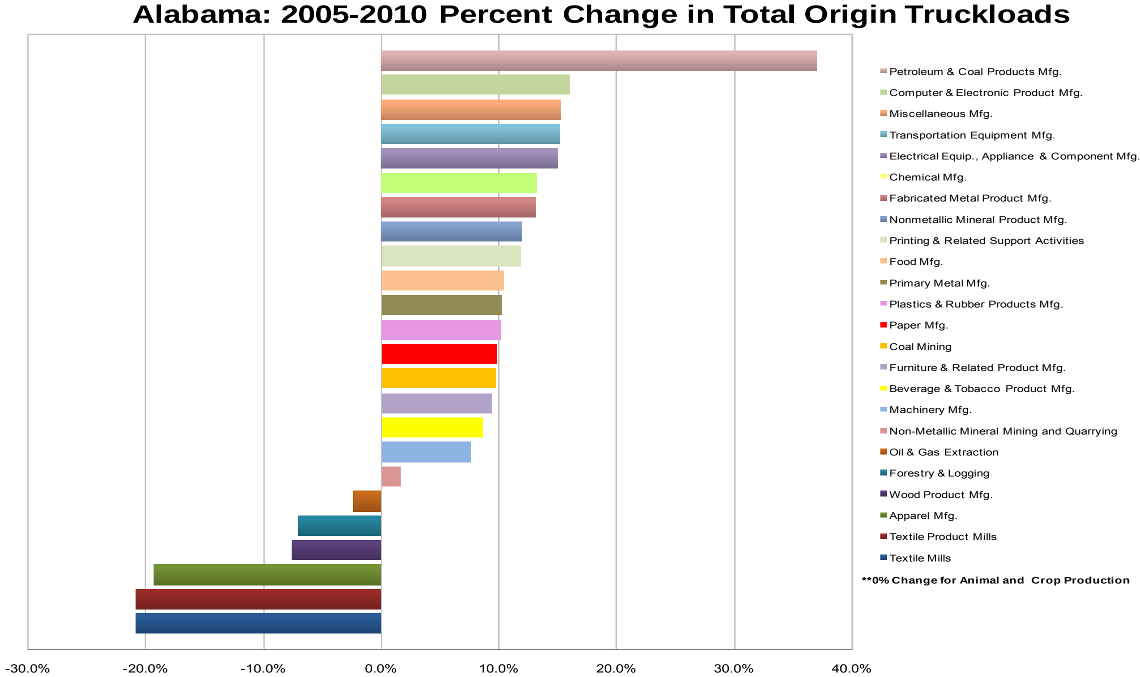


Figure 1.8 – Percentage Change in Total Origin Truckloads 2005 to 2010 by Industry Sector

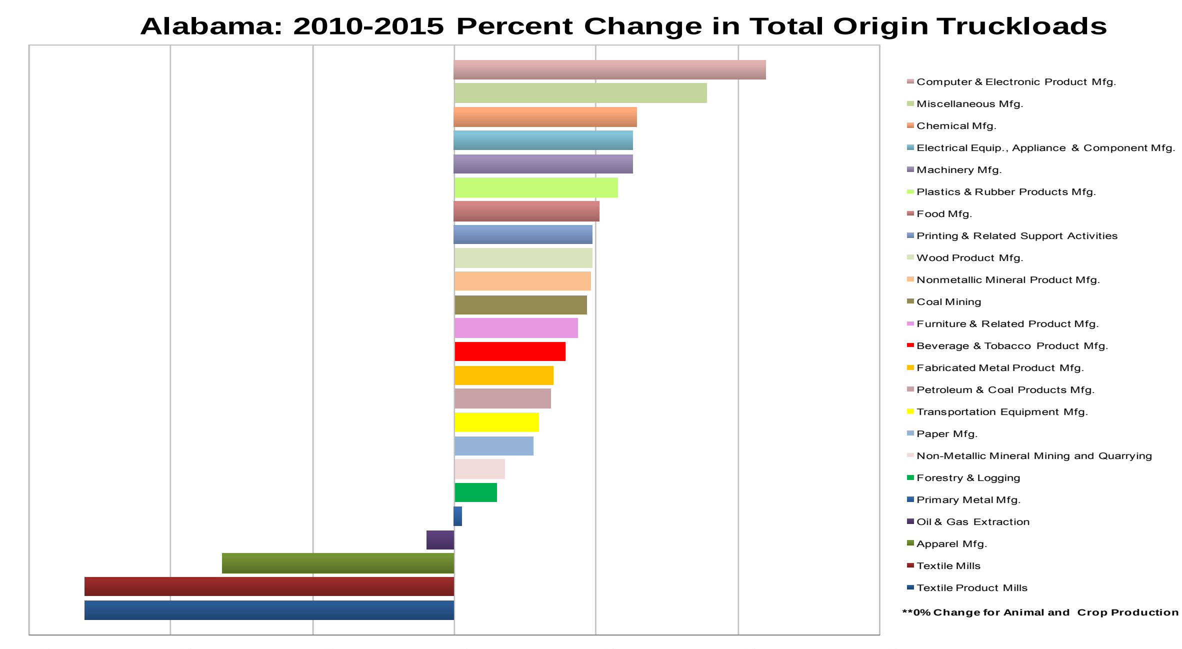


Figure 1.9 – Percentage Change in Total Origin Truckloads 2010 to 2015 by Industry Sector

Figure 1.10 presents maps of the top ten counties in Alabama based on the percentage change in originating truckloads for the periods 2005 to 2010 and 2010 to 2015. Five counties appear in both maps:

- Covington
- Elmore
- Houston
- Limestone
- Madison

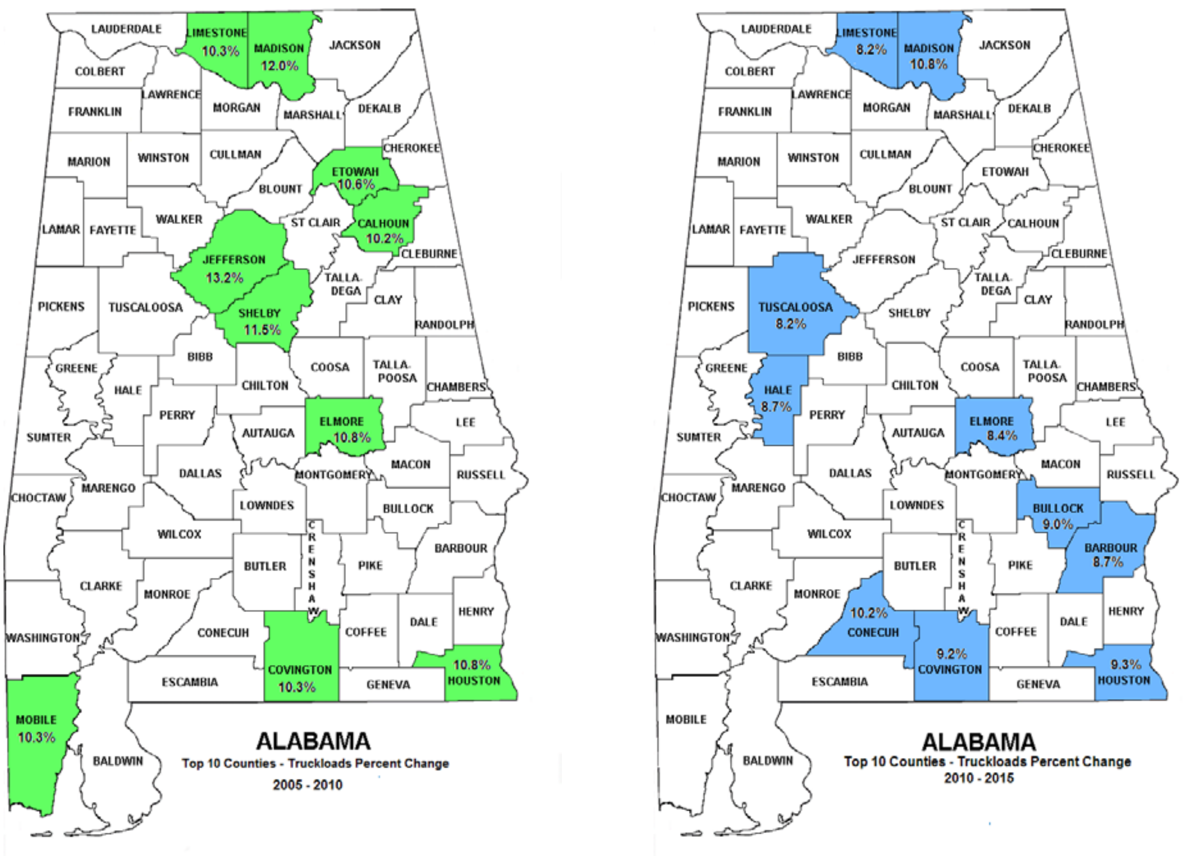


Figure 1.10 – Top Ten Counties by Percentage Change in Origin Truckloads 2005 to 2010 and 2010 to 2015

Examples of originating freight forecasts by industry sector are shown in Figures 1.11 through 1.13. The left map in each of these figures presents the counties with more than 1000 truckloads for that industry sector in 2005 and the map on the right presents the counties with more than 1000 truckloads in that industry sector in 2015.

Figure 1.11 is a presentation of the Transportation Equipment Manufacturing sector, Figure 1.12 presents the Paper Manufacturing sector and Figure 1.13 presents the Fabricated Metal manufacturing sector.

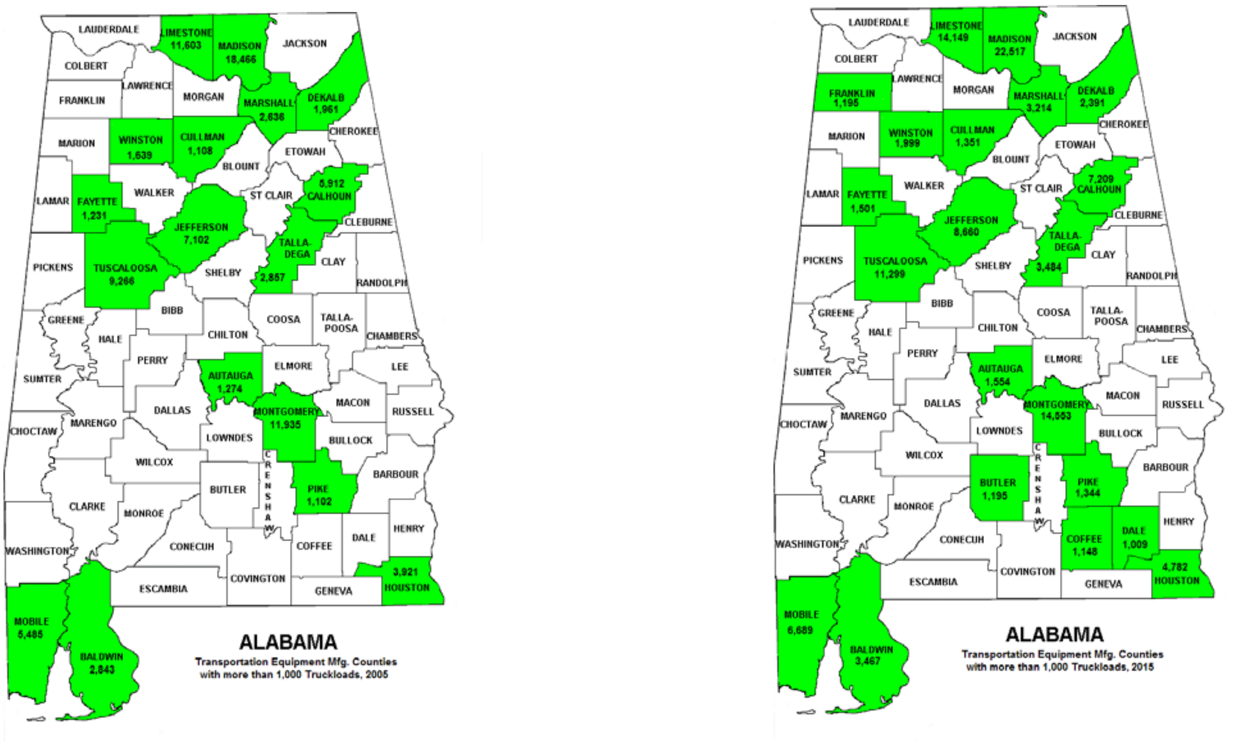


Figure 1.11 – Transportation Equipment Industry Sector Counties with more than 1000 Origin Truckloads 2005 and 2015

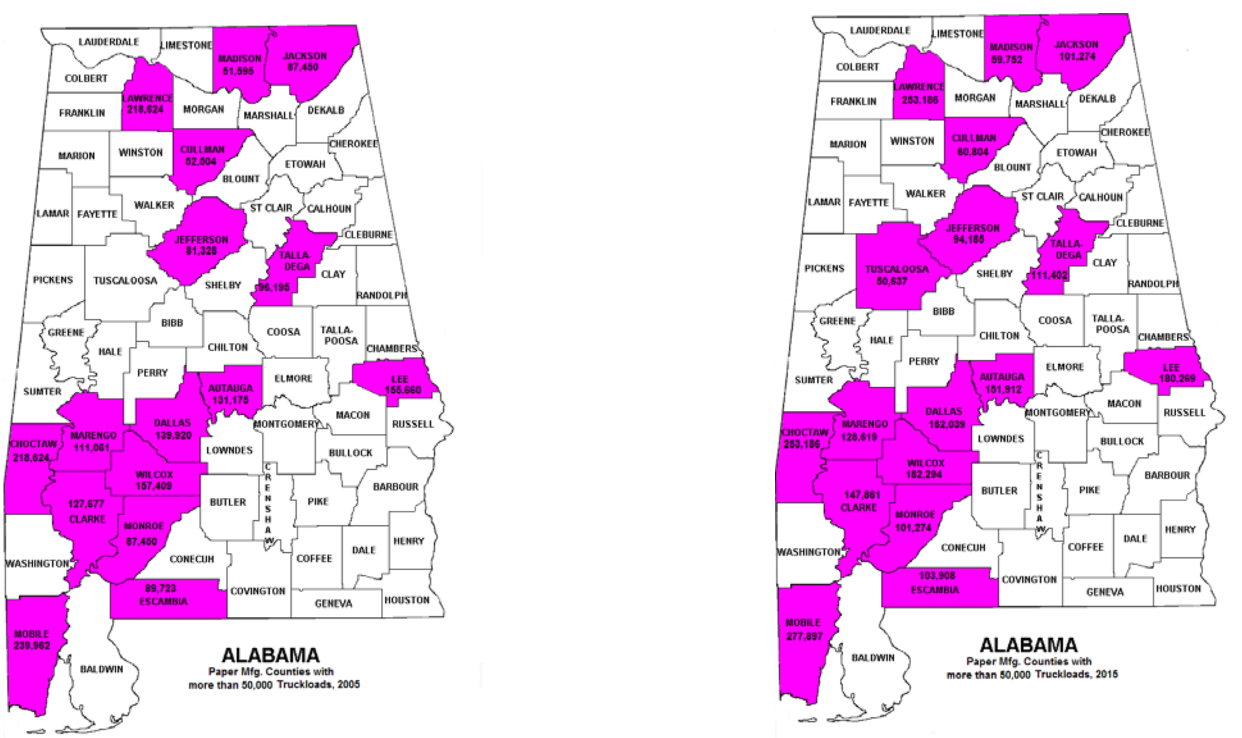
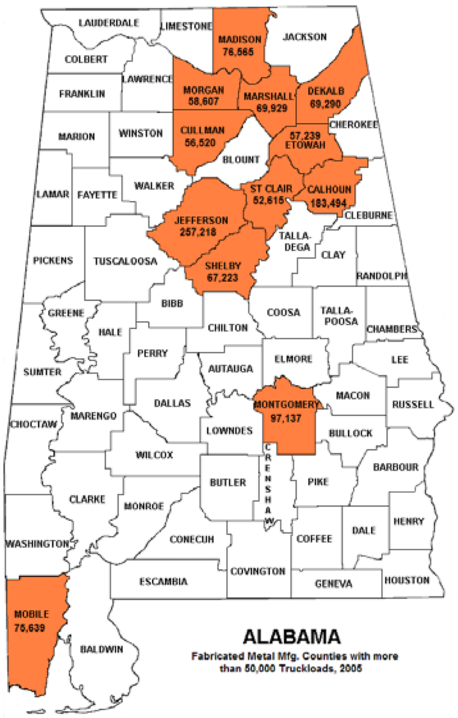


Figure 1.12 – Paper Manufacturing Industry Sector Counties with more than 1000 Origin Truckloads 2005 and 2015



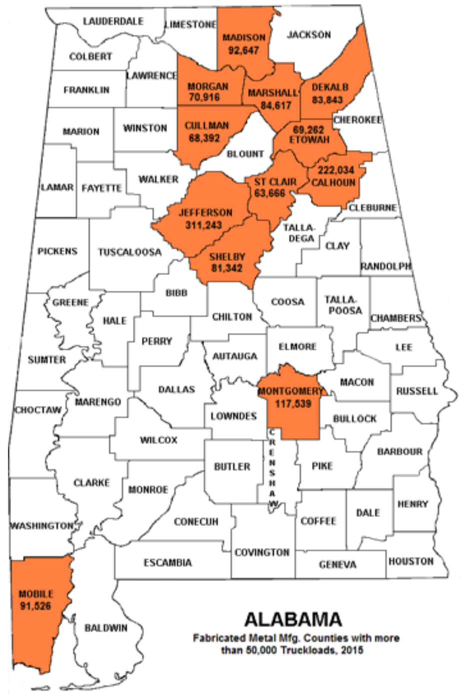


Figure 1.13 – Fabricated Metal Mfg. Industry Sector Counties with more than 1000 Origin Truckloads 2005 and 2015

1.3.2 Analysis of the Final Demand Sector

A substantial amount of freight traffic arises from the transport of finished goods, usually shipped from out-of-state, through warehouses and distribution centers to retailing locations serving the state's major population centers. It is important to include the supply side of freight activity by identifying the location and amount of freight traffic generated by distribution and major retailing centers. The locations of the state's major retail chains and distribution centers were identified through the course of this research effort. A list of retail sectors and the number of stores and distribution centers in each is shown in Table 1.4.

Additional information on the distribution network for each retail sector is being collected through published databases and personal interviews. An estimate of freight traffic to and from each distribution center and warehouse to each major retail location will be constructed and a projection of future freight demand from these sources will be prepared for each Alabama County based on each county's expected personal income growth to 2015. This additional work is being conducted through a new research effort funded by the Alabama Department of Transportation Research Advisory Council entitled "*Development of a Method to Forecast Freight Demand Arising from the Final Demand Sector and Examination of Federal Data to Analyze Transportation Demand for Local Area Through Trips*." Sectors in Table 1.4 marked with an asterisk are currently under investigation through the ALDOT RAC research project.

Alabama Retail Chain Sectors				
Sector	Alabama Stores	Urban Stores	Rural Stores	Alabama Dist Ctrs
Apparel	69	36	33	*
Auto parts	*	104	*	*
Books	30	21	9	*
Drugstores – Chain	328	178	150	*
Electronics	75	47	38	*
Furniture	*	*	*	*
Grocery	44	27	17	1
Hobby	23	21	2	*
Home Furnishings	56	34	22	*
Home Improvement	84	52	32	*
Office Supply	48	34	14	*
Pet Food	10	7	3	*
Sporting Goods	83	39	44	1
Super Centers	123	44	79	3
Tire Stores	*	*	*	*
Toy Stores	18	16	2	1
Variety Stores	580	167	413	1
Wholesale (Buying) Clubs	14	12	2	*
Gasoline Distributors	*	*	*	*
Parcel Delivery	*	*	*	1
Auto Dealers	*	*	*	*

* To Be Completed

Table 1.4 - Retail Sectors, Stores and Distribution Centers

The state's major retail distribution centers were found from data supplied by the Alabama Development Office and from a national market research database entitled *2006 High-Volume Retailers* compiled by TradeDimensions International. Major retail store locations were identified from a national internet research database – *Reference USA*. This data was supplemented by telephone directory listings to verify the locations. Petroleum product distributors were identified through the Alabama Department of Revenue Wholesale Licensed Distributors list. The completed list will be used to develop a survey and interview plan to complete the demand side freight data for the aggregate freight volumes utilizing Alabama transportation infrastructure.

The subtask for collecting and analyzing mode choice for transporting freight was limited to the freight commodities investigated in this research. The supply side modal choice is based upon the particular commodity. The bulk items, agricultural and natural resource commodities utilize barge, rail and truck. Manufactured items such as motor vehicles and electronics are primarily truck mode distribution. The demand side of modal choice is predominately truck. This research area and the validation of previous sampling is still underway and was not completed due to the higher demands on data collection and development during this period of performance.

1.4 Chapter References

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2. Refinement and Application of the Alabama Transportation Infrastructure Model

The ability to make informed decisions regarding transportation investment is limited by the quality and quantity of information available on the transportation infrastructure, and importantly, on the expected benefits arising from the investment. The ability to accurately model transportation infrastructure, identify congestion choke points, define needed capacity, and estimate improvements and benefits is vital to the planning decision-making needs of transportation systems. The movement of freight in a timely and efficient manner is quickly becoming one of the critical components of the U.S. economy. Heavy vehicles, 18 wheel trucks, are the backbone of logistics in the United States. National projections are that freight shipments will double in the next ten years. The increase in freight will have a significant impact on the level of congestion along the national transportation infrastructure and will require innovative congestion mitigation solutions. Alabama, with a growing manufacturing base and logistical industry, is expected to see substantial growth. A detailed understanding of the impact of the projected increase in truck traffic on the existing highway system is needed to examine the potential outcomes and develop a focused plan to accommodate the anticipated increase.

The ability to communicate with diverse audiences about transportation issues and the source of congestion is paramount to developing consensus on potential solutions and moving forward to creating a safe, effective and efficient transportation system. One method of communication is the construction of models that simulate the behavior of the system in order to visually portray the issues and the potential solutions. Visual representations allow for open discussion and debate on the underlying issues and assumptions and the merits of the potential solutions. This was the purpose behind the development of the Alabama Transportation Infrastructure Model (ATIM), and it has proved to be a valuable communication and analysis tool over the last year and a half.

A highway traffic model developed by UAH in 2004 using the TRANPLAN/CUBE software calculated a deterministic average traffic flow over a 24-hour day. Peak traffic flows and congestion levels were estimated based upon ratios to average flow. The model incorporated no interrelationships between modes of shipping, i.e., truck, rail, or water. The Alabama Transportation Infrastructure Model (ATIM), Figure 2.1, developed in 2005 overcame many of the limitations of the earlier model. The ATIM is a discrete event simulation that simulates traffic flows across Alabama's transportation infrastructure system over a twenty-four hour day. Automobile traffic (passenger cars) and freight truck traffic are independently calculated and used to simulate overall traffic flows. Alabama's rail and waterway infrastructure systems are also included, allowing the model to incorporate the dynamics between pair-wise modes of shipping, including truck-train, truck-barge, and barge-train. Air-to-truck transfers are not specifically modeled due to the low relative freight volumes carried by air. Instead, the truck movements initiated by airfreight are included in the truck-only movements. The ATIM is a stochastic program which incorporates the random variation inherent in transportation systems as well as the complex interactions of how freight moves over the transportation network and through intermodal connector points.

The ATIM provides estimates of how changes in the network or changes in utilization of network components will affect the performance of the overall transportation system. This enables effective communication of the expected performance of system investment alternatives through powerful visualization and animation presentations. Travel time, truck flow volumes, congestion indicators, zone utilization, and fuel mileage (measured in system ton-miles) are current metrics calculated and displayed by the ATIM include. Additional metrics can be added based upon the specific goals of the alternative comparison under consideration.

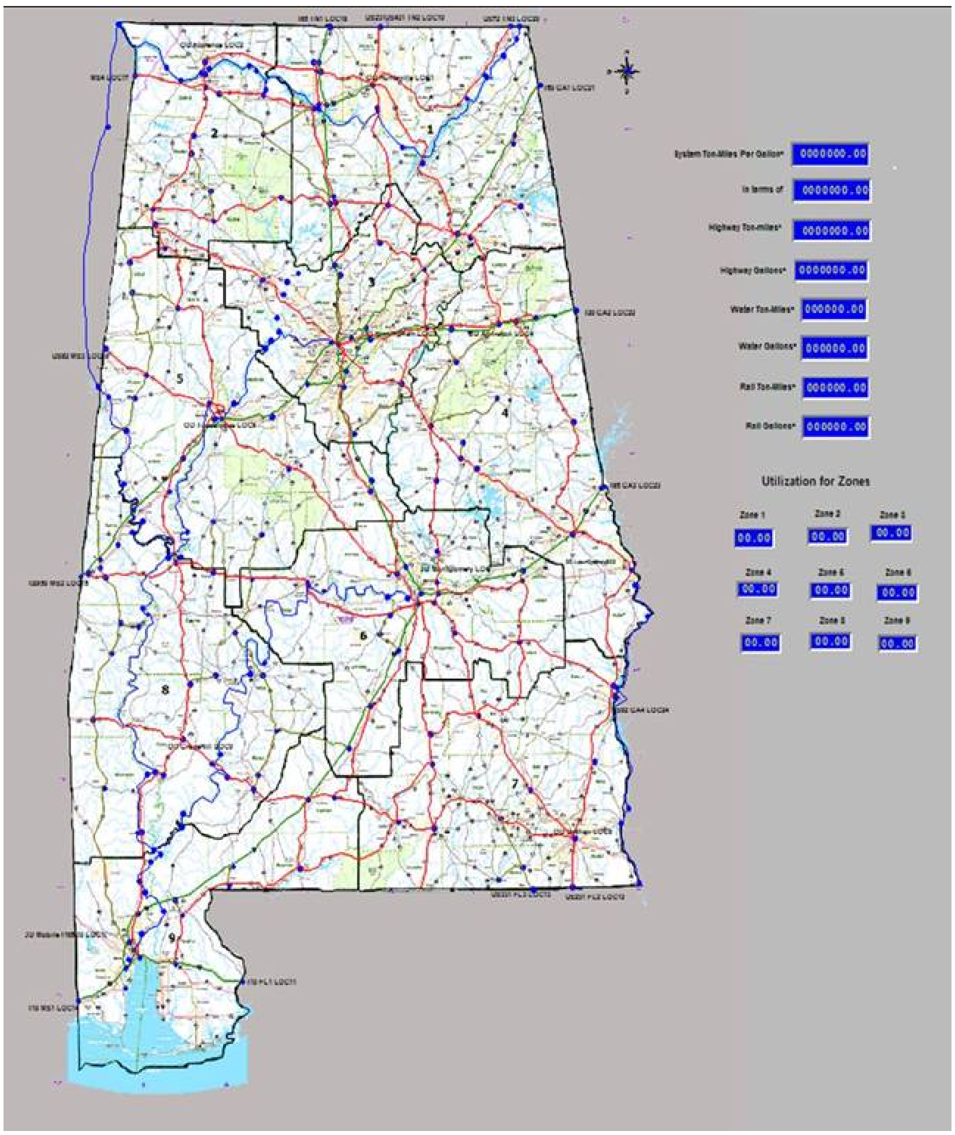

Figure 2.1 – Screen Shot of the Alabama Transportation Infrastructure Model (ATIM)

The ATIM works in conjunction with a TRANPLAN/CUBE gravity distribution model during the "modal split/assignment" step of freight modeling, as shown in the FAF pictured in Figure 1.2. The TRANPLAN/CUBE model provides 24-hour daily Origin-Destination volumes for the 67 counties and 15 external crossings represented in both models. These O-D volumes are then input to the ATIM, where the truck traffic is distributed across Alabama's roadways and modulated to a 24-hour time period according to NCHRP 365 time of day characteristics.

In 2005/06 the development of the model network and the loading of data were completed. Validation of the highway mode was initiated. Since the ATIM model accuracy is dependent on the TRANPLAN/CUBE model validity, both the TRANPLAN/CUBE and the ATIM were subject to verification and validation.

2.1 Verify Hourly Output of Model with DOT Vehicle Counts

The validation of the TRANPLAN/CUBE gravity distribution model examined the difference in truck count to assignment model volume, both on a statewide level and a local level. First, the weighting factor to convert kilotons shipped into actual vehicles was examined. A series of model runs were performed to convert the FAF2 database into trucks using a truck weight factor that varied from five tons to 35 tons in five ton increments. The disaggregation of the FAF2 from two zones into the 67 counties was based only on relative population for the initial tests. To determine the accuracy of the results, the Nash Sutcliffe's (NS) coefficient was selected as it measure the accuracy of the two data elements, truck count and model assignment, along the 1:1 slope line. The NS coefficient can range from -∞ to 1. An efficiency of 1 (*E*=1) corresponds to a perfect match of forecasted counts to the ground counts. An efficiency of 0 (*E*=0) indicates that the forecasted values are as accurate as the mean of the ground counts, whereas an efficiency less than zero (-∞<*E*<0) occurs when the forecasted mean is less than the ground values. The NS coefficient can be calculated using the formula:

$$\text{NS-Coefficient} = 1 - \frac{\sum_{1}^{n}(ModeledCounts - GroundCounts)^2}{\sum_{1}^{n}(GroundCounts - MeanGoundCounts)^2}$$

The results of the runs are shown in the Figure 2.2.

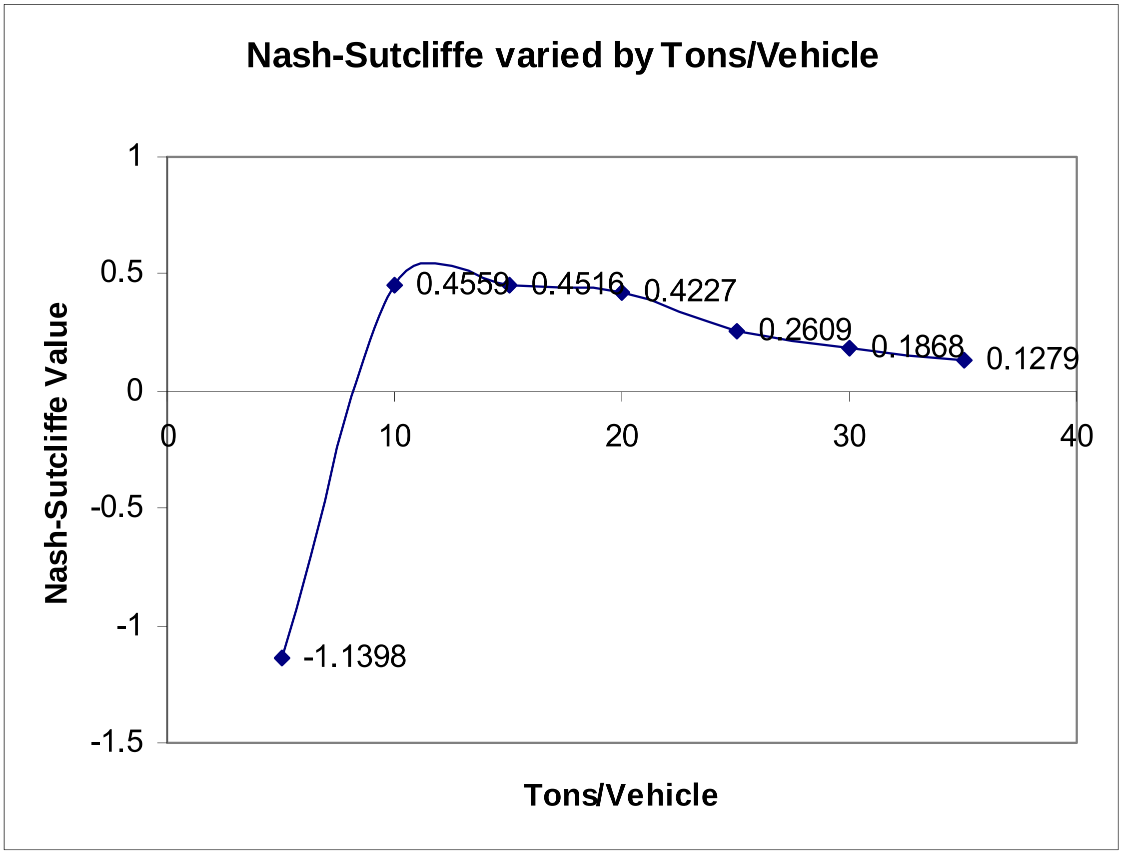

Figure 2.2 – Nash-Sutcliff Analysis Results

From the figure, it was determined that the validation should continue using a value of 10 tons per vehicle and that value was applied universally to all the 42 commodity groups. This approach is limited in its applicability to all commodities, but was used to serve as a base condition.

Using the information in Figure 2.2, the optimal weight per vehicle is around 10 tons. Therefore, a TRANPLAN/CUBE model run was performed using a 10 ton/per vehicle weight and disaggregating the FAF2 data using equal weighting factors applied to population, employment, value of shipment, and personal income that were available for each county in Alabama. The results from the TRANPLAN/CUBE run are shown in Figures 2.3 and 2.4. Figure 2.3 shows the assigned truck counts on the roadways in the model, with the relative thickness of the line representing the truck count. Figure 2.4 shows a scatter plot of the truck counts and assigned model volume with the 1:1 slope line included for reference.

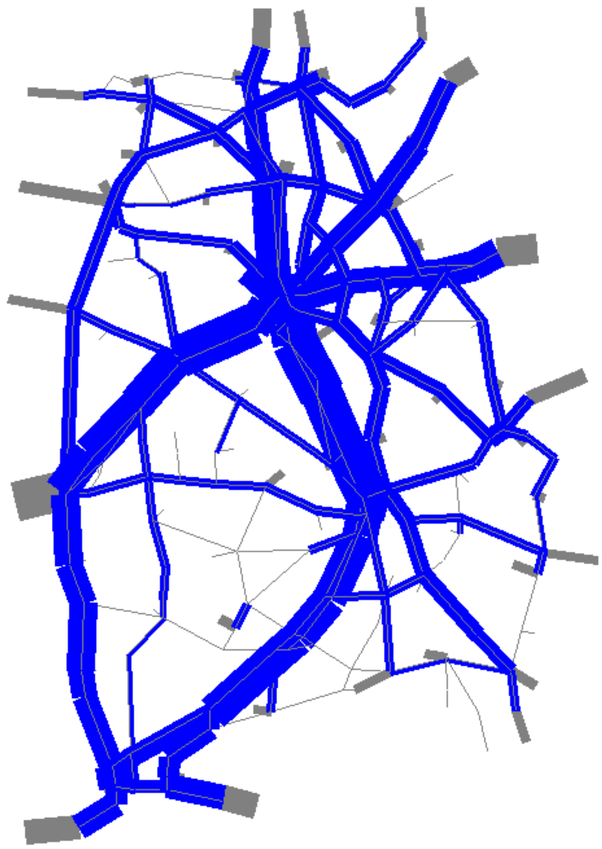

Figure 2.3 – Assigned Truck Counts on Alabama Roadways

The NS coefficient for this model was calculated as 0.50, which is impressive for models of this type.

A roadway specific validation was performed examining Interstate 565 in Madison County, Alabama. The ALDOT traffic count database shows 3,963 trucks on this roadway during the typical day in 2002. The output from the TRANPLAN/CUBE model has the same stretch of roadway assigned with 3,923 trucks for a typical day in 2002.

The reconstructed TRANPLAN/CUBE traffic model is currently undergoing continued validation processes to assure that the results from the model replicate the baseline ALDOT data. Preliminary results indicate a much more aligned model. Once that process is complete, link-specific verification and validation will be performed on the ATIM model highway component.

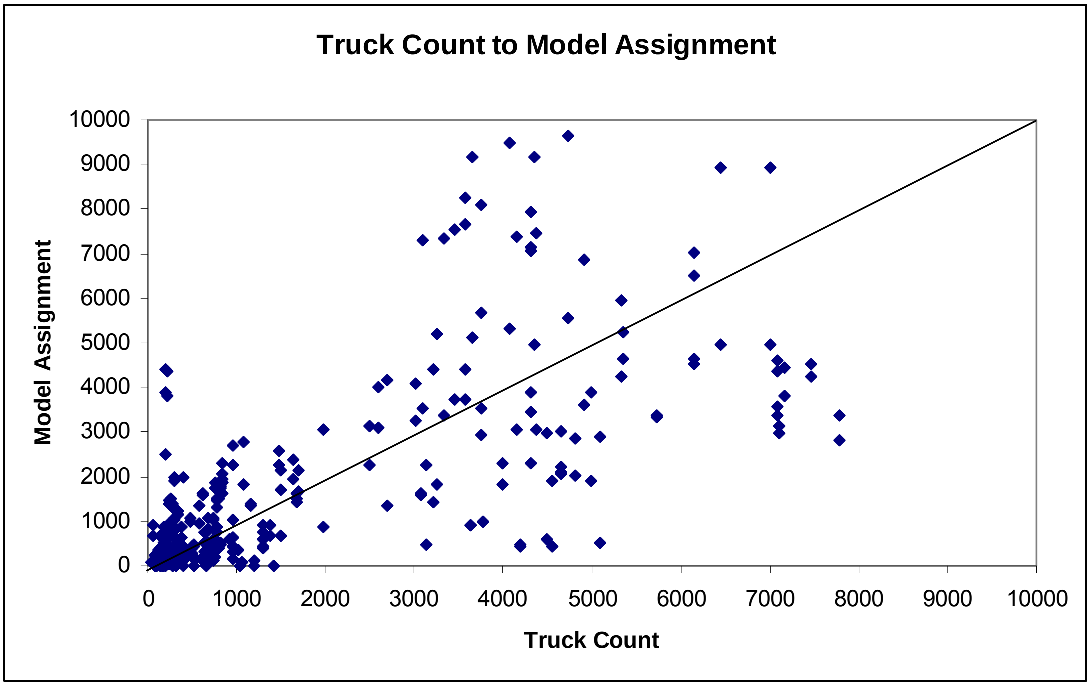

Figure 2.4 – Plot of Truck Counts and Assigned Model Volume

The output of the TRANPLAN/CUBE traffic model includes the origin-destination truck volumes and route distribution that are input to the ATIM model. These outputs are also used directly to create visual representation of the average annual daily traffic volumes and associated congestion patterns on Alabama's roadway network. The Alabama Department of Transportation has defined "congestion" as a volume-to-capacity (v/c) ratio of 0.90 in urban areas and 0.75 on rural roadways. Figures 2.5, 2.6, and 2.7 are examples of the TRANPLAN/CUBE output.

Figure 2.5 shows the 2006 congestion levels in Alabama based on ALDOT's reported traffic counts and roadway capacities. The dark red lines indicate where that the v/c ratio has exceeded ALDOT's congestion thresholds. In 2006, there were 28,000 total lane miles in the Alabama roadway system. Of those, 1,311 were congested. The congested areas cluster around the major cities in Alabama: Birmingham, Huntsville, Mobile, and Montgomery. Birmingham is subject to the intersection of three interstates: I-20, I-59, and I-60.

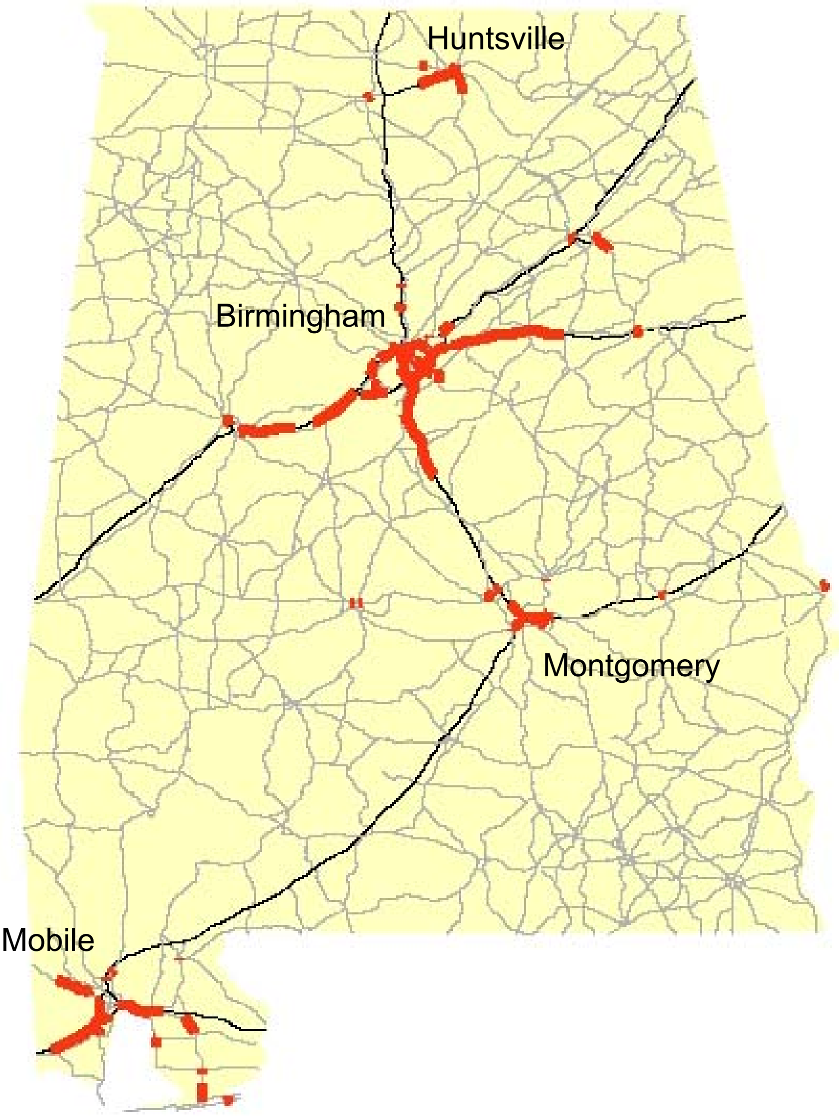

Figure 2.5 – 2006 Baseline Congestion Map

Using trendline forecasting, the most common method used in transportation modeling, the congestion map for 2011 is shown in Figure 2.6. The lane-miles of congested roadway have grown from 1,311 to 2,260. Congestion is still centered around the major cities, but has grown along the Interstate 20 corridor connecting Birmingham and Atlanta, Georgia.

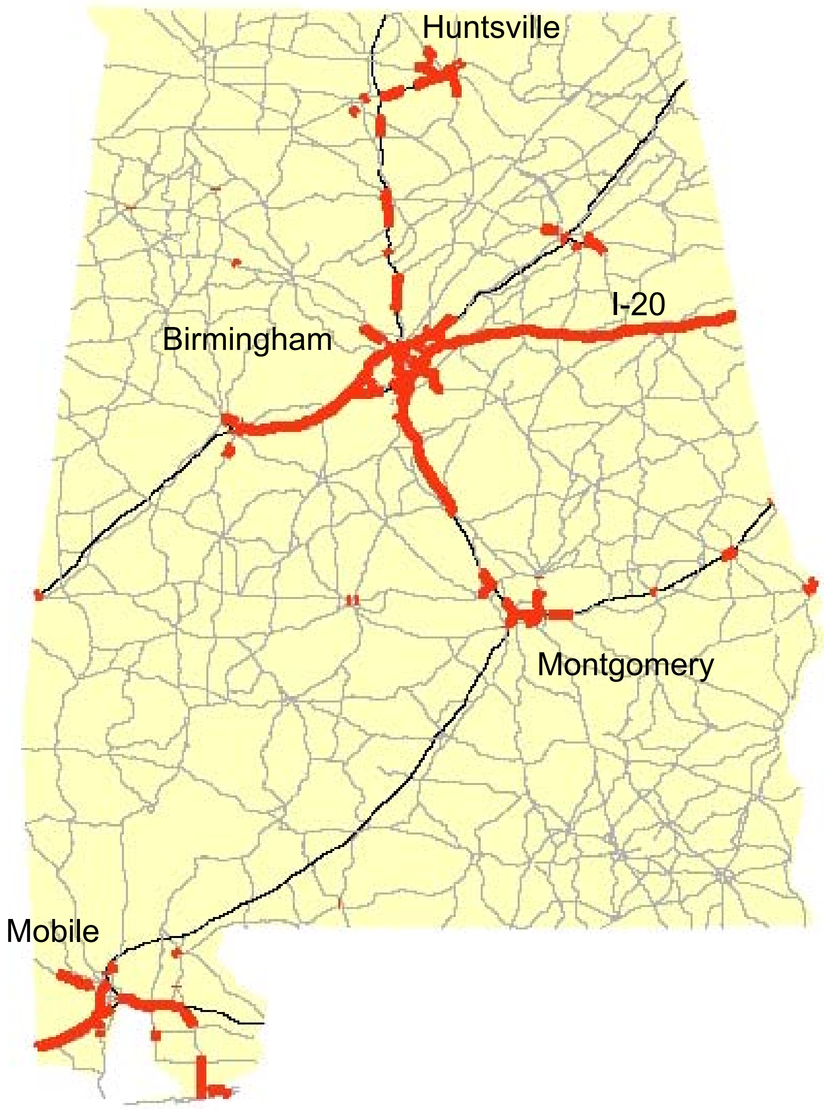

Figure 2.6 – 2011 Projected Trendline Congestion Map

Using the UAH forecasting method based on the presence of industry clusters, the congestion map for 2011 changes dramatically. Figure 2.6 shows that the lane-miles of congested roadway have grown from 1,311 to 3,332, 1,072 more than the simple trendline forecast projected. Congestion has spread from the major cities, along Interstates 20 and 85 to Atlanta, Georgia, and along Interstate 65 connecting Huntsville, Birmingham, and Montgomery. Congestion has also grown along rural routes in southeast Alabama that were completely missed by the trendline forecast.

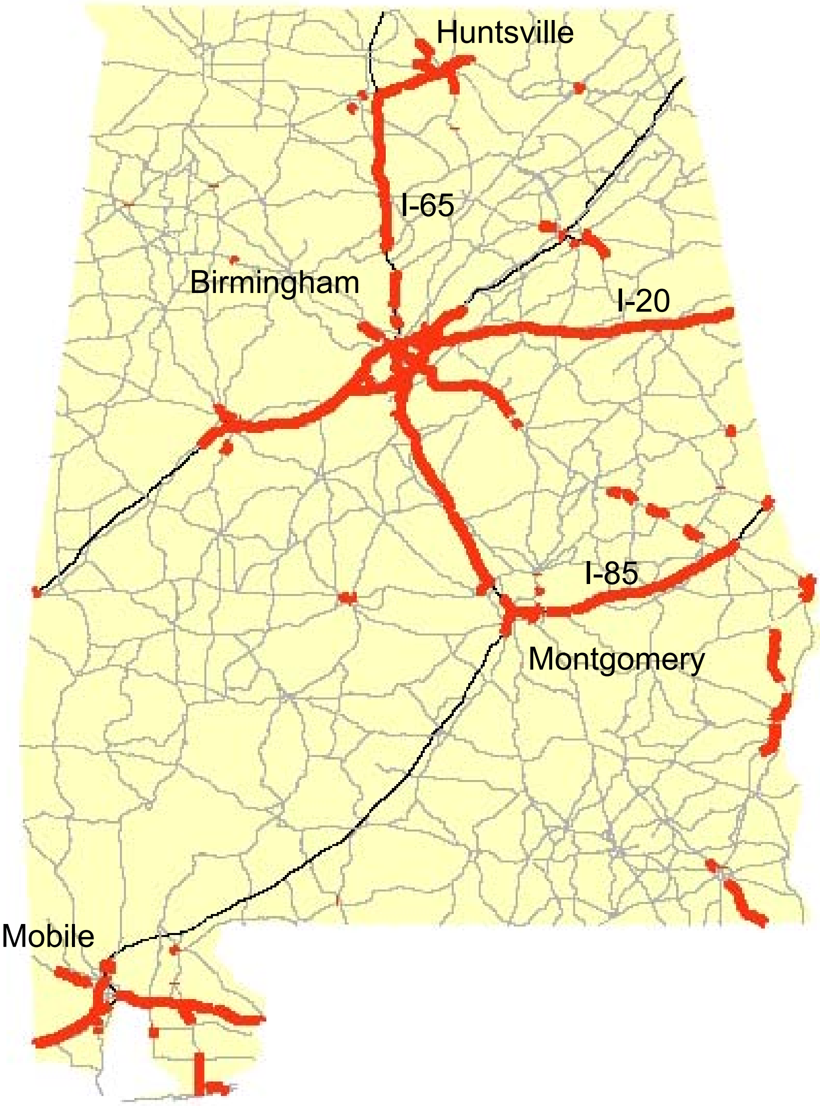

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Figure 2.7 – 2011 Congestion Map Based On UAH Freight Forecast

These figures illustrate the danger associated with underestimating the impact of freight when planning and designing infrastructure development.

2.2 Verify Model Response to Changing Truck Traffic

The ATIM includes an identical highway infrastructure that parallels the TRANPLAN/CUBE model. The ATIM includes all interstates in Alabama (961 miles), 2766 miles of US Highway, and 909 miles of Alabama highway. Figure 2.8 illustrates the roadway system included in the ATIM.

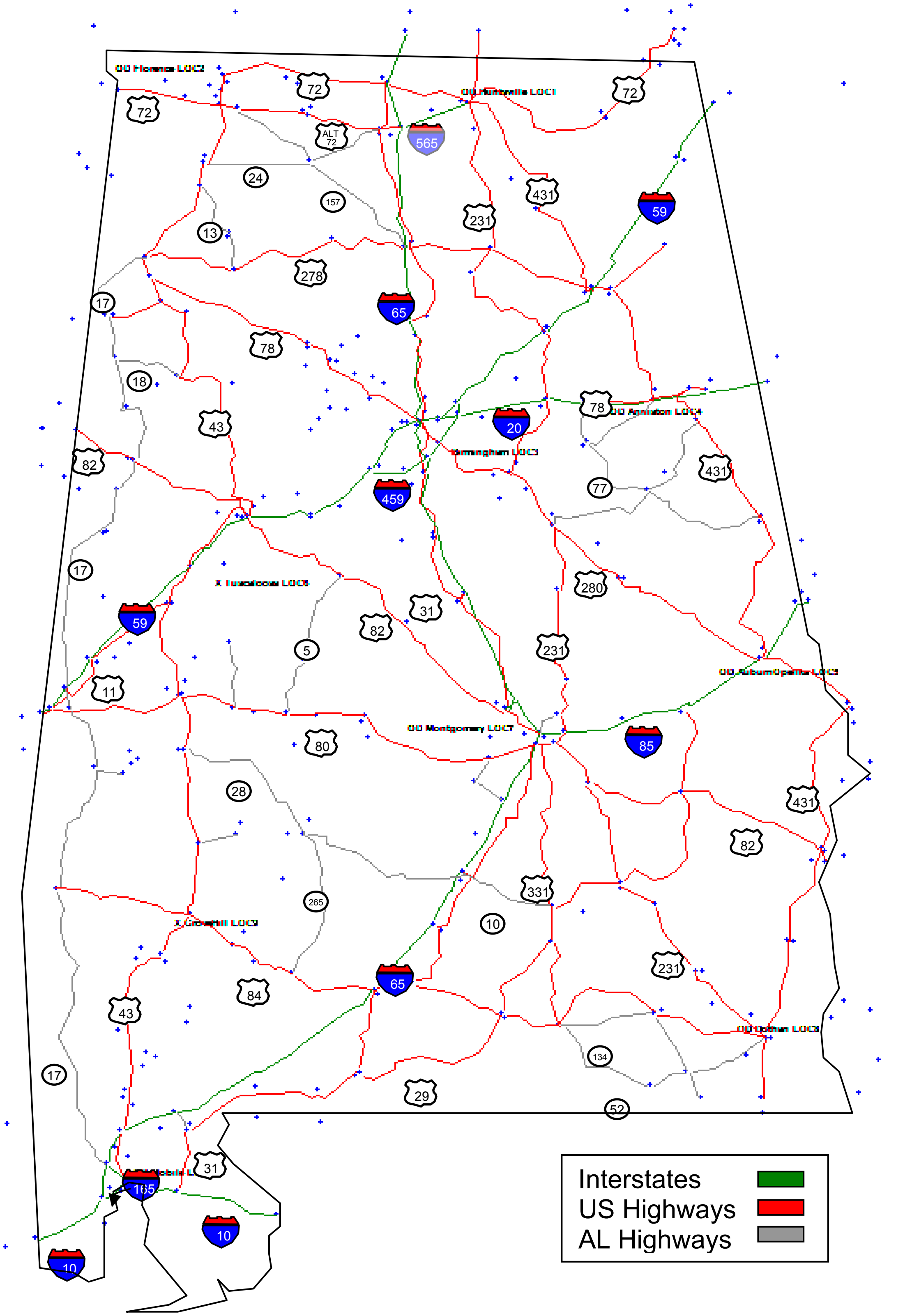


Figure 2.8 – Alabama Roadway Infrastructure Represented In the ATIM

Verification of the ATIM highway infrastructure system was performed using Extreme World scenarios [see Appendix B] concurrently with the TRANPLAN/CUBE model verification. The Extreme World method is used to create a range of plausible futures which bound the range of inherent uncertainty for a future time period.

The extreme world scenarios were constructed following the method outlined by Goodwin and Wright [1], shown in Figure 2.9.

1. Identify the issue of concern and the horizon year which will be captured in the scenarios.
2. Identify predetermined trends that have some degree of impact on the issue of concern.
3. Identify critical uncertainties, which when resolved (one way or the other) have some degree of impact on the issue of concern.
4. Identify the degree to which the trends and unresolved uncertainties have a negative or positive impact on the issue of concern.
5. Create extreme worlds by putting all positively resolved uncertainties in one scenario and all negatively resolved uncertainties in another scenario.
6. Add the predetermined trends to both scenarios.
7. Check for internal coherence. Could the trends and resolved uncertainties co-exist in a plausible future scenario?
8. Add in the actions of individuals and/or organizations who will be impacted by the future described in a scenario. What actions would they take/have taken to satisfy their own interests?

Figure 2.9 – Steps In Extreme World Scenario Construction [1]

The Extreme World method of scenario construction and analysis looked at the ATIM's response to traffic levels created due to high, low, and "status quo" economic development scenarios for the five year horizon ending in 2012. Figure 2.10 shows the unknown variables included in scenario construction: truck growth associated with base population growth, the truck traffic generated by the container handling terminal at Choctaw Point in the Port of Mobile, the truck traffic generated through Alabama because of the closing of the Mississippi River Gulf Outlet (MRGO) to deep draft vessels at the Port of New Orleans, the availability of drivers to support truck movements, and the truck traffic generated to support the planned Kia plant in West Point, Georgia.

Case	Base Truck Population Growth	Unknown 1: Choctaw Point Traffic*	Unknown 2: Port of New Orleans Traffic	Unknown 3: Toll Lanes	Unknown 4: Driver Availability**	Unknown 5: Kia Plant Production***
Status Quo Volume	Average growth rate at 31.58% (U.S. Department of Transportation 2006)	200,000 containers/year -- 60% sent by truck (Personal communication 2007)	MRGO Channel remains closed to ship traffic (Brown 2005)	Not implemented	Number of available drivers follows slight upward trend, but does not satisfy the total demand for drivers.	No production
Lowest Volume	Average growth rate at 0.3% (U.S. Census Bureau 2005)	500,000 containers/year -- 60% sent by truck (Personal communication 2007)	MRGO Channel dredged to 36' allowing ship traffic (Brown 2005)	Implemented along Interstates	Loss of truck drivers due to external factors limits the number of trucks on the road	No production
Highest Volume	Average growth rate at 40% (Cambridge Systematics 2004)	800,000 containers/year -- 60% sent by truck (Personal communication 2007)	MRGO Channel remains closed to ship traffic (Brown 2005)	Not implemented	Training and incentive packages generate enough growth in driver workforce to meet the industry demand for truck shipments.	Full production

Figure 2.10 – Variables Impacting Extreme World Scenarios

*Choctaw Point is the container terminal under construction at the Port of Mobile.

**Driver availability has the potential to constrain truck traffic. If truck traffic continues to grow, but driver recruitment does not, the number of licensed truck drivers will not be able to fill demand.

***The Kia plant in Georgia was planned to come online in 2008 producing 300,000 vehicles per year (Bernstein 2006). According to a survey of Alabama's automotive manufactures, this will produce approximately 705,000 additional truck trips per year (University of Alabama in Huntsville 2005). Kia is expected to use much of the same supplier base as its sister Hyundai plant in Montgomery, as well as importing parts and materials in containers from Korea through the Port of Mobile. For the Extreme World scenarios, it was estimated that1/3 of the trips associated with deliveries to the Kia plant will impact Alabama roadways at some point.

The dependent variable tested in exercising the Extreme World scenarios was the number of trucks on the Alabama roadway infrastructure. The number of truck then impacted the performance measures generated by the ATIM. Figure 2.11 shows the output of the ATIM on selected roadway segments based on the Extreme World scenarios tested. The roadways selected to illustrate model output, Interstate 10 and Interstate 65, are both considered “freight-significant corridors” by the U.S. Department of Transportation. Figure 2.11 shows the impact of additional truck traffic on average traveling speed. As the number of trucks in the system increases, the average speed decreases.

	I-65 Northbound	I-65 Southbound	I-10 West	I-10 East
Best Case	59.73	42.52	64.95	64.00
Status Quo	57.08	39.26	63.14	61.50
Worst Case	55.44	41.29	62.75	60.34

Figure 2.11 – Average Speed (mph) of Selected Roadway Segments

The Extreme World Scenarios tested indicate that the ATIM is responsive to changes in freight traffic levels, which allows the researchers to compare the impact of multiple scenarios to each other. Additional quantitative link-by-link analysis of the model's output in ongoing, coinciding with calibration of the TRANPLAN/CUBE model to truck traffic counts reported by the Alabama Department of Transportation.

2.3 Develop Origin and Destination Rail Information

Based on commodity flow, shipment densities, and gross tonnage levels published by the Alabama Rail Directory 2001, the Alabama Rail Plan Update 2001, and the Alabama Bureau of Tourism and Travel, the research team established estimates of rail freight volumes and Origin-Destination pairs for the Class I and Class III rail lines represented in the ATIM model. The rail system included in the ATIM consists of five Class I rail lines: Burlington Northern Santa Fe (BNSF), CSX Transportation (CSXT), Canadian Nation/Illinois Central Railroad Company (CNIC), Kansas City Southern Railway Company (KCS), and Norfolk Southern Rail Company (NS). The rail infrastructure included in the ATIM is shown in Figure 2.12 and the volumes in tons used to populate the ATIM rail mode for Class I railroads are shown in Table 2.1.

The ATIM also includes 20 Class III rail lines currently operating in the state that provide service to specific companies or communities. The Class III rail lines provide connections between the areas they serve and the Class I railroads; essentially, they serve as the "farm-to-market" pathways for the rail industry. The volume data in tons used to populate the Class III rail mode of the ATIM is shown in Table 2.2. The Carload Waybill Sample data for Alabama has been requested from the Surface Transportation Board through the Alabama Department of Transportation (ALDOT) in order to verify the volume estimates. As of this report date, the requested information has not been received.

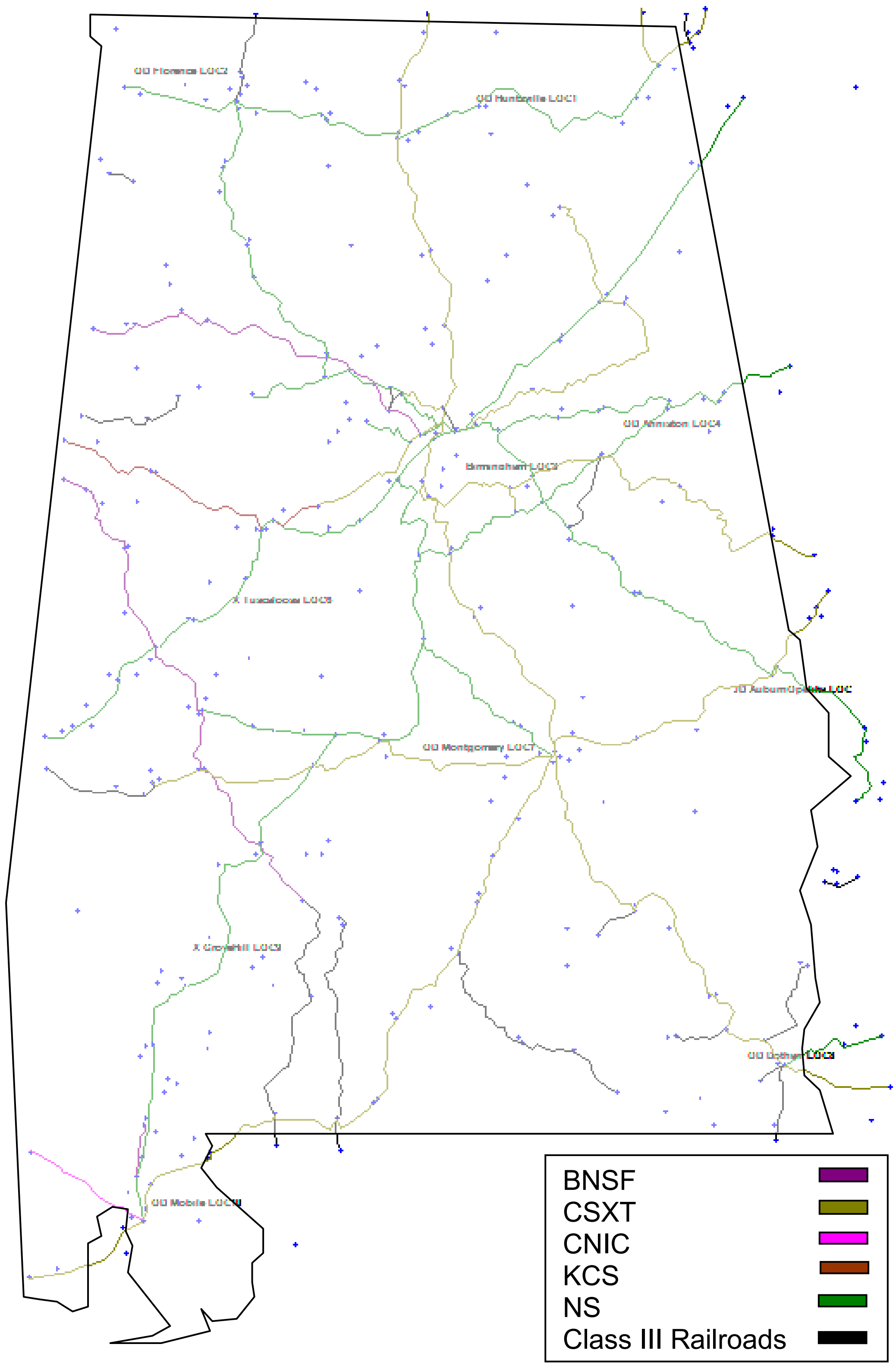


Figure 2.12 – Alabama Railway Infrastructure Represented In the ATIM

Railroad	Segment	Tons	Commodities	Notes
Burlington Northern Santa Fe Railway (BNSF)	Lamar County to Jasper	20,000,000	Chips, caustic soda, pulpboard, wood pulp, pulpwood logs, sulfuric acid, chlorine, scrap	Originating Tons: 3,301,334 Terminating Tons: 33,767,427 Intrastate Tons: 1,090,458
	Jasper - Birmingham	12,500,000		
	Pickens County	12,500,000		
CSX Trans. Inc. (CSXT)	Mobile County - Mobile	20,000,000	Paper, minerals, agricultural products	CSXT moves 22M tons of freight in Alabama. However, the Alabama Bureau of Tourism reports that CSXT has a gross traffic density of more than 20M tons on each of the segments indicated. This discrepancy has not been resolved at the time of this report, but is believed to related to the pass-through freight levels which neither originate or terminate in Alabama.
	Mobile - Montgomery	20,000,000		
	Montgomery - Dothan	12,500,000		
	Dothan - Houston County	12,500,000		
	Montgomery - Auburn	20,000,000		
	Auburn - Chambers County	20,000,000		
	Montgomery - Birmingham	20,000,000		
	Montgomery - Selma	3,000,000		
	Shelby County - Chambers County	20,000,000		
	Birmingham - Vance	3,000,000		
	Birmingham - Gadsden	3,000,000		
	Birmingham - Decatur	20,000,000		
	Decatur - Limestone County	20,000,000		
Canadian National / Illinois Central Railroad Company (CNIC)	Mobile - Mobile County	12,500,000	Petroleum and chemicals, grain, fertilizers, coal, metals & minerals, forest products, automotive products.	
Kansas City Southern Railway Company (KCS)	Pickens County - Tuscaloosa County	246,981,516	Coke, scrap iron or steel, synthetic rubber, pulpboard & fiberboard, soybean cake, sheet steel, scrap paper, sulphuric acid, fuel oil	KCS moves 247M tons of freight in Alabama. However, the Alabama Bureau of Tourism reports that KCS only has a gross traffic density of 1-5M tons on the KCS system in Alabama. This discrepancy has not been resolved at the time of this report.
Norfolk Southern Railway Company (NS)	Mobile - Marion Junction	12,500,000	Agriculture, automotive, chemical, coal, construction, paper	NS moves 7M tons of freight in Alabama. The Alabama Bureau of Tourism reports that CSXT has a gross traffic density of more than 20M tons on each of the segments indicated. This discrepancy has not been resolved at the time of this report, but is believed to related to the pass-through freight levels which neither originate or terminate in Alabama.
	Selma - Demopolis	3,000,000		
	Montgomery - Birmingham	12,500,000		
	Calera - Anniston	3,000,000		
	Birmingham - Cleburne County	20,000,000		
	Birmingham - Tuscaloosa	20,000,000		
	Birmingham - DeKalb County	20,000,000		
	Scottsboro - Lauderdale County	20,000,000		

Sources: Alabama Rail Directory, 2001 and Alabama Bureau of Tourism Rail Map

Table 2.1 - Class I Rail Line Volumes

Railroad	Tons	Major Commodities
Alabama & Gulf Coast (AGR)	2,049,735	Forest products, paper
Eastern Alabama (EARY)	960,000	Limestone, calcium
M & B Railroad (MNBR)	400,000	Paper
Wiregrass Central (WGCR)	336,000	Grain, peanut products
Southern Alabama (SUAB)	253,000	Corn, soybeans, plastic
The Bay Line (BAYL)	227,000	Forest products, paper
Alabama Railroad (ALAB)	127,190	Forest products
Sequatchie Valley (SQVR)	118,500	Gypsum board, plastic
Alabama & Florida (AF)	96,500	Chemicals, pulpwood
Georgia South Western (GSWR)	77,000	Ceramics, fertilizer
Luxapalila Valley (LXVR)	68,500	Wood products
Tennessee Southern (TSRR)	62,043	Phosphates, chemicals
Pine Belt Southern (PBRR)	58,750	Wood chips, pulpwood
Huntsville & Madison County (HMCR)	31,400	Sand, brick

Source: Alabama Rail Directory 2001, p4.4

Table 2.2 - Class III Rail Line Volumes

Although estimates for freight volume can be calculated for each rail line based on published public data, the true capacity of each rail segment is unknown outside of the private operating company. Unlike roadway capacity, which is a function of road design and operating conditions, rail capacity is a function of several factors:

- the number of sidings on a line
- the number of stops scheduled in cities along the route
- the achievable speed due to engine size, number of cars, and terrain
- the interaction with passenger rail
- the interactions with container trains on designated intermodal lines
- the speed and reliability of loading/unloading cars during stops
- the volume of cars in a given regional area and their projected travel schedules
- the efficiency of interchanges when a train moves from one rail company's line to another
- the available manpower to run the train
- switchyard volumes
- the interaction with the highway network at at-grade crossings
- etc.

To date, rail companies have been unable or unwilling to provide a fixed amount of capacity that is "available" on their lines. One company reported that they could accept 250,000 cars into their southeastern region, but could not translate that number into a figure for each rail route or even each state. This makes it hard for planners, researchers, and public officials to include rail in potential projects or congestion mitigation plans.

A second issue concerning rail freight transportation is the standardization of freight measurement. Currently, rail volume freight is often measured in tons and traffic density is measured in gross ton-miles per route-mile (GTM/M). While some roadway freight volumes are measured in tons, the more common measurement used by state DOTs and MPOs is number of trucks. Roadway traffic densities are measured in *passenger cars per hour per lane (PCPHPL)*. In order to accurately compare roadway and railway freight traffic patterns, a common measurement will need to be defined, as well as conversion factors to number of trucks and number of trains.

Rail is being touted with increased frequency as a possible solution to congestion in many areas of the country, including Alabama. This, however, may not actually be the case. Like roadways, rail has a limited capacity for moving freight along specific routes. Unlike popular perception, being a private industry does not guarantee that rail companies always have access to the capital necessary to increase that capacity. More information is still needed on to understand how the rail companies operate, schedule train movements, and calculate capacity. This information will not be obtained without strengthened relationships and cooperation with the decision makers within private railway companies.

2.4 Develop Origin and Destination Waterborne Information

The inland waterway system in Alabama consists of six rivers: the Mobile, the Alabama, the Tombigbee, the Chattahoochee, the Black Warrior, and the Tennessee. The rivers are all represented in the ATIM, as shown in Figure 2.13.

The waterway traffic simulated in the ATIM is based on commodity flow data for Alabama's inland waterways. This data is provided by the Army Corps of Engineers. The Corps provided the research team most recent data available (2004) on freight movement volumes on Alabama's inland waterways. This data was used to update the origin-destination pairs already in use in the ATIM. While spot-studies have been done in various communities along the Intracoastal Waterway and the Gulf Coast, the research team was unable to obtain any systematic records of recreational boat usage rates along the Intracoastal Waterway or on the inland waterways. The recreational data is needed to calculate the total "customer" demand for waterway transport and to estimate the amount of freight transport vehicles that the waterway system can absorb.

Current freight activity on Alabama's inland waterways consists primarily of the transport of bulk commodities that are considered not to have time-sensitive delivery: coal, chemicals, forest products, petroleum, and grain. The image of waterborne transport as slow and inflexible to shipper's needs has negatively affected the mode's competitive standing relative to rail and truck shipments. However, transport by barge remains the most fuel-efficient mode of freight transportation.

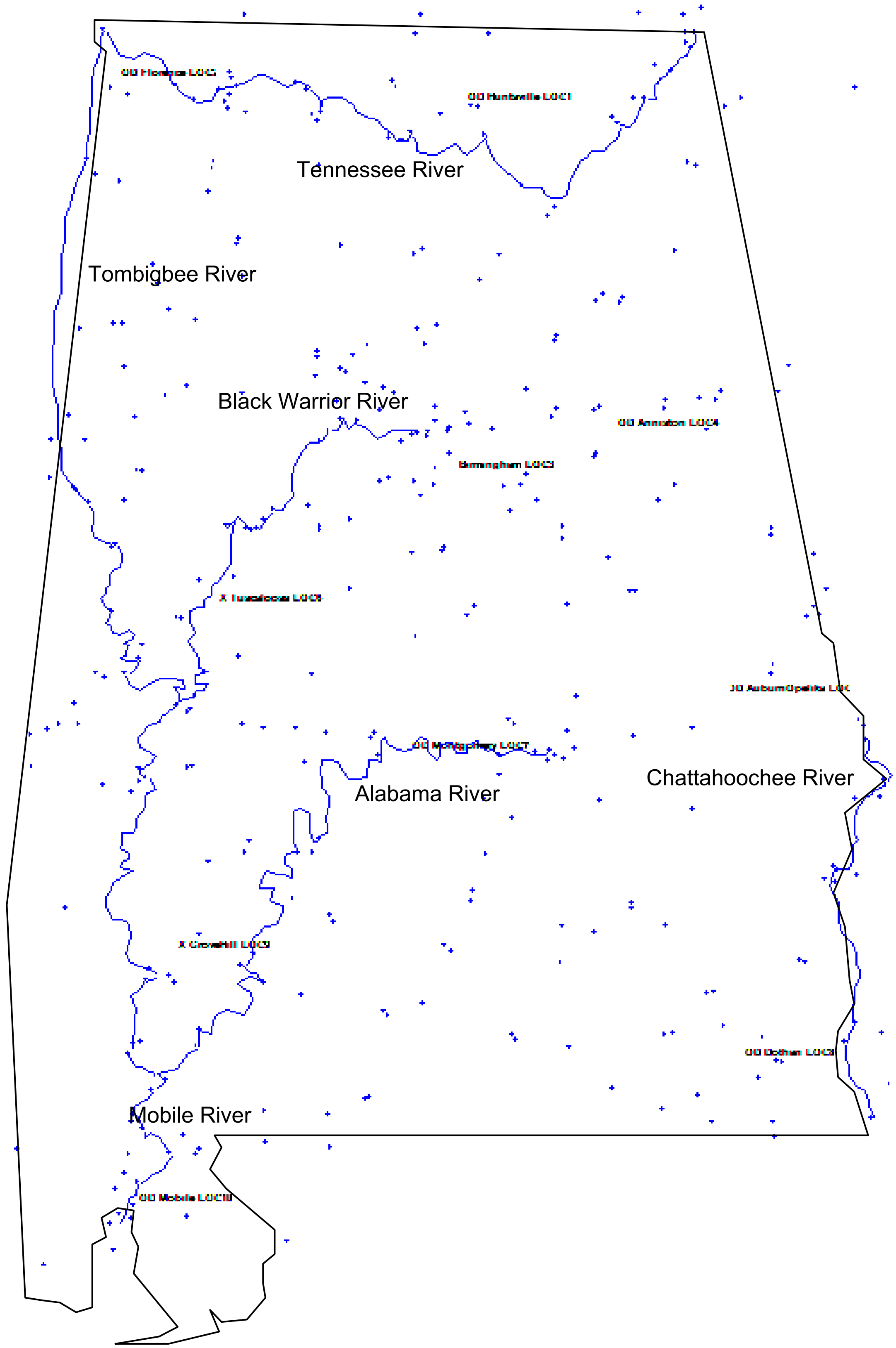


Figure 2.13 -- Alabama Inland Waterways Represented In the ATIM

The fuel-efficiency, and associated cost-efficiency, of barge transport was one of the factors that spurred the Coalition of Alabama Waterway Associations to produce the report "*Alabama Freight Mobility Study, Phase 1 – Business Perspectives on the Feasibility of Container-on-Barge Service (AFMS)*" [9]. The AFMS provides an overview of the Container-on-Barge (COB) business, and identifies some of the strengths and weaknesses Alabama has in providing such a service. The AFMS also contains a comprehensive list of ports along Alabama's inland waterway system and the types of freight handled at each destination. The AFMS outlines the intermodal connections available at each port in terms of accessibility of roadway and railway facilities.

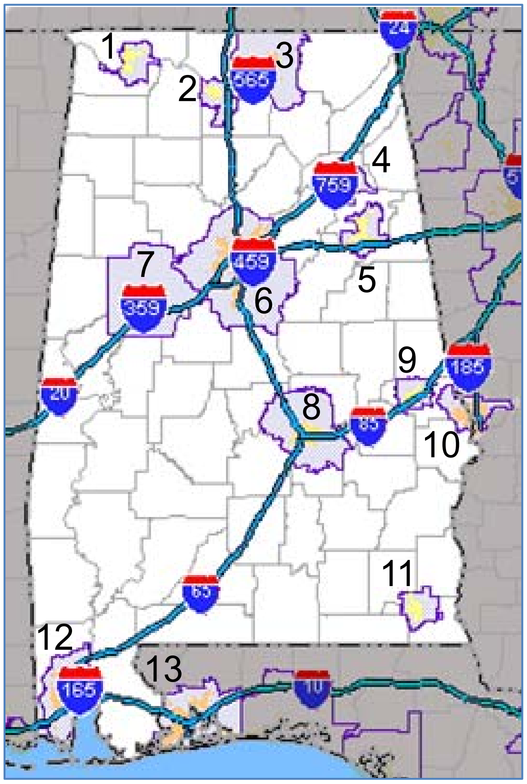
The Army Corps of Engineers Waterborne Commerce Statistics Center reports on domestic U.S. waterborne traffic are available only for a selection of Alabama waterways: the Black Warrior & Tombigbee Rivers, the Gulf Intracoastal Waterway, the Tennessee River, and the Tennessee-Tombigbee Waterway. All other Alabama waterways do not carry enough freight to be tracked by the Corps. For those waterways which are tracked, short ton volume values are only reported for eight "National Internal Commodities": coal, petroleum, chemicals, crude materials, manufactured goods, food and farm, and manufactured equipment. Origin and destinations locations associated with freight transport are not provided. The Corps data is only available through 2005, an approximate two-year lag between reporting and the current time period.

Waterborne freight transport, especially Container-on-Barge transport, represents an untapped opportunity for reducing congestion due to freight growth in key sections of Alabama's Freight-Significant Corridors (Interstates 10 and 65). However, without up-to-date information on the capacity of the locks and dams, maintenance and dredging needs of the waterway system and levels of recreational water vehicle demand on the inland waterway system, this key mode of freight transportation cannot be included in comprehensive freight plans and modeling efforts.

2.5 Work with MPO's to Develop Freight Information by City/Area

There are 13 Metropolitan Planning Organizations (MPO) in Alabama encompassing the Urban Areas in Alabama (Figure 2.15), and 12 Regional Councils of Government (RGOG) to support those areas that fall outside of the MPO boundaries (Figure 2.16). Members of the UAH research team worked with four of the MPOs and one of the RCOGs during the study period. It was discovered during those collaborative activities that the MPOs do very little, if any, freight forecasting or analysis within their geographical areas. The RCOGs do no freight traffic forecasting or modeling. It appears that the reluctance to investigate freight is due principally to the lack of a perceived positive cost/benefit ratio by the planning organizations.

All of the MPOs and RCOGs contacted indicated that they believed that more detailed information on freight movements within their areas of responsibility would be useful; however, lack of funds and experience were cited as the main reasons for not pursuing such projects. The MPOs who included freight in their modeling activities relied primarily on the state DOT forecasts. Several of the MPOs reported that they excluded freight forecasts from their modeling activities altogether due to the suspect nature of the data. These findings are consistent with the report from the 2007 Transportation Research Board Conference "Freight Demand Modeling: Tools for Public-Sector Decision Making" [10]. The researchers reinforce the observed trends in transportation modeling that planners tend to ignore or discount the impact of freight traffic on overall vehicular flows.



Alabama Metropolitan Planning Organizations

1. Muscle Shoals
2. Decatur
3. Huntsville
4. Gadsden-Etowah
5. Anniston
6. Birmingham
7. Tuscaloosa
8. Montgomery
9. Auburn-Opelika
10. Columbus-Phenix City
11. Dothan
12. Mobile
13. Alabama-Florida

Figure 2.14 – Metropolitan Planning Organizations for Alabama [11]

Ignoring freight in planning activities can lead to dangerous results: under-building or under-planning for future growth in freight demand. Freight vehicles negatively impact roadway maintenance needs, congestion levels, average speeds, environmental indicators, energy requirements, and safety attainment on the aging and saturated US roadway network. These metrics are important to urban environments faced with a high demand for transportation services that must support dense population levels on increasingly smaller budgets. Therefore, it is vitally important that transportation modelers obtain an advanced understanding of the impacts of freight traffic on the roadway system. Highway planners and higher-level decision makers need modeling tools that incorporate freight vehicles into traffic simulations to make better decisions on how to allocate limited resources to ever-growing demands and support the continued growth and prosperity of the nation.

Since urban freight knowledge is much more limited than expected, the UAH research team determined that the appropriate approach was to work closely with one or two MPO's to help develop the freight component in their planning activities. UAH is currently working with the Mobile, Alabama MPO to develop a specific freight plan for the urban area. The freight plan is an application of the Freight Planning Framework discussed earlier in this report and will include a forecast based on the industry clusters and intermodal activities present in their area of responsibility, and will be accompanied by a discrete-event simulation of the city based on the ATIM model.

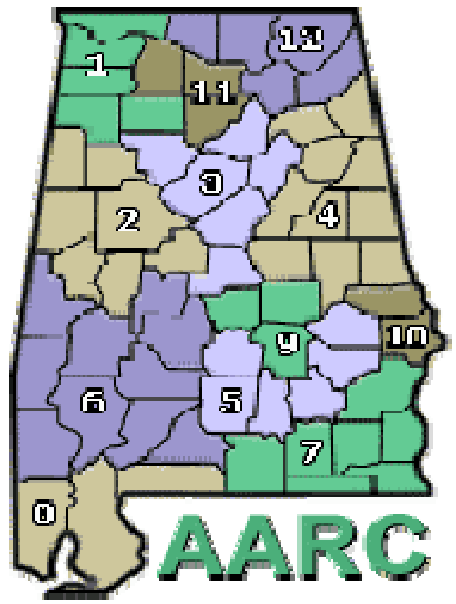


Figure 2.15 – Regional Councils of Government for Alabama [12]

2.6 Develop and Validate Intermodal Traffic Volumes

Within the freight transportation community, *intermodal transport* is defined as "the use of two or more modes to move a shipment from origin to destination [13]". The intermodal traffic types within Alabama include seagoing ship/inland waterway barges, seagoing ship/rail car, seagoing ship/truck, inland barge/rail, inland barge/truck, rail car/truck, and truck/air cargo. These intermodal transfers take place primarily at privately owned or operated transfer points; the docks at the Port of Mobile, the Port of Huntsville, ports along the inland waterway system, and private rail yards.

Estimates of the intermodal traffic volumes were developed for the Port of Mobile and the ports along the inland waterway system based on publicly available data [14, 15, 16]. These intermodal transfers were then explicitly coded into the ATIM. While this data captures much of the bulk freight intermodal transfer, the intermodal shipment of container freight is of more interest to roadway and railway planners. Table 2.3 shows the major commodities handled by intermodal river ports along the waterway system of Alabama.

Name	Location	Major Commodities	Intermodal Connections
G&R Cordova Inland Dock	Cordova	Project and manufactured equipment, steel coil, rock, gypsum	Truck only; no rail on site
Birmingham Marine Terminal	Birmingham	Iron and steel products, clay, slag, gypsum	Truck only; no rail on site
Miller and Co.	Birmingham	Carbon, wire rods, steel products, alloys	Truck only; no rail on site
Port Birmingham	Mulga	Dry bulk, coal, coke, iron pellets, pig iron, steel coil, slabs, wire, DRI	Truck and rail
Tuscaloosa-Northport Inland Dock	Northport	Steel coils, magnetite, DRI, pig iron	Truck only; no rail on site
Jackson City Port	Jackson	Raw wood products, chips, logs	Truck only; no rail on site
Pickens County Port	Pickensville	General cargo, grain, gypsum, potash, coal, cement, wood	Truck and rail
Crossroads of America Port	Eutaw	General cargo, wood products	Truck only; no rail on site
Port of Epes	Epes	General cargo, aggregates, dry bulk, wood products	Truck and rail
Florence-Lauderdale County Port Authority	Florence	Sand, aluminum, potash, salt, sulfate, steel coils, bulk cargo	Truck and rail
Mallard-Fox Creek River Port	Decatur	Steel coils, steel plates, pig iron, alloys, coke, cottonseed, agricultural products, bulk cargo	Truck and rail
Decatur State Docks	Decatur	Stainless steel	Truck and rail
Decatur Transit	Decatur	Grain, asphalt, steel, cast iron, general purpose cargo	Truck and rail
Guntersville Marine	Guntersville	Sand, salt, grain, gravel, iron, steel, forest products, bulk, mulch, foundry coke	Truck only; no rail on site
Kinder Morgan	Guntersville	Caustic soda, tin plate, pig iron, steel coil, wire rod coils, pet coke, coke breeze, rebar aluminum structural steel	Truck and rail
Columbia Inland Dock	Columbia	Potash, gypsum, urea, phosphates, liquid nitrogen	Truck and rail
Eufaula Inland Dock	Eufaula	Liquid fertilizer, aviation fuel, sand, gravel	Truck and rail
Phenix City Inland Dock	Phenix City	Liquid fertilizer, aviation fuel, sand, gravel	Truck and rail
Claiborne Terminal	Claiborne	Dry bulk	Truck only; no rail on site
Selma Terminal	Selma	General cargo, dry bulk	Truck only; no rail on site
Montgomery Terminal	Montgomery	Grain	Truck and rail

Table 2.3 - Major Commodities Handled by Intermodal River Ports in Alabama

Freight movement by container is the primary method of shipment for consumer goods though global supply chains and represents a fast-growing segment of the total freight movements through the United States. The Mobile Container Terminal at Choctaw Point container handling facility, currently under construction at the Port of Mobile, will create a significantly larger volume of container traffic through Alabama when it becomes operational in 2008. While the east- and west- bound traffic out of the port will have access to intermodal-designated rail lines, there is no north-bound intermodal-designated rail through Alabama. This means that the north-bound container traffic will be forced to move primarily through truck shipment. The major northern freight route through Alabama is Interstate 65, which passes through three of Alabama's largest cities: Mobile, Montgomery, and Birmingham. The increased container-on-truck traffic will negatively impact the level of congestion in these cities, compounding the freight issues associated with shipments destined for end points within the metropolitan areas.

Several alternatives to truck shipment have been proposed, including inland ports based on the Virginia Inland Port model [17]. Also, the feasibility of container-on-barge shipment is being researched by the Alabama Coalition of Waterways [9]. The growing ability of the Port of Mobile to accept container traffic represents and opportunity for Alabama companies to enter into the freight logistics and shipment business, but it also represents a potential crisis for the city and state entities responsible for maintaining the roadway surfaces and ensuring ease of mobility for the state's citizens.

Due to privacy concerns of the intermodal center operating companies and their clients, exact intermodal volumes of both bulk and container are unavailable at the time of this report. This has prevented the research team from validating the estimated traffic to exact ground counts. However, the research team is currently working with both the Alabama State Docks and the Huntsville International Intermodal Center to develop relationships that will allow the freight-handling entities to work with the research team without compromising the integrity of the private entities involved. The Alabama State Docks in Mobile have agreed to provide data to the researchers at UAH to validate and verify FAF2 data sources and the UAH transportation models.

2.7 Model Capacity Restrictions

To identify capacity restrictions on the roadways of interest, the research team analyzed the ALDOT traffic count data to pinpoint those roadway segments represented in the ATIM where AADT was larger than the as-built roadway capacity. One roadway section met the definition of restricted capacity: Interstate 65 between Pelham, AL, and the intersection with Interstate 459.

The restriction on I-65, shown in Figure 2.16 is due to the combination of roadway geometry and population growth in the suburbs of Birmingham. The terrain in the area consists primarily of hills and does not allow for further widening of the interstate to support population growth without an expensive large-scale construction effort. Some construction is currently underway in those areas where there is enough right-of-way to widen the road, but this improvement is not expected to completely eliminate the congestion in the area.

Population movement from the city limits of Birmingham, where employment opportunities are located, to the suburb of Pelham, where the housing is available, is not expected to decrease in the near future, indicating that this section of roadway will continue to be a bottleneck for freight and passenger traffic. According to "*Freight Performance Measurement: Travel Time in Freight Significant Corridors"* [18], the average truck speed through this section of interstate ranges between 55 and 60 miles per hour.

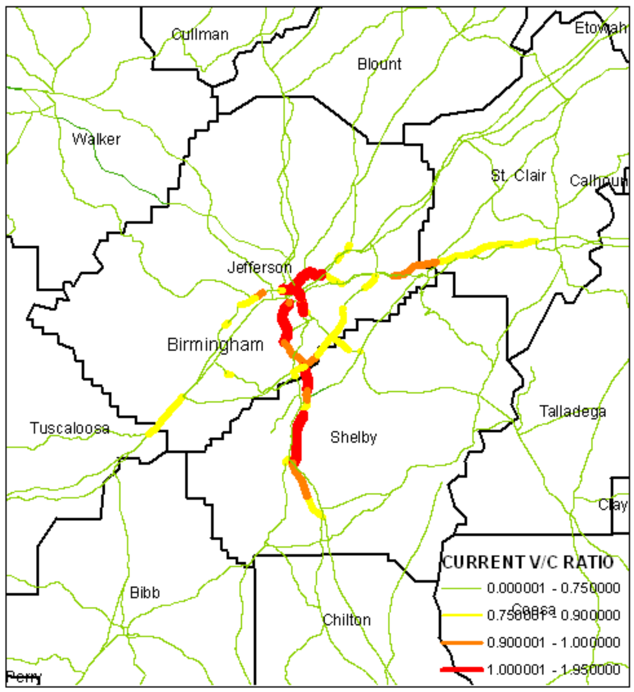


Figure 2.16 – Capacity Restricted Facilities in the Birmingham Area

Although it was expected that the research team would run model alternatives for this research effort, the unexpected lack of data, and incomplete data, required that the team apply their resources into data collection and generation. This has delayed the running of alternative potential solutions to congestion issues. The model will be used to run scenarios in the next phase of this research.

2.8 Model Enhancements

At present, the output of the TRANPLAN/CUBE gravity distribution model that serves as input to the ATIM is manually converted and input to ATIM. This necessary activity impedes the effectiveness of the simulation model as a tool due to the number of man hours the conversion and input takes to get a new solution output to analyze. To rectify this condition, OFLT was awarded a grant from the University Transportation Center for

Alabama to develop an independent software program to provide an electronic interface between the two models. The new software program will be designed to accept the output of the TRANPLAN/CUBE program and format the data for direct input to the Promodel discrete event simulation program, essentially building an electronic "bridge" between formerly incompatible software systems.

In addition to the effort mentioned above, the following model enhancements were performed during 2006/07 to enhance the ATIM's abilities to accurately model freight transport in Alabama.
The capacities of roadways in the ATIM were updated from the baseline values assumed in the original model development to the actual values reported by ALDOT. Using the actual roadway capacities provides more accurate speed calculations during model runs since travel time is calculated using the BPR equation: $t = t_0\left(1 + \alpha\left(\frac{v}{c}\right)^{\beta}\right)$.

- The roadway network was updated to include the future development of I-22 along the existing US 78 corridor. The added roadway extension is approximately 19 miles long and runs from the intersection of US 78 and US 43 to the Alabama-Mississippi border. This extension was added to study the effect the new roadway will have on changing freight patterns when the I-22 facility opens in 2012. This addition also necessitated the creation and inclusion of a new border crossing (external point) for both the ATIM and the TRANPLAN models.
- The county centroids were moved from the political county center to the economic "center" of each county. The economic centers were those cities determined to produce and attract the highest amount of freight. For example, Tuscaloosa is the political center of Tuscaloosa County, as well as the area with the highest population. However, the economic center of Tuscaloosa County was determined to be Vance, the location of Mercedes production and suppliers.
- Based on the output of the *Alabama Freight Mobility Study*, the inland barge transportation routes were redesigned. Previously, the research team only had data for the commodity flow through the locks and dams on the inland waterway system provided by the Army Corps of Engineers. Because of this, the freight routings on the river system were based on these seven locations. However, the AFMS provides data for 20 ports along the Alabama inland waterway system, giving us greater ability to distribute freight throughout the port and waterway system.
- 811 miles of roadway were added to the TRANPLAN component of the FPS to match the ATIM network.
    a. 19 miles of I-22
    b. 492 miles of US Highway (US31 – 374 miles, US78 – 118 miles)
    c. 99 miles of AL Highway (various locations in south Alabama to reach county centers not served by Interstate or US Highways)

  The additional miles of roadway network will allow the research team to distribute freight in a more "natural" manner. Adding additional roadway miles and alternate route configurations will allow the TRANPLAN program to offload some traffic from the interstate system and improve error percentages during validation.

- Expansion of scope:
    a. 4992 additional O-D routings were added to the truck network, facilitating movement to the full matrix of 67 counties and 14 roadway border points (6561 total roadway routes are available)
    b. 62 additional O-D routings were added to the waterway network (81 total waterway routes are available)
    c. 252 additional O-D routings were added to the waterway network (288 total waterway routes are available)

    The additional roadway routings were necessary to allow testing of the disaggregation methods at the county level. The original ATIM platform included disaggregation to the ALDOT Planning District level; the platform will now handle disaggregation to the county-level.
- The research team collaborated with Dr. Dietmar Moeller of the University of Hamburg to develop a Java-based simulation of the city of Hamburg. The Hamburg model tested the impact of changing roadway geometries on the congestion levels of freight leaving the Port of Hamburg. The results from the Hamburg model exposed a flaw in the speed update calculations being used in the ATIM, which was provided to UAH as feedback on the model and an opportunity to improve the Alabama simulation. The speed update calculations and logic are now being studied to assess whether the ProModel-based DE simulation can be improved to match the Java-model performance.
- Preliminary scenario validation of the ATIM using the Extreme World Method was conducted, and results showed that the ATIM results follow the expected trends in performance. Full explanation of the EWM scenarios and the testing process are available in Appendix B.

2.9 Chapter References

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3. Development of the System Dynamics Model of the Alabama Transportation Infrastructure

The highway traffic model developed in 2004 provided a calculated average snapshot of highway traffic for a day for the interstate and secondary highways of Alabama. Alternative assumptions for economic growth could be used to generate snapshots of future congestion. This model, however, did not show variation during the day nor did it include other forms of transportation and shipping. The ATIM model simulates all forms of shipping and transportation during a twenty-four hour day. This allows the investigation of peak congestion and impacts of network and infrastructure improvements. Both of these models however do not have the capability of examining the long-term interaction between a state's economy and its transportation infrastructure. These dynamics are influenced by several long-term feedback loops that interact, influence, and in many ways determine the evolution of a state's well being. Another set of dynamic interrelationships involve growth, tax revenues, and future infrastructure improvements to ease congestion. Policies affecting transfer of freight from truck to rail or water can also have multiple impacts through the various relationships, both on highway traffic and the economy. In 2005, UAH researchers developed a preliminary system dynamics model that illustrated these interrelationships. During this period of performance the researchers at UAH expanded and enhanced the system dynamics model to offer more fidelity and analysis capability of the Alabama economy and transportation infrastructure.

3.1 Alabama Historical Population

The population in Alabama has steadily increased from 3,444,354 residents in 1970 to approximately 4,525,375 residents in 2004. The percent change in the population in Alabama from 1970-2004 was 31.39%, a full ten percentage points below the U.S population percent change of 41.44%.

Alabama has lagged behind in overall population growth when compared to neighboring states of Florida, Georgia, and Tennessee. Florida was the leader in percentage change in population of neighboring states between 1970 and 2004 with an increase of 156.16%. Georgia was second with a percentage change in population of 92.45% and the percentage change in population for Tennessee over this same time period was 50.3%. These neighboring states all exceeded the national average for percentage population growth over the 34-year period. Figure 3.1 presents the percentage change in population for these four states. The drivers for population growth are the state's economic development activity, the age composition of the state's residents, and net immigration.

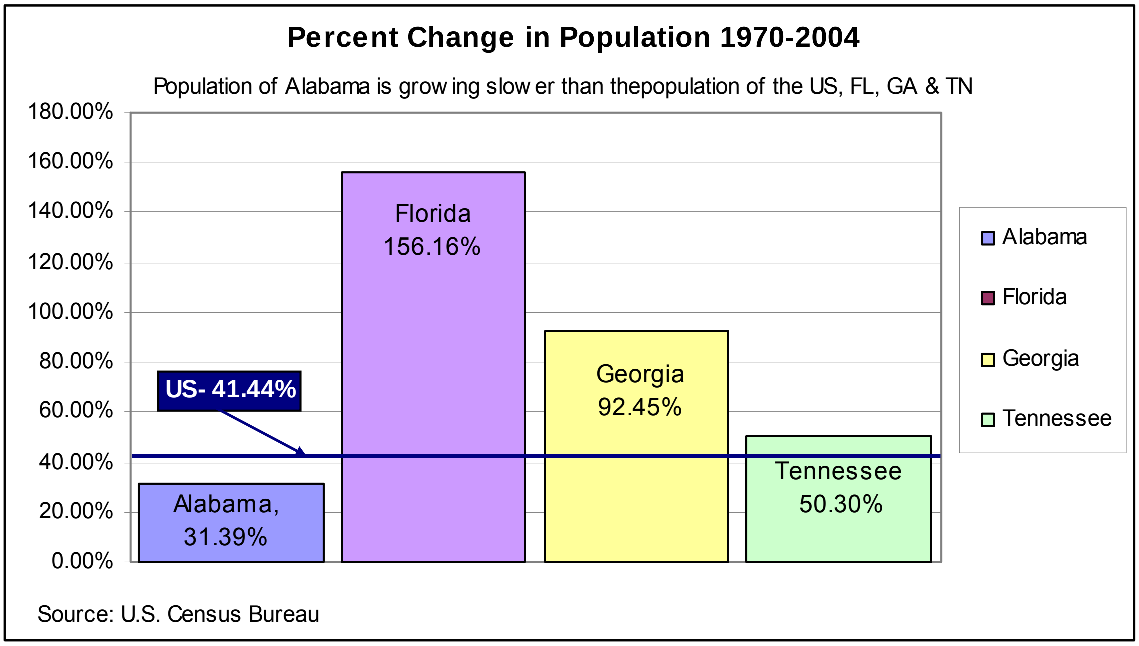

Figure 3.1 - Percent Change in Population 1970 – 2004

During the period 1970-2004, the 18-34 age group experienced a fairly small increase in total population (1970: 811,308; 2004: 1,059,410). This small increase in the population of the 18-34 age group, the group most likely to produce children, coupled with a declining birth rate has resulted in a gradual decline of the population in the 0-17 age group. Figure 3.2 and 3.3 shows this graphically.

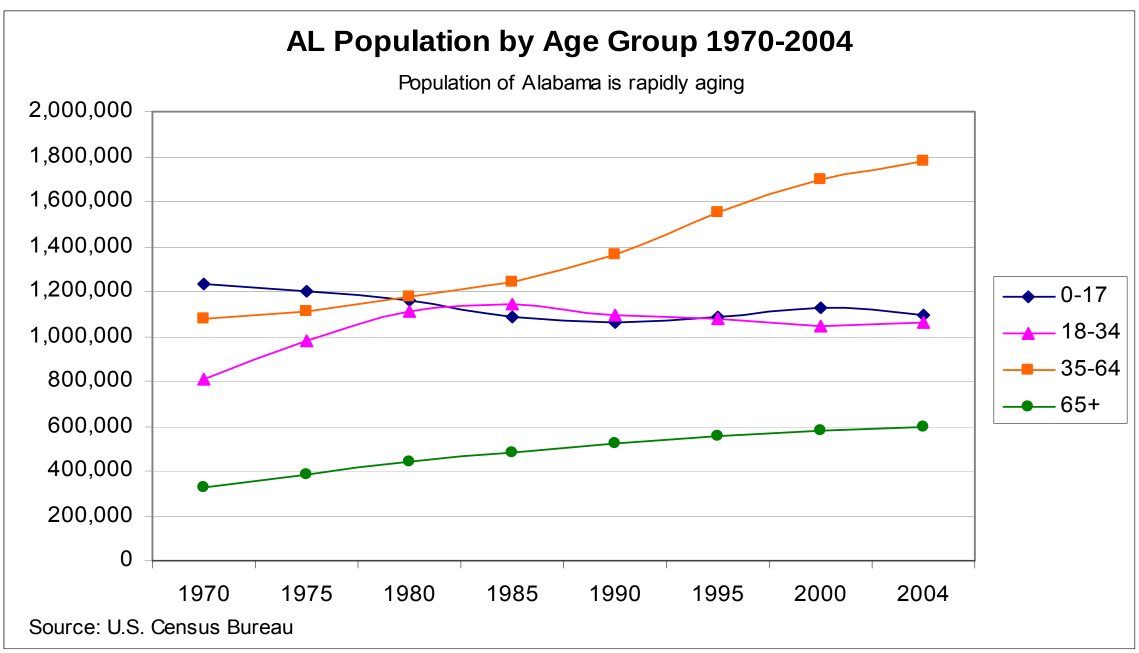

Figure 3.2 - Population by Age Group 1970 to 2004

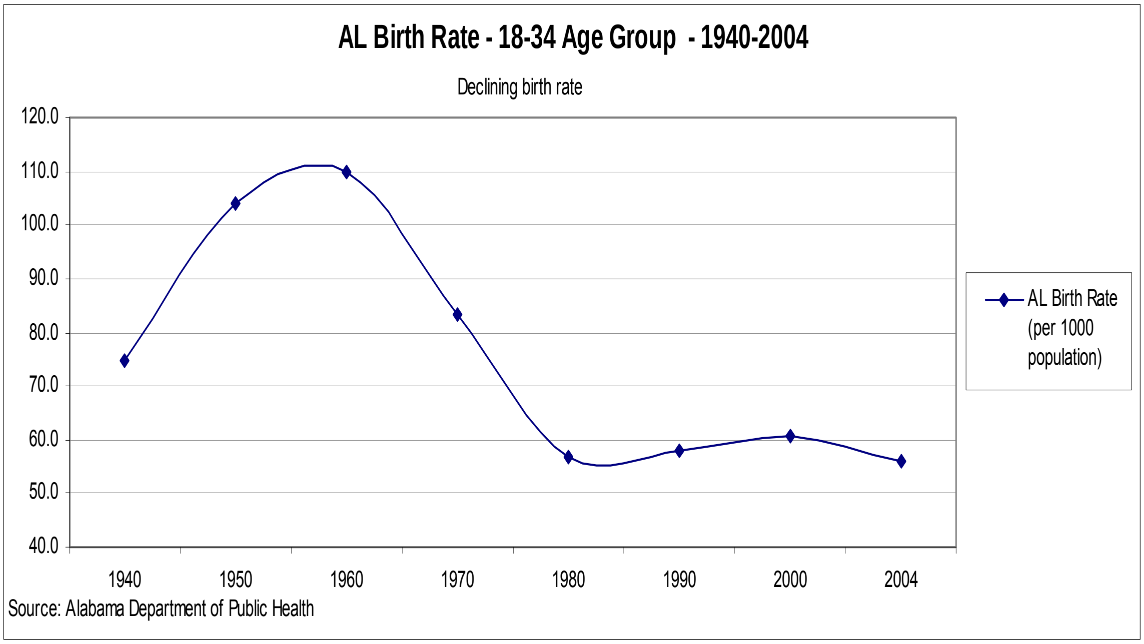

Figure 3.3 - Alabama Birth Rate 1940 to 2004

The reduction of 0-17 and the small increase in 18-34 over the period 1970-2004, has led to an aging of the total population. The gradual aging of the state's population has also resulted in a steady increase in the number of Alabama residents in the 65+ age group. This increase in the 65+ population is at a faster pace than the death rate. Because of this unbalanced growth, there is a lagre contingent of Alabamians that cannot significantly contribute to the needed workforce and economic development. Figure 3.4 illustrates the change in the death rate over the period 1940-2004.

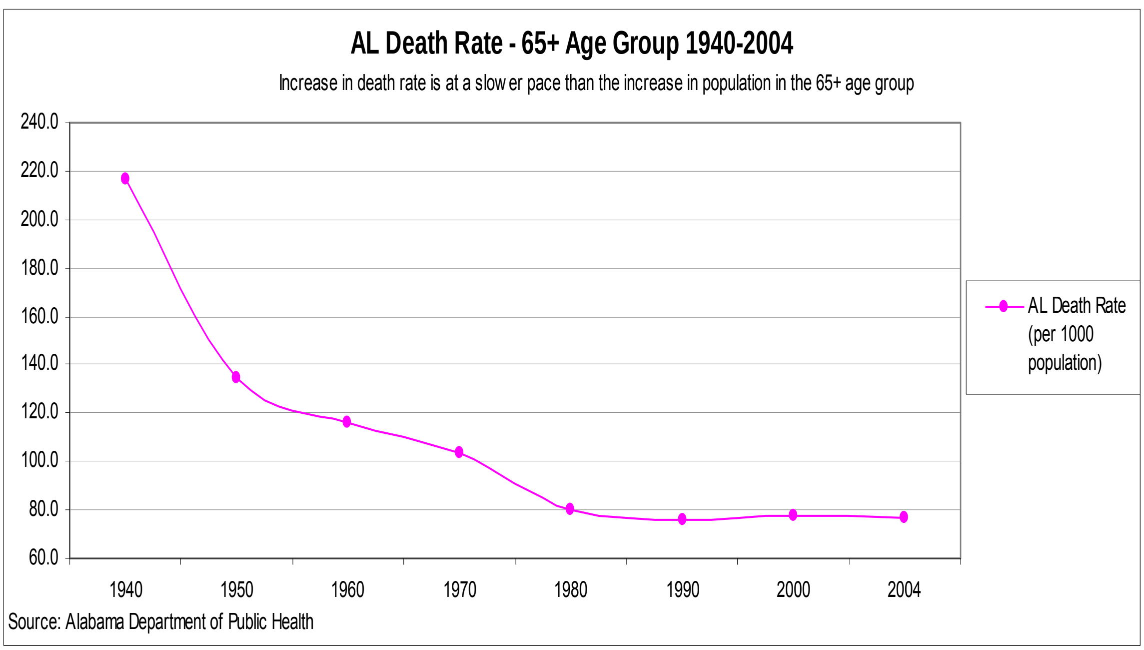

Figure 3.4 - Alabama Death Rate 1940 to 2004

In 1970, the 0-17 age group was the largest segment of the total population in Alabama at 36%. By 2004, the 0–17 age group in Alabama had fallen to 24% of the total population. Figure 3.5 presents the comparison of age groups in terms of percentage of the total population for the years 1970 and 2004.

The 18–34 age group has remained stable over the 34 year period accounting for 24% of the total population in 1970 and 23% of the total population in 2004.

The 35-64 age group accounted for the second largest percentage of the total population of Alabama in 1970 at 31%. In 2004, this age group accounted for the largest percentage of the total population in the state at 39%. From 1970 until 2004, the 65+ age group percentage increased from 9% to 13%.

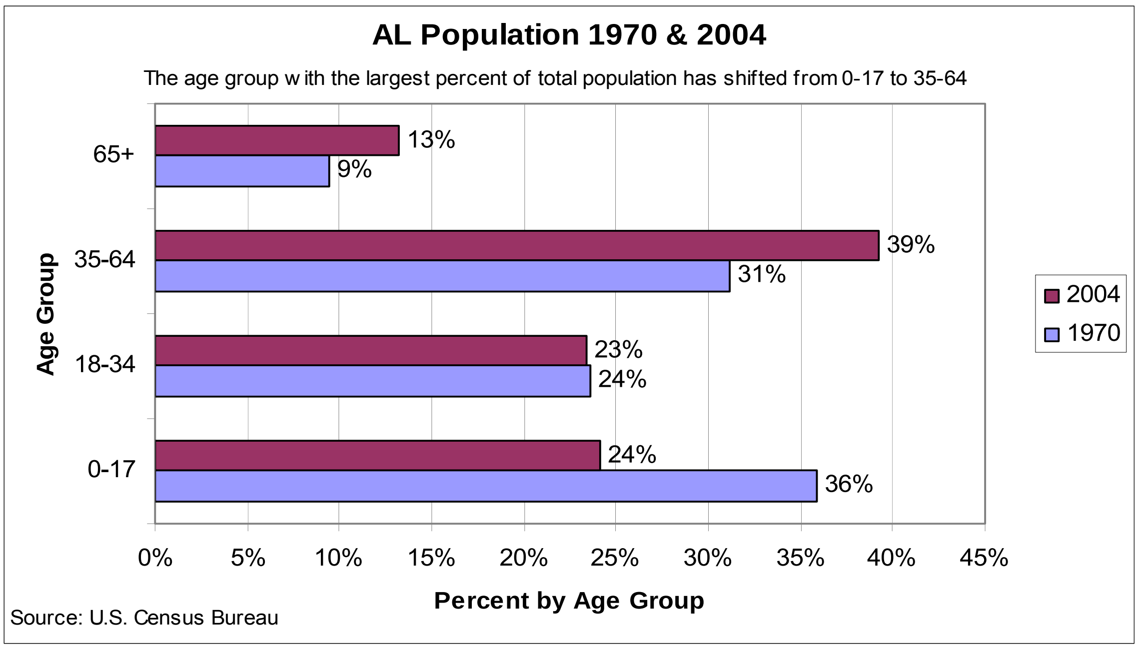

Figure 3.5 - Percent of Total Population by Age Group in 1970 and 2004

Another component of population change is migration. Population loss due to emigration has contributed to a population growth in Alabama less than the U.S average. In the periods 1970-1980 and 1990-2000, Alabama added 115,014 and 210,267 residents due to immigration (includes international and interstate immigration). But, emigration for the years 1960-1970 and 1980-1990 was -229, 681 and -89,120 respectively. The net gain of population due to migration over the 40 year period (1960-2000) is 6,480.

3.2 Population Trends and School Enrollment in Alabama

The elementary education system, comprised of grades 1 through 8, has decreased in enrollment 17.7% from 1970 to 2004. For Alabama, this is a decrease of 100,929 school-aged children. Comparatively, the national average for elementary education enrollment decreased but by a smaller margin of 4.11%. Secondary education, comprised of grades 9 through 12, experienced a similar decrease in enrollment of 12.6% over the same period. This represents a decrease of 29,751 school-aged children. During the years 1970 to 2004, national enrollment in secondary education increased nationally by 14%. The loss of school-aged population in Alabama may be attributed to a decrease in the state's birth rate. A comparison of the decline in Alabama's elementary and secondary enrollment as well as the national averages can be seen in Figure 3.6.

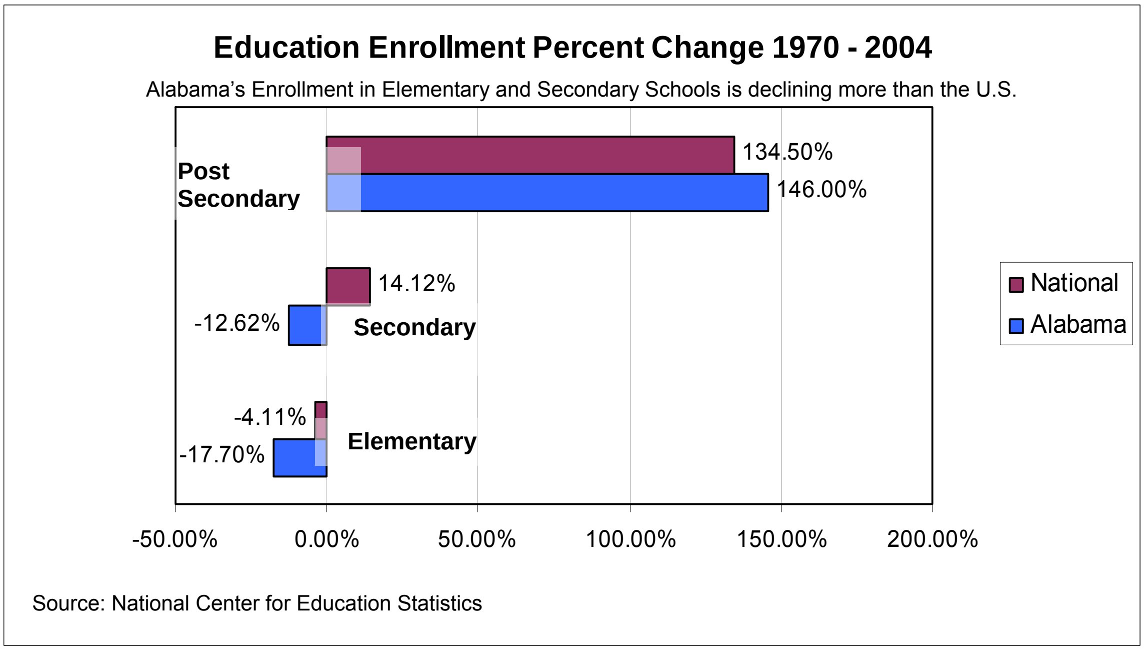

Figure 3.6 – Percent Change in Education Enrollment from 1970 - 2004

Alabama experienced a dramatic increase in total post-secondary education which consists of both 2 and 4-year colleges. The number of students enrolled in post-secondary education increased 146% from 1970 to 2004, a change of over 150,000 students. This increase exceeds that of the nation, which only grew by 134.5% between 1970 and 2004. The 2-year college enrollment in Alabama increased by 249% over the same period. The population of Alabama between ages 18-34 increased by 31% from 1970 to 2004 and could explain some of the increase in post secondary education enrollment. Another factor that could have lead to such an increase in enrollment is the addition of 15 post secondary schools to the Alabama education system since 1980, providing easier access to many Alabamians.

Increased investment and expansion leads to net immigration and population growth. The neighboring states of Florida, Georgia, and Tennessee have experienced an increase as a result of the factors mentioned here but Alabama has not experienced the same level of growth in population and jobs.

3.3 Alabama Industry Employment

Alabama has made a dramatic transition from predominantly Agriculture & Natural Resources and Basic Manufacturing industries to Service, Advanced Manufacturing, and Knowledge industries. This dramatic transition is evident in the employment changes for these various industry groupings. For model analysis purposes, industries in the state of Alabama were divided into five broad industry groupings: (1) Agriculture & Natural Resources, (2) Basic Manufacturing, (3) Advanced Manufacturing, (4) Services, and (5) Knowledge.

3.3.1 Agriculture & Natural Resources

The Agriculture & Natural Resources industry grouping consists of the Faming, Forestry, Fishing, and Mining industries. Employment in each of these industries for the period 1970-2004 is shown in Table 3.1.

Alabama - Agriculture & Natural Resources Employment								
	1970	1975	1980	1985	1990	1995	2000	2004
Farming	94,764	91,265	83,371	72,452	63,007	59,789	56,061	53,504
Forestry & Fishing	7,631	8,247	11,044	14,147	17,795	23,960	28,004	18,873
Mining	8,565	12,709	17,765	16,247	15,050	12,491	9,933	8,890
Total Agriculture & Natural Resources	**110,960**	**112,221**	**112,180**	**102,846**	**95,852**	**96,240**	**93,998**	**81,267**
Source: Bureau of Economic Analysis								

Table 3.1 - Alabama Agriculture & Natural Resources Employment

Over the aforementioned period Agriculture & Natural Resources experienced a decline in employment, shown in Figure 3.7.

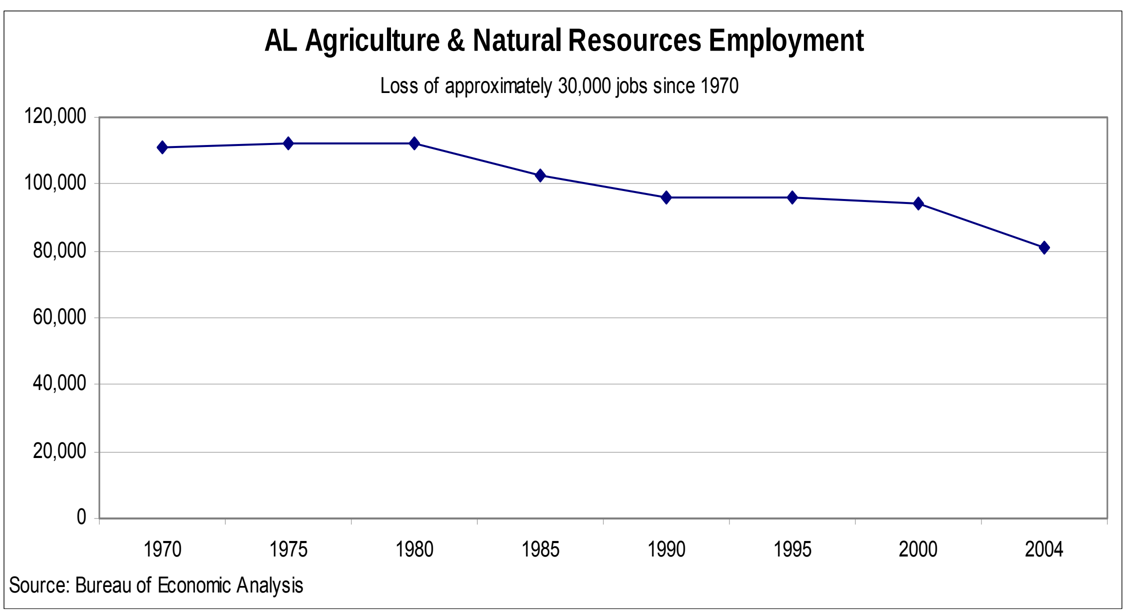

Figure 3.7 - AL Agriculture & Natural Resources Employment

There were 110,960 Alabamians employed in the Agriculture & Natural Resources industry in 1970. By 2004, the number of workers employed in Agriculture & Natural Resources declined by 27% to 81,267 workers.

In 1970, the Farming industry accounted for 85% of total employment in Agriculture & Natural Resources. Continued decline in Farming employment, along with small employment increases in Forestry, Fishing, and Mining may have been the contributing factor to the overall decline in the Agriculture & Natural Resources industry.

In 1970, there were 94,764 Alabamians employed in Farming. By 1980, Farming had lost approximately 11,400 jobs. This decline in Farm employment almost doubled in 1990. In 2004, 53,504 Alabamians were employed in Farming, indicating a further loss of approximately 9,500 jobs.

3.3.2 Basic Manufacturing

The Basic Manufacturing industry grouping consists of industries with minimal education and training requirements. Examples of industries that fall under this grouping are Apparel Manufacturing, Paper Manufacturing, and Food & Tobacco Product Manufacturing. Additional industries this grouping, along with the 1970-2004 employment totals for these industries, are shown in Table 3.2.

Alabama - Basic Manufacturing Employment								
	1970	1975	1980	1985	1990	1995	2000	2004
Wood Product Manufacturing	28,529	28,628	35,364	35,823	33,854	40,826	40,385	22,449
Nonmetallic Mineral Product Manufacturing	9,171	9,351	10,554	10,194	9,185	9,595	9,922	8,740
Primary Metal Manufacturing	47,799	41,470	39,486	26,544	26,563	26,070	25,883	18,027
Fabricated Metal Product Manufacturing	19,612	22,231	25,590	23,427	24,628	24,428	24,703	28,257
Machinery Manufacturing	11,273	12,679	16,080	20,087	28,866	29,648	27,272	13,076
Furniture and Related Product Manufacturing	5,712	5,459	8,237	10,484	10,716	12,690	11,788	14,972
Food & Tobacco Product Manufacturing	28,621	26,757	29,386	29,677	35,852	38,894	39,176	38,663
Apparel Manufacturing & Other Textile Products	44,318	48,652	54,537	54,833	55,512	52,972	26,088	28,622
Textile Product Mills	45,051	45,662	43,112	36,503	41,212	41,633	38,429	10,989
Leather and Allied Product Manufacturing	1,226	1,198	209	134	114	224	146	207
Paper manufacturing	18,284	18,986	19,989	21,878	22,286	21,290	19,024	14,834
Printing and Related Support Activities	8,506	9,471	11,192	12,889	15,439	15,988	16,152	16,144
Petroleum and Coal Products Manufacturing	1,157	1,343	1,571	1,487	1,375	1,470	1,509	2,126
Chemical Manufacturing	12,836	14,868	15,633	11,946	12,103	11,927	12,257	10,257
Plastics and Rubber Products Manufacturing	9,046	12,411	14,683	16,597	17,925	17,167	17,314	13,922
Miscellaneous Manufacturing	6,722	6,005	9,033	9,731	10,649	10,037	9,818	8,318
Total Basic Manufacturing	**297,863**	**305,171**	**334,656**	**322,234**	**346,279**	**354,859**	**319,866**	**249,603**
Source: Bureau of Economic Analysis								

Table 3.2 - Alabama Basic Manufacturing Employment

Employment in Basic Manufacturing climbed from 297,863 in 1970 to 334,656 in 1980 and 346,279 in 1990, before falling to 319,866 in 2000 and 249,603 by 2004. Figure 3.8 illustrates the employment changes experienced in the Basic Manufacturing industry.

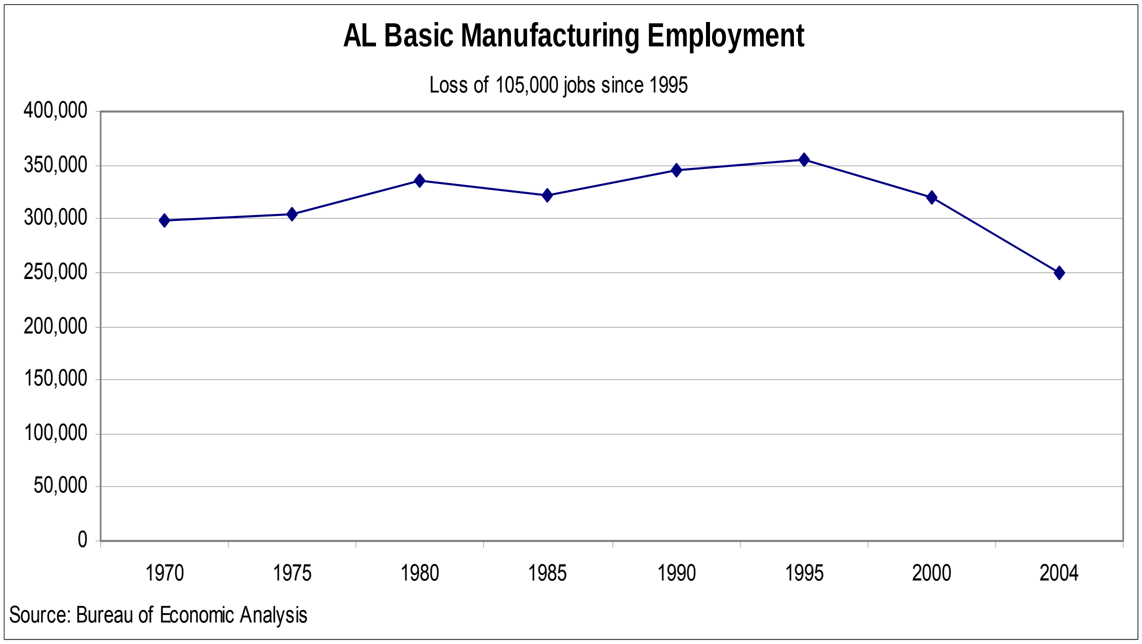

Figure 3.8 - AL Basic Manufacturing Employment

Increased employment in many of the industry sectors comprising the Basic Manufacturing sector contributed to the 36,793 workers added from 1970-1980, and the additional 11,623 workers from 1980-1990. Wood Product Manufacturing, Fabricated Metal Product Manufacturing, Apparel Manufacturing & Other Textile Products, and Plastics & Rubber Products Manufacturing were significant contributors to the increased employment in Basic Manufacturing from 1970-1990.

From 1995-2004, there was a significant decline in employment in Basic Manufacturing. Globalization of manufacturing, international competition, technological advances, and increased industry consolidation are factors that contributed to the Basic Manufacturing employment decline of 105,256 jobs from 1995-2000. This decline can be attributed to the reduced employment in Apparel Manufacturing & Other Textile Products, Textile Product Mills, and Wood Product Manufacturing. These industries alone accounted for 73,371 or 70% of the 105,256 jobs lost in Basic Manufacturing.

3.3.3 Advanced Manufacturing

The Advanced Manufacturing industry grouping consists of industries requiring increased training and education above that required for Basic Manufacturing. The industry composition and employment from 1970-2004 for Advanced Manufacturing, is shown in Table 3.3

Alabama - Advanced Manufacturing Employment								
	1970	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2004**
Electrical Equipment and Computer & Electronic Product Manufacturing	10,004	10,933	18,343	23,009	20,049	21,974	21,152	21,022
Transportation Equipment Manufacturing	23,881	18,855	23,239	26,289	29,920	27,911	29,944	38,911
Total Advanced Manufacturing	**33,885**	**29,788**	**41,582**	**49,298**	**49,969**	**49,885**	**51,096**	**59,933**
Source: Bureau of Economic Analysis								

Table 3.3 - Alabama Advanced Manufacturing Employment

Employment in the Advanced Manufacturing sector experienced a decline from 1970 to1975, but has steadily increased from 1975 through 2004. Figure 3.9 illustrates the employment changes in Advanced Manufacturing over the period 1970-2004.

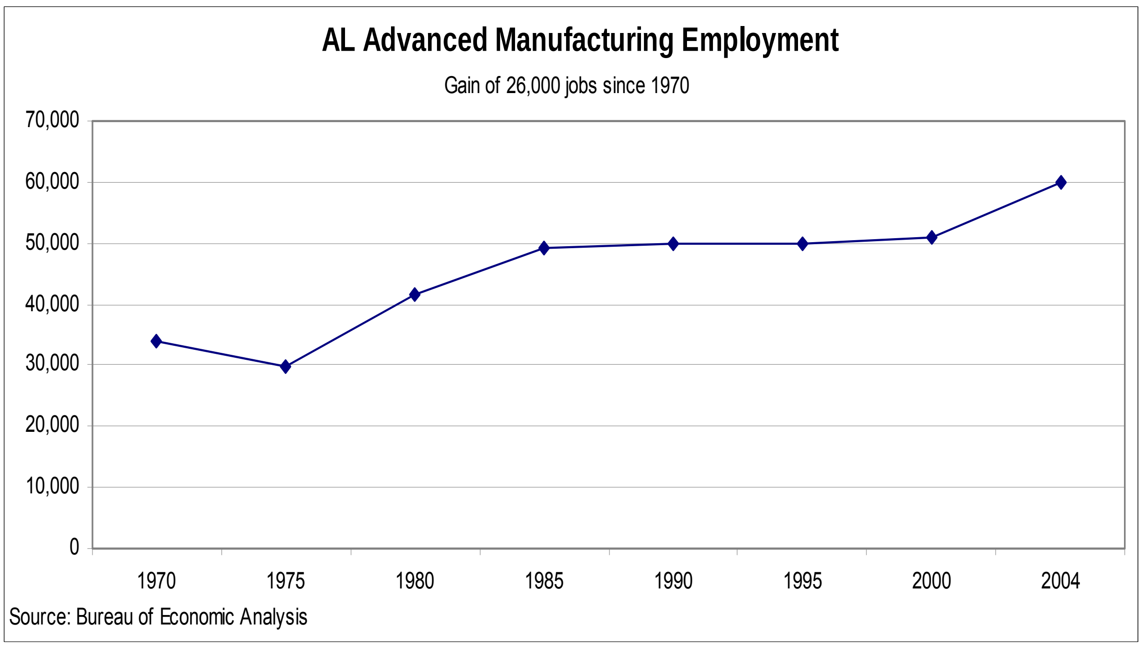

Figure 3.9 - AL Advanced Manufacturing Employment

Growth of the Automotive industry in Alabama has been a major contributor to employment increases from 1990-2004. Employment in Advanced Manufacturing increased from 49,969 jobs in 1990 to 59,933 in 2004. Advanced Manufacturing employment has grown by 26,048 jobs from 1970-2004. The growth in Advanced Manufacturing has also increased the need for more skilled workers in Alabama.

3.3.4 Service Industry

The components of the Service industry are illustrated in Table 3.4.

Alabama - Services Industry Employment								
	1970	1975	1980	1985	1990	1995	2000	2004
Finance, Insurance, & Real Estate	59,167	80,282	97,686	104,518	110,817	119,093	147,909	164,613
Educational Services	12,162	14,303	14,647	15,373	19,316	22,238	27,217	30,030
Health Care and Social Assistance	36,901	64,146	86,544	100,942	128,469	160,335	175,694	200,032
Arts, Entertainment, and Recreation	5,226	7,502	9,123	11,301	15,779	20,717	27,384	29,223
Accommodation and Food Services	40,148	51,901	69,776	87,608	103,431	125,845	143,580	153,620
Government and Government Enterprises	286,473	307,830	348,146	351,209	376,744	383,174	385,840	399,655
Utilities	9,885	12,393	16,200	18,198	18,493	17,702	16,756	14,332
Construction	64,187	85,392	91,967	98,003	118,708	133,408	156,673	161,847
Wholesale Trade	55,941	70,241	81,109	83,194	91,389	98,942	105,963	85,521
Retail Trade	154,297	169,234	187,324	201,047	234,001	266,688	279,992	288,488
Transportation & Warehousing	37,689	37,377	42,573	46,329	54,339	63,799	74,490	69,415
Miscellaneous Services	187,191	170,351	170,990	208,065	211,321	249,433	267,075	305,606
[1]Information							32,247	27,757
Total Services	**949,267**	**1,070,952**	**1,216,085**	**1,325,787**	**1,482,807**	**1,661,374**	**1,840,820**	**1,930,139**
Source: Bureau of Economic Analysis								
[1]Information sector was first broken out in 2001, and 32,247 is the number for that year. In prior years, information was distributed throughout multiple sectors.								

Table 3.4 - Alabama Service Industry Employment

For the period 1970-2004, employment in the Service industry continuously increased. In 1970, Service employment was 949,267. By 2004, Service employment had more than doubled to 1,930,139. Figure 3.10 illustrates the change in employment in the Service Industry.

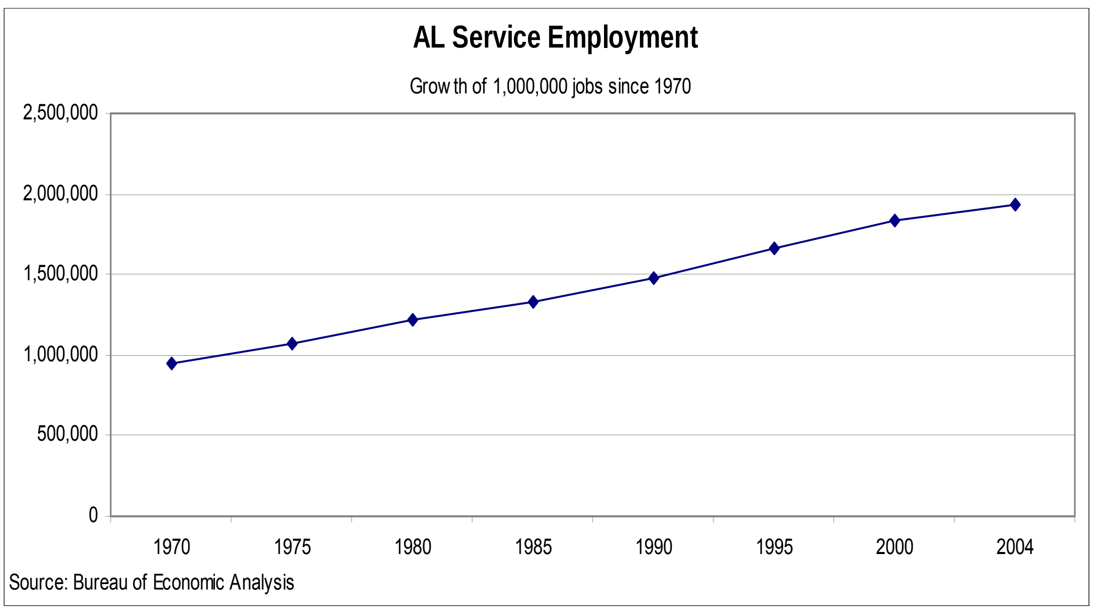

Figure 3.10 – AL Service Employment

This increase in Service employment may be attributed to the continuous growth in employment in numerous sectors. Government & Government Enterprises and Retail Trade had the largest overall employment numbers, but were not consistently the largest contributors to Service employment.

The Utilities sector experienced a decline in employment from 1995-2004. This decrease in employment from 1may have occurred as a result of the efforts made by electric utility companies to increase their competitiveness as the industry deregulated.

Comparison of the percent of total employment held by each of the five industry sectors clearly shows that the Service industry was the most dominant industry from 1970-2004. In 1970, the Service industry accounted for 69% of the total employment in Alabama. By 2004, the percentage of total employment held by the Service industry increased to 79%.

Growth in service employment can also be attributed to the increased number of women entering the civilian labor force of Alabama. In 1980 there were 616,000 women employed in Alabama. By 2004, this number had risen to 957,000 women, an increase of 341,000. Figure 3.11 illustrates the employment change for women in Alabama from 1980-2004.

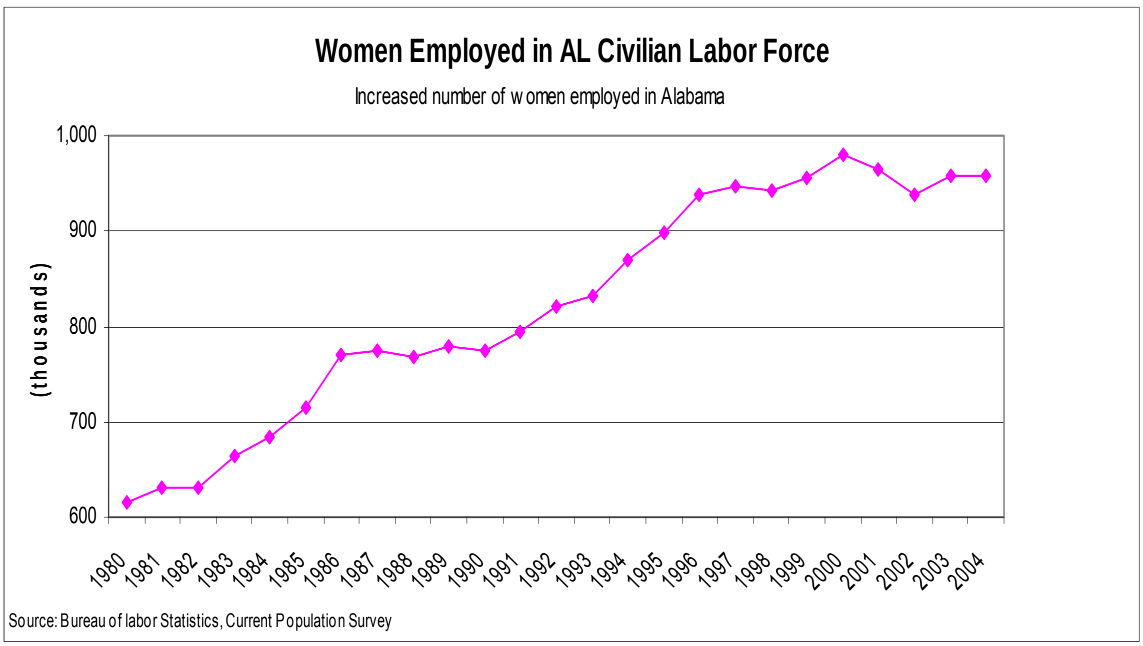

Figure 3.11 - Women Employed in Alabama Civilian Labor Force

The gap between men and women employed in Alabama decreased between 1980 and 2004. In 1980 there were 266,000 more men than women employed in Alabama. In 2004 the number of employed men compared to women had fallen to 139,000. Figure 3.12 shows the change in gender employment for Alabama over the aforementioned period.

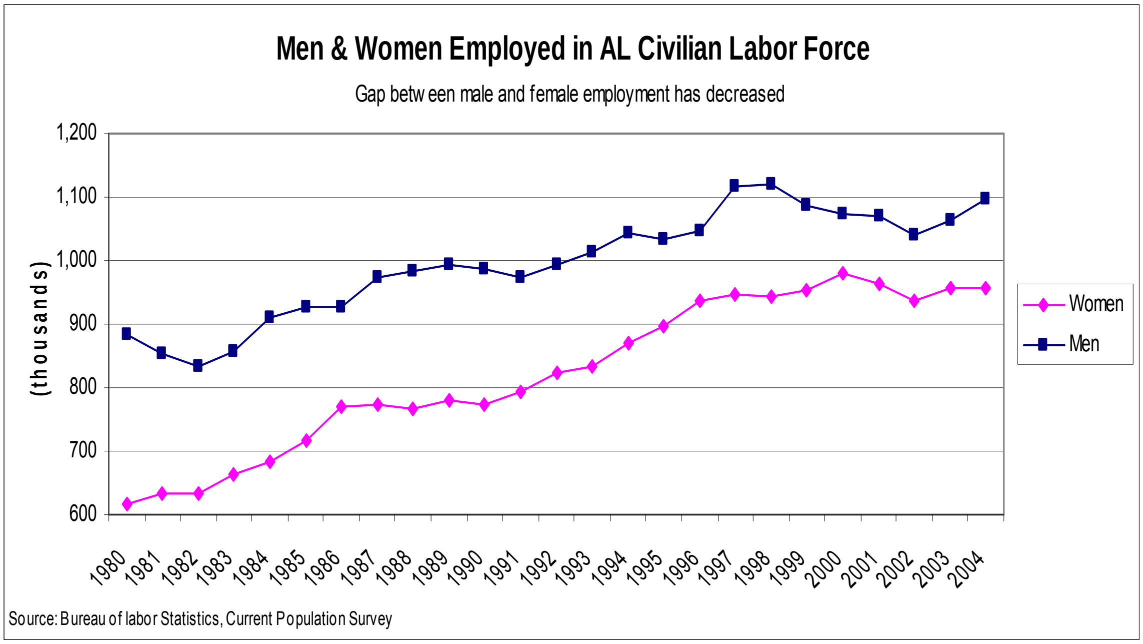

Figure 3.12 - Gender Employment in AL Civilian Labor Force

3.3.5 Knowledge Industry

The Knowledge industry grouping consists of industries involved in Professional, Scientific, and Technical Services. Such services include Legal Services, Architectural, Engineering, and Related Services, Scientific Research & Development Services, and Management, Scientific, and Technical Consulting Services. Employment for the Knowledge industry is illustrated in Table 3.5 below.

Alabama - Knowledge Industry Employment								
	1970	1975	1980	1985	1990	1995	2000	2004
Professional, Scientific, & Technical Services	65,753	70,180	77,289	76,705	92,194	99,715	116,642	135,821
Source: Bureau of Economic Analysis								

Table 3.5 - Alabama Knowledge Industry Employment

Figure 3.13 graphically depicts employment changes in the Knowledge Industry.

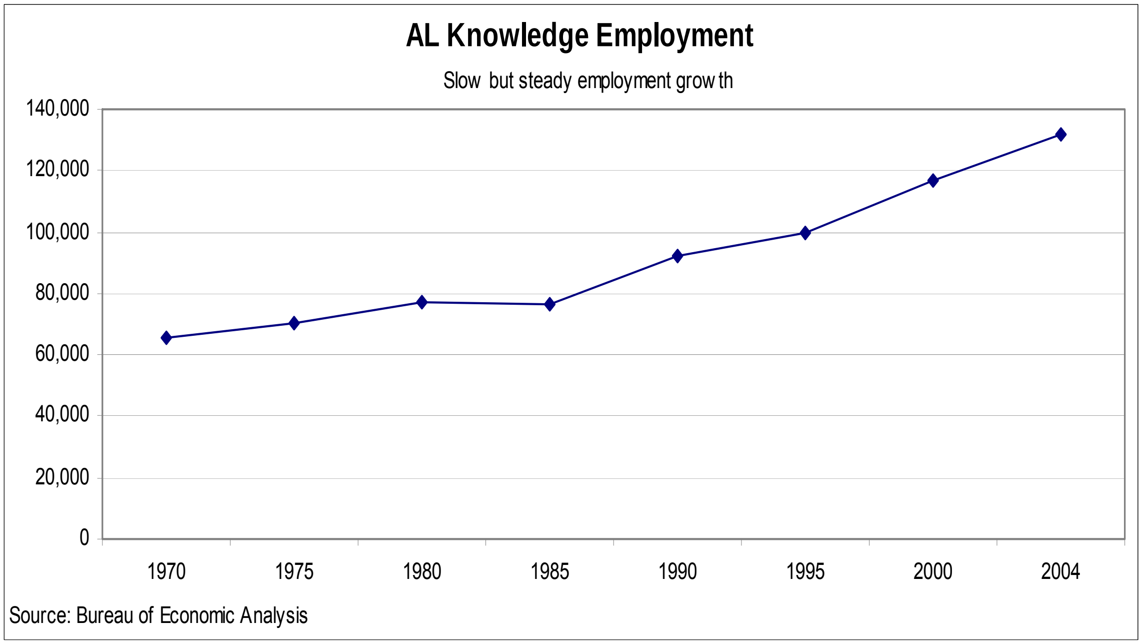

Figure 3.13 - AL Knowledge Employment

The distinguishing feature of the Knowledge industry is that most of the industries within this grouping depend on highly skilled and educated workers; therefore; continuous growth in this industry places demands on the education system to produce such individuals and on the economic environment to attract and retain a workforce necessary to sustain the Knowledge industry. Table 3.6 and Figure 3.14 show the jobs gained and lost in the five industry groupings from 1970-2004.

Change in Alabama Industry Employment (Jobs Gained or Lost) - 1970 - 2004					
	Agriculture & Natural Resources	**Basic Manufacturing**	**Advanced Manufacturing**	**Knowledge**	**Services**
1970-1975	1,261	7,308	-4,097	4,427	121,685
1975-1980	-41	29,485	11,794	7,109	145,133
1980-1985	-9,334	-12,422	7,716	-584	109,702
1985-1990	-6,994	24,045	671	15,489	157,020
1990-1995	388	8,580	-84	7,521	178,567
1995-2000	-2,242	-34,993	1,211	16,927	179,446
2000-2004	-12,731	-70,263	8,837	15,424	89,319
1970-2004	**-29,693**	**-48,260**	**26,048**	**66,313**	**980,872**

Table 3.6 - Change in Alabama Industry Employment 1970 - 2004

The gradual aging of the state's population along with relatively weak immigration has contributed to the decline in population. The continuation of this population trend will result in a society that is unable to effectively sustain economic growth. Reduced economic growth decreases the attractiveness of the state to skilled and educated workers.

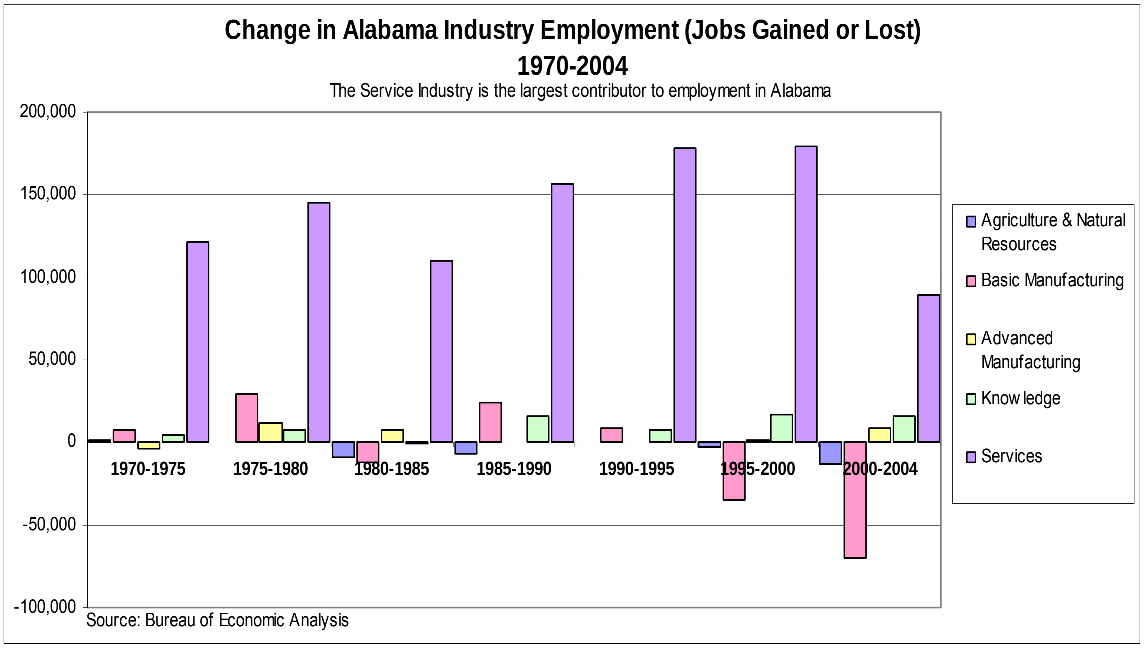

Figure 3.14 - Change in Alabama Industry Employment 1970 - 2004

The number of jobs in Alabama that require skilled and/or college-educated individuals continue to increase. Education and training of the labor force and immigration are failing to keep up with this growth. If Alabama is unable to educate, attract, and retain the talent required for its expanding Advanced Manufacturing, Services, and Knowledge industries, then economic growth in Alabama would eventually be constrained.

3.4 Historical Growth in Interstate Traffic

Growth in traffic volume on Alabama interstates is represented in figures 3.15 and 3.16. Daily traffic grew on every mile of interstate from 1985 to 2004; however, urban areas such as Birmingham experienced significant growth. Figure 3.15 displays the Annual Average Daily Traffic for Interstate 65 in 1985 and 2004. In the Mobile area (mile markers 1-10) daily traffic grew approximately 69% over the 19 year period. Montgomery traffic on Interstate 65 (mile markers 166 – 176) increased by 83% during these years. The Birmingham area (mile markers 247 – 262) experienced the largest amount of growth, 86%, with the stretch south of Birmingham growing at a faster rate than the north.

Interstate 20 also saw a growth in daily traffic between 1985 and 2004. Just as with Interstate 65, significant growth occurred in urban areas where the interstates are located. Tuscaloosa, as well as the area around the Mercedes Benz plant, experienced growth of about 134%. This area is represented as mile markers 70 – 100 in Figure 3.16. Birmingham traffic (mile markers 115 – 130) increased by 39%.

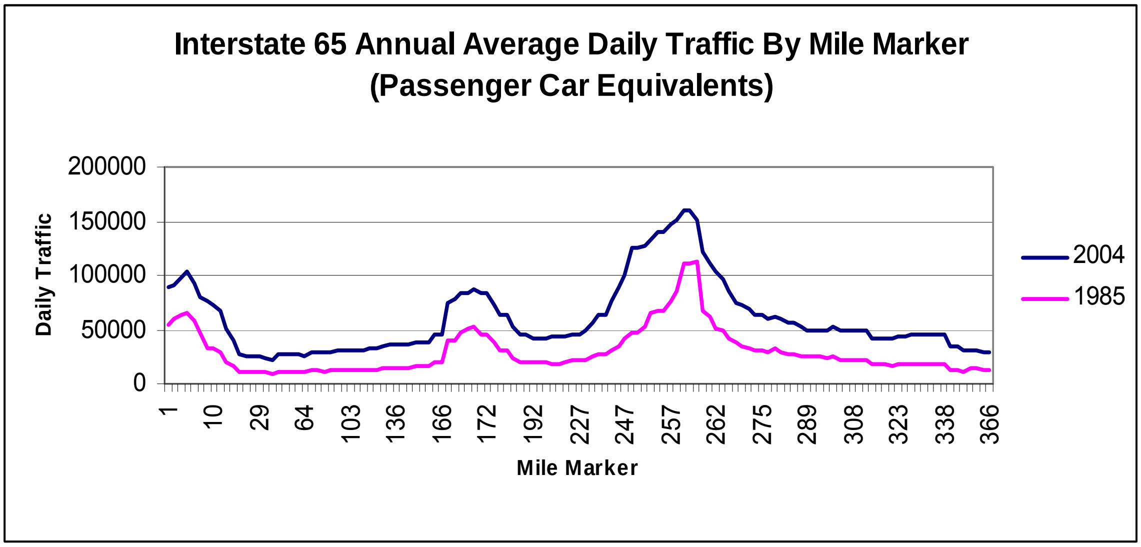

Figure 3.15 - Interstate 65 AADT by Mile Marker

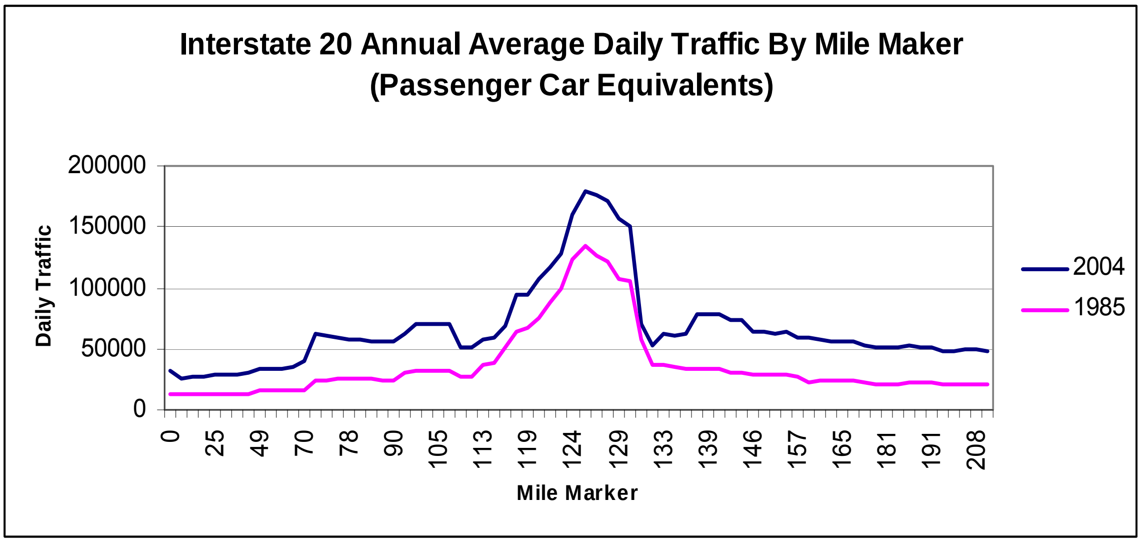

Figure 3.16 - Interstate 20 AADT by Mile Marker

Figure 3.17 presents the growth in hours of delay for travelers in urban areas from 1982 to 2003 for 11 U.S. cities, including Birmingham, AL. As the chart indicates, Birmingham still has a relatively low level of delay caused from congestion compared to other cities with the same size population. This is currently a positive attribute for Birmingham and other major Alabama cities.

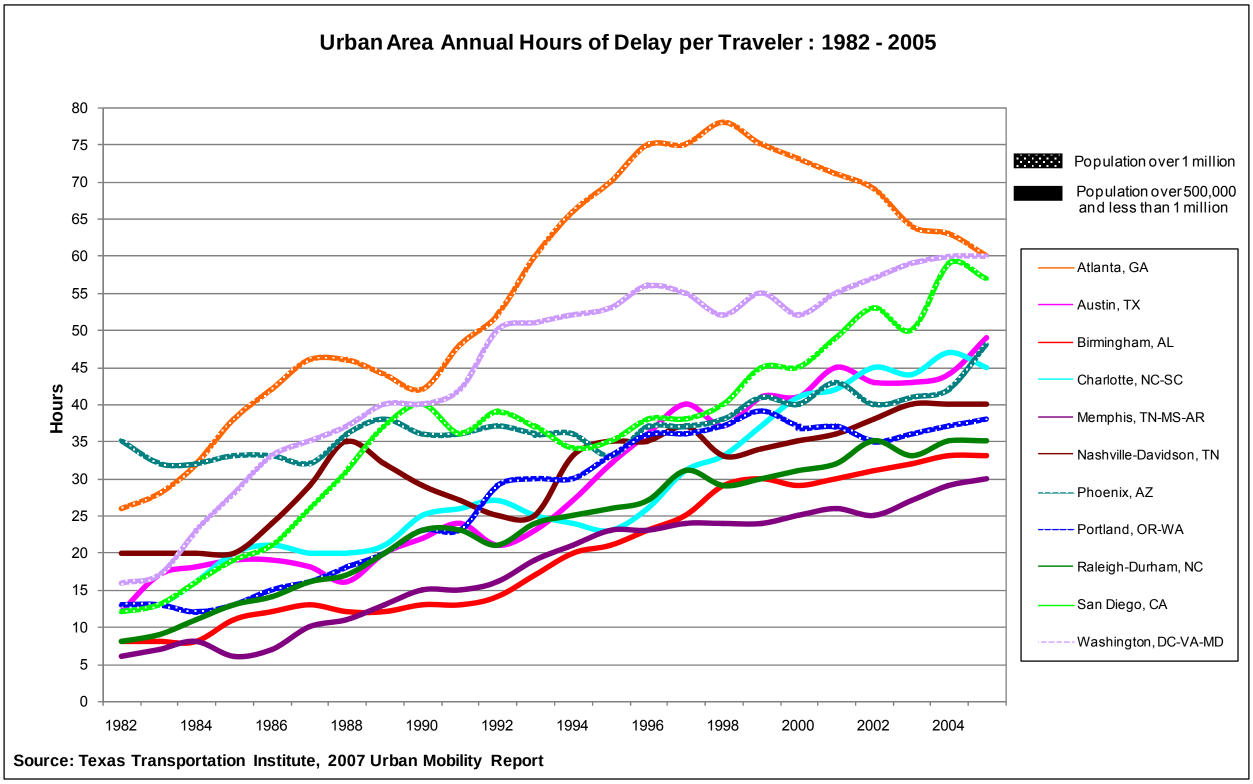

Figure 3.17 - Urban Area Annual Hours of Delay per Traveler 1982-2003

3.5 Model Outlook for Interstate Traffic

It is important that Alabama's historical and current system performance is measured to better understand future infrastructure needs. Critical to the modeling of the transportation infrastructure system is the ability to evaluate the performance of that system. The purpose of the transportation infrastructure system is to permit and enhance the efficient and effective movement of people and commerce from origins to destinations. To evaluate the effectiveness by which the interstate system performs this mission, a Total Flow Index (TFI) was created. Figure 3.18 presents the TFI for Alabama interstates between 1980 and 2004.

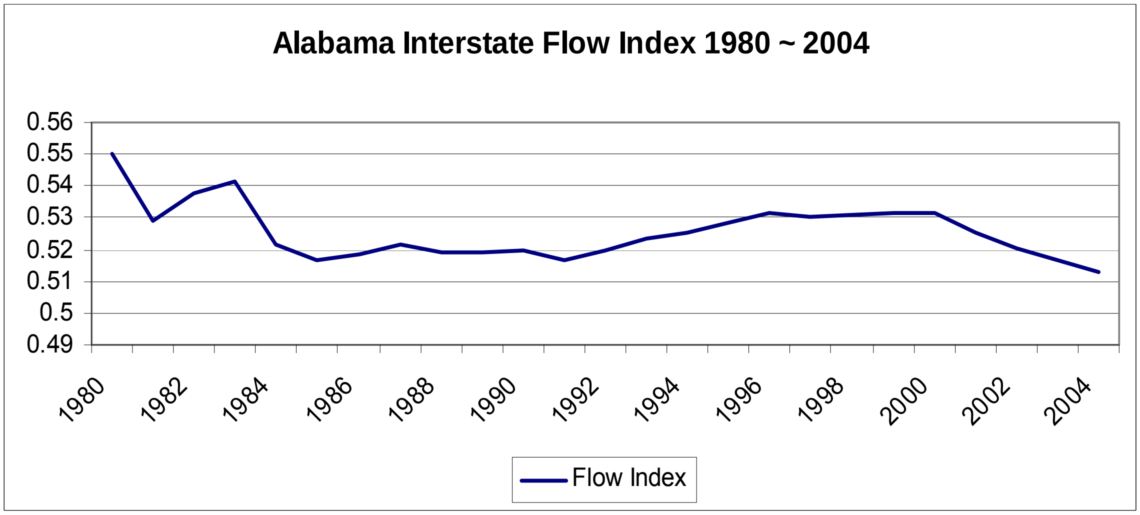

Figure 3.18 - Alabama Total Flow Index 1980 – 2004

The TFI takes into account the interrelationships and interactions between many different variables such as population and vehicles per household. The Peak Nodal Flow Index (PNFI) is an indicator of the level of congestion experienced on interstates in and around the largest metropolitan centers in Alabama. The TFI is created by dividing the total vehicle volume by the interstate lane miles multiplied by and average capacity per lane mile per hour, shown in Eq. 3.1.

(Eq. 3.1) $$TFI = \frac{TV}{ILM * Cap}$$

Descriptions:

TFI – Total Flow Index *TV – Total Vehicle Volume*
ILM – Interstate Lane Miles *Cap – Average Capacity per Hour*

The total vehicle volume is calculated by multiplying the Department of Transportation (DOT) vehicle counts by a calculated truck factor, shown in Eq. 3.2.

(Eq. 3.2) $$TV = CV * TF$$

Descriptions:

TV – Total Volume, CV – Car Volume, TF – Truck Factor

Car volume (Eq. 3.3) is established by multiplying the interstate households by an assumed number of trips per household (9.55), times an assumed percentage of cars on the interstates during peak traffic hours (.2). The 9.55 trips per household is taken from the Institute of Transportation Engineers' standard for trips per household per day. The percentage of cars on the interstates during peak hours, 20%, was derived from the *"Travel Estimation Techniques for Urban Planning"* [1] which states that 7.06% of cars make trips between 7:00 and 8:00am, 8.95% make trips between 4:00 and 5:00pm, and 8.85% cars make trips between 5:00 and 6:00pm. The total of 24.8% of cars traveling on the interstates during peak hours was rounded down to 20% for purposes of this research.

(Eq. 3.3) $$CV = TpH * IH * CIPH$$

Descriptions:

CV – Car Volume | *TpH – Trips per Household (9.55)*
IH – Interstate Households | *CIPH – Cars on Interstates during Peak Hours (0.2)*

The 2000 census states that the average population per household is 2.59 persons in the U.S. For the model, one person is equivalent to 39% of a household, or 1 divided by 2.59. The interstate population is determined to be the population in Alabama counties through which the interstates traverse. Interstate households, shown in Eq. 3.4, are calculated using the interstate population and multiplying by the population per household.

(Eq. 3.4) $$IH = IP * PpH$$

Descriptions:

IH – Interstate Households, *IP – Interstate Population,*
PpH – Population per Household

A basic assumption in the model is that Advanced Manufacturing companies access the interstate and highway transportation infrastructure more than Basic Manufacturing companies that tend to use more bulk shipment modes (see Table 3.7). With this in mind, a truck factor was created to establish the truck component load as a function of the total vehicle volume. The truck factor was established by doubling the employment in advanced manufacturing and adding the employment in basic manufacturing and dividing the resulting product by the average population in interstate counties. This quantity was doubled, then multiplied by the average DOT estimated truck volume as a percentage of the total counted volume with the total added to 1.

(Eq. 3.5) $$TF = 1 + [.21 * 2 * \frac{(2 * Emp^{AM} + Emp^{BM})]}{175,000}$$

Definitions:

TF – Truck Factor
Emp^{AM} *– Employment in Advanced Manufacturing*
Emp^{BM}*- Employment in Basic Manufacturing*

Basic Manufacturing:	Advanced Manufacturing:
Fabricated Metal Product Manufacturing	Electrical Equipment and Appliance Manufacturing
Non-Metallic Product Manufacturing	Motor Vehicle, Body, Trailer and Parts
Plastics & Rubber Products Manufacturing	Other Transportation Equipment Manufacturing
Wood Product Manufacturing	
Machinery Manufacturing	
Food Product Manufacturing	
Textile and Textile Product Mills	
Apparel Manufacturing	
Paper Manufacturing	
Printing and Related Support Activities	
Chemical Manufacturing	
Primary Metal Manufacturing	

Table 3.7 - Basic and Advanced Manufacturing Categories

Historical data for interstate lane miles obtained from the Alabama Department of Transportation indicates that interstate lane miles increase at a rate of 5.1% per year and they deteriorate at a rate of 5% per year. The initial value (1980) for lane miles was approximately 3,500. The capacity per lane mile in the model was assumed to be and average of 2,200 vehicles per mile per lane per hour.

The Total Flow Index was calculated using all of the interstate lane miles in Alabama, and the Nodal Peak Flow Index was calculated from the interstate lane miles located in heavier populated counties (Autauga, Baldwin, Blount, Cullman, Escambia, Jefferson, Lee, Limestone, Madison, Mobile, Montgomery, St. Clair, Shelby, and Tuscaloosa Counties). Figure 3.19 presents the PNFI for Alabama interstates between 1980 and 2004. The PNFI was calculated in the same manner as the TFI, with a few exceptions. The nodal truck factor was calculated as the truck factor plus one tenth due to the heavier concentration of manufacturing operations in the nodal counties. The nodal car volume was based on nodal households. Nodal households are calculated as the percentage of interstate households in nodal areas. 76% of the interstate households are found in nodal areas.

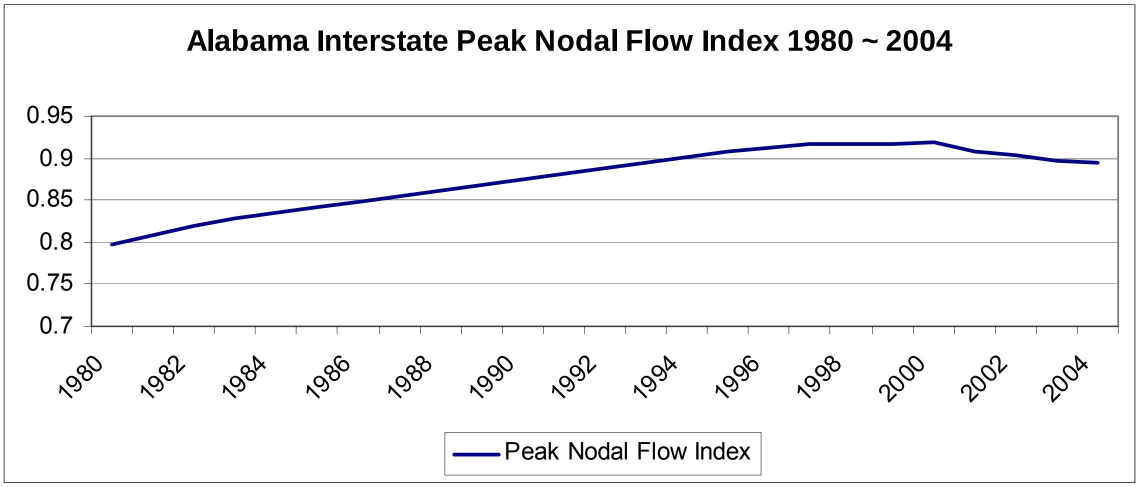

Figure 3.19 - Alabama Interstate Peak Nodal Flow Index 1980 – 2004

Alabama's interstate system as a whole has been performing at approximately .5 or half capacity since 1980 (Figure 3.18). However, a total system view can be misleading because over half of Alabama's interstate miles are in rural areas such as Butler, Conecuh, Macon, and Sumter Counties. A review of system performance in the heavier populated counties using the Peak Nodal Flow Index on the interstates (Figure 3.19), it can be seen that the performance level is operating at .9 or almost full capacity over the same time period.

The small decrease in Peak Nodal Flow Index and Flow Index in the year 2000 as shown in Figures 3.18 and 3.19 is a result of two factors: Alabama entered a recession at the end of 1999 and the effects of the recession were beginning to be felt by mid 2000 and Alabama's employment in Basic Manufacturing industries (see Figure 3.8) began to decline after 1995, decreases which are still occurring. As mentioned earlier in this chapter, Flow Index and Peak Nodal Flow Index are calculated using a truck factor, which takes into account the number of people, employed in Basic Manufacturing as well as Advanced Manufacturing. The decline in both Flow Index and Peak Nodal Flow Index can be attributed to the fact that, since 1995, Basic Manufacturing employment declined at a faster rate (318,900 in 1995 and 242,600 in 2005) than employment grew in Advanced Manufacturing (49,600 in 1995 and 75,300 in 2005).

3.6 Description of the Model Used to Investigate Likely Trends in Population and Workforce

There are eight major components of the system dynamics model: population, education, workforce, employment, training, asset investment, infrastructure and congestion. Population, specifically the birth rate, feeds the education sector, which, in turn, generates additions to the workforce. Employment is determined by workforce availability and desired employment by industry. Population, employment and industry output create traffic and levels of congestion. Congestion can then lead to slowdowns in industry growth or even force struggling existing industries to shut down. Figure 3.20 shows the basic structure of the model.

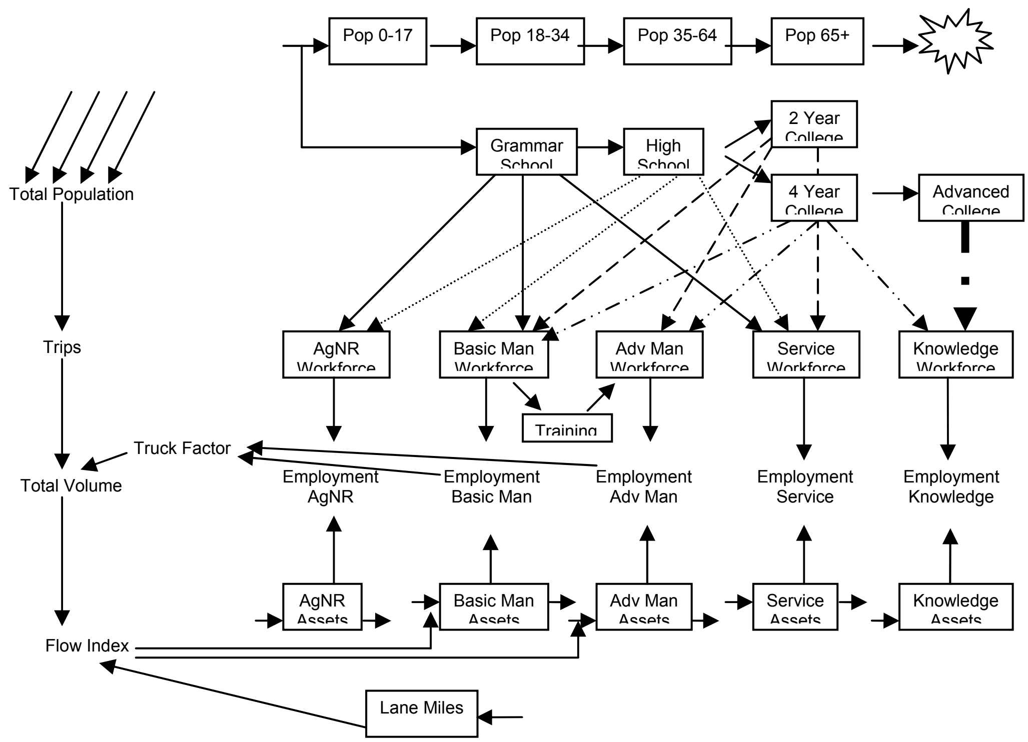

Figure 3.20 - Basic Structure of the Model

3.6.1 Population

Figure 3.21 shows the model structure for the population sector. For the purpose of the analysis, the population of Alabama is divided into four different age groups. The first group consists of ages 0–17, the second group is ages 18–34, the third is ages 35-64, and the last group consists of ages 65 and older. Population increases by births and decreases by deaths. At present, the model does not account for migration into and out of the state with the exception of individuals leaving the state after graduating from college.

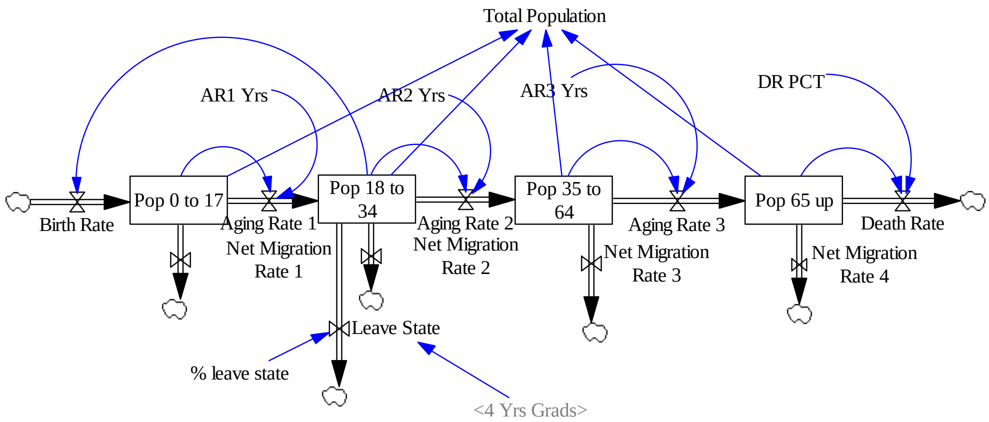

Figure 3.21 - Population Sector of the Model

The annual birth rate data was collected from 2004 Alabama Vital Statistics and was calculated by dividing the number of births each year by the population in the 18-34 age group to come up with an approximate annual birth rate percentage. Figure 3.22 shows the annual birth rate based off the 18-34 population sector. There is a dramatic decrease in the number of births the first 10 years. This decline in the birthrate can be attributed to a decrease in the number of children being born to baby boomers. After 1980, the number of births stays fairly consistent. In order to account for this in the model, the initial points for the 0-17 and 18-34 age sectors were inflated slightly. For the years 1970-2004, the model uses the actual birth rate percentages from the historical data. From 2004 on, the birth rate is 5.59% of the 18-34 age sector.

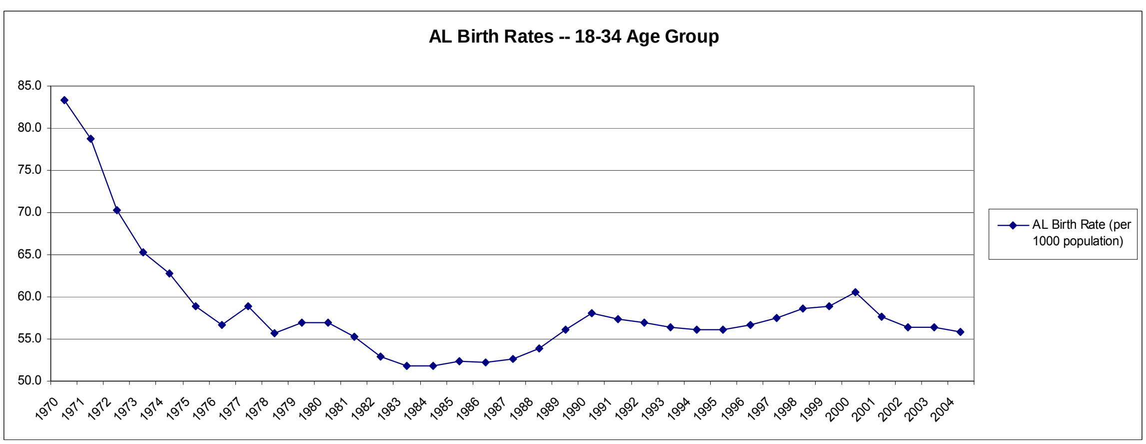

Figure 3.22 - Alabama Birth Rates Per Thousand of the 18-34 Age Group

The death rate percentage is based on historical death data from 1970 to 2004, also from 2004 Alabama Vital Statistics. The approximate percentage was determined by dividing the number of deaths per year by the number of individuals in the 65+ age group. Figure 3.23 shows the Alabama death rate based off of the 65+ age group. The death rate shows a very similar pattern to the birth rate. There is a steep decline over the first 10 years of the data and then the deaths become more consistent.

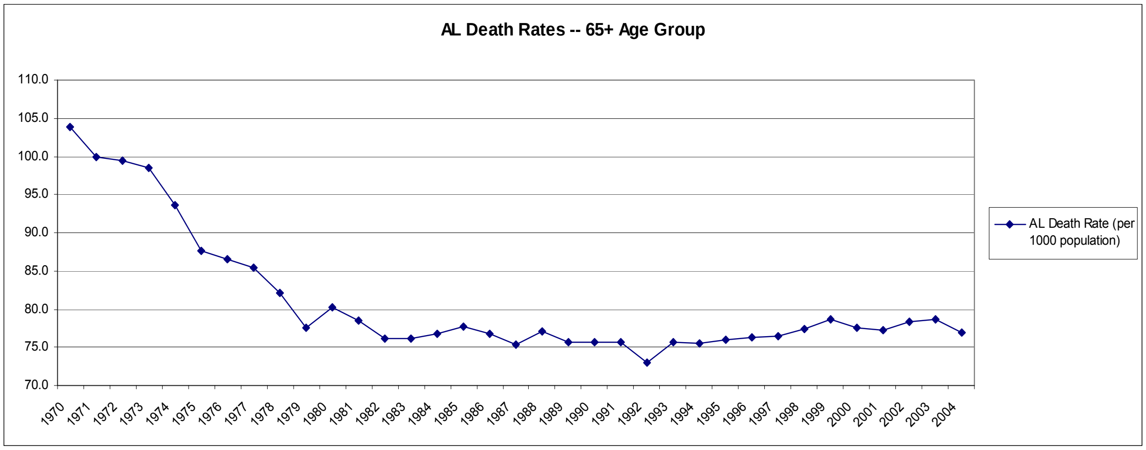

Figure 3.23 - Alabama Death Rates Per Thousand of the 65+ Age Group

The birth rate, after a five year delay, feeds the lower school population. This in turn, after eight years, feeds the high school population, which in turn feeds the workforce, and the two and four year colleges. In the absence of major immigration, these dynamics largely shape the future workforce.

3.6.2 Education

Figure 3.24 shows the education sector of the model. The birth rate in the population sector of the model drives the number of students entering the education process. In this model, there are two levels of education prior to college. The lower level consists of students through grade 8. After grade 8, the students enter high school.

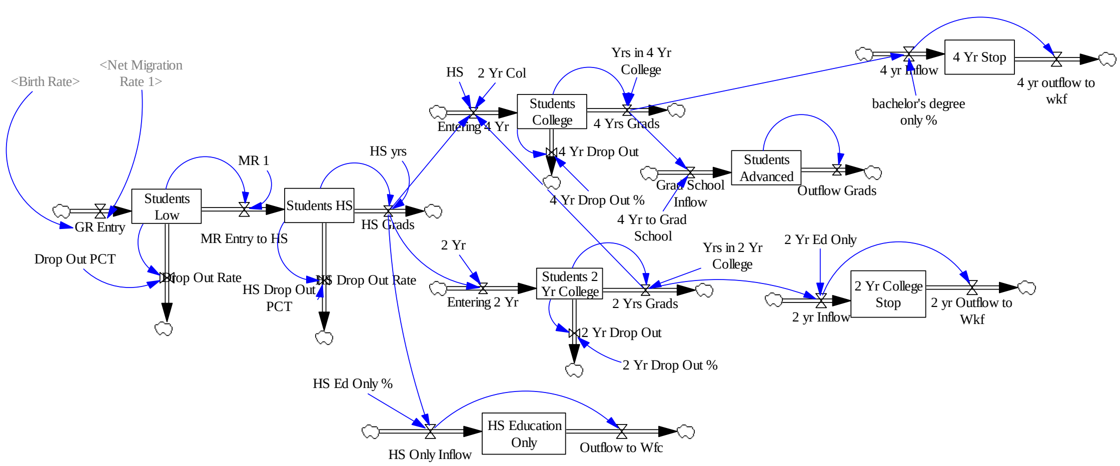

Figure 3.24 - Education Sector of the Model

Upon graduation from high school, a student can chose to join the workforce, attend a 2-year college, or attend a 4-year college. If the 2-year college route is chosen then the student may either join the workforce or attend a 4-year college once graduated. When a student graduates from a 4-year college, he may either join the workforce or attend graduate school. The model also accounts for individuals who drop-out at all school levels, and those who both work and go to school. Individuals who work and go to school simultaneously are included in the model as either students or available workforce.

3.6.3 Workforce

Figure 3.25 shows the workforce sector of the model and Figure 3.26 shows the industry sector of the model. The model includes five different workforce and industry groupings: Agriculture & Natural Resources, Basic Manufacturing, Advanced Manufacturing, Service, and Knowledge. The workforce availability is determined by the level of education an individual has achieved. The number of employees available to work in each industry is determined by the workforce. The model uses the dollar amount of asset investment for each of the industry groupings and a dollar amount of investment per employee for each of the industries to determine the desired number of employees needed in each industry.

If needed, individuals can go through training to become qualified for employment in a different workforce grouping. Presently in the model, training pulls only from the excess workforce in Basic Manufacturing and feeds only the Advanced Manufacturing workforce. Figure 3.27 shows the training sector of the model.

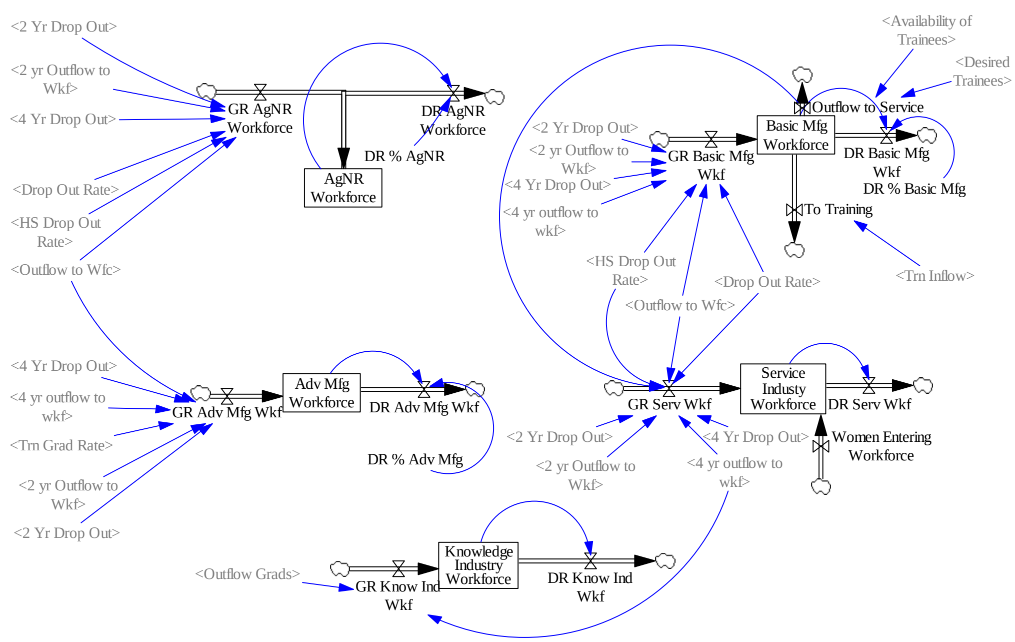

Figure 3.25 - Workforce Sector of the Model

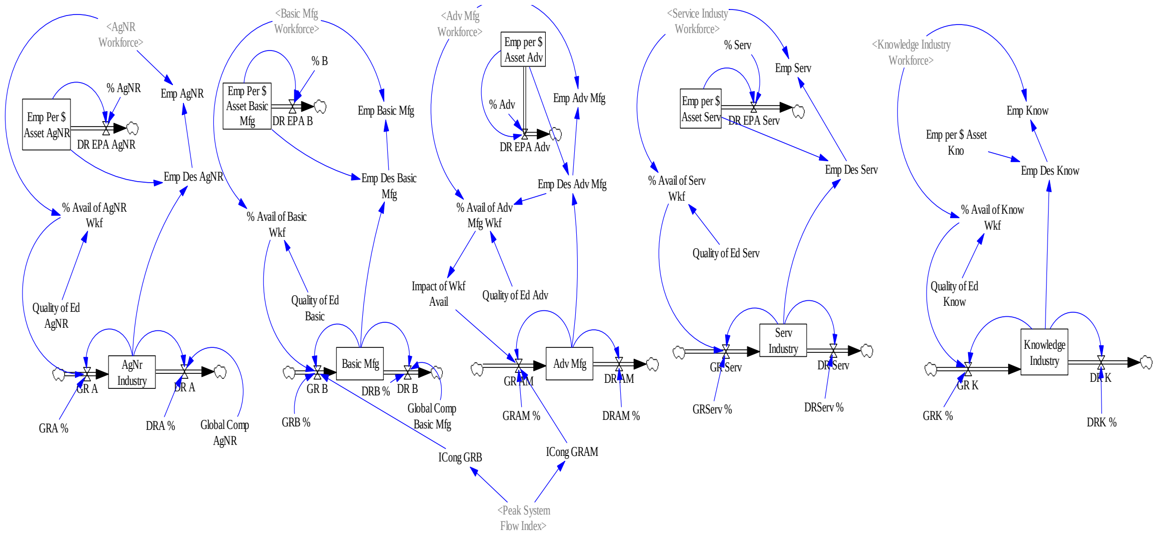

Figure 3.26 - Industry Sector of the Model

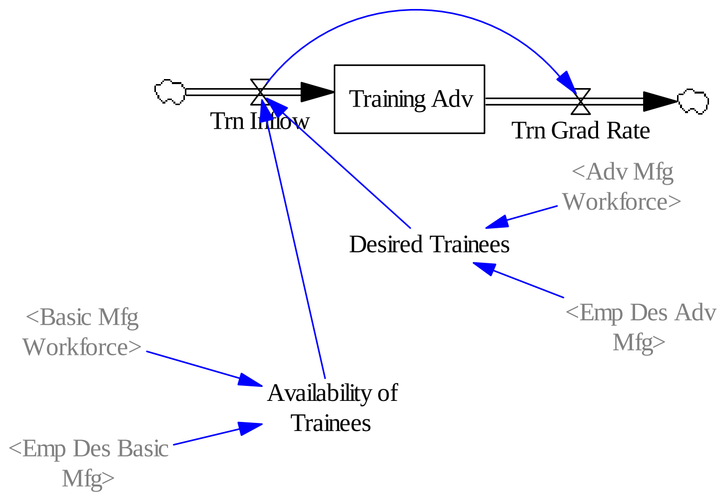

Figure 3.27 - Training Sector of the Model

3.6.4 Transportation

Figure 3.28 shows the infrastructure sector of the model. The population totals for each population sector are added together to determine the total population for the state. The current model is only considering interstate lane miles, so the population living near an interstate is determined from the total population (65% in 1970 increasing by 0.215% each year). A population per household factor is used (0.39) to determine the number of households living close to an interstate.

The volume of passenger vehicles (Car Volume) on the interstate during peak hours was determined by multiplying the number of interstate households, the number of passenger vehicles on the interstate during peak hours (20%), and the average number of trips each household makes (9.55). To develop a total volume of vehicles on the road, a truck factor had to be considered. This factor is influenced by the number of employees in basic manufacturing and by the number of employees in advanced manufacturing. More activity in basic and/or advanced manufacturing causes more trucks to be on the roads. The truck factor rate is added to 1 and multiplied by the passenger vehicle volume to come up with a total volume on vehicles on the interstates during peak hours. The total number of interstate lane miles is divided by the total vehicle volume and a capacity per lane mile factor (2200 vehicles per mile of lane). This number is the Peak System Flow Index, which indicates the congestion level.

Since many interstate miles in Alabama are through rural areas, it became important to look at a more congested stretch of interstate. For this model, the following counties were considered in the peak nodal flow index: Madison, Limestone, Cullman, Blount, Jefferson, Shelby, Lee, Montgomery, Baldwin, Mobile, and Tuscaloosa. The number of nodal households is determined using the number of interstate households and multiplying it by the number of households in the nodal area (76%).

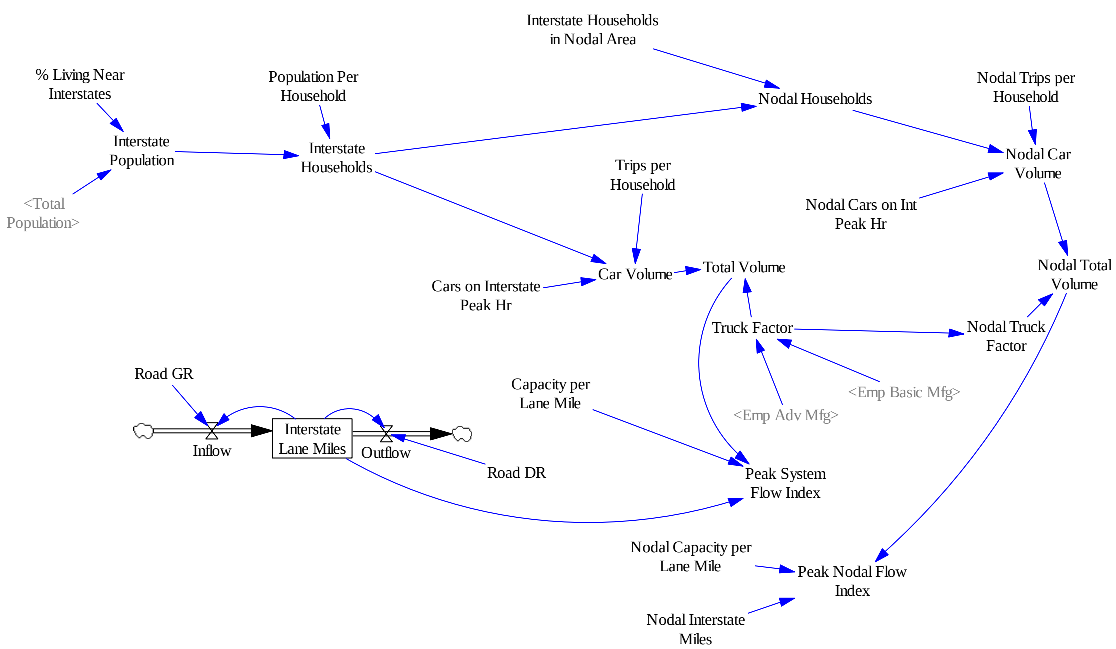

Figure 3.28 - Infrastructure Sector of the Model

The volume of passenger vehicles (Car Volume) on the nodal interstate during peak hours was determined by multiplying the number of nodal interstate households, the number of passenger vehicles on the nodal interstate during peak hours (20%), and the average number of trips each nodal household makes (9.55). To determine a total volume of vehicles on the road, a truck factor had to be considered. This factor is influenced by the number of employees in basic manufacturing and by the number of employees in advanced manufacturing. More activity in basic and/or advanced manufacturing causes more trucks to be on the roads and since the majority of manufacturing is in the defined nodal area basic and advanced manufacturing influence the truck factor even more. The nodal truck factor is then added to 1 and multiplied by the nodal passenger vehicle volume to come up with a nodal total volume on vehicles on the interstates during peak hours. The total number of nodal interstate lane miles is divided by the total vehicle volume and a capacity per lane mile factor (2200 vehicles per mile of lane). This number gives the Peak Nodal Flow Index, which reflects peak congestion level.

3.7 Interrelationships

The model incorporates interactions between industry investment and employment. In one set of relationships, increased investment leads to higher levels of desired employment. If quality workforce is available, this can lead to increased investment. On the other hand, if workforce is unavailable, investment could be decreased. Similarly, investment leads to increased output, increased traffic, growing congestion and a lower availability of workers in the region. Congestion plays a dual role on investment in new plant assets and reductions in assets of old facilities. These relationships are embedded into dynamic equations that enable simulation of the regional system over a long time period.

3.8 Comparison of Model Output with Historical Data

In order to verify the model, the ability of the model to reproduce the past must be examined. Statistics were collected from 1970 through 2004 for the different sectors of the model. The 1970 value was used as the initial point for the model. Output for the first 35 years was compared to the historical data to ensure that the model was representing past trends. Figures 3.29 through 3.33 show the model output for the first 35 years of the simulation compared to the historical data for population by sector and collectively. Figures 3.34 and 3.35 show the model output for the number of students through high school compared to the actual numbers. Figures 3.36 through 3.40 show the employment output for the different industries compared to the actual data.

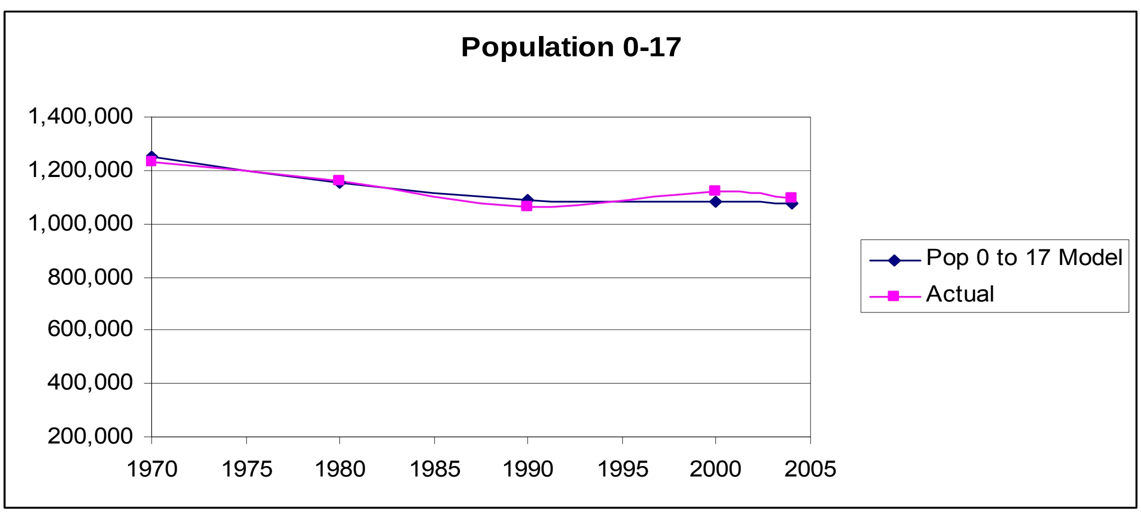

Figure 3.29 - Population 0-17 Actual vs. Model

For the population 0-17, the model is running very close to the actual numbers collected.

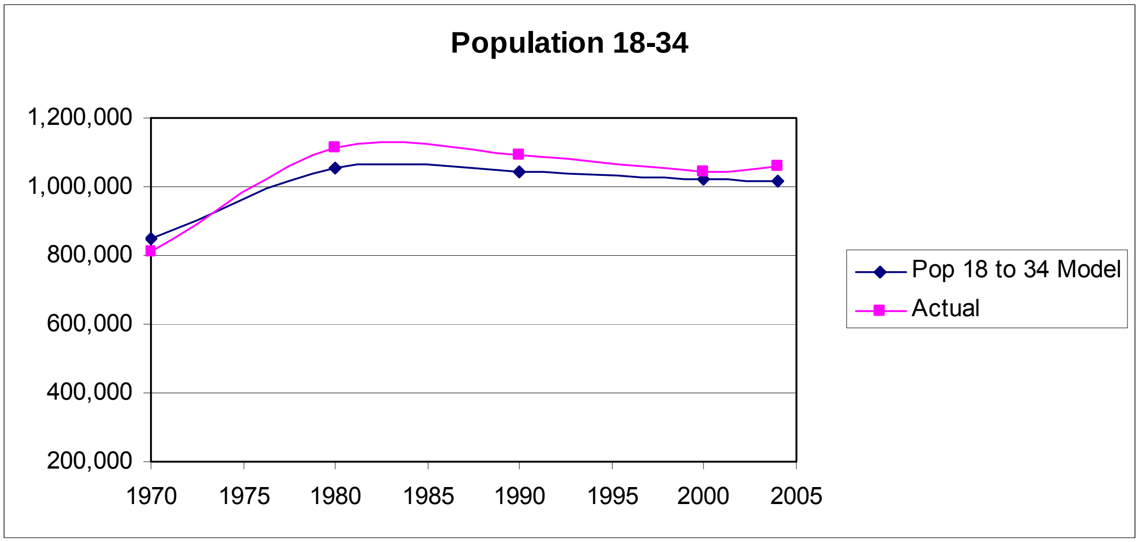

Figure 3.30 - Population 18-34 Actual vs. Model

For the population 18-34, the model is running a little below the historical data collected. The initial point for this age sector is a little higher than the actual.

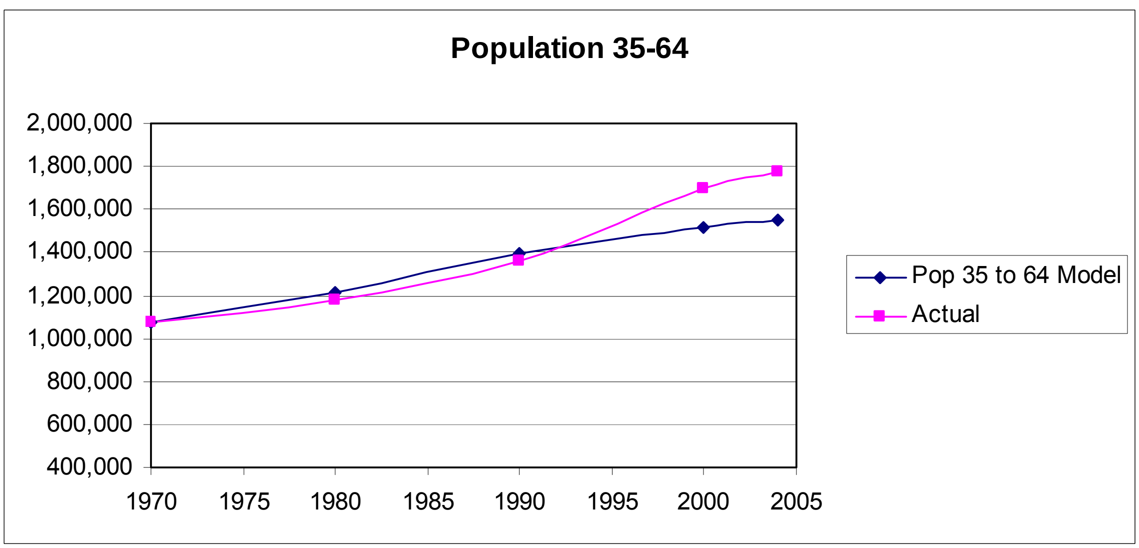

Figure 3.31 - 35-64 Actual vs. Model

This figure shows that the model fairly approximates what happened for the 35-64 age group between the years 1970 and 2005.

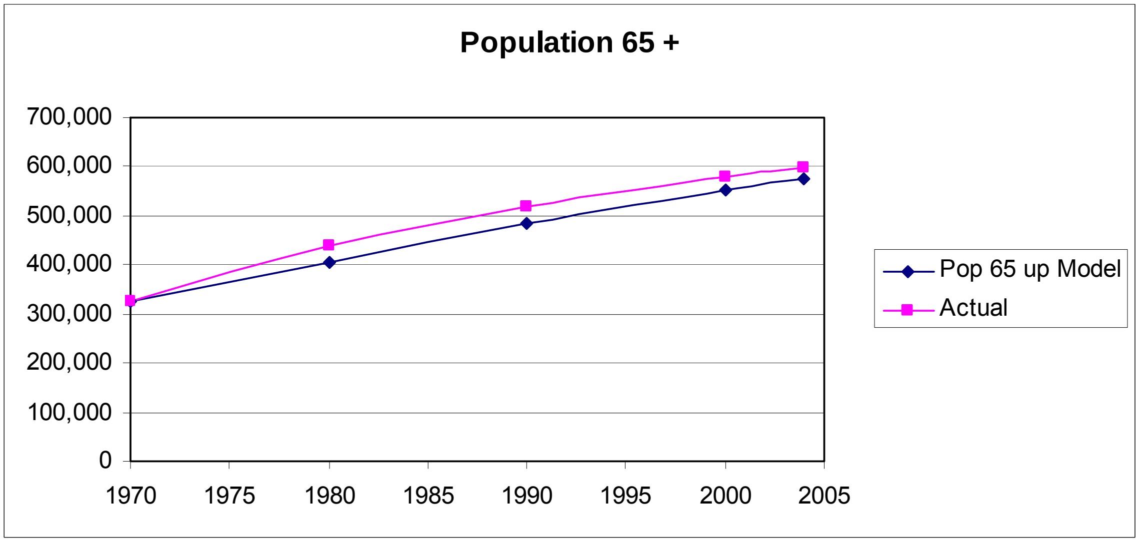

Figure 3.32 - Population 65 and Up Actual vs. Model

There is a nominal difference between the simulation output and the actual data collected for the population 65+.

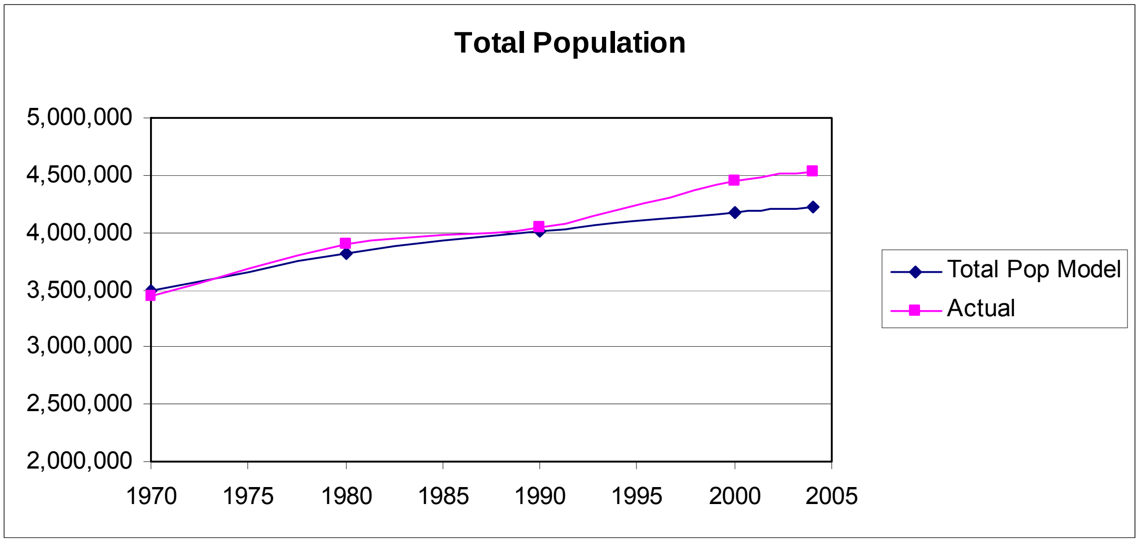

Figure 3.33 - Total Population Actual vs. Model

The total population chart shows that the model's output is similar to the historical data.

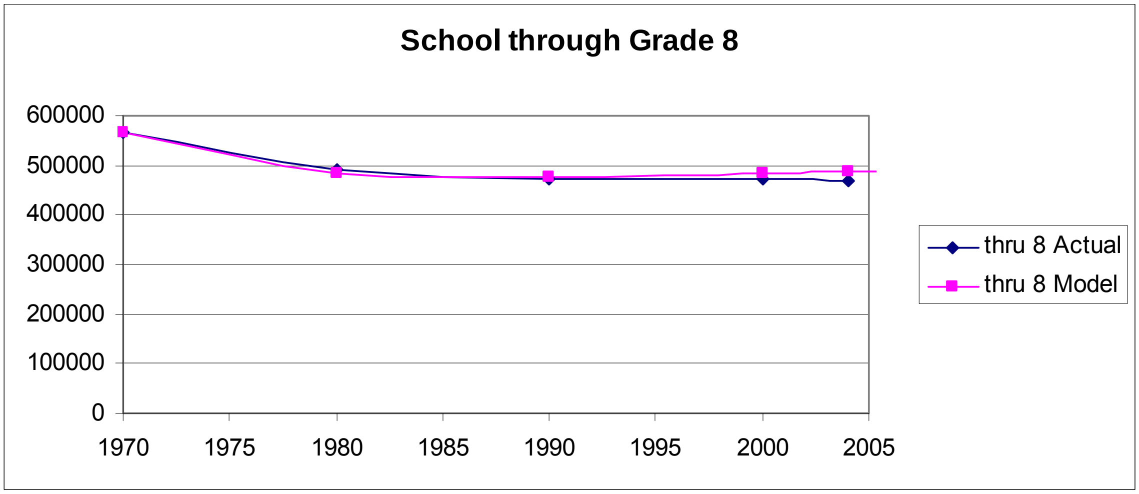

Figure 3.34 - School Through Grade 8 Actual vs. Model

There is virtually no difference between the model's output and the collected data for school students through the 8th grade.

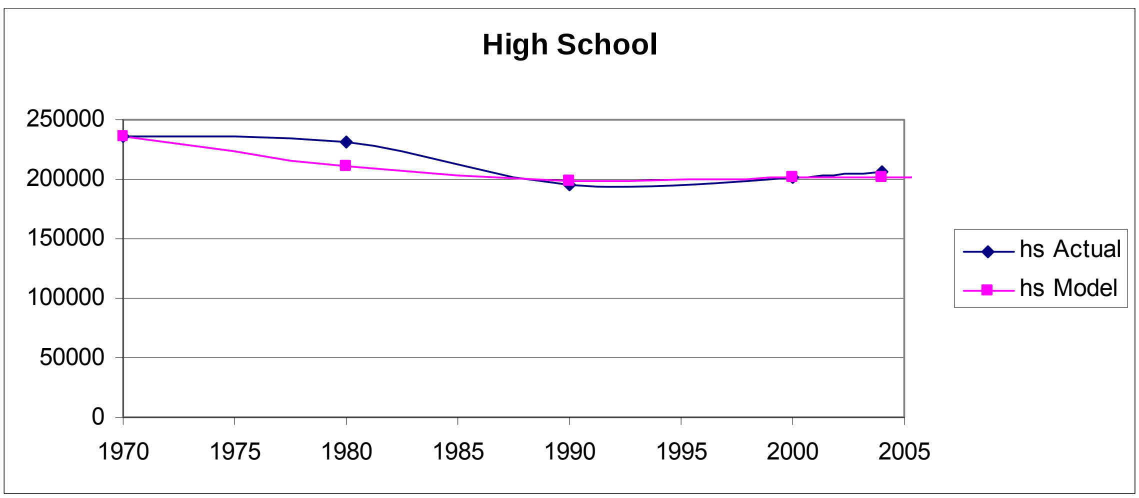

Figure 3.35 - High School Actual vs. Model

The model falls slightly below the actual data until around 1985. After 1985, the model more closely simulates the past trends for high school students.

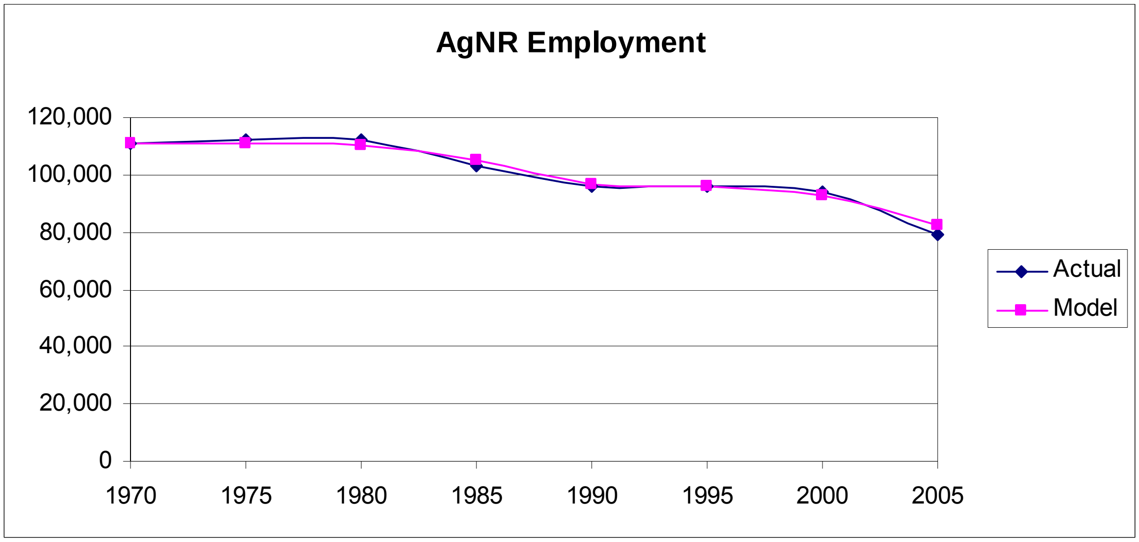

Figure 3.36 - AgNR Employment Actual vs. Model

Figure 3.36 looks at the employment data collected for the Agriculture and Natural Resources industry. The model closely simulates the actual data collected.

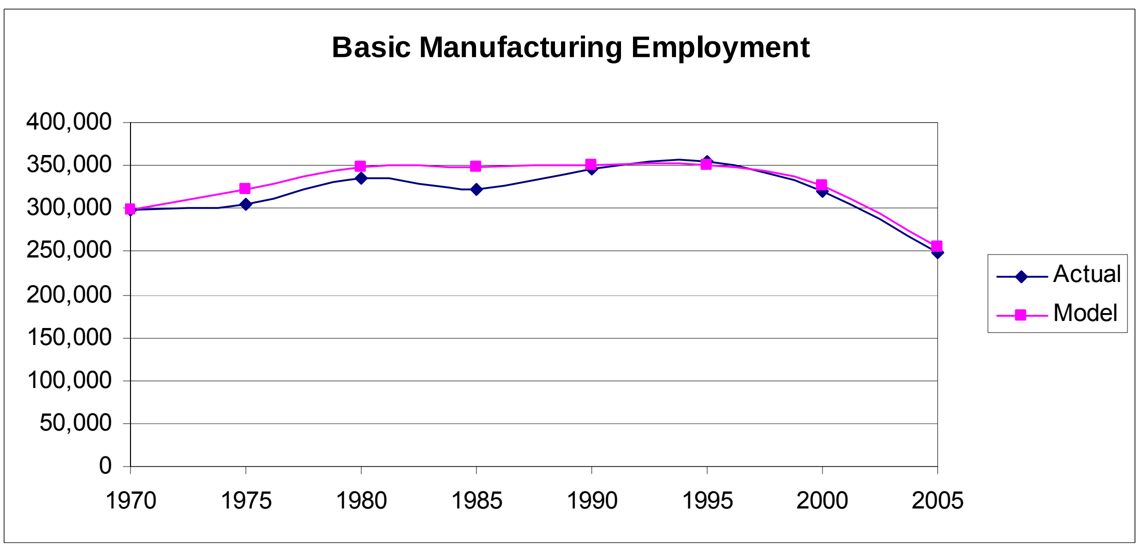

Figure 3.37 - Basic Manufacturing Employment Actual vs. Model

For Basic Manufacturing employment, the simulation outlook runs slightly above the actual data until around 1990 when it beings to vary only nominally from the actual data.

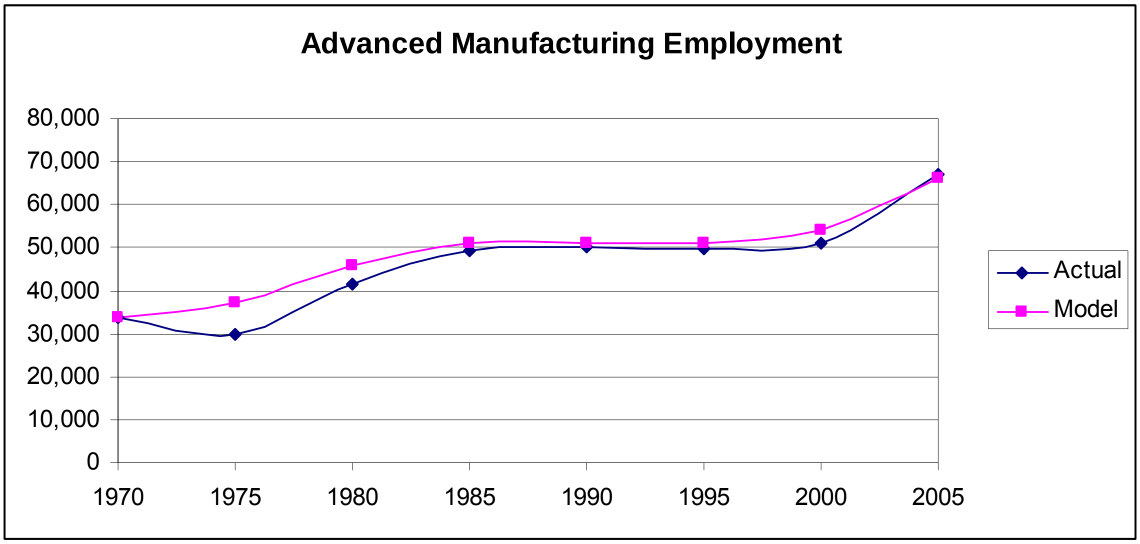

Figure 3.38 - Advanced Manufacturing Employment Actual vs. Model

The model outlook for Advanced Manufacturing Employment also starts out slightly above the actual data, but by 1985 the model and the actual are not very different.

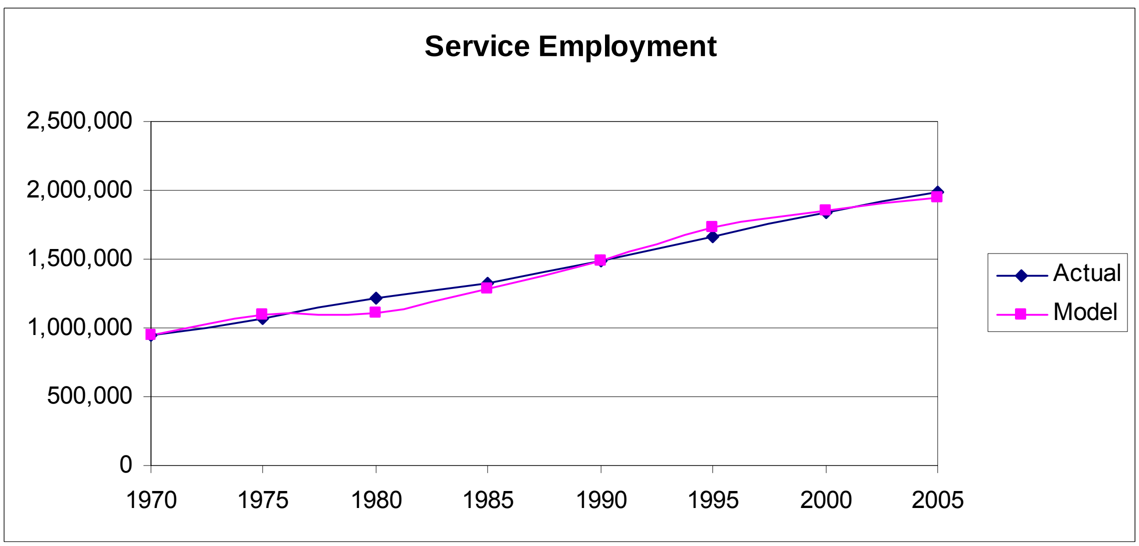

Figure 3.39 - Service Employment Actual vs. Model

The model outlook for the Service industry employment does not vary greatly from the actual data collected.

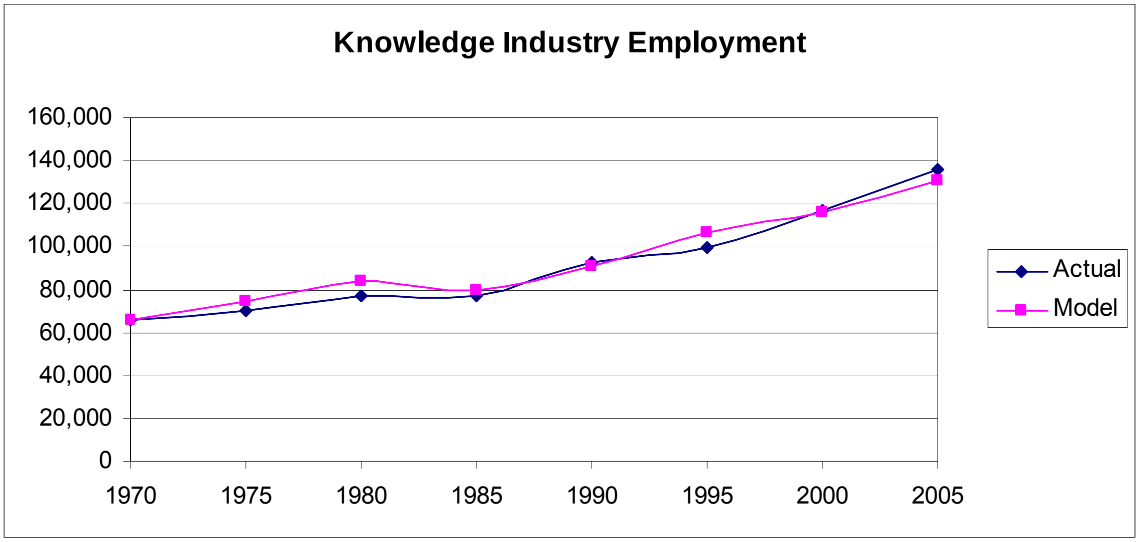

Figure 3.40 Knowledge Employment Actual vs. Model

There is not a big difference between the model outlook for the Knowledge industry employment and the actual data collected.

3.9 Likely Future Trends in Population, Workforce, Etc.

It is apparent from the model that the outlook for any region is shaped by the interactions of many factors over time. Even though many factors are at play, regional evolution is a slow moving process with great inertia. Population dynamics establish a foundation for future economic trends in terms of future students and future workforce. For most states, population dynamics evolve with incremental birth and death processes, which are the fundamental underlying processes that lead to an aging population and an aging, slowly growing workforce. These population and workforce dynamics, combined with slowly growing transportation infrastructure and resultant growth in congestion, create likely regional futures that are bounded by workforce availability on one hand and congestion on the other. This appears to be the case for Alabama as indicated in the preliminary model outlook.

Figure 3.41 shows the different population sectors in the model and their evolution over time. The largest growth can be seen in the 35 - 64 sector and the 65+ sector. In the future, the 18 - 34 sector and the 0 - 17 sector will slowly decline. As this chart shows, the population of Alabama will continue to age. As the population continues to age, the total workforce availability will decrease even though the total population numbers are increasing. Figure 3.42 compares the total population and the total available workforce and shows the gap between these two, making the strain that an aging population can put on the workforce apparent.

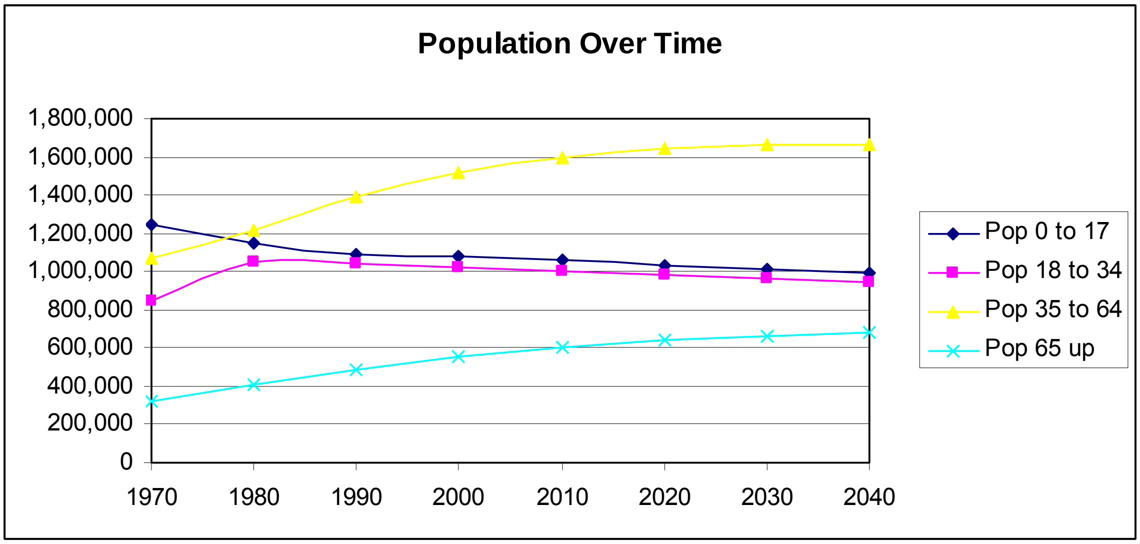

Figure 3.41 - Population Outlook from the Model

Figures 3.42 through 3.47 show the model's outlook comparing workforce and employment for each industry. Figure 3.42 looks at workforce as a percentage of the total population ages 18-64, since the vast majority of the employed come from this age range. Figures 3.43 through 3.47 show the employment for each industry compared to the total workforce available in that industry. These charts give an idea of the impact of the strain placed on each industry. By the end of the simulation, the employment numbers are either being constrained by the available workforce or are leaving a minimal number of available workforce. It is important to note that employment is very much constrained and limited by workforce. The economy seems to have reached a slowly growing balanced point whereas workforce and congestion are countervailing limiting forces.

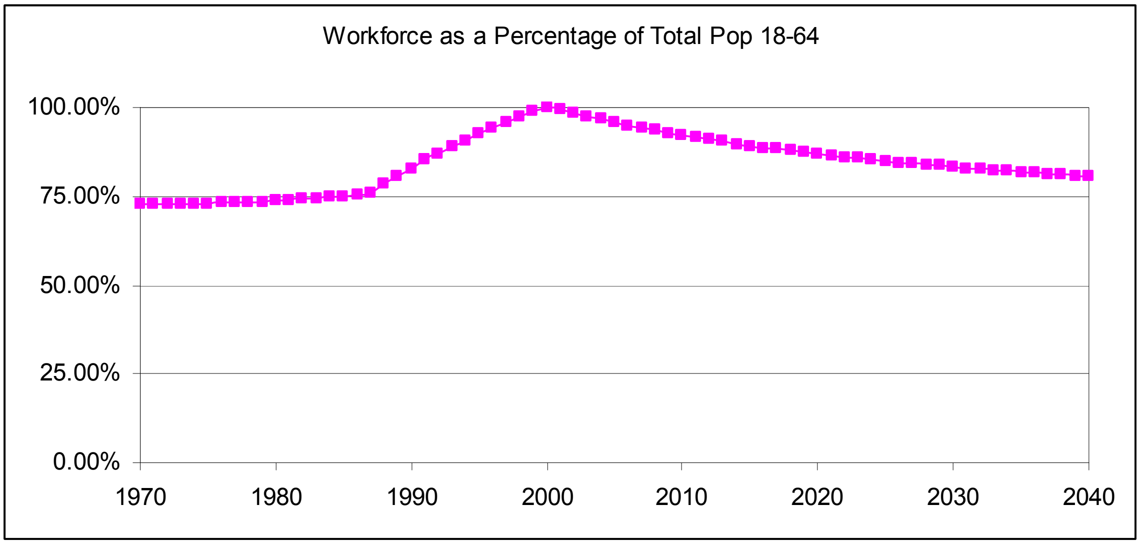

Figure 3.42 - Total Workforce Compared to Total Population 18-64

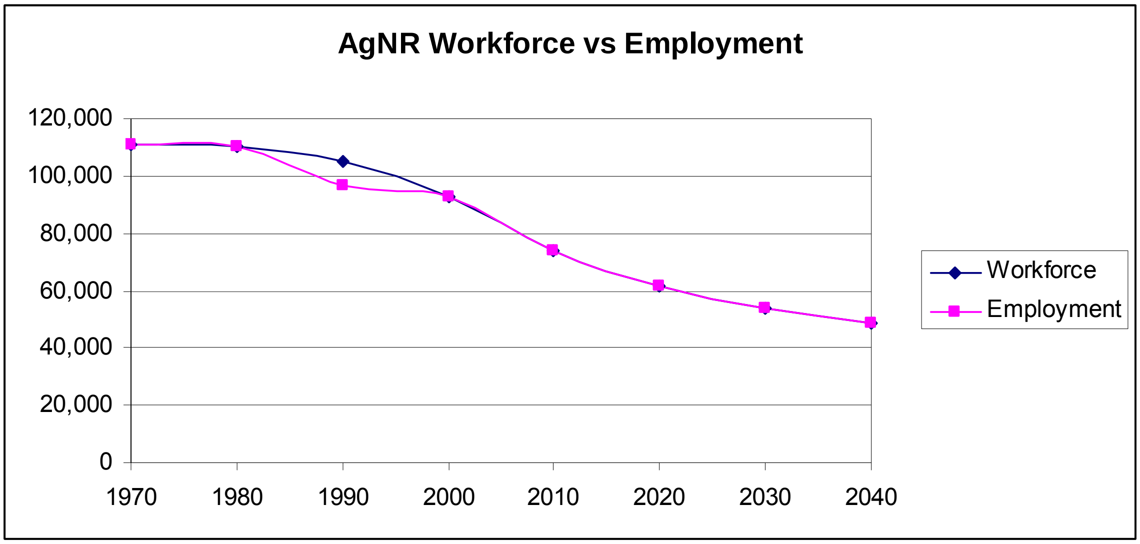

Figure 3.43 - AgNR Employment and AgNR Workforce

Here it can be seen that the majority of the time employment is constrained by the available workforce. The rest of the time, there is only a small percentage of workforce available after employment needs are met.

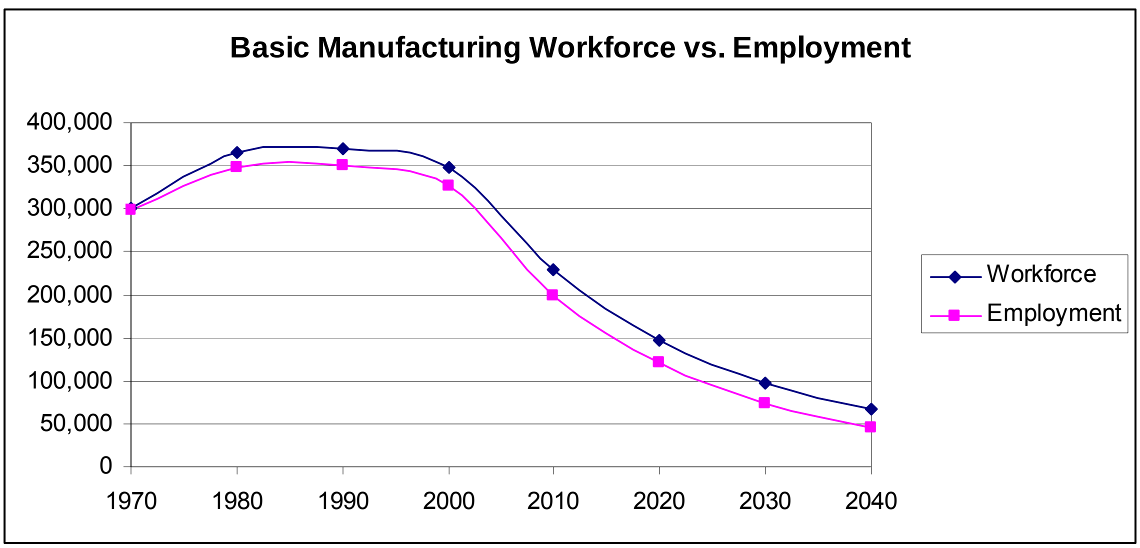

Figure 3.44 - Basic Manufacturing Employment and Basic Manufacturing Workforce

In reality, there is more workforce available in Basic Manufacturing than is needed but there is a shortage of workforce in Advanced Manufacturing. Available workforce from Basic Manufacturing is pulled into training so that the employment needs for Advanced Manufacturing can be met. Refer to Figure 3.27 for the training sector of the model. Also, if there is still workforce available in Basic Manufacturing after the Advanced Manufacturing needs are met, these individuals are added to the Service Industry Workforce.

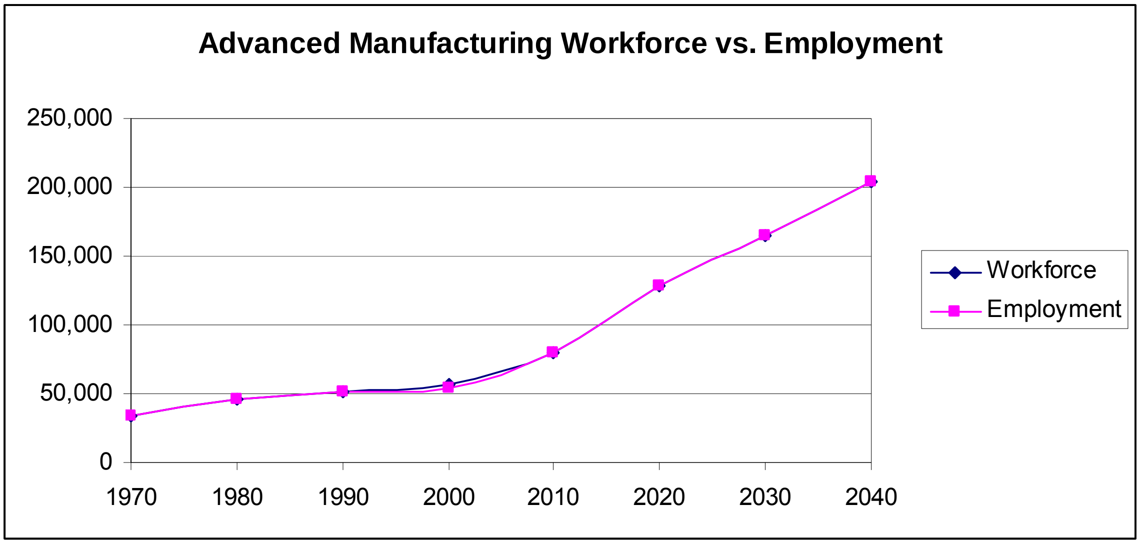

Figure 3.45 - Advanced Manufacturing Employment and Advanced Manufacturing Workforce

Advanced Manufacturing is able to meet its employment needs, but only through the training of Basic Manufacturing workforce for Advanced Manufacturing jobs.

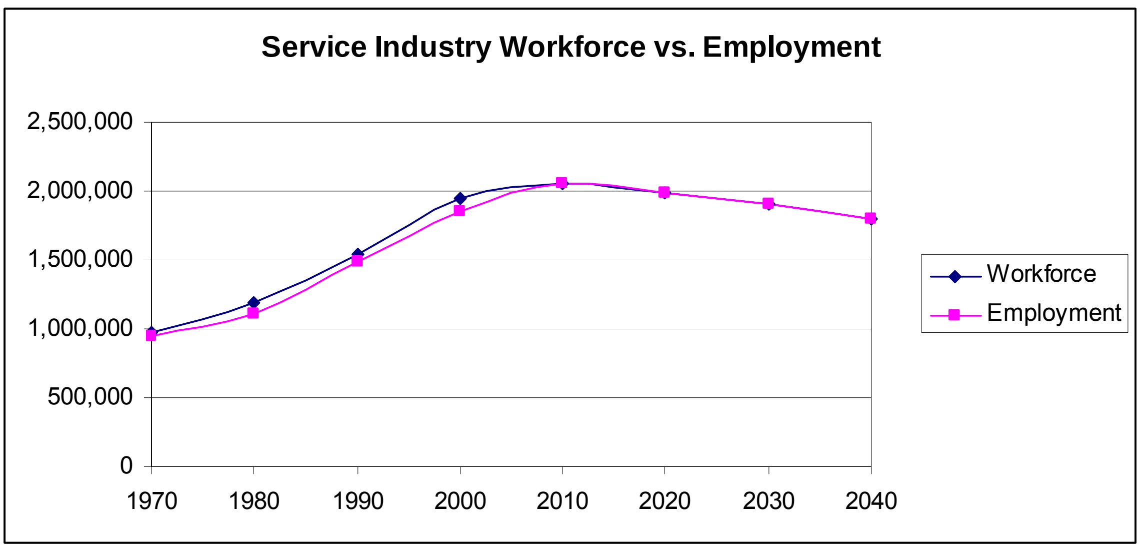

Figure 3.46 - Service Employment and Service Workforce

The Service industry is growing very rapidly. The model outlook shows that the Service industry employment is likely to be constrained by the available workforce. If extra workforce exists in Basic Manufacturing after Basic and Advanced Manufacturing workforce needs are met, these individuals join the Service industry workforce if they can be used there. Also helping the Service industry meet its employment needs are women entering the workforce. The model has women entering the Service industry workforce starting in 1980.

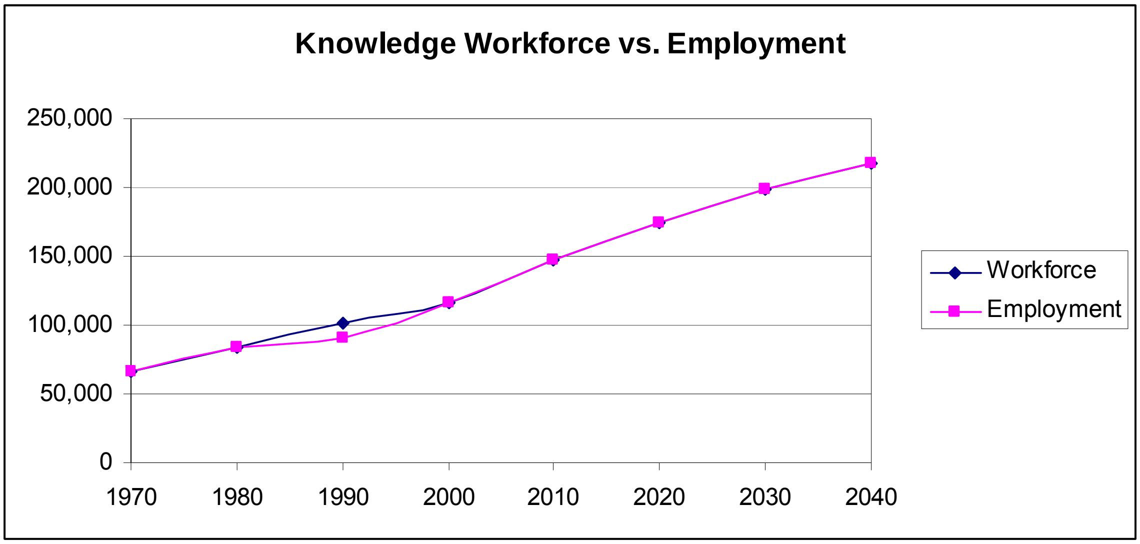

Figure 3.47 - Knowledge Employment and Knowledge Workforce

The available workforce limits Knowledge industry employment. More college graduates are needed to fill these positions.

Figures 3.48 and 3.49 show the employment trends for Alabama over time. Since the Service industry is growing so rapidly, Figure 3.50 excludes the Service industry. Figures 3.49 and 3.51 are the same as Figures 3.48 and 3.50, but with the actual data collected through 2005 also shown.

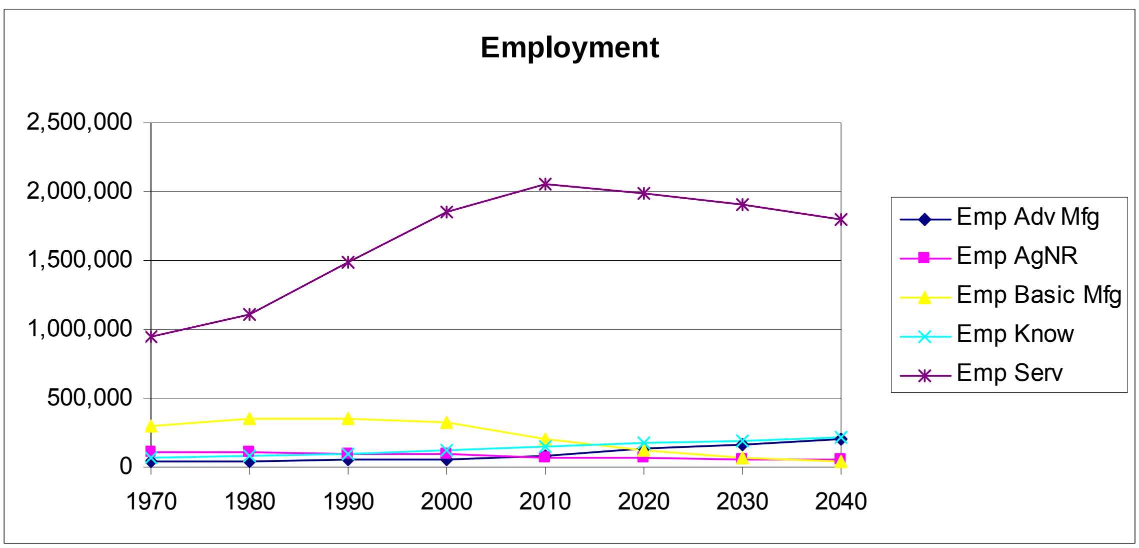

Figure 3.48 - Employment Model Outlook

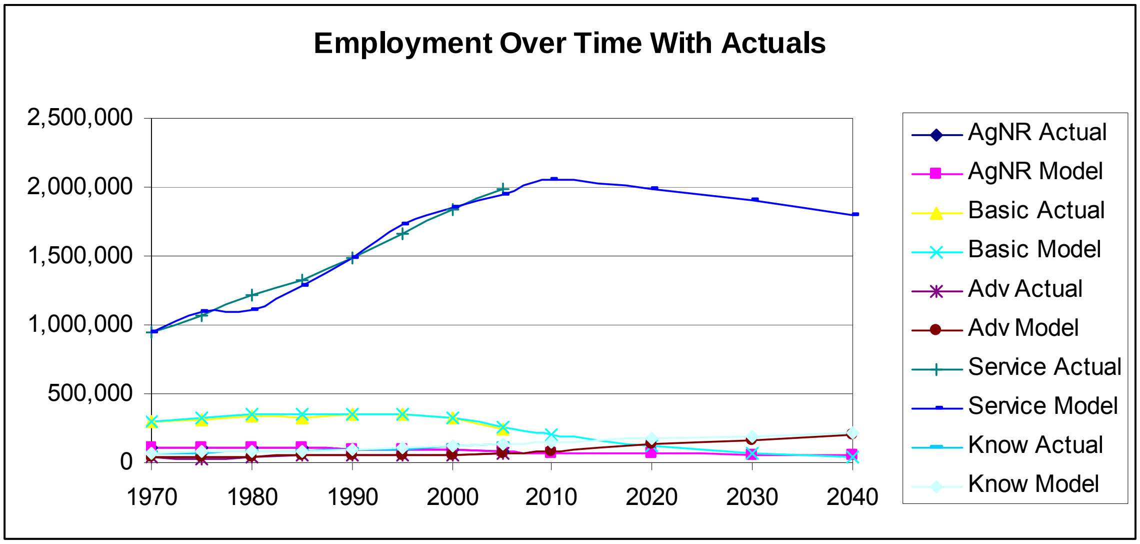

Figure 3.49 - Employment Model Outlook With Actuals

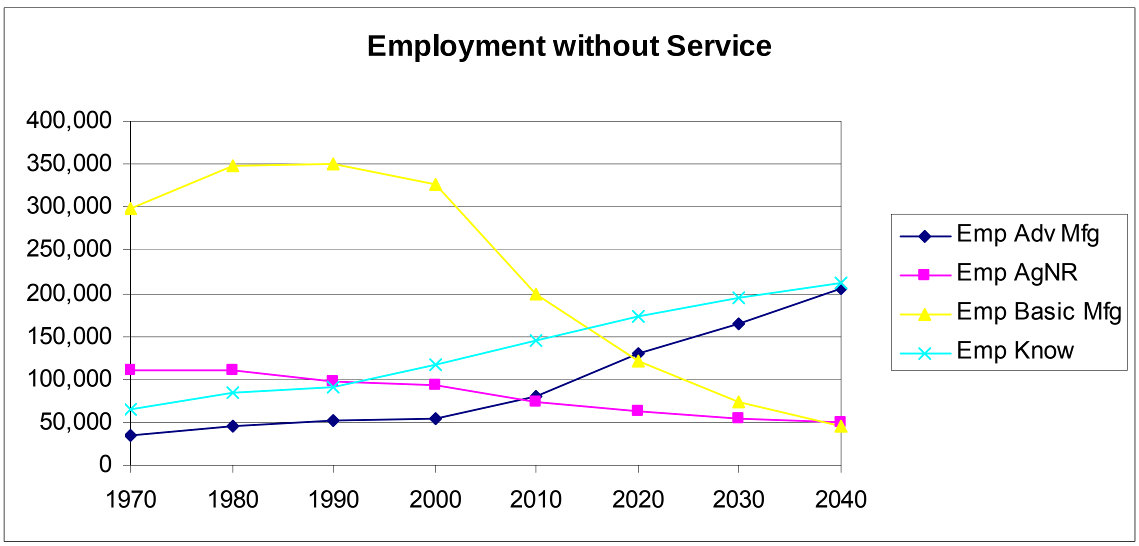

Figure 3.50 - Employment Excluding Service Industry Model Outlook

At present, there is more workforce available for Basic Manufacturing than is needed, while Advanced Manufacturing and Knowledge industries fall short of their desired workforce. This puts a strain on the existing and future workforce. Both growing congestion and workforce issues will be potential constraints to investment in Advanced Manufacturing and Knowledge industries. However, growth in Advanced Manufacturing and Knowledge industries can provide an opportunity for Alabama to offer higher paying jobs and possibly attract a workforce from other parts of the country. This growth could also force Alabama school systems and Alabama training programs to step up and provide the state with more individuals trained for high skill jobs.

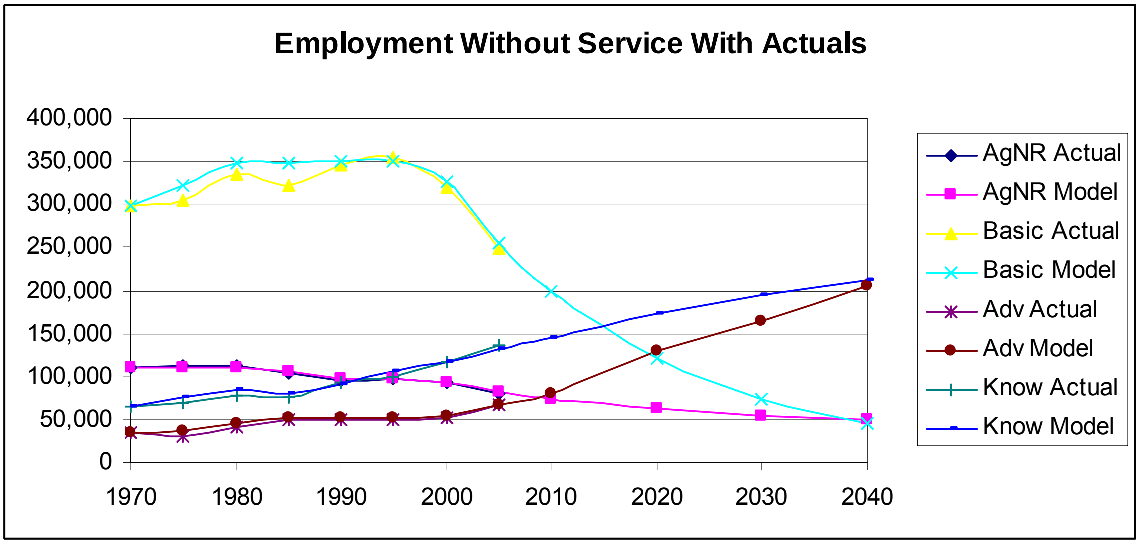

Figure 3.51 - Employment Excluding Service Industry Model Outlook With Actuals

In the meantime, investments in assets for Basic Manufacturing are declining, and will continue to decline, especially in economic centers, as congestion grows. Once congestion reaches a level where the cost of travel exceeds the ability to attract workers, the Basic Manufacturing industry plants will relocate, either in a more rural, accessible area or to a lower wage environment. See Figure 3.52 for the congestion index. As congestion grows, economies that survive will have to transform from Basic Manufacturing industries to Knowledge industries. Congestion and the availability of workforce are two main factors that will act as constraints to a thriving economy.

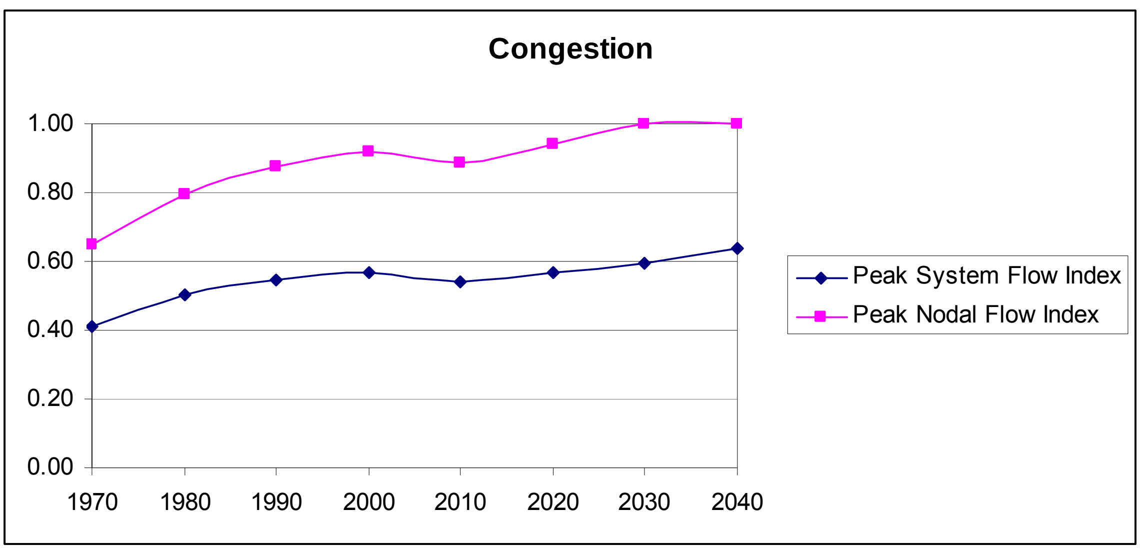

Figure 3.52 - Congestion Flow Index

Figure 3.52 shows the congestion factor, or flow index, for the interstate system in the state of Alabama. The chart can be interpreted as 0.00 being no congestion on the interstates and 1.00 being the interstates are completely congested and traffic cannot move. The blue line represents the system flow index during peak driving hours for all of the interstate system. The pink line represents the system flow index during peak driving hours for the most highly populated areas of the interstate system. This chart shows that by 2030 the interstates in the highly populated areas will be completely congested unless something changes, and the interstates in the more rural areas will be highly congested.

3.10 Conclusions

Congestion continues to grow, even though each year the interstate lane miles are increasing slightly. Alabama's workforce is and will continue to be strained to fill needed positions. The available workforce in Basic Manufacturing is being used to keep Advanced Manufacturing and Service where they need to be. A switch from a Basic Manufacturing job to an Advanced Manufacturing job cannot be accomplished, in most cases, without going through additional training. It is important that the Alabama school system and training centers teach the skills necessary to perform at a minimum Advanced Manufacturing jobs. However, the state will need more than just better training to get the workforce where it needs to be; the state needs additional population. A public relations campaign could be a way to advertise the attractiveness of Alabama to workers.

3.11 Chapter References

[1] Martin, W A; McGuckin, N A, Travel Estimation Techniques for Urban Planning, NCHRP Report No. 365. Transportation Research Board and Barton-Aschman Associates, Incorporated, 1998.

4. Establishment of an Online Information Warehouse for Transportation Related Data and Research Publications for Alabama and the Tennessee Valley Region

As transportation and freight research at the University of Alabama in Huntsville (UAH) continues to grow, the quality and volume of data and information has increased at a rapid pace. Management of this data and providing broad access, both to UAH personnel and external researchers became a priority. To address this situation, UAH has embarked upon a project to create an online information warehouse for transportation related data and research publications for Alabama and the Tennessee Valley region. This centralized database will facilitate the effective and efficient retrieval of data and information pertinent to the research process.

The first step in the development of the online information warehouse was to establish the boundaries of the project and ensure that all data and information collected was aligned with this scope. It would be very easy to allow "scope creep" to enter into the process and for the project requirements not to be met as a result. Second, the UAH researchers established the main categories for information organization. The initial transportation infrastructure research examined the interrelationships between population, infrastructure, and economic activity in the 2005 report to the U.S. Department of Transportation entitled *"Transportation Infrastructure in Alabama – Meeting the Needs for Economic Growth."* The P-I-E interrelationship model has become the basis for future research within the center. It naturally developed that these would be the major data and information category headings.

The online information warehouse provides search features to allow researchers to find data, publications, reports, and presentations used and developed from the transportation research at UAH. The data, reports, publications, and presentations produced by UAH researchers are converted to Adobe PDF files and are accessible through the internet. Researchers at UAH will upload the materials periodically and archive materials as new or updated materials supersede them.

The current Online Information Warehouse will be integrated into a revised website for the Center for Management and Economic Research early in 2008. Examples of the data available in the Online Information Warehouse and a more detailed description of the ultimate Online Information Warehouse follows.

4.1 Population, Infrastructure, and Economic Activity (P-I-E) Data

The main page for the P-I-E Data section of the Online Information Warehouse will contain the following:

<u>A brief explanation of the contents</u>

This section consists of data obtained from various non-proprietary databases and/or documents which have been used in research efforts conducted by the UAH research team.

A searchable feature
This feature will allow the user to perform data searches by keywords. The result of this search will be a list of available data that falls under the search criteria. Each item in the list will be a link to the PDF data file. Researchers will also have the option of obtaining certain data in Microsoft Excel format by submitting an emailed request for data.

A list feature
This feature will allow the user to view a list of all data categorized under the following headings: Population, Infrastructure, and Economic Activity. The result will be a list of all available data that falls under the searched heading.

4.2 Data found under each main heading of the P-I-E Data section of the Online Information Warehouse

Population
Population data was obtained from the US Census Bureau, Population Division. The Population Division provides annual population estimates at the national, state, and local level, and conducts a population census each decade. Population data currently found in the UAH transportation research online information warehouse:

- Total population of all counties in Alabama from the period 1980-2006. Table 4.1 presents an example of the data for total population of several Alabama counties.

Population of Alabama by County 1980 - 2006							
	Census 1980	1985	Census 1990	1995	Census 2000	2005	2006
United States	226,545,805	237,923,795	248,790,925	262,803,276	281,421,906	296,507,061	299,398,484
Alabama	3,893,888	3,972,523	4,040,389	4,262,731	4,447,100	4,548,327	4,599,030
Autauga	32,259	32,245	34,222	39,112	43,671	48,454	49,730
Baldwin	78,556	89,401	98,280	120,896	140,415	162,749	169,162
Barbour	24,756	25,002	25,417	27,854	29,038	28,291	28,171
Bibb	15,723	16,157	16,598	18,507	20,826	21,454	21,482
Blount	36,459	37,417	39,248	44,060	51,024	55,572	56,436
Bullock	10,596	10,777	11,042	11,431	11,714	11,011	10,906
Butler	21,680	22,427	21,892	21,824	21,399	20,642	20,520
Calhoun	119,761	118,644	116,032	116,790	112,249	112,242	112,903
Chambers	39,191	38,614	36,876	37,179	36,583	35,373	35,176
Cherokee	18,760	18,890	19,543	21,871	23,988	24,592	24,863
Chilton	30,612	31,560	32,458	35,537	39,593	41,648	41,953
Choctaw	16,839	16,710	16,018	16,195	15,922	14,727	14,656
Clarke	27,702	27,419	27,240	27,455	27,867	27,082	27,248
Clay	13,703	13,700	13,252	13,590	14,254	13,920	13,829
Cleburne	12,595	12,659	12,730	13,080	14,123	14,521	14,700
Coffee	38,533	40,386	40,240	43,174	43,615	45,448	46,027
Colbert	54,519	52,858	51,666	53,702	54,984	54,597	54,766
Conecuh	15,884	15,029	14,054	14,322	14,089	13,227	13,403
Coosa	11,377	11,033	11,063	11,952	12,202	11,133	11,044
Covington	36,850	37,152	36,478	37,489	37,631	36,969	37,234
Crenshaw	14,110	13,899	13,635	13,585	13,665	13,598	13,719
Cullman	61,642	65,039	67,613	73,037	77,483	79,747	80,187
Source: U.S Census Bureau, Population Division							

Table 4.1 – Population of Alabama by County 1980 – 2006

- Total population of Alabama by age group from 1980-2006. Population for the age group categories 0-17, 18-34, 35-64, and 65+years is illustrated in Table 4.2.

Population of Alabama by Age Group 1980-2006				
	0-17	18-34	35-64	65+
1980	1,162,248	1,113,755	1,177,870	440,015
1981	1,142,241	1,113,755	1,177,870	450,370
1982	1,120,767	1,139,820	1,186,100	458,969
1983	1,103,928	1,138,618	1,206,875	465,943
1984	1,092,755	1,140,659	1,223,573	474,533
1985	1,089,123	1,140,865	1,243,673	482,802
1986	1,088,506	1,138,687	1,261,908	490,738
1987	1,085,912	1,131,710	1,280,608	499,733
1988	1,079,280	1,125,950	1,303,662	506,871
1989	1,069,557	1,115,549	1,322,148	514,608
1990	1,064,350	1,093,280	1,362,899	519,860
1991	1,054,525	1,095,706	1,411,670	529,124
1992	1,061,262	1,092,041	1,448,761	537,205
1993	1,068,870	1,091,851	1,487,141	545,252
1994	1,075,172	1,084,812	1,521,931	551,050
1995	1,083,152	1,074,056	1,548,742	556,781
1996	1,079,316	1,067,654	1,581,964	561,469
1997	1,084,747	1,059,028	1,611,470	565,036
1998	1,075,159	1,059,487	1,649,504	566,887
1999	1,066,177	1,054,143	1,681,590	567,952
2000	1,123,422	1,042,627	1,701,253	579,798
2001	1,118,557	1,039,824	1,723,596	584,641
2002	1,113,289	1,038,259	1,738,456	587,567
2003	1,108,511	1,042,337	1,751,567	592,674
2004	1,106,522	1,044,742	1,769,304	596,874
2005	1,107,079	1,045,136	1,790,429	605,683
2006	1,114,301	1,049,388	1,819,744	615,597
Source: US Census Bureau, Population Division				

Table 4.2 – Population of Alabama by Age Group 1980 – 2006

- Total population of the state of Alabama compared to the population of the states that make up the Southeastern United States for the period 1980-2006. Population comparison data is depicted in Table 4.3.

Population of South Eastern United States 1980 - 2006							
	Census 1980	1985	Census 1990	1995	Census 2000	2005	2006
United States	226,545,805	237,923,795	248,790,925	262,803,276	281,421,906	296,507,061	299,398,484
Alabama	3,893,888	3,972,523	4,040,389	4,262,731	4,447,100	4,548,327	4,599,030
Arkansas	2,286,435	2,327,046	2,350,624	2,480,121	2,673,400	2,775,708	2,810,872
Florida	9,746,324	11,351,118	12,938,071	14,185,403	15,982,378	17,768,191	18,089,888
Georgia	5,463,105	5,962,661	6,478,149	7,188,538	8,186,453	9,132,553	9,363,941
Kentucky	3,660,777	3,694,826	3,686,892	3,855,248	4,041,769	4,172,608	4,206,074
Mississippi	2,520,638	2,588,102	2,575,475	2,690,788	2,844,658	2,908,496	2,910,540
North Carolina	5,881,766	6,253,954	6,632,448	7,185,403	8,049,313	8,672,459	8,856,505
South Carolina	3,121,820	3,303,209	3,486,316	3,699,943	4,012,012	4,246,933	4,321,249
Tennessee	4,591,120	4,715,296	4,877,203	5,241,168	5,689,283	5,955,745	6,038,803
Virginia	5,346,818	5,715,153	6,189,197	6,601,392	7,078,515	7,564,327	7,642,884
West Virginia	1,949,644	1,906,831	1,793,477	1,820,560	1,808,344	1,814,083	1,818,470
Source: U.S Census Bureau, Population Division							

Table 4.3 – Population of South Eastern United States 1980 – 2006

- Alabama population projected to 2025. Population projection data is based on trends between the 1990 and 2000 census, and was obtained from the Center for Business and Economic Research at the University of Alabama. Table 4.4 shows population projections for a number of counties in Alabama.

Alabama County Population Projections 2010-2025					
	Census 2000	2010	2015	2020	2025
Autauga	43,671	53,469	58,273	63,217	68,368
Baldwin	140,415	184,375	206,251	227,727	248,436
Barbour	29,038	31,871	33,156	34,290	35,246
Bibb	20,826	24,861	26,910	28,889	30,749
Blount	51,024	63,715	70,005	76,031	81,713
Bullock	11,714	12,145	12,343	12,498	12,578
Butler	21,399	20,806	20,640	20,543	20,447
Calhoun	112,249	112,184	112,392	112,536	112,472
Chambers	36,583	36,355	36,404	36,477	36,532
Cherokee	23,988	28,320	30,407	32,384	34,220
Chilton	39,593	47,398	51,347	55,242	59,022
Choctaw	15,922	15,813	15,755	15,672	15,568
Clarke	27,867	28,450	28,759	29,052	29,365
Clay	14,254	15,277	15,738	16,160	16,553
Cleburne	14,123	15,409	15,983	16,487	16,920
Coffee	43,615	46,526	47,860	49,112	50,303
Colbert	54,984	57,311	58,208	58,934	59,484
Conecuh	14,089	14,133	14,155	14,148	14,101
Coosa	12,202	13,127	13,478	13,727	13,875
Covington	37,631	38,150	38,262	38,315	38,294
Crenshaw	13,665	13,710	13,738	13,738	13,714
Cullman	77,483	86,982	91,341	95,358	98,897
Source: The University of Alabama, Center for Business and Economic Research					

Table 4.4 – Alabama County Population Projections 2010-2025

- Data on certain components of population change can also be found under the population heading in the P-I-E Data section of the online information warehouse. Table 4.5 highlights birth and death data for Alabama for the period 1980-2005.

Total Births and Deaths in Alabama 1980 - 2005		
	Births	Deaths
1980	63,405	35,305
1981	61,497	35,348
1982	60,296	34,957
1983	59,057	35,471
1984	59,104	36,431
1985	59,663	37,531
1986	59,441	37,690
1987	59,558	37,681
1988	60,718	39,077
1989	62,530	38,924
1990	63,420	39,335
1991	62,798	40,024
1992	62,226	39,199
1993	61,588	41,232
1994	60,836	41,631
1995	60,264	42,321
1996	60,460	42,806
1997	60,887	43,208
1998	62,025	43,905
1999	62,070	44,720
2000	63,166	44,967
2001	60,295	45,196
2002	58,867	46,017
2003	59,356	46,598
2004	59,170	46,019
2005	60,262	46,797
Source: Alabama Vital Statistics 2005, Center for Health Statistics, Statistical Analysis Division		

Table 4.5 – Total Births and Deaths in Alabama 1980 - 2005

Infrastructure

- Interstate and total estimated Lane Miles and Vehicle Miles Travelled in Alabama data from 1980-2005 was obtained from the U.S. Department of Transportation, Federal Highway Administration. Tables 4.6 and 4.7 illustrate lane miles and vehicle miles travelled respectively for the above stated period.

Alabama: Lane Miles 1980-2005		
	Interstate Lane Miles	Total Lane Miles
1980	3,250	180,870
1985	3,654	181,485
1990	3,775	187,597
1995	3,854	193,124
2000	3,873	195,298
2001	3,875	195,652
2002	3,889	195,680
2003	3,890	195,683
2004	3,894	197,892
2005	3,930	199,093
Source: U.S. Department of Transportation, Federal Highway Administration Highway Statistics		

Table 4.6 – Alabama: Lane Miles 1980-2005

Alabama: Annual Vehicle - Miles Travelled 1980-2005		
	Interstate Annual Vehicle Miles Traveled (millions)	Total Annual Vehicle Miles Traveled (millions)
1980	4,144	29,027
1985	5,762	35,091
1990	7,995	42,347
1995	10,082	50,628
2000	11,989	56,534
2001	12,159	56,769
2002	12,255	57,515
2003	12,547	58,637
2004	12,939	59,035
2005	13,321	58,637
Source: U.S. Department of Transportation, Federal Highway Administration Highway Statistics		

Table 4.7 – Alabama Annual Vehicle Miles Travelled 1980-2005

- The total number of bridges in Alabama that are functionally obsolete or structurally deficient over the period 1992-2006 information was obtained from the Federal Highway Administration, Bridge Inventory. Table 4.8 shows bridge condition data for Alabama.

Bridge Conditions of Alabama Road Systems 1992-2006					
	Total Bridges	Total Structurally Deficient	Total Functionally Obsolete	Total Deficient	Total Non-Deficient
1992	15,388	3,513	2,208	5,721	9,667
1993	15,426	3,112	2,229	5,341	10,085
1994	15,418	3,021	2,180	5,201	10,217
1995	15,446	2,888	2,178	5,066	10,380
1996	15,458	2,805	2,203	5,008	10,450
1997	15,516	2,772	2,159	4,931	10,585
1998	15,591	2,767	2,198	4,965	10,626
1999	15,636	2,863	2,223	5,086	10,550
2000	15,635	2,846	2,208	5,054	10,581
2001	15,641	2,677	2,245	4,922	10,719
2002	15,697	2,611	2,276	4,887	10,810
2003	15,715	2,588	2,302	4,890	10,825
2004	15,648	2,393	2,286	4,679	10,969
2005	15,703	2,248	2,240	4,488	11,215
2006	15,879	2,102	2,205	4,307	11,572
Source: Federal Highway Administration, National Bridge Inventory					

Table 4.8 – Bridge Conditions of Alabama Road Systems 1992-2006

- The infrastructure section of the P-I-E Data section of the Online Information Warehouse also contains charts depicting Traffic Level and Average Annual Daily Traffic by mile marker for major interstates and highways in Alabama. The traffic data was obtained from the Alabama Department of Transportation, Traffic AADT Database.

Figure 4.1 illustrates the annual average daily traffic by mile marker on Interstate 65 for 1985, 1990, 1995, 2000, and 2004.

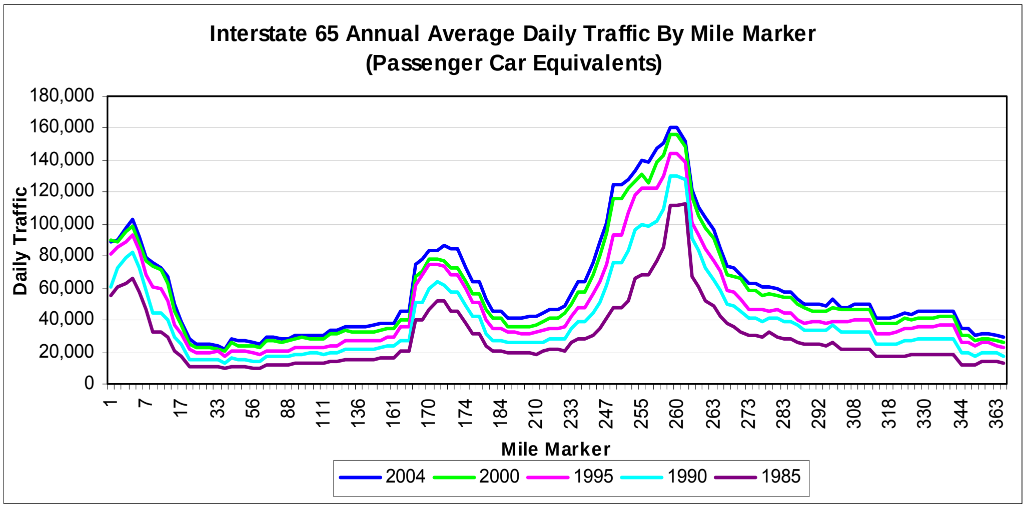

Figure 4.1 – Annual Average Daily Traffic by Mile Marker on Interstate 65

Figure 4.2 illustrates the traffic level by mile marker in 2004 on Interstate 65

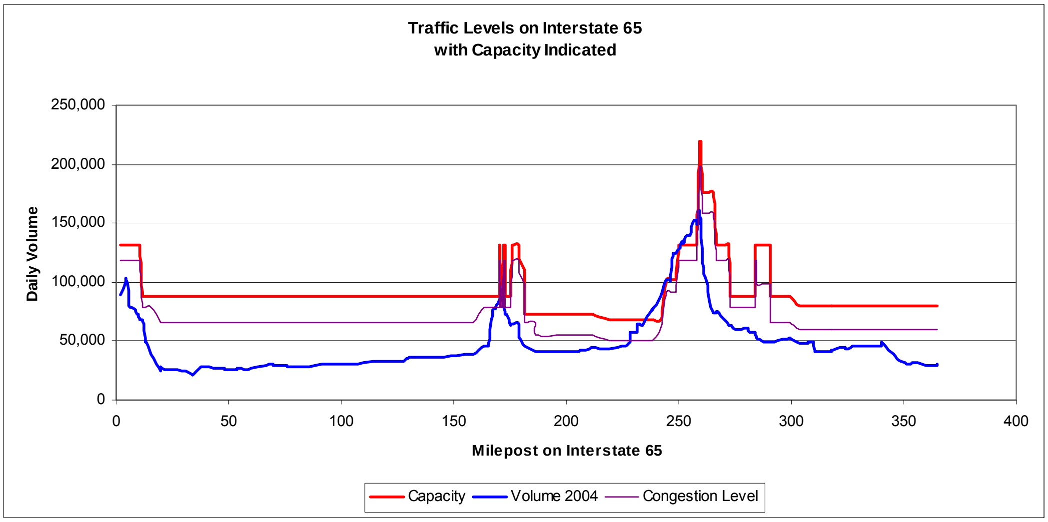

Figure 4.2 –Traffic Level by Mile Marker on Interstate 65

- Urban Area Annual Hours of Delay per Traveler and Travel Time Index from 1982-2005, obtained from the Texas Transportation Institute (TTI) 2007 Urban Mobility Report.

Figure 4.3 shows the change in annual hours of delay for travelers in urban areas from 1982-2005 for 11 cities in the United States. Alabama is represented by the city of Birmingham for the TTI 2007 Urban Mobility Study.

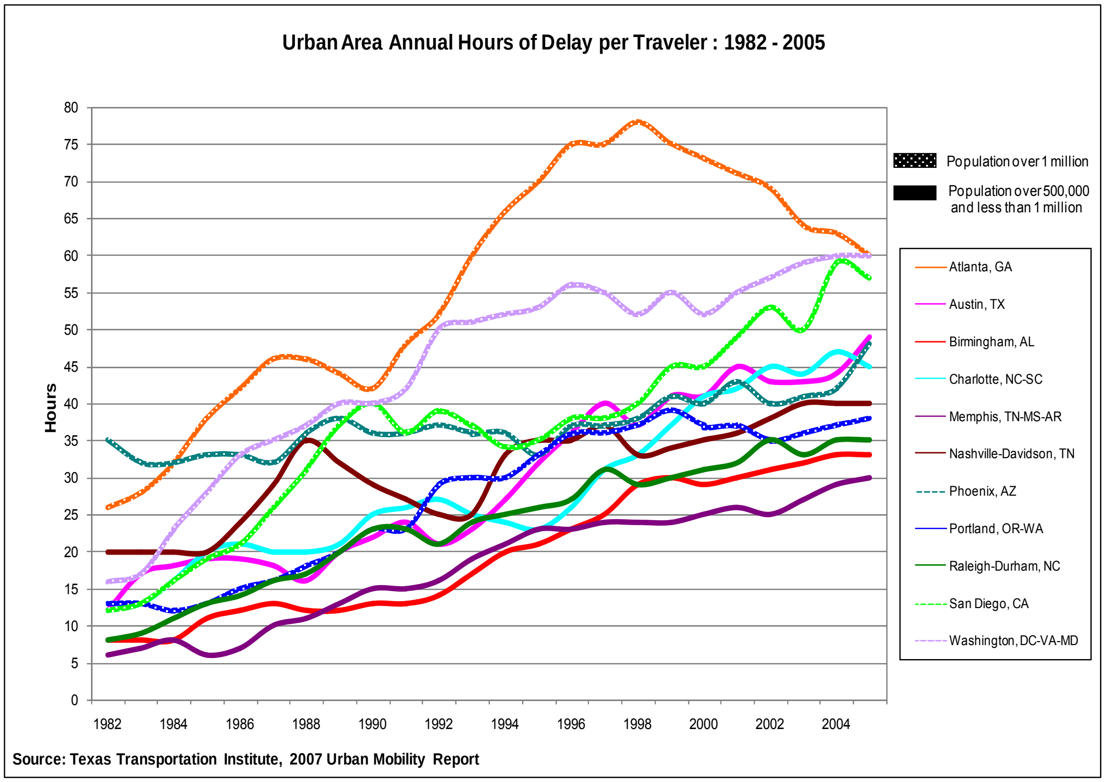

Figure 4.3 –Urban Area Annual Hours of Delay per Traveler: 1982-2005

Annual Delay per Traveler is the extra travel time for an area divided by the estimated number of people travelling during peak periods (6 to 9 am and 4 to 7pm).

Figure 4.4 presents the change in Travel Time Index from 1982-2005. Travel Time Index is the ratio of travel time during the peak period to the travel time during off peak (free flow) period. For example a travel time index of 1.25 means average peak travel times are 25% longer than off peak (free flow) travel times, therefore, a 40 minute trip during off peak period would take 50 minutes during peak period.

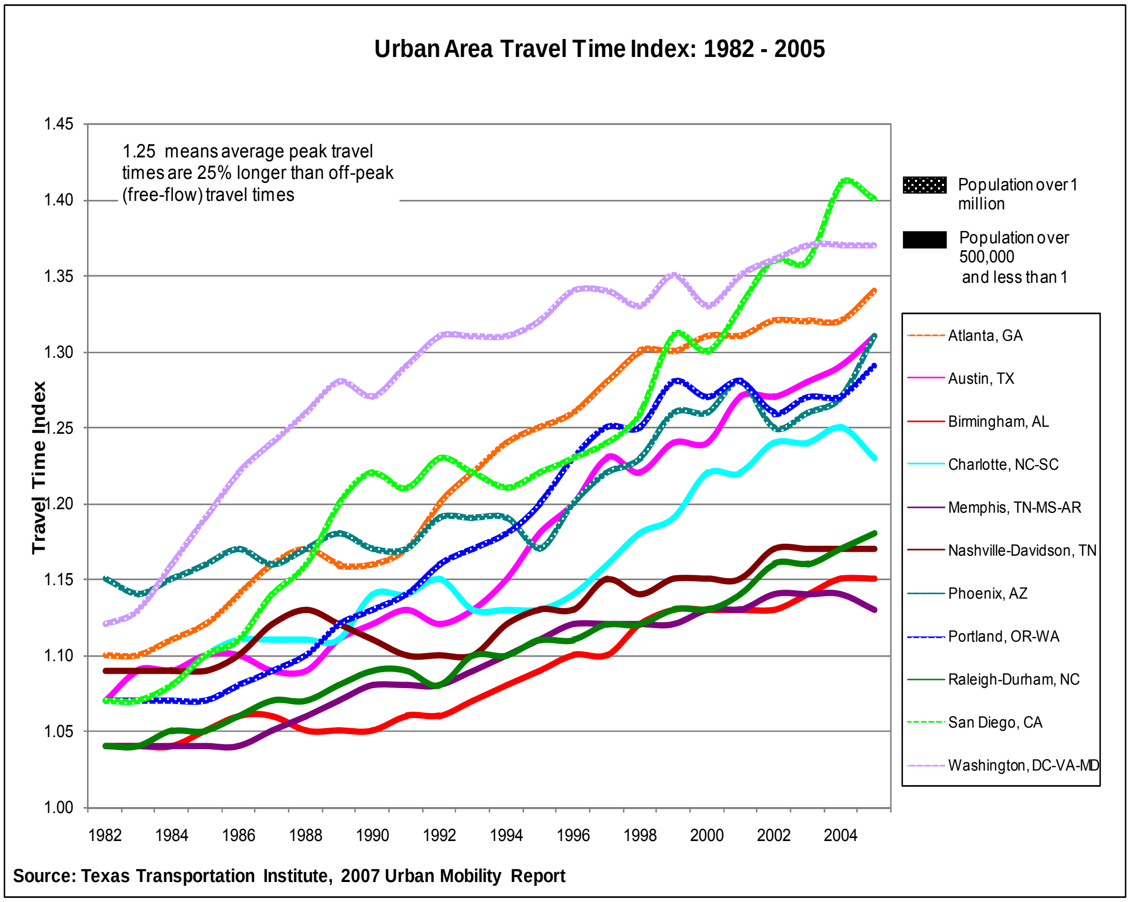

Figure 4.4 – Urban Area Travel Time Index: 1982-2005

Economic

Economic data currently found in the UAH online information warehouse includes Employment by industry for the state of Alabama from 1980-2006, obtained from the Bureau of Economic Analysis. 1980-1989 data is based on the 1972 and 1987 Standard Industrial Classification (SIC), and 1990-2006 data is based on the 2002 North American Industry Classification System.

- Table 4.9 and 4.10 shows industry employment from 1980-1989 and 1990-2006 respectively, for several industries that are part of the economy of Alabama.

Alabama Industry Employment based on the Standard Industrial Classification (SIC): 1980-1989										
Industry	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
Total employment	**1,735,992**	**1,724,213**	**1,692,494**	**1,722,047**	**1,786,763**	**1,830,870**	**1,867,726**	**1,922,545**	**1,981,827**	**2,019,228**
Farm employment	**83,371**	**79,564**	**75,807**	**79,965**	**75,998**	**72,452**	**65,583**	**64,775**	**64,788**	**63,332**
Agricultural services, forestry, fishing and other	**11,044**	**11,948**	**11,504**	**12,630**	**13,538**	**14,147**	**14,844**	**16,318**	**16,347**	**16,672**
Agricultural services	7,148	7,407	7,538	8,668	9,467	9,966	10,614	12,634	12,735	13,155
Forestry, fishing, and other	3,896	4,541	3,966	3,962	4,071	4,181	4,230	3,684	3,612	3,517
Mining	**17,765**	**16,960**	**16,813**	**14,843**	**15,631**	**16,247**	**14,035**	**12,852**	**12,878**	**13,248**
Metal mining	(D)	(D)	78	98	91	75	(D)	(D)	(D)	(D)
Coal mining	12,755	11,680	11,898	9,824	10,055	10,461	9,001	8,053	7,600	7,165
Oil and gas extraction	2,363	2,812	2,603	2,746	3,149	3,278	2,598	(D)	(D)	(D)
Nonmetallic minerals, except fuels	(D)	(D)	2,234	2,175	2,336	2,433	(D)	(D)	2,414	2,673
Construction	**91,967**	**85,258**	**78,911**	**82,263**	**89,771**	**98,003**	**104,126**	**107,474**	**112,048**	**112,805**
Manufacturing	**376,238**	**374,160**	**347,782**	**352,110**	**372,756**	**371,532**	**372,820**	**379,595**	**390,666**	**396,677**
Durable goods	185,926	183,552	165,763	167,485	184,465	185,588	184,048	184,629	189,909	193,881
Lumber and wood products	35,364	32,474	29,984	32,945	35,775	35,823	35,259	33,753	33,995	34,124
Furniture and fixtures	8,237	8,894	8,645	9,481	10,341	10,484	10,674	10,751	10,523	10,801
Stone, clay, and glass products	10,554	10,284	9,370	9,770	9,909	10,194	10,724	10,346	10,282	9,884
Primary metal industries	39,486	37,434	29,795	24,995	26,833	26,544	25,229	25,477	27,007	26,839
Fabricated metal products	25,590	26,036	23,353	22,039	23,765	23,427	23,096	22,524	22,141	24,393
(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the total.										
Source: U.S. Department of Commerce, Bureau of Economic Analysis										

Table 4.9 – Alabama Employment by SIC Industry 1980-1989

Alabama Industry Employment based on the North American Industry Classification System (NAICS): 1990-2006									
Industry	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Total employment	**2,061,101**	**2,256,073**	**2,416,422**	**2,392,552**	**2,387,215**	**2,396,939**	**2,462,638**	**2,529,649**	**2,590,644**
Farm employment	**63,007**	**59,789**	**56,061**	**54,914**	**55,360**	**53,582**	**53,467**	**52,133**	**52,156**
Forestry, fishing, related activities, and other	**19,150**	**22,100**	**20,120**	**(D)**	**19,879**	**18,284**	**18,829**	**18,664**	**18,513**
Forestry and logging	9,569	10,887	9,330	(D)	8,832	8,427	8,725	8,979	9,127
Fishing, hunting, and trapping	1,397	(T)	1,885	1,650	1,955	1,455	1,659	1,623	1,747
Agriculture and forestry support activities	8,184	9,618	8,905	8,693	9,092	8,402	8,445	8,062	7,639
Mining	**13,171**	**11,736**	**9,630**	**9,551**	**9,263**	**9,151**	**9,071**	**9,867**	**10,070**
Oil and gas extraction	1,688	1,648	1,634	1,843	1,657	1,970	1,781	1,944	1,964
Mining (except oil and gas)	9,536	8,906	6,994	6,736	6,653	6,302	6,312	6,807	6,940
Support activities for mining	1,947	1,182	1,002	972	953	879	978	1,116	1,166
Utilities	**15,785**	**14,838**	**14,652**	**14,685**	**14,272**	**13,872**	**13,830**	**13,085**	**13,418**
Construction	**123,092**	**137,649**	**160,325**	**160,742**	**154,090**	**156,284**	**164,962**	**175,483**	**185,323**
Manufacturing	**366,316**	**377,799**	**355,616**	**337,240**	**316,901**	**301,615**	**299,929**	**306,993**	**312,490**
Durable goods manufacturing	175,482	183,574	192,197	183,339	177,351	169,880	173,515	183,770	193,185
Wood product manufacturing	21,586	26,518	27,210	24,762	23,932	22,236	22,353	22,607	23,299
Nonmetallic mineral product manufacturing	8,721	9,114	9,422	9,384	8,994	8,709	8,709	8,867	9,496
Primary metal manufacturing	24,872	24,610	22,964	21,185	19,201	18,406	18,000	18,663	18,589
Fabricated metal product manufacturing	28,141	29,783	30,007	29,431	28,709	28,238	28,227	29,071	30,356
(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the total.									
(T) Estimate for employment suppressed to cover corresponding estimate for earnings. Estimates for this item are included in the total.									
Source: U.S. Department of Commerce, Bureau of Economic Analysis									

Table 4.10 – Alabama Employment by NAICS Industry 1990-2006

- Alabama Civilian Labor Force by Gender for the period 1980-2004 data was obtained from the Bureau of Labor Statistics. Table 4.11 illustrates civilian labor force data over the aforementioned period.

Alabama: Civilian Labor Force by Gender 1980-2004								
	Men in Civilian Labor Force				Women in Civilian Labor Force		
Year	Employed	Unemployed	Total		Employed	Unemployed	Total
1980	882	72	954		616	71	687
1981	855	91	946		632	87	719
1982	834	136	970		632	111	743
1983	858	136	994		663	104	767
1984	911	99	1,010		683	101	784
1985	927	84	1,011		716	76	792
1986	927	94	1,021		771	91	862
1987	972	73	1,045		774	74	848
1988	983	66	1,049		768	70	838
1989	993	64	1,057		780	70	850
1990	986	66	1,052		775	64	839
1991	975	72	1,047		794	67	861
1992	995	69	1,064		822	76	898
1993	1,012	79	1,091		833	73	906
1994	1,043	51	1,094		870	70	940
1995	1,034	71	1,105		898	58	956
1996	1,047	54	1,101		938	54	992
1997	1,116	51	1,167		948	59	1,007
1998	1,119	40	1,159		943	51	994
1999	1,088	51	1,139		955	51	1,006
2000	1,074	50	1,124		981	49	1,030
2001	1,069	59	1,128		964	56	1,020
2002	1,040	63	1,103		938	61	999
2003	1,064	60	1,124		958	64	1,022
2004	1,096	61	1,157		957	66	1,023
Source: Bureau of Labor Statistics, Current Population Survey							

Table 4.11 – Alabama Civilian Labor Force by Gender 1980-2004

- Education enrolment for Alabama from 1980-2004. Enrolment data was acquired from the National Center for Education Statistics. Enrolment for Elementary, Secondary, and Post-Secondary education is shown in Table 4.12.

Alabama: Enrollment by Education Level 1980-2005							
	1980	1985	1990	1995	2000	2004	2005
Elementary	492,176	463,766	473,030	470,246	472,686	466,920	466,164
Secondary	230,968	213,099	194,709	206,840	201,358	205,907	212,414
Post Secondary	328,612	358,686	437,178	451,224	467,924	511,652	
Source: National Center for Education Statistics (NCES)							

Table 4.12 – Alabama: Enrollment by Education Level

4.3 Presentations, Publications, and Reports

The main page for the presentations, publications, and reports section of the Online Information Warehouse will contain the following:

A brief explanation of its contents
This section consists of presentations, publications, and reports published and/or delivered by UAH transportation researchers.

A searchable feature
This feature will allow the user to perform searches by keywords, author's name, title, and topic area. The result of this search will be a list of available data that falls under the search criteria. Each item in the list will be a link to the PDF document, and for publications additional information about the item, namely: title, publication year, author, and abstract.

4.4 Project Images

Figures 4.5 and 4.6 illustrate the interim web pages of the Online Information Warehouse.

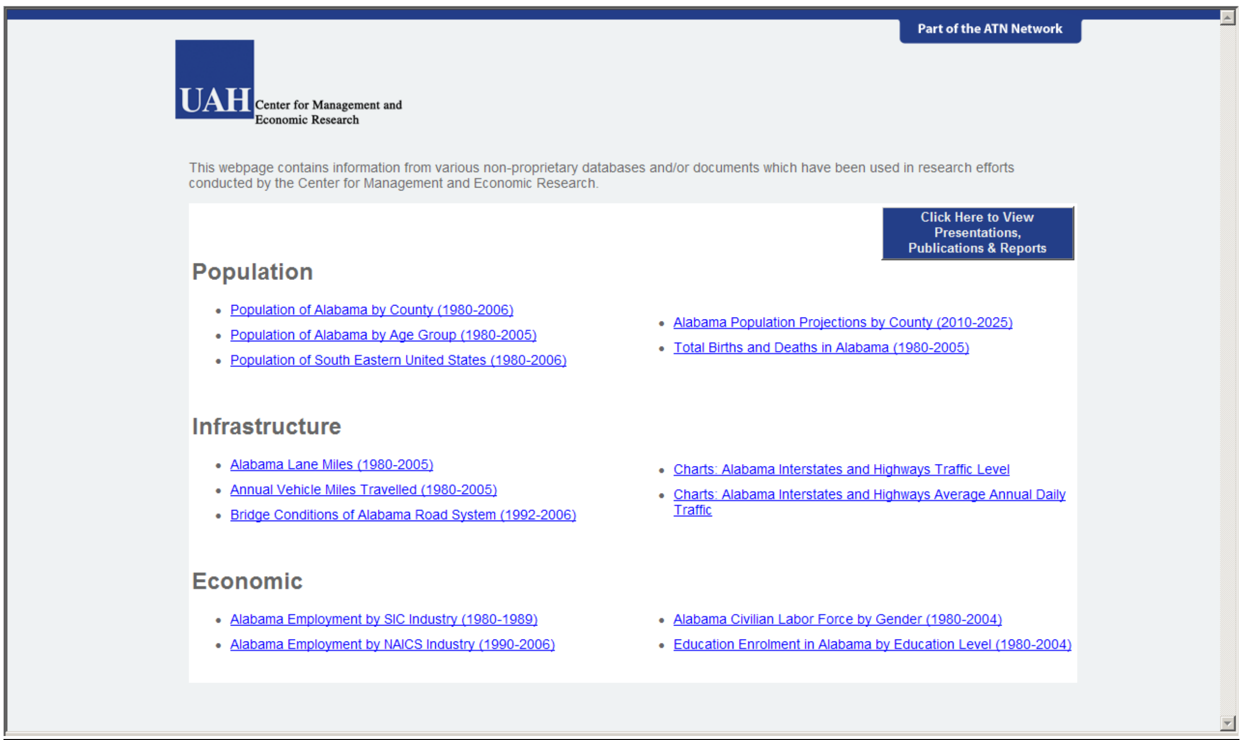

Figure 4.5 –Population, Infrastructure, and Economic Activity (P-I-E) Interim Webpage

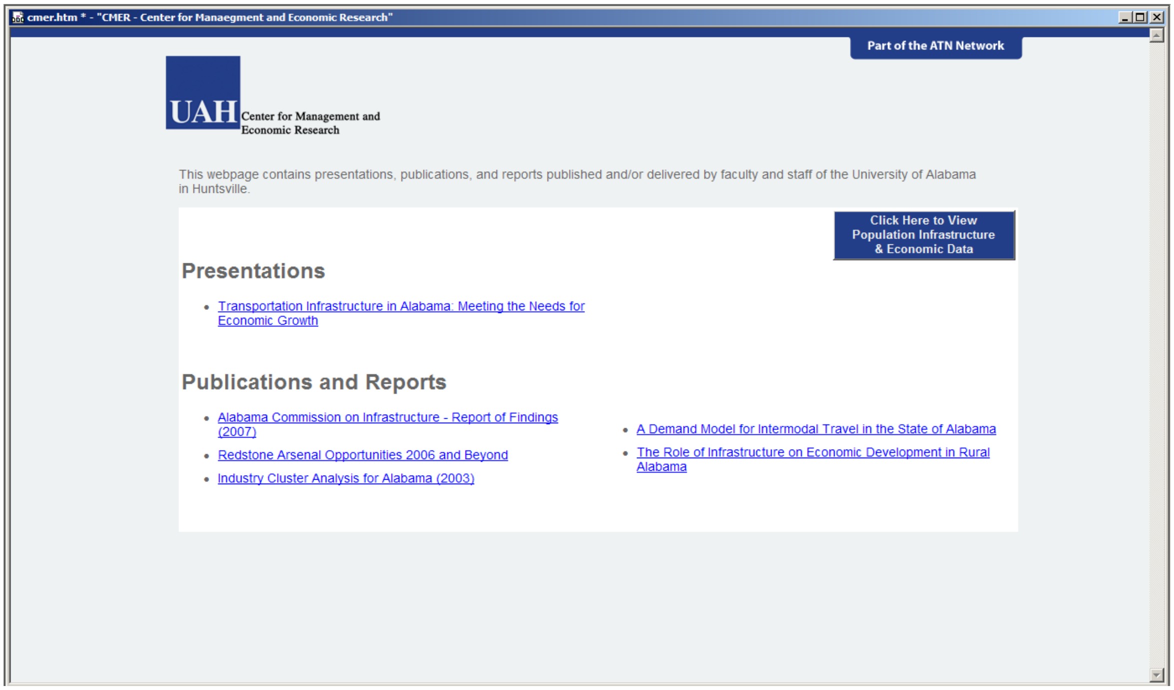

Figure 4.6 – Presentations, Publications, and Reports Interim Webpage

Figures 4.7 and 4.8 illustrate the proposed main pages of the Online Information Warehouse.

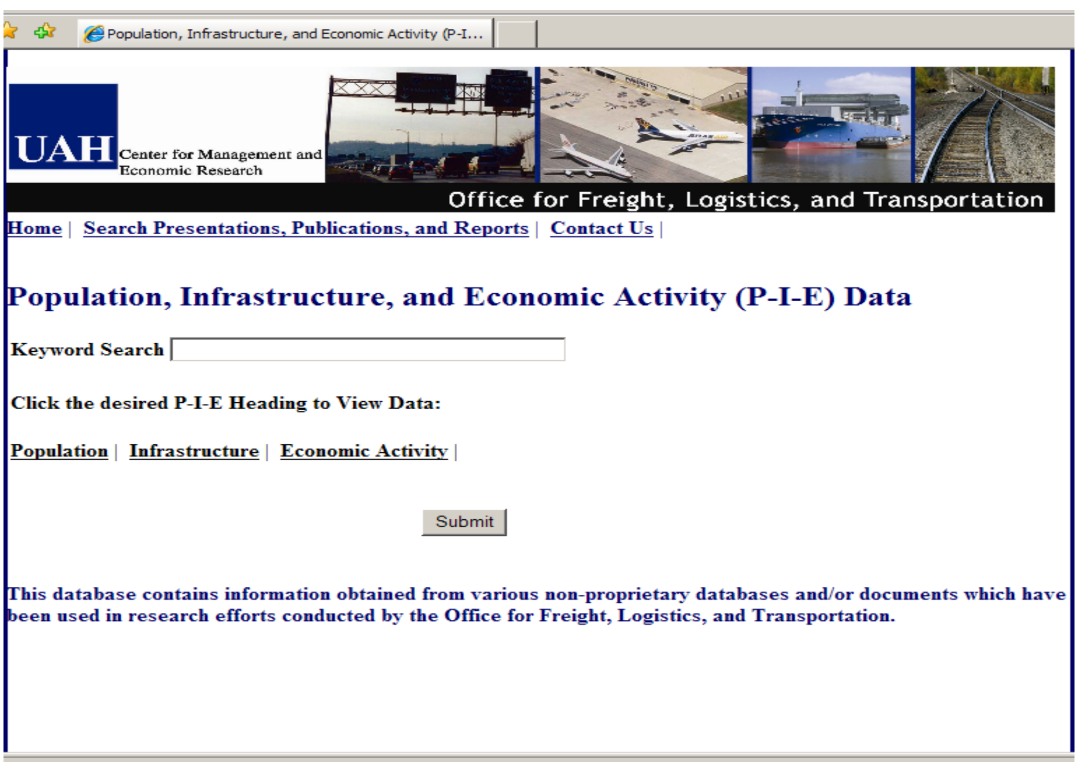

Figure 4.7 – Main Page of the Population, Infrastructure, and Economic Activity (P-I-E) Database

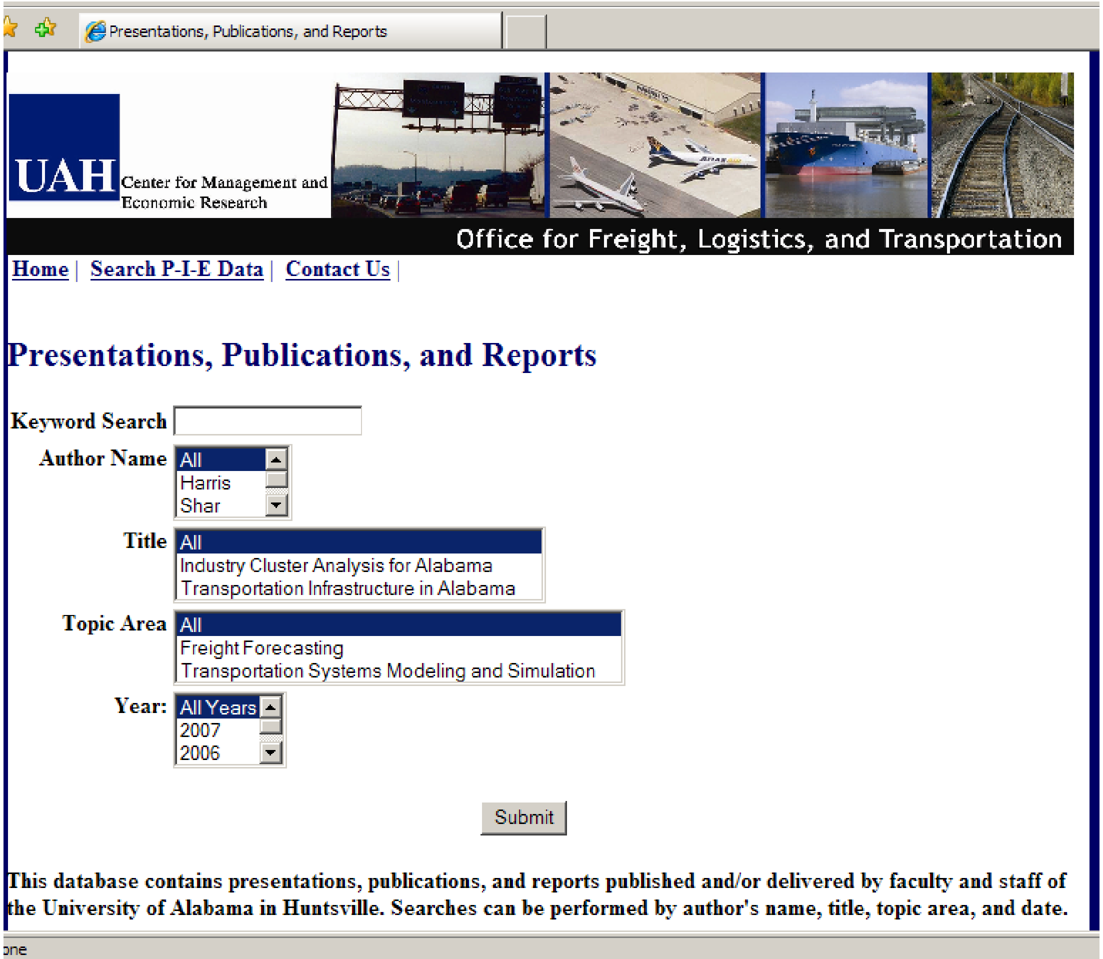

Figure 4.8 – Main Page of the Presentations, Publications, and Reports Database

4.5 Conclusions

Transportation and freight planning requires immediate access to a broad array of data. Moreover, transportation planning is rapidly becoming focused on regions that cut across metropolitan areas, counties, and even states. The online information warehouse is designed to aid all transportation planners whose regions include all or part of Alabama.

5. Conclusions and Next Steps

Research on transportation infrastructure in Alabama completed by UAH since 2003 has created significant awareness of the tie between infrastructure and economic growth in the state. Evidence of this new awareness can be found in the creation of a Legislative Commission on Infrastructure initiated in January of 2006 by the Speaker of the Alabama House of Representatives, the Honorable Seth Hammett. The purpose of this commission is to investigate and evaluate the state of infrastructure in Alabama and develop solutions to constraints within the system that hold back economic progress. In recognition of the research that initiated the commission, a Research Committee, staffed by the transportation research team at UAH, was established as an official committee of the commission to support the Freight, Non-Freight, Maintenance, and Economic Development committees with research and guidance. The full report of the Commission on Infrastructure is located in Appendix B.

The work of the Commission on Infrastructure led to the introduction of several Bills in the 2007 legislative session. A list of the Bills can be found in Appendix C of this report. Four bills were passed by the House of Representatives and one bill made it out of committee in the Senate prior to the end of the session. The Bills are scheduled to be re-introduced in the next legislative session (February 2008).

The Office for Freight, Logistics and Transportation (OFLT) at UAH has developed an excellent working relationship with the Alabama Department of Transportation (ALDOT) and is considered a transportation planning information resource by the department. ALDOT requested that the Statewide Transportation Plan consultant, Carter-Burgess, engage the OFLT to include the freight projections from our models as part of the new 5-year transportation plan. OFLT has provided the initial information requested and will be continuing to work with Carter-Burgess on the future projections.

The Alabama Development Office (ADO) and Alabama Department of Economic and Community Affairs (ADECA), agencies of the state government, view the research performed by the OFLT at UAH as vital to continued economic growth Alabama.

5.1 Current Research Streams

The success of the previously described research led to the establishment of the Office for Freight, Logistics and Transportation (OFLT) at UAH. The OFLT research team consists of full time research staff and faculty from the Colleges of Engineering and Business Administration. Expertise in specific areas of research has led the team to focus on four research streams:

- Freight Forecasting, Planning, and Analysis
- Transportation Systems Modeling & Simulation
- Interrelationships between Infrastructure, Economic Activity, and Population
- Productivity Enhancements in Transportation, Logistics, and Supply Chain

5.1.1 Freight Forecasting, Planning and Analysis

Passenger car forecasting techniques have been studied and improved for over half a century, but freight modeling has often been neglected by the planning community or at best considered only at minimal levels. The application of backward-looking data analysis and forward-projecting trend line forecasting has been the traditional method of freight planning in the U.S. The explosive growth of global supply chains and international trade has shown this method of analysis and planning to be wholly inadequate for the economic environment of today. A deficiency of trend line forecasting is its inability to provide adequate insight into the dynamics of existing and future economic environment, at best assuming that whatever has happened in the past is going to be replicated in the future. In fact, the use of trend line forecasting in 1992 would have (and did) completely miss the advent and growth of the automotive industry in Alabama, which now consists of three Original Equipment Manufacturers and more than 300 suppliers.

Freight planning typically has taken a back seat to urban traffic planning. Traffic planners are generally skeptical of the truck data provided by the state Department of Transportation (DOT). This is due to lack of confidence in the collection procedures and resulting values, frequently presented as a percentage of overall traffic. The planners often contend that it is better not use the DOT provided information rather than introducing incorrect or suspect data. Nevertheless, problems related to truck traffic growth will be a long-term issue for transportation planners. Aging infrastructure is stressed to breaking limits and capacity is significantly slower to add than needs appear. It is important to develop a better method for analyzing and forecasting freight demand on transportation infrastructure.

The research completed last year at UAH in developing a comprehensive approach to freight forecasting, planning and analysis is one of the first efforts to provide transportation planners with tools adequate to perform the required tasks of integrating freight into the transportation planning process. The Freight Planning Framework developed at UAH provides a foundation and guide for needed research that will bring freight planning to the level of planning for passenger car travel. Research into the comprehensive approach to freight planning will be a main focus of the research at UAH in the future.

5.1.2 Transportation Systems Modeling and Simulation

Communication of current and future transportation infrastructure usage and condition is a vital aspect of developing consensus to solutions. Industry growth and development in a region can create a much higher demand on the transportation infrastructure than would be indicated by historical data. The Alabama Transportation Infrastructure Model provides a way to evaluate the impact of changing freight patterns in order to more accurately plan for future transportation infrastructure needs. As a statewide transportation model, the ATIM will give stakeholders the ability to evaluate the impact of multiple solutions to issues in the state’s freight transportation system.

The ATIM can estimate how changes in the network or changes in utilization of network components will affect the performance of the overall transportation system. Moreover, it provides a means to effectively communicate the expected performance of system investment alternatives. This is accomplished through powerful visualization and animation presentations. Current metrics calculated and displayed by the ATIM include travel time, truck flow volumes, congestion indicators, zone utilization, and fuel mileage (measured in system ton-miles). Additional metrics can be added based on the specific goals of the alternative comparison under consideration.

In 2005/06 the model network and loading of highway data and expansion of the highway, rail and waterway networks was completed and validation of the highway mode initiated. The validation process included a preliminary qualitative validation of the highway infrastructure system based on Extreme World Scenarios. The validation effort brought to light needed model modifications and led to a more robust model. Still, the data needed to bring the rail and water modes of freight transport up to the level of the highway data is still underway. New and growing relationships are opening access to the data required from these other modes of transport.

5.1.3 Interrelationships Between Population, Infrastructure, and Economic Activity

The interrelationships between population, infrastructure and economic activity are continually evolving and changing. It is critical not only to understand the status and conditions of those relationships today, but to be in position to benefit from the inevitable changes to come. With regard to population, the demographics of Alabama will tend to follow the prevailing trends in the U.S. Gross population numbers will increase, but the labor force as a percentage of the population will decline due to the aging “baby boomer” generation. Highly skilled workers are needed in the advanced manufacturing, technology and knowledge based industries, creating a strain on the existing and future workforce. Growth in these industry sectors will create opportunities for the state to provide high paying jobs and attract workforce from other parts of the country. The customers of the education systems in the state (the industries seeking the appropriate workforce) are going to demand training that will move potential worker skill sets from lower-skilled service industry and basic industry to the higher level skills needed to support advanced manufacturing, technology and knowledge based jobs. Basic manufacturing will continue the decline that the sector has experienced as congestion grows. Congestion acts as a deterrent to workforce access. Once congestion reaches a level at which the cost of travel exceeds the ability to attract workers, the basic industry plants will relocate, either in a more rural, accessible area or to a lower wage environment. Growing congestion and workforce issues are potential constraints to investment in the advanced manufacturing, technology industries and knowledge based industries.

The approach used at UAH was to develop basic understanding utilizing multiple databases and reports from many industry sectors. This knowledge was then applied to develop models that forecast likely future conditions. Although this is important research, the system dynamics modeling has evolved to another level of complexity of which transportation and congestion are a small part. The workforce, population and education issues bring much more weight to the issues facing Alabama than the transportation infrastructure at this time. Research into the relationships between population, infrastructure and economic activity will continue as it relates to the development of freight forecasting, planning and analysis tool development.

5.1.4 Productivity Enhancements in Transportation, Logistics and Supply Chains

Productivity in transportation, logistics and supply chains must continue to improve if the economy in the United States is to remain competitive with the emerging economic powers throughout the world. The U.S. can no longer compete on the basis of lowest labor cost, but must sustain a competitive edge through the use of continuous improvement principles and the application of technology. The simulations developed to investigate and reproduce the activities in container and coal terminal ports have proven to be an inexpensive and valuable tool for determining where productivity improvements are needed and communicating the potential benefits of changes in operations or facilities to increase the efficient and effective movement of freight through ports of entry.

Personnel from the Alabama Technology Network Center at UAH, working with the OFLT, have been engaged with the Alabama State Docks in Mobile, Alabama to introduce lean enterprise principles and help create a culture of continuous improvement. Although work is still ongoing, results to date have been phenomenal. The throughput of coal at the McDuffie Island Coal Terminal has almost doubled since the UAH experts began training the workforce and facilitating improvement events. Results such as these indicate that there is much to be gained in the flow of freight through improving operational efficiency and effectiveness at ports and other logistics hubs.

Alabama is standing on the threshold of significant economic growth and the need for transportation infrastructure to carry the economy forward is greater now than ever. It is imperative to increase understanding of the nature of economic development and associated transportation needs. The next steps for transportation research at UAH will build on previous OFLT successes and will expand the body of knowledge within each of the four strategic research initiatives.

5.2 Next Steps

5.2.1 Development of Freight Analysis Zones

Usable freight data is elusive and difficult to assimilate into cohesive, applicable form. The best available data today is the Federal Highway Administration's Freight Analysis

Framework (FAF) database. The second generation of the Freight Analysis Framework (FAF) known as FAF2 is a continuation of the original Freight Analysis Framework developed by the U.S. Department of Transportation, Federal Highway Administration (FHWA). The Origin-Destination in the FAF2 data covers both the base year (2002) and future years between 2010 and 2035 with a 5-year interval. To use the FAF2 and survey data successfully, it is important to develop accurate conversion factors for turning the data into the number of shipment by mode that the data represents. Although there are difficulties in applying the FAF2 data to local research, it is the most comprehensive data publicly available.

The data provided by the FAF2 database is presented in a 114 origins and destinations format, of which Alabama comprises two zones. From this data, it is important to derive the potential freight that is destined for, originating from, passing through and internal to Alabama. The freight destined for and originating in Alabama is not difficult since that is only a sort of the existing FAF2 database. The freight that is simply passing through Alabama is a more difficult task. To determine what freight is passing through Alabama, all origin and destinations that do not include one of the Alabama points must be evaluated as to the route most likely to be taken. This must then be analyzed to determine whether or not that freight would pass through a highway in Alabama. The aggregate value for the internal Alabama traffic is easy to determine, as this also only requires a database sort. However, since the zone structure for the database is limited within the state and there are only two zones representing Alabama the development of an understanding of the freight patterns within the state is a challenge.

This highly aggregated data in the FAF2 database must be disaggregated to predict what segments of that freight will be destined for or originating in the particular points within Alabama. This disaggregation could be performed at a county level, a metropolitan level or in configured Freight Analysis Zones (FAZs). In a state such as Alabama, it might be feasible to perform the disaggregation at a county level since there are only 67 counties. However, using counties as the proposed disaggregation level is not efficient or effective when there are many counties within a state with negligible levels of freight activity. It does not justify the expenditure of resources to include them in an analysis as an independent entity when they could be aggregated into a larger regional freight zone. The use of metropolitan areas as a zone for analysis is efficient, but leaves out significant portions of state infrastructure that may need to be included in a freight analysis. The appropriate approach seems to be the development of FAZs sized such that each FAZ contains approximately equal proportions of freight activity. Researchers at UAH will continue the development of freight analysis zones to determine optimal levels at which freight analysis, planning and forecasting should be undertaken in Alabama.

Specific tasks to be performed:

- Develop the methodology for the establishment of Freight Analysis Zones in Alabama.

- Apply the FAZ methodology to freight in Alabama through the development of various freight flow models using the different zone structures.
- Perform analysis to compare different FAZ structures to county level freight planning zones to determine the benefits and costs.

5.2.2 Expansion and Enhancement of the Alabama Transportation Infrastructure Model (ATIM)

In 2006 the model network and loading of data was completed and validation of the highway mode began. Validation and calibration of the model is ongoing with alternative data sets needed. To validate the rail and waterway modes it is necessary to collect and analyze additional data. Access to this data is being pursued and headway should be made in the near future.

To determine the true capabilities of the ATIM the following specific activities will be undertaken:

- Regionalization through tying ATIM and VITS. The ATIM is built upon the same platform as the Mississippi VITS model. OFLT will pursue the uniting of the two models to investigate the ability of a discrete event simulation to provide meaningful data and analysis capability across state lines. This effort will require coordination with researchers in Mississippi to obtain statewide origin/destination flows or the potential development of a Mississippi planning model.

- Improve Graphics. The OFLT will work to improve the graphics of the ATIM. Improved graphics leads to improved communication of transportation issues to legislators and the general public.

- The application of system performance measures within ATIM. This effort ties in with another research project in OFLT of developing appropriate transportation system metrics.

- Exercise ATIM through running scenarios from other transportation entities. The ATIM will be used to support other transportation research throughout the state by running proposed scenarios for evaluating outcomes. Performance of the model will be documented to determine opportunities for enhancements.

- Develop a methodology for determining the time of day characteristics for rural roadways. The accuracy of discrete event simulation is dependent on understanding the underlying statistical distributions of entities within the system. Current traffic models assume that total vehicle trips on rural roadways can be distributed in the same pattern as in urban areas.

- Evaluation of Commuter Rail Service in an Alabama MPO. The research team will work with the Transportation Planning group in an Alabama MPO and the Alabama Department of Transportation to build a simulation model for evaluation of commuter rail service as a part of the overall transportation system.

5.2.3 Modeling Intermodal Operations Using Discrete Event Simulation

Conceptual simulation models of intermodal facilities can be used to identify needed improvements and the potential benefits of continuous improvement activities. The use of simulation for intermodal operations at the International intermodal Center at the Huntsville/Madison County International Airport and the Alabama State Docks in Mobile can be used to establish performance targets for planning future process improvement activities. UAH is focusing on developing models that will evaluate the effect of increasing freight volume on the immediate egresses to and from each facility and the resulting volumes on connector facilities in the region.

5.2.4 Continuous Improvement In Logistics & Transportation Systems

A study of best practice logistics operations is needed to better understand the opportunities Alabama has in the transportation and logistics industry sector identified in the 2005 report to U.S. DOT "Transportation Infrastructure in Alabama – Meeting the Needs for Economic Growth" produced with the support of the Office of the Secretary, U.S. Department of Transportation Grant No. DTTS59-03-G-00008. Some areas for research include:

- What are the best performing logistics companies?
- What are the characteristics of the best performing companies?
- How do their activities relate to lean thinking?
- Development of lean logistics & transportation principles.

5.2.5 Support the Online Information Warehouse for Alabama and the Tennessee Valley Region

State level economic data is a major component of the Freight Planning Framework being developed by OFLT. It is important to document the data and information used in previous research and add to the data and information as updated versions are available. The online information warehouse should continue to be a focus of the effort in transportation research. The data warehouse is expected to accessible via the Internet with links to various datasets and research reports developed and compiled by OFLT.

Table of Tables

Table of Figures

Appendix A

Figures A1 – A22 show the 2002 Employment, Value of Shipments, and Total Truckloads for each county in Alabama by NAICS industry code. The tables also include value of shipments and total truckloads projections for 2005, 2010 and 2015. The NAICS codes shown in the figures include:

- Food Manufacturing
- Beverage & Tobacco Product Manufacturing
- Textile Mills
- Textile Product Mills
- Apparel Manufacturing
- Wood Product Manufacturing
- Paper Manufacturing
- Printed and Related Support Materials
- Petroleum & Coal Products Manufacturing
- Chemical Manufacturing
- Plastics & Rubber Products Manufacturing
- Nonmetallic Mineral Products Manufacturing
- Primary Metal Manufacturing
- Fabricated Metal Product Manufacturing
- Machinery Manufacturing
- Computer & Electronic Products Manufacturing
- Electrical Equipment, Appliance, and Component Manufacturing
- Transportation Equipment Manufacturing
- Furniture & Related Product Manufacturing
- Miscellaneous Manufacturing
- Oil & Gas Extraction
- Coal Mining

Figures A23 – A25 show 2002 total truckload data by county and projections for 2005, 2010, and 2015. This data includes the following NAICS industries:

- Forestry & Logging
- Crop Production
- Animal Production

NAICS 311: Food Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	10	2,140	132	2,187	135	2,412	149	2,658	164
Baldwin	250	52,848	3,255	54,016	3,326	59,580	3,669	65,652	4,043
Barbour	1,498	316,234	19,475	323,223	19,905	356,516	21,955	392,852	24,193
Bibb	3	642	40	656	40	724	45	797	49
Blount	1,152	243,060	14,968	248,431	15,299	274,021	16,875	301,948	18,595
Bullock	953	201,123	12,386	205,568	12,659	226,742	13,963	249,851	15,387
Butler	0	0	0	0	0	0	0	0	0
Calhoun	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Chambers	10	2,140	132	2,187	135	2,412	149	2,658	164
Cherokee	35	7,489	461	7,654	471	8,443	520	9,303	573
Chilton	10	2,140	132	2,187	135	2,412	149	2,658	164
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	279	58,839	3,623	60,140	3,704	66,334	4,085	73,095	4,501
Cleburne	329	69,537	4,282	71,074	4,377	78,395	4,828	86,385	5,320
Coffee	1,713	285,565	17,586	291,876	17,975	321,940	19,826	354,752	21,847
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	61	12,838	791	13,121	808	14,473	891	15,948	982
Coosa	0	0	0	0	0	0	0	0	0
Covington	61	12,838	791	13,121	808	14,473	891	15,948	982
Crenshaw	289	60,979	3,755	62,327	3,838	68,746	4,234	75,753	4,665
Cullman	611	129,018	7,945	131,870	8,121	145,453	8,957	160,277	9,870
Dale	17	3,637	224	3,718	229	4,101	253	4,519	278
Dallas	507	106,980	6,588	109,345	6,734	120,608	7,427	132,900	8,184
De Kalb	1,014	213,961	13,176	218,689	13,468	241,215	14,855	265,799	16,369
Elmore	0	0	0	0	0	0	0	0	0
Escambia	0	0	0	0	0	0	0	0	0
Etowah	1,675	375,492	23,124	383,790	23,635	423,322	26,069	466,466	28,726
Fayette	10	2,140	132	2,187	135	2,412	149	2,658	164
Franklin	1,989	419,791	25,852	429,069	26,423	473,264	29,145	521,498	32,115
Geneva	60	12,624	777	12,903	795	14,232	876	15,682	966
Greene	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Hale	836	176,518	10,870	180,419	11,111	199,003	12,255	219,285	13,504
Henry	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Houston	1,635	345,119	21,253	352,746	21,723	389,080	23,961	428,734	26,403
Jackson	10	2,140	132	2,187	135	2,412	149	2,658	164
Jefferson	5,125	836,632	51,522	855,122	52,661	943,202	58,085	1,039,331	64,005
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	507	106,980	6,588	109,345	6,734	120,608	7,427	132,900	8,184
Lawrence	10	2,140	132	2,187	135	2,412	149	2,658	164
Lee	405	85,584	5,271	87,476	5,387	96,486	5,942	106,320	6,547
Limestone	988	208,612	12,847	213,222	13,131	235,185	14,483	259,154	15,959
Lowndes	20	4,279	264	4,374	269	4,824	297	5,316	327
Macon	0	0	0	0	0	0	0	0	0
Madison	628	132,656	8,169	135,587	8,350	149,553	9,210	164,796	10,149
Marengo	203	42,792	2,635	43,738	2,694	48,243	2,971	53,160	3,274
Marion	101	21,396	1,318	21,869	1,347	24,122	1,485	26,580	1,637
Marshall	5,183	993,996	61,213	1,015,963	62,566	1,120,611	69,010	1,234,821	76,044
Mobile	1,277	137,527	8,469	140,566	8,656	155,045	9,548	170,847	10,521
Monroe	5	1,070	66	1,093	67	1,206	74	1,329	82
Montgomery	1,853	391,121	24,086	399,764	24,619	440,942	27,154	485,881	29,922
Morgan	1,326	279,861	17,235	286,046	17,616	315,510	19,430	347,666	21,410
Perry	329	69,537	4,282	71,074	4,377	78,395	4,828	86,385	5,320
Pickens	20	4,279	264	4,374	269	4,824	297	5,316	327
Pike	245	51,779	3,189	52,923	3,259	58,374	3,595	64,323	3,961
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	249	52,634	3,241	53,798	3,313	59,339	3,654	65,387	4,027
St.Clair	101	21,396	1,318	21,869	1,347	24,122	1,485	26,580	1,637
Sumter	6	1,284	79	1,312	81	1,447	89	1,595	98
Talladega	405	85,584	5,271	87,476	5,387	96,486	5,942	106,320	6,547
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	964	203,477	12,531	207,974	12,808	229,396	14,127	252,775	15,567
Walker	591	124,739	7,682	127,496	7,852	140,629	8,660	154,961	9,543
Washington	0	0	0	0	0	0	0	0	0
Wilcox	10	2,140	132	2,187	135	2,412	149	2,658	164
Winston	61	12,838	791	13,121	808	14,473	891	15,948	982
Alabama	36,393	7,150,635	440,356	7,308,664	450,088	8,061,483	496,449	8,883,091	547,046

Figure A1 - NAICS 311: Food Manufacturing

NAICS 312: Beverage & Tobacco Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	10	3,590	612	3,958	674	4,292	731	4,629	789
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	3,590	612	3,958	674	4,292	731	4,629	789
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Dallas	225	80,775	13,761	89,054	15,171	96,580	16,453	104,142	17,741
De Kalb	0	0	0	0	0	0	0	0	0
Elmore	10	3,590	612	3,958	674	4,292	731	4,629	789
Escambia	0	0	0	0	0	0	0	0	0
Etowah	10	3,590	612	3,958	674	4,292	731	4,629	789
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	375	134,625	22,934	148,424	25,285	160,966	27,422	173,570	29,569
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	819	293,449	49,991	323,528	55,000	350,866	59,773	378,338	64,453
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	188	67,492	11,498	74,410	12,676	80,698	13,747	87,016	14,824
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	175	62,825	10,703	69,265	11,800	75,117	12,797	80,999	13,799
Morgan	10	3,590	612	3,958	674	4,292	731	4,629	789
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	10	3,590	612	3,958	674	4,292	731	4,629	789
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	0	0	0	0	0	0	0	0	0
Walker	10	3,590	612	3,958	674	4,292	731	4,629	789
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	2,092	750,456	127,848	827,378	140,835	897,291	152,861	967,549	164,829

Figure A2- NAICS 312: Beverage & Tobacco Product Manufacturing

NAICS 313: Textile Mills									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	161	28,905	221	26,044	199	20,618	157	15,242	116
Baldwin	206	37,164	284	33,486	256	26,509	202	19,597	150
Barbour	780	140,397	1,072	126,501	966	100,146	765	74,035	565
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	413	74,328	568	66,971	512	53,018	405	39,195	299
Chambers	2,894	520,956	3,979	469,394	3,585	371,601	2,838	274,713	2,098
Cherokee	383	68,877	526	62,060	474	49,130	375	36,321	277
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	123	22,133	169	19,943	152	15,788	121	11,671	89
Coosa	170	30,557	233	27,533	210	21,796	166	16,113	123
Covington	918	165,173	1,262	148,825	1,137	117,819	900	87,100	665
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	389	79,495	607	71,627	547	56,704	433	41,920	320
Elmore	727	130,817	999	117,869	900	93,313	713	68,983	527
Escambia	55	9,910	76	8,930	68	7,069	54	5,226	40
Etowah	0	0	0	0	0	0	0	0	0
Fayette	175	31,548	241	28,426	217	22,503	172	16,636	127
Franklin	0	0	0	0	0	0	0	0	0
Geneva	9	1,652	13	1,488	11	1,178	9	871	7
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	459	82,587	631	74,413	568	58,909	450	43,550	333
Jackson	459	82,587	631	74,413	568	58,909	450	43,550	333
Jefferson	18	3,303	25	2,977	23	2,356	18	1,742	13
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	229	41,293	315	37,206	284	29,455	225	21,775	166
Lawrence	0	0	0	0	0	0	0	0	0
Lee	734	132,138	1,009	119,060	909	94,255	720	69,680	532
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	18	3,303	25	2,977	23	2,356	18	1,742	13
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	551	99,104	757	89,295	682	70,691	540	52,260	399
Mobile	0	0	0	0	0	0	0	0	0
Monroe	138	24,776	189	22,324	171	17,673	135	13,065	100
Montgomery	138	24,776	189	22,324	171	17,673	135	13,065	100
Morgan	5	826	6	744	6	589	4	435	3
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	593	89,360	683	80,516	615	63,741	487	47,122	360
Russell	358	64,417	492	58,042	443	45,949	351	33,969	259
Shelby	697	125,531	959	113,107	864	89,542	684	66,196	506
St.Clair	313	56,324	430	50,749	388	40,176	307	29,701	227
Sumter	0	0	0	0	0	0	0	0	0
Talladega	1,446	298,213	2,278	268,697	2,052	212,717	1,625	157,255	1,201
Tallapoosa	1,632	293,843	2,244	264,760	2,022	209,600	1,601	154,951	1,184
Tuscaloosa	5	826	6	744	6	589	4	435	3
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	15,195	2,765,120	21,121	2,491,443	19,030	1,972,376	15,066	1,458,118	11,137

Figure A3 - NAICS 313: Textile Mills

NAICS 314: Textile Product Mills									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	30	5,787	42	5,215	38	4,128	30	3,052	22
Baldwin	9	1,654	12	1,490	11	1,179	8	872	6
Barbour	9	1,654	12	1,490	11	1,179	8	872	6
Bibb	0	0	0	0	0	0	0	0	0
Blount	3	496	4	447	3	354	3	262	2
Bullock	0	0	0	0	0	0	0	0	0
Butler	225	43,324	312	39,035	281	30,902	223	22,845	165
Calhoun	793	152,955	1,102	137,814	993	109,102	786	80,656	581
Chambers	150	28,937	208	26,073	188	20,641	149	15,259	110
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	86	16,536	119	14,899	107	11,795	85	8,720	63
Clay	17	3,307	24	2,980	21	2,359	17	1,744	13
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	13	2,480	18	2,235	16	1,769	13	1,308	9
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	43	8,268	60	7,449	54	5,897	42	4,360	31
Dale	0	0	0	0	0	0	0	0	0
Dallas	257	49,607	357	44,696	322	35,384	255	26,159	188
De Kalb	9	1,654	12	1,490	11	1,179	8	872	6
Elmore	4	827	6	745	5	590	4	436	3
Escambia	214	41,339	298	37,247	268	29,487	212	21,799	157
Etowah	9	1,654	12	1,490	11	1,179	8	872	6
Fayette	0	0	0	0	0	0	0	0	0
Franklin	51	9,921	71	8,939	64	7,077	51	5,232	38
Geneva	9	1,654	12	1,490	11	1,179	8	872	6
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	600	115,750	834	104,292	751	82,564	595	61,037	440
Houston	95	18,355	132	16,538	119	13,092	94	9,679	70
Jackson	2,250	434,062	3,127	391,094	2,817	309,614	2,230	228,888	1,649
Jefferson	428	82,678	596	74,494	537	58,974	425	43,598	314
Lamar	4	827	6	745	5	590	4	436	3
Lauderdale	43	8,268	60	7,449	54	5,897	42	4,360	31
Lawrence	0	0	0	0	0	0	0	0	0
Lee	86	16,536	119	14,899	107	11,795	85	8,720	63
Limestone	4	827	6	745	5	590	4	436	3
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	117	22,489	162	20,262	146	16,041	116	11,859	85
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	428	82,678	596	74,494	537	58,974	425	43,598	314
Monroe	17	3,307	24	2,980	21	2,359	17	1,744	13
Montgomery	171	33,071	238	29,798	215	23,590	170	17,439	126
Morgan	857	165,357	1,191	148,988	1,073	117,948	850	87,195	628
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	43	8,268	60	7,449	54	5,897	42	4,360	31
Shelby	9	1,654	12	1,490	11	1,179	8	872	6
St.Clair	4	827	6	745	5	590	4	436	3
Sumter	0	0	0	0	0	0	0	0	0
Talladega	86	16,536	119	14,899	107	11,795	85	8,720	63
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	15	2,976	21	2,682	19	2,123	15	1,570	11
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	17	3,307	24	2,980	21	2,359	17	1,744	13
Alabama	7,203	1,389,825	10,012	1,252,246	9,021	991,353	7,142	732,878	5,280

Figure A4 - NAICS 314: Textile Product Mills

NAICS 315: Apparel Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	55	6,543	247	6,118	231	4,934	187	4,126	156
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	92	10,905	412	10,196	386	8,223	311	6,876	260
Calhoun	385	45,801	1,732	42,824	1,619	34,538	1,306	28,881	1,092
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	128	15,267	577	14,275	540	11,513	435	9,627	364
Chilton	9	1,090	41	1,020	39	822	31	688	26
Choctaw	137	16,357	618	15,294	578	12,335	466	10,314	390
Clarke	252	29,989	1,134	28,039	1,060	22,614	855	18,910	715
Clay	0	0	0	0	0	0	0	0	0
Cleburne	374	44,492	1,682	41,600	1,573	33,552	1,269	28,055	1,061
Coffee	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	545	21	510	19	411	16	344	13
Crenshaw	192	22,900	866	21,412	810	17,269	653	14,440	546
Cullman	64	7,633	289	7,137	270	5,756	218	4,813	182
Dale	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Dallas	275	32,715	1,237	30,588	1,157	24,670	933	20,629	780
De Kalb	6,901	821,360	31,056	767,971	29,037	619,387	23,419	517,925	19,583
Elmore	5	545	21	510	19	411	16	344	13
Escambia	55	6,543	247	6,118	231	4,934	187	4,126	156
Etowah	82	9,814	371	9,177	347	7,401	280	6,189	234
Fayette	321	38,167	1,443	35,686	1,349	28,782	1,088	24,067	910
Franklin	5	545	21	510	19	411	16	344	13
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	49	5,780	219	5,404	204	4,358	165	3,644	138
Henry	0	0	0	0	0	0	0	0	0
Houston	9	1,090	41	1,020	39	822	31	688	26
Jackson	44	5,234	198	4,894	185	3,947	149	3,301	125
Jefferson	18	2,181	82	2,039	77	1,645	62	1,375	52
Lamar	5	545	21	510	19	411	16	344	13
Lauderdale	508	60,413	2,284	56,486	2,136	45,558	1,723	38,095	1,440
Lawrence	9	1,090	41	1,020	39	822	31	688	26
Lee	46	5,452	206	5,098	193	4,112	155	3,438	130
Limestone	46	5,452	206	5,098	193	4,112	155	3,438	130
Lowndes	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Macon	0	0	0	0	0	0	0	0	0
Madison	18	2,181	82	2,039	77	1,645	62	1,375	52
Marengo	344	40,894	1,546	38,235	1,446	30,838	1,166	25,786	975
Marion	5	545	21	510	19	411	16	344	13
Marshall	92	10,905	412	10,196	386	8,223	311	6,876	260
Mobile	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Monroe	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Montgomery	13	1,527	58	1,427	54	1,151	44	963	36
Morgan	183	21,810	825	20,392	771	16,447	622	13,753	520
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	367	43,620	1,649	40,784	1,542	32,894	1,244	27,505	1,040
Russell	18	2,181	82	2,039	77	1,645	62	1,375	52
Shelby	9	1,090	41	1,020	39	822	31	688	26
St.Clair	18	2,181	82	2,039	77	1,645	62	1,375	52
Sumter	0	0	0	0	0	0	0	0	0
Talladega	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Tallapoosa	550	65,430	2,474	61,177	2,313	49,340	1,866	41,258	1,560
Tuscaloosa	13	1,527	58	1,427	54	1,151	44	963	36
Walker	0	0	0	0	0	0	0	0	0
Washington	5	545	21	510	19	411	16	344	13
Wilcox	0	0	0	0	0	0	0	0	0
Winston	10	1,200	45	1,122	42	905	34	756	29
Alabama	13,775	1,639,448	61,988	1,532,884	57,958	1,236,308	46,745	1,033,787	39,088

Figure A5 - NAICS 315: Apparel Manufacturing

NAICS 321: Wood Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	174	31,062	145	31,969	149	29,535	138	32,413	151
Barbour	532	81,346	379	83,723	390	77,348	360	84,884	395
Bibb	241	43,161	201	44,422	207	41,040	191	45,039	210
Blount	60	10,655	50	10,966	51	10,131	47	11,118	52
Bullock	0	0	0	0	0	0	0	0	0
Butler	542	89,257	416	91,865	428	84,871	395	93,139	434
Calhoun	451	80,724	376	83,083	387	76,757	357	84,236	392
Chambers	190	33,951	158	34,943	163	32,283	150	35,428	165
Cherokee	3	542	3	558	3	515	2	565	3
Chilton	471	84,336	393	86,800	404	80,192	373	88,005	410
Choctaw	124	22,213	103	22,862	106	21,121	98	23,179	108
Clarke	600	127,421	593	131,144	611	121,159	564	132,963	619
Clay	15	2,709	13	2,788	13	2,576	12	2,827	13
Cleburne	10	1,806	8	1,859	9	1,717	8	1,884	9
Coffee	5	903	4	929	4	859	4	942	4
Colbert	528	94,449	440	97,209	453	89,808	418	98,558	459
Conecuh	505	90,296	420	92,934	433	85,858	400	94,223	439
Coosa	97	17,337	81	17,843	83	16,485	77	18,091	84
Covington	5	903	4	929	4	859	4	942	4
Crenshaw	61	10,835	50	11,152	52	10,303	48	11,307	53
Cullman	233	41,717	194	42,936	200	39,666	185	43,531	203
Dale	0	0	0	0	0	0	0	0	0
Dallas	385	68,805	320	70,816	330	65,424	305	71,798	334
De Kalb	73	13,003	61	13,382	62	12,364	58	13,568	63
Elmore	107	19,143	89	19,702	92	18,202	85	19,975	93
Escambia	484	81,662	380	84,048	391	77,649	362	85,214	397
Etowah	467	83,614	389	86,057	401	79,505	370	87,251	406
Fayette	224	40,091	187	41,263	192	38,121	178	41,835	195
Franklin	391	69,889	325	71,931	335	66,454	309	72,929	340
Geneva	10	1,806	8	1,859	9	1,717	8	1,884	9
Greene	65	11,558	54	11,896	55	10,990	51	12,061	56
Hale	262	46,954	219	48,326	225	44,646	208	48,996	228
Henry	217	38,827	181	39,962	186	36,919	172	40,516	189
Houston	187	33,409	156	34,386	160	31,768	148	34,863	162
Jackson	66	11,738	55	12,081	56	11,162	52	12,249	57
Jefferson	119	21,310	99	21,932	102	20,263	94	22,237	104
Lamar	515	92,102	429	94,793	441	87,575	408	96,108	448
Lauderdale	244	43,703	204	44,980	209	41,555	194	45,604	212
Lawrence	30	5,418	25	5,576	26	5,151	24	5,653	26
Lee	280	50,024	233	51,485	240	47,565	221	52,200	243
Limestone	20	3,612	17	3,717	17	3,434	16	3,769	18
Lowndes	5	903	4	929	4	859	4	942	4
Macon	5	903	4	929	4	859	4	942	4
Madison	203	36,299	169	37,359	174	34,515	161	37,878	176
Marengo	750	76,400	356	78,632	366	72,645	338	79,723	371
Marion	1,305	195,413	910	201,123	937	185,810	865	203,913	950
Marshall	1,090	124,083	578	127,709	595	117,985	549	129,480	603
Mobile	1,213	248,267	1,156	255,521	1,190	236,066	1,099	259,066	1,206
Monroe	812	163,148	760	167,915	782	155,130	722	170,244	793
Montgomery	594	106,188	494	109,290	509	100,969	470	110,807	516
Morgan	503	89,934	419	92,562	431	85,515	398	93,846	437
Perry	0	0	0	0	0	0	0	0	0
Pickens	502	88,936	414	91,535	426	84,565	394	92,804	432
Pike	190	33,951	158	34,943	163	32,283	150	35,428	165
Randolph	101	18,059	84	18,587	87	17,172	80	18,845	88
Russell	177	31,603	147	32,527	151	30,050	140	32,978	154
Shelby	475	84,878	395	87,358	407	80,707	376	88,570	412
St.Clair	117	20,949	98	21,561	100	19,919	93	21,860	102
Sumter	159	28,353	132	29,181	136	26,959	126	29,586	138
Talladega	404	72,237	336	74,347	346	68,687	320	75,379	351
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	685	122,441	570	126,019	587	116,424	542	127,767	595
Walker	227	40,633	189	41,820	195	38,636	180	42,400	197
Washington	61	10,835	50	11,152	52	10,303	48	11,307	53
Wilcox	252	45,148	210	46,467	216	42,929	200	47,112	219
Winston	2,233	372,941	1,737	383,838	1,787	354,613	1,651	389,163	1,812
Alabama	21,053	3,614,791	16,833	3,720,412	17,325	3,437,145	16,006	3,772,024	17,565

Figure A6 - NAICS 321: Wood Product Manufacturing

NAICS 322: Paper Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	771	317,619	116,849	356,559	131,175	391,335	143,968	412,926	151,912
Baldwin	239	98,674	36,301	110,771	40,752	121,575	44,726	128,282	47,194
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Chambers	180	74,111	27,265	83,197	30,607	91,311	33,593	96,349	35,446
Cherokee	3	1,270	467	1,426	525	1,565	576	1,652	608
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	1,285	529,364	194,748	594,264	218,624	652,224	239,947	688,211	253,186
Clarke	750	309,149	113,733	347,050	127,677	380,899	140,129	401,915	147,861
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	168	69,029	25,395	77,492	28,509	85,050	31,289	89,743	33,015
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	458	127,130	46,770	142,716	52,504	156,636	57,625	165,278	60,804
Dale	0	0	0	0	0	0	0	0	0
Dallas	822	338,793	124,639	380,329	139,920	417,424	153,566	440,455	162,039
De Kalb	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Elmore	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Escambia	527	217,251	79,925	243,886	89,723	267,673	98,474	282,442	103,908
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	208	85,545	31,471	96,033	35,330	105,399	38,775	111,215	40,915
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	99	40,655	14,957	45,640	16,790	50,091	18,428	52,855	19,445
Jackson	514	211,746	77,899	237,706	87,450	260,890	95,979	275,284	101,274
Jefferson	478	196,924	72,446	221,066	81,328	242,628	89,260	256,014	94,185
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	37	15,246	5,609	17,115	6,296	18,784	6,910	19,820	7,292
Lawrence	1,285	529,364	194,748	594,264	218,624	652,224	239,947	688,211	253,186
Lee	915	376,907	138,661	423,116	155,660	464,384	170,842	490,006	180,269
Limestone	103	42,349	15,580	47,541	17,490	52,178	19,196	55,057	20,255
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	303	124,930	45,961	140,246	51,595	153,925	56,628	162,418	59,752
Marengo	653	268,917	98,932	301,886	111,061	331,330	121,893	349,611	128,619
Marion	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Marshall	103	42,349	15,580	47,541	17,490	52,178	19,196	55,057	20,255
Mobile	1,410	581,030	213,756	652,265	239,962	715,882	263,366	755,380	277,897
Monroe	514	211,746	77,899	237,706	87,450	260,890	95,979	275,284	101,274
Montgomery	154	63,524	23,370	71,312	26,235	78,267	28,794	82,585	30,382
Morgan	105	43,196	15,891	48,492	17,840	53,222	19,580	56,158	20,660
Perry	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	31	12,705	4,674	14,262	5,247	15,653	5,759	16,517	6,076
St.Clair	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Sumter	118	48,702	17,917	54,672	20,113	60,005	22,075	63,315	23,293
Talladega	565	232,920	85,689	261,476	96,195	286,979	105,577	302,813	111,402
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	257	105,873	38,950	118,853	43,725	130,445	47,989	137,642	50,637
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	925	381,142	140,219	427,870	157,409	469,602	172,762	495,512	182,294
Winston	0	0	0	0	0	0	0	0	0
Alabama	14,178	5,780,741	2,126,680	6,489,460	2,387,411	7,122,393	2,620,261	7,515,368	2,764,833

Figure A7 - NAICS 322: Paper Manufacturing

NAICS 323: Printing & Related Support Activities

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	3	394	58	380	56	425	63	466	69
Baldwin	189	25,089	3,704	24,181	3,570	27,036	3,991	29,675	4,381
Barbour	10	1,314	194	1,266	187	1,416	209	1,554	229
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	3	394	58	380	56	425	63	466	69
Calhoun	385	51,097	7,543	49,248	7,270	55,063	8,128	60,438	8,922
Chambers	19	2,496	368	2,405	355	2,689	397	2,952	436
Cherokee	10	1,314	194	1,266	187	1,416	209	1,554	229
Chilton	11	1,445	213	1,393	206	1,557	230	1,709	252
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	5	657	97	633	93	708	104	777	115
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	69	9,195	1,357	8,862	1,308	9,909	1,463	10,876	1,605
Colbert	37	4,860	717	4,684	691	5,237	773	5,749	849
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	657	97	633	93	708	104	777	115
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	46	6,042	892	5,824	860	6,511	961	7,147	1,055
Dale	0	0	0	0	0	0	0	0	0
Dallas	40	5,254	776	5,064	748	5,662	836	6,215	917
De Kalb	43	5,648	834	5,444	804	6,087	899	6,681	986
Elmore	6	788	116	760	112	849	125	932	138
Escambia	8	1,051	155	1,013	150	1,132	167	1,243	183
Etowah	42	5,517	814	5,317	785	5,945	878	6,525	963
Fayette	10	1,314	194	1,266	187	1,416	209	1,554	229
Franklin	5	657	97	633	93	708	104	777	115
Geneva	5	657	97	633	93	708	104	777	115
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	98	13,004	1,920	12,534	1,850	14,014	2,069	15,381	2,271
Jackson	40	5,254	776	5,064	748	5,662	836	6,215	917
Jefferson	2,175	288,453	42,581	278,016	41,040	310,845	45,887	341,185	50,365
Lamar	5	657	97	633	93	708	104	777	115
Lauderdale	96	12,741	1,881	12,280	1,813	13,730	2,027	15,071	2,225
Lawrence	99	13,135	1,939	12,660	1,869	14,155	2,090	15,537	2,294
Lee	126	16,682	2,463	16,078	2,373	17,977	2,654	19,732	2,913
Limestone	10	1,314	194	1,266	187	1,416	209	1,554	229
Lowndes	5	657	97	633	93	708	104	777	115
Macon	10	1,314	194	1,266	187	1,416	209	1,554	229
Madison	228	30,211	4,460	29,118	4,298	32,557	4,806	35,734	5,275
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	129	17,076	2,521	16,458	2,430	18,402	2,716	20,198	2,982
Mobile	283	37,567	5,546	36,208	5,345	40,483	5,976	44,435	6,559
Monroe	10	1,314	194	1,266	187	1,416	209	1,554	229
Montgomery	449	59,503	8,784	57,350	8,466	64,122	9,466	70,381	10,390
Morgan	130	17,207	2,540	16,585	2,448	18,543	2,737	20,353	3,004
Perry	5	657	97	633	93	708	104	777	115
Pickens	20	2,627	388	2,532	374	2,831	418	3,107	459
Pike	14	1,839	271	1,772	262	1,982	293	2,175	321
Randolph	0	0	0	0	0	0	0	0	0
Russell	5	657	97	633	93	708	104	777	115
Shelby	251	33,232	4,906	32,030	4,728	35,812	5,287	39,308	5,803
St.Clair	23	3,021	446	2,912	430	3,256	481	3,573	528
Sumter	5	657	97	633	93	708	104	777	115
Talladega	272	36,122	5,332	34,815	5,139	38,926	5,746	42,726	6,307
Tallapoosa	5	657	97	633	93	708	104	777	115
Tuscaloosa	126	16,682	2,463	16,078	2,373	17,977	2,654	19,732	2,913
Walker	11	1,445	213	1,393	206	1,557	230	1,709	252
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	5	657	97	633	93	708	104	777	115
Alabama	5,580	740,178	109,264	713,398	105,311	797,638	117,746	875,490	129,239

Figure A8 - NAICS 323: Printing & Related Support Activities

NAICS 324: Petroleum & Coal Products Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	10	9,890	417	10,697	451	11,287	476	12,051	508
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	10	9,890	417	10,697	451	11,287	476	12,051	508
Dallas	10	9,890	417	10,697	451	11,287	476	12,051	508
DeKalb	10	9,890	417	10,697	451	11,287	476	12,051	508
Elmore	0	0	0	0	0	0	0	0	0
Escambia	10	9,890	417	10,697	451	11,287	476	12,051	508
Etowah	10	9,890	417	10,697	451	11,287	476	12,051	508
Fayette	0	0	0	0	0	0	0	0	0
Franklin	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Geneva	0	0	0	0	0	0	0	0	0
Greene	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Hale	0	0	0	0	0	0	0	0	0
Henry	10	9,890	417	10,697	451	11,287	476	12,051	508
Houston	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	592	585,488	24,704	633,264	4,155	668,220	28,195	713,392	30,101
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	10	9,890	417	10,697	451	11,287	476	12,051	508
Lee	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	383	378,787	15,983	409,696	17,287	432,311	18,241	461,535	19,474
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	10	9,890	417	10,697	451	11,287	476	12,051	508
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	10	9,890	417	10,697	451	11,287	476	12,051	508
St.Clair	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	10	9,890	417	10,697	451	11,287	476	12,051	508
Tuscaloosa	809	800,407	33,772	865,720	36,528	913,508	38,545	975,261	41,150
Walker	10	9,890	417	10,697	451	11,287	476	12,051	508
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	2,174	2,150,392	90,731	2,325,864	75,573	2,454,252	103,555	2,620,159	110,555

Figure A9 - NAICS 324: Petroleum & Coal Products Manufacturing

NAICS 325: Chemical Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	101	48,776	2,793	58,114	3,327	65,810	3,768	74,313	4,255
Barbour	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Bibb	0	0	0	0	0	0	0	0	0
Blount	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	151	73,164	4,189	87,171	4,991	98,716	5,652	111,470	6,382
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	50	24,388	1,396	29,057	1,664	32,905	1,884	37,157	2,127
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	5	2,439	140	2,906	166	3,291	188	3,716	213
Clarke	5	2,439	140	2,906	166	3,291	188	3,716	213
Clay	0	0	0	0	0	0	0	0	0
Cleburne	5	2,439	140	2,906	166	3,291	188	3,716	213
Coffee	40	19,510	1,117	23,246	1,331	26,324	1,507	29,725	1,702
Colbert	417	201,444	11,534	240,011	13,742	271,797	15,562	306,913	17,572
Conecuh	5	2,439	140	2,906	166	3,291	188	3,716	213
Coosa	0	0	0	0	0	0	0	0	0
Covington	1,392	672,132	38,483	800,812	45,850	906,867	51,922	1,024,033	58,630
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	99	47,800	2,737	56,952	3,261	64,494	3,693	72,827	4,170
Dale	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Dallas	5	2,439	140	2,906	166	3,291	188	3,716	213
De Kalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Etowah	81	39,021	2,234	46,491	2,662	52,648	3,014	59,450	3,404
Fayette	0	0	0	0	0	0	0	0	0
Franklin	5	2,439	140	2,906	166	3,291	188	3,716	213
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	7	3,414	195	4,068	233	4,607	264	5,202	298
Houston	101	48,776	2,793	58,114	3,327	65,810	3,768	74,313	4,255
Jackson	629	303,874	17,398	362,051	20,729	409,999	23,474	462,970	26,507
Jefferson	650	314,117	17,985	374,255	21,428	423,819	24,266	478,576	27,401
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Lawrence	10	4,878	279	5,811	333	6,581	377	7,431	425
Lee	41	19,998	1,145	23,827	1,364	26,982	1,545	30,468	1,744
Limestone	10	4,878	279	5,811	333	6,581	377	7,431	425
Lowndes	822	397,036	22,732	473,048	27,084	535,697	30,671	604,908	34,634
Macon	0	0	0	0	0	0	0	0	0
Madison	596	287,778	16,477	342,873	19,631	388,281	22,231	438,447	25,103
Marengo	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Marion	30	14,633	838	17,434	998	19,743	1,130	22,294	1,276
Marshall	119	57,556	3,295	68,575	3,926	77,656	4,446	87,689	5,021
Mobile	3,404	1,580,991	90,519	1,883,672	107,849	2,133,136	122,131	2,408,735	137,911
Monroe	10	4,878	279	5,811	333	6,581	377	7,431	425
Montgomery	126	60,970	3,491	72,643	4,159	82,263	4,710	92,891	5,318
Morgan	2,503	1,209,155	69,229	1,440,647	82,483	1,631,440	93,407	1,842,220	105,475
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	151	73,164	4,189	87,171	4,991	98,716	5,652	111,470	6,382
Randolph	5	2,439	140	2,906	166	3,291	188	3,716	213
Russell	252	121,940	6,982	145,285	8,318	164,526	9,420	185,783	10,637
Shelby	74	35,606	2,039	42,423	2,429	48,042	2,751	54,249	3,106
St.Clair	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Sumter	0	0	0	0	0	0	0	0	0
Talladega	325	157,058	8,992	187,127	10,714	211,910	12,133	239,288	13,700
Tallapoosa	30	14,633	838	17,434	998	19,743	1,130	22,294	1,276
Tuscaloosa	250	120,964	6,926	144,123	8,252	163,210	9,344	184,296	10,552
Walker	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Washington	1,201	579,945	33,204	690,976	39,561	782,486	44,801	883,582	50,589
Wilcox	5	2,439	140	2,906	166	3,291	188	3,716	213
Winston	0	0	0	0	0	0	0	0	0
Alabama	14,201	6,796,111	389,107	8,097,226	463,602	9,169,585	524,999	10,354,283	592,828

Figure A10 - NAICS 325: Chemical Manufacturing

NAICS 326: Plastics & Rubber Products Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	248	39,835	1,593	43,825	1,752	48,242	1,929	53,787	2,150
Baldwin	125	19,997	799	22,000	880	24,217	968	27,001	1,079
Barbour	371	59,514	2,379	65,476	2,618	72,074	2,881	80,359	3,213
Bibb	0	0	0	0	0	0	0	0	0
Blount	59	9,522	381	10,476	419	11,532	461	12,858	514
Bullock	0	0	0	0	0	0	0	0	0
Butler	59	9,522	381	10,476	419	11,532	461	12,858	514
Calhoun	30	4,761	190	5,238	209	5,766	231	6,429	257
Chambers	198	31,741	1,269	34,921	1,396	38,440	1,537	42,858	1,713
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	137	22,060	882	24,270	970	26,716	1,068	29,787	1,191
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	222	35,709	1,428	39,286	1,571	43,245	1,729	48,216	1,928
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	10	1,587	63	1,746	70	1,922	77	2,143	86
Colbert	595	77,818	3,111	85,613	3,423	94,241	3,768	105,074	4,201
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	794	32	873	35	961	38	1,071	43
Crenshaw	5	794	32	873	35	961	38	1,071	43
Cullman	652	104,587	4,181	115,063	4,600	126,659	5,064	141,218	5,646
Dale	10	1,587	63	1,746	70	1,922	77	2,143	86
Dallas	10	1,587	63	1,746	70	1,922	77	2,143	86
De Kalb	187	29,995	1,199	33,000	1,319	36,326	1,452	40,501	1,619
Elmore	789	126,647	5,063	139,333	5,570	153,374	6,132	171,005	6,836
Escambia	5	794	32	873	35	961	38	1,071	43
Etowah	1,264	202,984	8,115	223,317	8,928	245,822	9,828	274,079	10,957
Fayette	0	0	0	0	0	0	0	0	0
Franklin	59	9,522	381	10,476	419	11,532	461	12,858	514
Geneva	5	794	32	873	35	961	38	1,071	43
Greene	0	0	0	0	0	0	0	0	0
Hale	5	794	32	873	35	961	38	1,071	43
Henry	0	0	0	0	0	0	0	0	0
Houston	786	126,171	5,044	138,809	5,549	152,798	6,109	170,362	6,811
Jackson	10	1,587	63	1,746	70	1,922	77	2,143	86
Jefferson	972	156,007	6,237	171,635	6,862	188,931	7,553	210,649	8,421
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	361	57,927	2,316	63,730	2,548	70,152	2,805	78,217	3,127
Lawrence	5	794	32	873	35	961	38	1,071	43
Lee	1,671	301,765	12,064	331,993	13,272	365,450	14,610	407,458	16,289
Limestone	134	21,584	863	23,746	949	26,139	1,045	29,144	1,165
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	2,253	469,424	18,767	516,446	20,647	568,491	22,727	633,840	25,340
Marengo	59	9,522	381	10,476	419	11,532	461	12,858	514
Marion	445	71,417	2,855	78,571	3,141	86,489	3,458	96,431	3,855
Marshall	511	82,051	3,280	90,270	3,609	99,367	3,973	110,789	4,429
Mobile	318	51,103	2,043	56,222	2,248	61,888	2,474	69,002	2,759
Monroe	10	1,587	63	1,746	70	1,922	77	2,143	86
Montgomery	1,138	233,208	9,323	256,568	10,257	282,424	11,291	314,889	12,589
Morgan	411	66,021	2,639	72,635	2,904	79,955	3,196	89,145	3,564
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	667	107,126	4,283	117,857	4,712	129,734	5,187	144,647	5,783
Randolph	5	794	32	873	35	961	38	1,071	43
Russell	0	0	0	0	0	0	0	0	0
Shelby	171	27,456	1,098	30,206	1,208	33,250	1,329	37,072	1,482
St.Clair	92	14,760	590	16,238	649	17,874	715	19,929	797
Sumter	0	0	0	0	0	0	0	0	0
Talladega	133	21,425	857	23,571	942	25,947	1,037	28,929	1,157
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	2,875	461,515	18,451	507,745	20,299	558,913	22,344	623,161	24,913
Walker	5	794	32	873	35	961	38	1,071	43
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	119	19,045	761	20,952	838	23,064	922	25,715	1,028
Alabama	18,202	3,096,027	123,774	3,406,156	136,172	3,749,413	149,895	4,180,410	167,126

Figure A11 - NAICS 326: Plastics & Rubber Products Manufacturing

NAICS 327: Nonmetallic Mineral Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	29	5,944	1,031	6,114	1,060	6,842	1,186	7,502	1,301
Baldwin	162	33,285	5,772	34,236	5,937	38,313	6,644	42,010	7,285
Barbour	10	1,981	344	2,038	353	2,281	395	2,501	434
Bibb	3	594	103	611	106	684	119	750	130
Blount	11	2,179	378	2,242	389	2,509	435	2,751	477
Bullock	10	1,981	344	2,038	353	2,281	395	2,501	434
Butler	10	1,981	344	2,038	353	2,281	395	2,501	434
Calhoun	108	22,190	3,848	22,824	3,958	25,542	4,429	28,007	4,857
Chambers	314	64,390	11,166	66,231	11,486	74,117	12,853	81,269	14,094
Cherokee	3	594	103	611	106	684	119	750	130
Chilton	14	2,972	515	3,057	530	3,421	593	3,751	650
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	1,981	344	2,038	353	2,281	395	2,501	434
Clay	10	1,981	344	2,038	353	2,281	395	2,501	434
Cleburne	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Coffee	5	991	172	1,019	177	1,140	198	1,250	217
Colbert	33	6,736	1,168	6,929	1,202	7,754	1,345	8,502	1,474
Conecuh	19	3,962	687	4,076	707	4,561	791	5,001	867
Coosa	0	0	0	0	0	0	0	0	0
Covington	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	19	3,962	687	4,076	707	4,561	791	5,001	867
Dale	37	7,529	1,306	7,744	1,343	8,666	1,503	9,502	1,648
Dallas	182	37,247	6,459	38,312	6,644	42,874	7,435	47,011	8,153
De Kalb	43	8,916	1,546	9,170	1,590	10,262	1,780	11,253	1,951
Elmore	158	32,492	5,635	33,421	5,796	37,401	6,486	41,010	7,112
Escambia	58	11,887	2,062	12,227	2,120	13,683	2,373	15,004	2,602
Etowah	291	59,635	10,342	61,340	10,637	68,644	11,904	75,268	13,053
Fayette	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Franklin	193	39,625	6,872	40,757	7,068	45,611	7,910	50,012	8,673
Geneva	10	1,981	344	2,038	353	2,281	395	2,501	434
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Jackson	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Jefferson	1,407	379,140	65,750	389,976	67,629	436,413	75,682	478,524	82,985
Lamar	10	1,981	344	2,038	353	2,281	395	2,501	434
Lauderdale	77	15,850	2,749	16,303	2,827	18,244	3,164	20,005	3,469
Lawrence	10	1,981	344	2,038	353	2,281	395	2,501	434
Lee	107	21,992	3,814	22,620	3,923	25,314	4,390	27,757	4,813
Limestone	68	13,869	2,405	14,265	2,474	15,964	2,768	17,504	3,036
Lowndes	0	0	0	0	0	0	0	0	0
Macon	15	3,170	550	3,261	565	3,649	633	4,001	694
Madison	906	204,430	35,452	210,273	36,465	235,311	40,807	258,017	44,745
Marengo	128	26,351	4,570	27,104	4,700	30,331	5,260	33,258	5,768
Marion	23	4,755	825	4,891	848	5,473	949	6,001	1,041
Marshall	187	38,436	6,666	39,535	6,856	44,242	7,672	48,511	8,413
Mobile	727	156,780	27,189	161,261	27,966	180,463	31,296	197,877	34,315
Monroe	466	95,496	16,561	98,225	17,034	109,922	19,062	120,528	20,902
Montgomery	218	44,776	7,765	46,056	7,987	51,540	8,938	56,513	9,800
Morgan	96	19,614	3,401	20,175	3,499	22,577	3,915	24,756	4,293
Perry	0	0	0	0	0	0	0	0	0
Pickens	48	9,906	1,718	10,189	1,767	11,403	1,977	12,503	2,168
Pike	10	1,981	344	2,038	353	2,281	395	2,501	434
Randolph	10	1,981	344	2,038	353	2,281	395	2,501	434
Russell	402	82,420	14,293	84,775	14,702	94,870	16,452	104,025	18,040
Shelby	940	192,775	33,431	198,285	34,386	221,896	38,481	243,307	42,194
St.Clair	217	44,578	7,731	45,852	7,952	51,312	8,898	56,263	9,757
Sumter	5	991	172	1,019	177	1,140	198	1,250	217
Talladega	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Tallapoosa	29	5,944	1,031	6,114	1,060	6,842	1,186	7,502	1,301
Tuscaloosa	281	57,654	9,998	59,302	10,284	66,364	11,509	72,767	12,619
Walker	45	9,312	1,615	9,578	1,661	10,719	1,859	11,753	2,038
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	10	1,981	344	2,038	353	2,281	395	2,501	434
Alabama	8,690	1,899,181	329,353	1,953,460	338,766	2,186,071	379,105	2,397,013	415,686

Figure A12 - NAICS 327: Nonmetallic Mineral Product Manufacturing

NAICS 331: Primary Metal Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	927	273,891	35,170	265,283	34,064	292,480	37,557	293,918	37,741
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	9	2,739	352	2,653	341	2,925	376	2,939	377
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	1,109	176,108	22,614	170,573	21,903	188,060	24,148	188,985	24,267
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Colbert	1,177	347,842	44,666	336,909	43,262	371,450	47,697	373,276	47,931
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	5	1,369	176	1,326	170	1,462	188	1,470	189
Dale	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Dallas	153	45,192	5,803	43,772	5,621	48,259	6,197	48,496	6,227
De Kalb	37	10,956	1,407	10,611	1,363	11,699	1,502	11,757	1,510
Elmore	5	1,369	176	1,326	170	1,462	188	1,470	189
Escambia	278	82,167	10,551	79,585	10,219	87,744	11,267	88,175	11,322
Etowah	56	16,433	2,110	15,917	2,044	17,549	2,253	17,635	2,264
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	5	1,369	176	1,326	170	1,462	188	1,470	189
Henry	0	0	0	0	0	0	0	0	0
Houston	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Jackson	9	2,739	352	2,653	341	2,925	376	2,939	377
Jefferson	7,980	2,280,038	292,774	2,208,376	283,572	2,434,784	312,645	2,446,754	314,182
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	335	99,149	12,731	96,032	12,331	105,878	13,596	106,398	13,662
Lawrence	0	0	0	0	0	0	0	0	0
Lee	162	47,931	6,155	46,424	5,961	51,184	6,572	51,436	6,605
Limestone	5	1,369	176	1,326	170	1,462	188	1,470	189
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	481	142,150	18,253	137,682	17,679	151,797	19,492	152,544	19,588
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	463	136,946	17,585	132,641	17,032	146,240	18,778	146,959	18,871
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	375	110,926	14,244	107,440	13,796	118,454	15,210	119,037	15,285
Morgan	940	511,984	65,743	495,892	63,676	546,732	70,205	549,420	70,550
Perry	145	42,727	5,486	41,384	5,314	45,627	5,859	45,851	5,888
Pickens	46	13,695	1,758	13,264	1,703	14,624	1,878	14,696	1,887
Pike	284	83,811	10,762	81,177	10,424	89,499	11,492	89,939	11,549
Randolph	0	0	0	0	0	0	0	0	0
Russell	5	1,369	176	1,326	170	1,462	188	1,470	189
Shelby	541	159,952	20,539	154,925	19,894	170,808	21,933	171,648	22,041
St.Clair	56	16,433	2,110	15,917	2,044	17,549	2,253	17,635	2,264
Sumter	0	0	0	0	0	0	0	0	0
Talladega	263	63,818	8,195	61,812	7,937	68,149	8,751	68,484	8,794
Tallapoosa	162	47,931	6,155	46,424	5,961	51,184	6,572	51,436	6,605
Tuscaloosa	668	197,476	25,357	191,269	24,560	210,878	27,078	211,915	27,211
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	5	1,369	176	1,326	170	1,462	188	1,470	189
Alabama	17,054	5,030,806	645,994	4,872,688	625,690	5,372,247	689,837	5,398,659	693,229

Figure A13 - NAICS 331: Primary Metal Manufacturing

NAICS 332: Fabricated Metal Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	92	10,696	4,049	10,482	3,968	11,855	4,488	12,684	4,801
Baldwin	226	26,183	9,911	25,659	9,713	29,021	10,985	31,048	11,753
Barbour	481	55,709	21,087	54,594	20,665	61,747	23,373	66,060	25,006
Bibb	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Blount	115	13,259	5,019	12,993	4,918	14,696	5,563	15,722	5,951
Bullock	5	557	211	546	207	617	234	661	250
Butler	10	1,114	422	1,092	413	1,235	467	1,321	500
Calhoun	2,629	494,658	187,243	484,755	183,494	548,269	207,536	586,570	222,034
Chambers	139	16,044	6,073	15,723	5,952	17,783	6,731	19,025	7,202
Cherokee	3	334	127	328	124	370	140	396	150
Chilton	131	15,153	5,736	14,849	5,621	16,795	6,357	17,968	6,802
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Clay	10	1,114	422	1,092	413	1,235	467	1,321	500
Cleburne	10	1,114	422	1,092	413	1,235	467	1,321	500
Coffee	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Colbert	462	53,481	20,244	52,410	19,839	59,277	22,438	63,418	24,006
Conecuh	37	4,234	1,603	4,149	1,571	4,693	1,776	5,021	1,900
Coosa	10	1,114	422	1,092	413	1,235	467	1,321	500
Covington	19	2,228	843	2,184	827	2,470	935	2,642	1,000
Crenshaw	5	557	211	546	207	617	234	661	250
Cullman	928	152,366	57,675	149,316	56,520	168,879	63,926	180,677	68,392
Dale	143	16,601	6,284	16,269	6,158	18,400	6,965	19,686	7,452
Dallas	48	5,571	2,109	5,459	2,067	6,175	2,337	6,606	2,501
De Kalb	1,105	186,789	70,705	183,050	69,290	207,033	78,368	221,496	83,843
Elmore	867	100,276	37,957	98,269	37,198	111,144	42,071	118,908	45,010
Escambia	79	9,136	3,458	8,953	3,389	10,126	3,833	10,834	4,101
Etowah	1,139	154,304	58,409	151,215	57,239	171,027	64,739	182,975	69,262
Fayette	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Franklin	372	43,007	16,280	42,146	15,954	47,668	18,044	50,998	19,304
Geneva	543	62,840	23,787	61,582	23,310	69,650	26,365	74,516	28,206
Greene	0	0	0	0	0	0	0	0	0
Hale	24	2,785	1,054	2,730	1,033	3,087	1,169	3,303	1,250
Henry	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Houston	823	95,262	36,060	93,355	35,338	105,587	39,968	112,963	42,760
Jackson	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Jefferson	4,816	693,400	262,473	679,518	257,218	768,551	290,919	822,241	311,243
Lamar	15	1,783	675	1,747	661	1,976	748	2,114	800
Lauderdale	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Lawrence	19	2,228	843	2,184	827	2,470	935	2,642	1,000
Lee	315	36,434	13,791	35,704	13,515	40,382	15,286	43,203	16,354
Limestone	215	24,846	9,405	24,349	9,217	27,539	10,424	29,463	11,153
Lowndes	5	557	211	546	207	617	234	661	250
Macon	0	0	0	0	0	0	0	0	0
Madison	1,646	206,402	78,129	202,270	76,565	228,772	86,597	244,754	92,647
Marengo	10	1,114	422	1,092	413	1,235	467	1,321	500
Marion	315	36,434	13,791	35,704	13,515	40,382	15,286	43,203	16,354
Marshall	1,075	188,513	71,358	184,739	69,929	208,944	79,092	223,541	84,617
Mobile	1,570	203,906	77,184	199,824	75,639	226,005	85,550	241,794	91,526
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	1,303	261,859	99,121	256,617	97,137	290,239	109,864	310,515	117,539
Morgan	1,365	157,990	59,804	154,827	58,607	175,113	66,286	187,347	70,916
Perry	5	557	211	546	207	617	234	661	250
Pickens	5	557	211	546	207	617	234	661	250
Pike	0	0	0	0	0	0	0	0	0
Randolph	11	1,226	464	1,201	455	1,358	514	1,453	550
Russell	65	7,465	2,826	7,316	2,769	8,274	3,132	8,852	3,351
Shelby	816	181,218	68,596	177,590	67,223	200,858	76,031	214,890	81,342
St.Clair	880	141,839	53,690	138,999	52,615	157,212	59,509	168,194	63,666
Sumter	0	0	0	0	0	0	0	0	0
Talladega	490	56,712	21,467	55,576	21,037	62,858	23,794	67,249	25,456
Tallapoosa	119	13,816	5,230	13,539	5,125	15,313	5,796	16,383	6,201
Tuscaloosa	584	78,660	29,775	77,085	29,179	87,185	33,002	93,276	35,308
Walker	214	24,735	9,363	24,240	9,175	27,416	10,378	29,331	11,103
Washington	5	557	211	546	207	617	234	661	250
Wilcox	29	3,343	1,265	3,276	1,240	3,705	1,402	3,964	1,500
Winston	131	15,153	5,736	14,849	5,621	16,795	6,357	17,968	6,802
Alabama	26,976	3,925,728	1,486,005	3,847,135	1,456,255	4,351,198	1,647,058	4,655,168	1,762,120

Figure A14 - NAICS 332: Fabricated Metal Product Manufacturing

NAICS 333: Machinery Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	162	29,060	738	30,931	785	33,258	844	37,445	951
Baldwin	334	59,967	1,523	63,829	1,621	68,631	1,743	77,270	1,962
Barbour	0	0	0	0	0	0	0	0	0
Bibb	9	1,680	43	1,788	45	1,922	49	2,164	55
Blount	24	4,367	111	4,649	118	4,998	127	5,628	143
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	81	14,446	367	15,376	390	16,533	420	18,614	473
Chambers	3	504	13	536	14	577	15	649	16
Cherokee	3	504	13	536	14	577	15	649	16
Chilton	5	840	21	894	23	961	24	1,082	27
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	9	1,680	43	1,788	45	1,922	49	2,164	55
Cleburne	5	840	21	894	23	961	24	1,082	27
Coffee	9	1,680	43	1,788	45	1,922	49	2,164	55
Colbert	301	53,920	1,369	57,392	1,457	61,710	1,567	69,478	1,764
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	66	11,758	299	12,515	318	13,457	342	15,151	385
Crenshaw	5	840	21	894	23	961	24	1,082	27
Cullman	583	104,649	2,657	111,387	2,828	119,768	3,041	134,844	3,424
Dale	0	0	0	0	0	0	0	0	0
Dallas	1,877	336,792	8,552	358,478	9,102	385,448	9,787	433,969	11,019
De Kalb	490	87,851	2,231	93,508	2,374	100,543	2,553	113,200	2,874
Elmore	13	2,352	60	2,503	64	2,691	68	3,030	77
Escambia	94	16,798	427	17,879	454	19,224	488	21,644	550
Etowah	501	61,359	1,558	65,310	1,658	70,224	1,783	79,064	2,008
Fayette	47	8,399	213	8,940	227	9,612	244	10,822	275
Franklin	5	840	21	894	23	961	24	1,082	27
Geneva	5	840	21	894	23	961	24	1,082	27
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	94	16,798	427	17,879	454	19,224	488	21,644	550
Jackson	258	46,361	1,177	49,347	1,253	53,059	1,347	59,738	1,517
Jefferson	1,436	310,367	7,881	330,352	8,388	355,206	9,019	399,920	10,154
Lamar	662	118,759	3,015	126,406	3,210	135,916	3,451	153,026	3,886
Lauderdale	464	83,316	2,115	88,681	2,252	95,353	2,421	107,356	2,726
Lawrence	0	0	0	0	0	0	0	0	0
Lee	546	97,930	2,487	104,236	2,647	112,078	2,846	126,187	3,204
Limestone	641	115,063	2,922	122,472	3,110	131,687	3,344	148,264	3,765
Lowndes	9	1,680	43	1,788	45	1,922	49	2,164	55
Macon	0	0	0	0	0	0	0	0	0
Madison	449	80,628	2,047	85,820	2,179	92,277	2,343	103,893	2,638
Marengo	0	0	0	0	0	0	0	0	0
Marion	464	83,316	2,115	88,681	2,252	95,353	2,421	107,356	2,726
Marshall	567	113,683	2,887	121,003	3,072	130,107	3,304	146,485	3,719
Mobile	215	38,634	981	41,122	1,044	44,216	1,123	49,782	1,264
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	635	113,888	2,892	121,221	3,078	130,341	3,310	146,749	3,726
Morgan	1,354	309,598	7,861	329,533	8,367	354,326	8,997	398,929	10,129
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	9	1,680	43	1,788	45	1,922	49	2,164	55
Russell	19	3,360	85	3,576	91	3,845	98	4,329	110
Shelby	504	95,239	2,418	101,371	2,574	108,998	2,768	122,719	3,116
St.Clair	185	33,259	844	35,401	899	38,064	966	42,856	1,088
Sumter	0	0	0	0	0	0	0	0	0
Talladega	140	25,196	640	26,819	681	28,837	732	32,467	824
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	13	2,352	60	2,503	64	2,691	68	3,030	77
Walker	9	1,680	43	1,788	45	1,922	49	2,164	55
Washington	0	0	0	0	0	0	0	0	0
Wilcox	5	840	21	894	23	961	24	1,082	27
Winston	56	10,079	256	10,728	272	11,535	293	12,987	330
Alabama	13,367	2,505,670	63,622	2,667,010	67,719	2,867,664	72,813	3,228,656	81,979

Figure A15 - NAICS 333: Machinery Manufacturing

NAICS 334: Computer & Electronic Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	310	89,904	340	113,302	428	212,743	804	398,585	1,507
Barbour	169	49,013	185	61,769	234	115,981	439	217,297	822
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	58	16,804	64	21,178	80	39,765	150	74,502	282
Calhoun	97	28,007	106	35,297	133	66,275	251	124,170	470
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	97	28,007	106	35,297	133	66,275	251	124,170	470
Colbert	5	1,400	5	1,765	7	3,314	13	6,208	23
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	97	28,007	106	35,297	133	66,275	251	124,170	470
Dale	19	5,601	21	7,059	27	13,255	50	24,834	94
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	5	1,400	5	1,765	7	3,314	13	6,208	23
Elmore	483	140,037	530	176,483	667	331,375	1,253	620,849	2,348
Escambia	0	0	0	0	0	0	0	0	0
Etowah	48	14,004	53	17,648	67	33,138	125	62,085	235
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	879	255,148	965	321,552	1,216	603,766	2,283	1,131,187	4,277
Jackson	10	2,801	11	3,530	13	6,628	25	12,417	47
Jefferson	69	20,165	76	25,414	96	47,718	180	89,402	338
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	550	159,642	604	201,191	761	377,768	1,428	707,768	2,676
Limestone	81	23,526	89	29,649	112	55,671	211	104,303	394
Lowndes	0	0	0	0	0	0	0	0	0
Macon	19	5,601	21	7,059	27	13,255	50	24,834	94
Madison	6,887	1,998,329	7,556	2,518,414	9,523	4,728,727	17,881	8,859,513	33,500
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	241	70,019	265	88,242	334	165,688	627	310,424	1,174
Mobile	476	138,077	522	174,012	658	326,736	1,235	612,157	2,315
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	173	50,133	190	63,181	239	118,632	449	222,264	840
Morgan	71	20,725	78	26,120	99	49,044	185	91,886	347
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	58	16,804	64	21,178	80	39,765	150	74,502	282
Randolph	58	16,804	64	21,178	80	39,765	150	74,502	282
Russell	5	1,400	5	1,765	7	3,314	13	6,208	23
Shelby	180	52,374	198	66,005	250	123,934	469	232,197	878
St.Clair	5	1,400	5	1,765	7	3,314	13	6,208	23
Sumter	0	0	0	0	0	0	0	0	0
Talladega	241	70,019	265	88,242	334	165,688	627	310,424	1,174
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	965	280,074	1,059	352,966	1,335	662,751	2,506	1,241,698	4,695
Walker	5	1,400	5	1,765	7	3,314	13	6,208	23
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	12,360	3,586,630	13,562	4,520,086	17,092	8,487,186	32,092	15,901,181	60,126

Figure A16 - NAICS 334: Computer & Electronic Product Manufacturing

NAICS 335: Electrical Equipment, Appliance & Component Manufacturing								
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	3	636	3	634	3	729	3	821	4
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	448	106,075	494	105,707	493	121,569	566	136,874	638
Bibb	0	0	0	0	0	0	0	0	0
Blount	90	21,215	99	21,141	99	24,314	113	27,375	128
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	54	12,729	59	12,685	59	14,588	68	16,425	77
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	157	37,126	173	36,997	172	42,549	198	47,906	223
Coffee	0	0	0	0	0	0	0	0	0
Colbert	18	4,243	20	4,228	20	4,863	23	5,475	26
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	18	4,243	20	4,228	20	4,863	23	5,475	26
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	18	4,243	20	4,228	20	4,863	23	5,475	26
Elmore	0	0	0	0	0	0	0	0	0
Escambia	4	1,061	5	1,057	5	1,216	6	1,369	6
Etowah	45	10,607	49	10,571	49	12,157	57	13,687	64
Fayette	0	0	0	0	0	0	0	0	0
Franklin	9	2,121	10	2,114	10	2,431	11	2,737	13
Geneva	4	1,061	5	1,057	5	1,216	6	1,369	6
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	224	53,037	247	52,853	246	60,784	283	68,437	319
Jackson	224	53,037	247	52,853	246	60,784	283	68,437	319
Jefferson	717	135,891	633	135,419	631	155,741	726	175,348	817
Lamar	224	53,037	247	52,853	246	60,784	283	68,437	319
Lauderdale	179	42,430	198	42,283	197	48,628	227	54,750	255
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	108	25,670	120	25,581	119	29,420	137	33,124	154
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	282	66,827	311	66,595	310	76,588	357	86,231	402
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	358	84,860	395	84,565	394	97,255	453	109,500	510
Mobile	18	4,243	20	4,228	20	4,863	23	5,475	26
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	1,732	410,296	1,912	408,873	1,905	470,229	2,191	529,430	2,467
Morgan	1,987	498,413	2,322	496,684	2,314	571,216	2,662	643,132	2,997
Perry	4	1,061	5	1,057	5	1,216	6	1,369	6
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	9	2,121	10	2,114	10	2,431	11	2,737	13
Shelby	295	70,009	326	69,766	325	80,235	374	90,337	421
St.Clair	9	2,121	10	2,114	10	2,431	11	2,737	13
Sumter	0	0	0	0	0	0	0	0	0
Talladega	4	1,061	5	1,057	5	1,216	6	1,369	6
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	4	1,061	5	1,057	5	1,216	6	1,369	6
Walker	54	12,729	59	12,685	59	14,588	68	16,425	77
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	7,300	1,723,266	8,030	1,717,286	8,002	1,974,983	9,203	2,223,634	10,362

Figure A17 - NAICS 335: Electrical Equipment, Appliance & Component Manufacturing

NAICS 336: Transportation Equipment Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	307	131,378	1,162	144,116	1,274	165,919	1,467	175,737	1,554
Baldwin	686	293,073	2,592	321,489	2,843	370,128	3,273	392,029	3,467
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	9	4,042	36	4,434	39	5,105	45	5,407	48
Bullock	0	0	0	0	0	0	0	0	0
Butler	236	101,060	894	110,858	980	127,630	1,129	135,182	1,195
Calhoun	1,329	609,426	5,389	668,516	5,912	769,656	6,806	815,199	7,209
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	166	70,742	626	77,601	686	89,341	790	94,628	837
Chilton	95	40,424	357	44,343	392	51,052	451	54,073	478
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	5	2,021	18	2,217	20	2,553	23	2,704	24
Clay	0	0	0	0	0	0	0	0	0
Cleburne	5	2,021	18	2,217	20	2,553	23	2,704	24
Coffee	227	97,017	858	106,424	941	122,525	1,084	129,775	1,148
Colbert	76	32,339	286	35,475	314	40,842	361	43,258	383
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	19	8,085	71	8,869	78	10,210	90	10,815	96
Cullman	723	114,213	1,010	125,287	1,108	144,242	1,276	152,777	1,351
Dale	200	85,294	754	93,564	827	107,720	953	114,094	1,009
Dallas	189	80,848	715	88,687	784	102,104	903	108,146	956
De Kalb	473	202,119	1,787	221,717	1,961	255,261	2,257	270,365	2,391
Elmore	9	4,042	36	4,434	39	5,105	45	5,407	48
Escambia	19	8,085	71	8,869	78	10,210	90	10,815	96
Etowah	103	44,062	390	48,334	427	55,647	492	58,940	521
Fayette	297	126,931	1,122	139,238	1,231	160,304	1,418	169,789	1,501
Franklin	236	101,060	894	110,858	980	127,630	1,129	135,182	1,195
Geneva	5	2,021	18	2,217	20	2,553	23	2,704	24
Greene	0	0	0	0	0	0	0	0	0
Hale	5	2,021	18	2,217	20	2,553	23	2,704	24
Henry	57	24,254	214	26,606	235	30,631	271	32,444	287
Houston	946	404,239	3,575	443,434	3,921	510,521	4,515	540,730	4,782
Jackson	95	40,424	357	44,343	392	51,052	451	54,073	478
Jefferson	1,713	732,076	6,474	803,058	7,102	924,554	8,176	979,262	8,660
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	61	26,276	232	28,823	255	33,184	293	35,147	311
Lawrence	0	0	0	0	0	0	0	0	0
Lee	5	2,021	18	2,217	20	2,553	23	2,704	24
Limestone	2,798	1,196,142	10,578	1,312,120	11,603	1,510,632	13,359	1,600,020	14,149
Lowndes	95	40,424	357	44,343	392	51,052	451	54,073	478
Macon	0	0	0	0	0	0	0	0	0
Madison	4,453	1,903,560	16,834	2,088,129	18,466	2,404,044	21,260	2,546,297	22,517
Marengo	5	2,021	18	2,217	20	2,553	23	2,704	24
Marion	57	24,254	214	26,606	235	30,631	271	32,444	287
Marshall	592	271,710	2,403	298,055	2,636	343,148	3,035	363,453	3,214
Mobile	4,181	565,448	5,000	620,274	5,485	714,116	6,315	756,371	6,689
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	518	221,523	1,959	243,002	11,935	279,766	13,740	296,320	14,553
Morgan	77	32,743	290	35,918	318	41,352	366	43,799	387
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	266	113,591	1,005	124,605	1,102	143,456	1,269	151,945	1,344
Randolph	0	0	0	0	0	0	0	0	0
Russell	28	12,127	107	13,303	118	15,316	135	16,222	143
Shelby	0	0	0	0	0	0	0	0	0
St.Clair	142	60,636	536	66,515	588	76,578	677	81,109	717
Sumter	0	0	0	0	0	0	0	0	0
Talladega	2,268	294,527	2,605	323,084	2,857	371,964	3,289	393,974	3,484
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	2,235	955,216	8,447	1,047,834	9,266	1,206,361	10,668	1,277,745	11,299
Walker	19	8,085	71	8,869	78	10,210	90	10,815	96
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	395	168,972	1,494	185,355	1,639	213,398	1,887	226,025	1,999
Alabama	26,423	9,262,593	81,911	10,160,694	99,639	11,697,914	114,713	12,390,108	121,501

Figure A18 - NAICS 336: Transportation Equipment Manufacturing

NAICS 337: Furniture & Related Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	10	1,260	8	1,252	8	1,369	9	1,488	10
Baldwin	1,185	151,147	983	150,220	977	164,235	1,068	178,502	1,161
Barbour	0	0	0	0	0	0	0	0	0
Bibb	7	882	6	876	6	958	6	1,041	7
Blount	60	7,683	50	7,636	50	8,349	54	9,074	59
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	501	67,766	441	67,351	438	73,634	479	80,030	520
Chambers	3	378	2	376	2	411	3	446	3
Cherokee	20	2,519	16	2,504	16	2,737	18	2,975	19
Chilton	142	18,138	118	18,026	117	19,708	128	21,420	139
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	130	16,626	108	16,524	107	18,066	117	19,635	128
Clay	2,332	297,382	1,934	295,559	1,922	323,132	2,102	351,202	2,284
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	10	1,260	8	1,252	8	1,369	9	1,488	10
Colbert	62	7,935	52	7,887	51	8,622	56	9,371	61
Conecuh	10	1,260	8	1,252	8	1,369	9	1,488	10
Coosa	395	50,382	328	50,073	326	54,745	356	59,501	387
Covington	22	2,771	18	2,754	18	3,011	20	3,273	21
Crenshaw	5	630	4	626	4	684	4	744	5
Cullman	297	37,913	247	37,680	245	41,196	268	44,774	291
Dale	15	1,889	12	1,878	12	2,053	13	2,231	15
Dallas	58	7,431	48	7,386	48	8,075	53	8,776	57
De Kalb	95	12,092	79	12,018	78	13,139	85	14,280	93
Elmore	173	22,042	143	21,907	142	23,951	156	26,031	169
Escambia	14	1,763	11	1,753	11	1,916	12	2,083	14
Etowah	111	14,107	92	14,021	91	15,329	100	16,660	108
Fayette	5	630	4	626	4	684	4	744	5
Franklin	49	6,298	41	6,259	41	6,843	45	7,438	48
Geneva	59	7,557	49	7,511	49	8,212	53	8,925	58
Greene	0	0	0	0	0	0	0	0	0
Hale	10	1,260	8	1,252	8	1,369	9	1,488	10
Henry	59	7,557	49	7,511	49	8,212	53	8,925	58
Houston	148	18,893	123	18,778	122	20,529	134	22,313	145
Jackson	494	62,978	410	62,592	407	68,431	445	74,376	484
Jefferson	1,066	131,090	853	130,286	847	142,441	926	154,815	1,007
Lamar	321	40,936	266	40,685	265	44,480	289	48,344	314
Lauderdale	538	68,646	446	68,225	444	74,590	485	81,069	527
Lawrence	0	0	0	0	0	0	0	0	0
Lee	416	53,027	345	52,702	343	57,619	375	62,624	407
Limestone	494	62,978	410	62,592	407	68,431	445	74,376	484
Lowndes	0	0	0	0	0	0	0	0	0
Macon	5	630	4	626	4	684	4	744	5
Madison	124	15,870	103	15,773	103	17,245	112	18,743	122
Marengo	5	630	4	626	4	684	4	744	5
Marion	123	15,744	102	15,648	102	17,108	111	18,594	121
Marshall	62	7,935	52	7,887	51	8,622	56	9,371	61
Mobile	378	48,241	314	47,945	312	52,418	341	56,972	371
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	419	53,405	347	53,078	345	58,030	377	63,071	410
Morgan	172	21,916	143	21,782	142	23,814	155	25,883	168
Perry	0	0	0	0	0	0	0	0	0
Pickens	5	630	4	626	4	684	4	744	5
Pike	10	1,260	8	1,252	8	1,369	9	1,488	10
Randolph	529	67,512	439	67,098	436	73,358	477	79,731	519
Russell	30	3,779	25	3,756	24	4,106	27	4,463	29
Shelby	92	11,714	76	11,642	76	12,728	83	13,834	90
St.Clair	296	37,787	246	37,555	244	41,059	267	44,625	290
Sumter	0	0	0	0	0	0	0	0	0
Talladega	395	50,382	328	50,073	326	54,745	356	59,501	387
Tallapoosa	123	15,744	102	15,648	102	17,108	111	18,594	121
Tuscaloosa	131	16,752	109	16,649	108	18,203	118	19,784	129
Walker	203	25,947	169	25,788	168	28,194	183	30,643	199
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	1,779	163,502	1,063	162,500	1,057	177,660	1,155	193,093	1,256
Alabama	14,198	1,746,486	11,358	1,735,780	11,289	1,897,714	12,342	2,062,565	13,414

Figure A19 - NAICS 337: Furniture & Related Product Manufacturing

NAICS 339: Miscellaneous Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	41	6,970	654	7,505	705	8,646	812	10,187	956
Baldwin	392	66,640	6,257	71,751	6,737	82,665	7,761	97,396	9,144
Barbour	161	27,370	2,570	29,469	2,767	33,952	3,188	40,002	3,756
Bibb	0	0	0	0	0	0	0	0	0
Blount	43	7,310	686	7,871	739	9,068	851	10,684	1,003
Bullock	10	1,700	160	1,830	172	2,109	198	2,485	233
Butler	30	5,100	479	5,491	516	6,326	594	7,454	700
Calhoun	347	58,990	5,538	63,515	5,963	73,175	6,870	86,215	8,095
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	111	18,870	1,772	20,317	1,908	23,408	2,198	27,579	2,589
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	1,700	160	1,830	172	2,109	198	2,485	233
Clay	0	0	0	0	0	0	0	0	0
Cleburne	10	1,700	160	1,830	172	2,109	198	2,485	233
Coffee	39	6,630	622	7,139	670	8,224	772	9,690	910
Colbert	15	2,550	239	2,746	258	3,163	297	3,727	350
Conecuh	325	55,194	5,182	59,427	5,580	68,466	6,428	80,667	7,574
Coosa	10	1,700	160	1,830	172	2,109	198	2,485	233
Covington	30	5,100	479	5,491	516	6,326	594	7,454	700
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	12	2,040	192	2,196	206	2,531	238	2,981	280
Dale	10	1,700	160	1,830	172	2,109	198	2,485	233
Dallas	18	3,060	287	3,295	309	3,796	356	4,472	420
DeKalb	305	51,850	4,868	55,827	5,241	64,318	6,039	75,780	7,115
Elmore	82	13,940	1,309	15,009	1,409	17,292	1,624	20,374	1,913
Escambia	10	1,700	160	1,830	172	2,109	198	2,485	233
Etowah	30	5,100	479	5,491	516	6,326	594	7,454	700
Fayette	10	1,700	160	1,830	172	2,109	198	2,485	233
Franklin	0	0	0	0	0	0	0	0	0
Geneva	30	5,100	479	5,491	516	6,326	594	7,454	700
Greene	0	0	0	0	0	0	0	0	0
Hale	30	5,100	479	5,491	516	6,326	594	7,454	700
Henry	26	4,420	415	4,759	447	5,483	515	6,460	607
Houston	673	114,410	10,742	123,185	11,566	141,922	13,325	167,212	15,699
Jackson	20	3,400	319	3,661	344	4,218	396	4,969	467
Jefferson	1,142	146,212	13,728	157,426	14,780	181,371	17,029	213,691	20,063
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	36	6,120	575	6,589	619	7,592	713	8,944	840
Lawrence	30	5,100	479	5,491	516	6,326	594	7,454	700
Lee	26	4,420	415	4,759	447	5,483	515	6,460	607
Limestone	524	89,080	8,364	95,912	9,005	110,501	10,375	130,192	12,223
Lowndes	225	38,250	3,591	41,184	3,867	47,448	4,455	55,903	5,249
Macon	0	0	0	0	0	0	0	0	0
Madison	342	58,140	5,459	62,599	5,877	72,121	6,771	84,973	7,978
Marengo	10	1,700	160	1,830	172	2,109	198	2,485	233
Marion	10	1,700	160	1,830	172	2,109	198	2,485	233
Marshall	205	34,850	3,272	37,523	3,523	43,230	4,059	50,934	4,782
Mobile	164	27,880	2,618	30,018	2,818	34,584	3,247	40,747	3,826
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	491	83,470	7,837	89,872	8,438	103,542	9,721	121,993	11,454
Morgan	368	62,560	5,874	67,358	6,324	77,604	7,286	91,433	8,584
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	172	29,240	2,745	31,483	2,956	36,271	3,405	42,735	4,012
St.Clair	10	1,700	160	1,830	172	2,109	198	2,485	233
Sumter	0	0	0	0	0	0	0	0	0
Talladega	30	5,100	479	5,491	516	6,326	594	7,454	700
Tallapoosa	11	1,870	176	2,013	189	2,320	218	2,733	257
Tuscaloosa	130	22,100	2,075	23,795	2,234	27,414	2,574	32,300	3,033
Walker	12	2,040	192	2,196	206	2,531	238	2,981	280
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	30	5,100	479	5,491	516	6,326	594	7,454	700
Alabama	6,798	1,107,676	104,005	1,192,635	111,974	1,374,034	129,005	1,618,887	151,994

Figure A20 - NAICS 339: Miscellaneous Manufacturing

NAICS 211: Oil & Gas Extraction									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
DeKalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	71	91,289	3,804	94,028	3,918	91,800	3,825	90,000	3,750
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	0	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	174	223,723	9,322	230,435	9,601	224,974	9,374	220,564	9,190
Lamar	10	12,858	536	13,243	552	12,930	539	12,676	528
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	393	505,306	21,054	520,465	21,686	508,130	21,172	498,171	20,757
Monroe	70	90,004	3,750	92,704	3,863	90,507	3,771	88,733	3,697
Montgomery	10	12,858	536	13,243	552	12,930	539	12,676	528
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	0	0	0	0	0	0	0	0	0
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	83	106,719	4,447	109,920	4,580	107,315	4,471	105,212	4,384
Walker	10	12,858	536	13,243	552	12,930	539	12,676	528
Washington	10	12,858	536	13,243	552	12,930	539	12,676	528
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	831	1,068,472	44,521	1,100,526	45,855	1,074,444	44,768	1,053,385	43,891

Figure A21 - NAICS 211: Oil and Gas Extraction

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Truckloads	2010 Total Value of Shipments ($1000)	2010 Truckloads	2015 Total Value of Shipments ($1000)	2015 Truckloads
NAICS 2121: Coal Mining									
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	61	12,739	5,226	12,866	5,278	14,116	5,791	15,433	6,331
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
DeKalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	0	0	0	0	0	0	0	0	0
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	254	53,044	21,761	53,574	21,978	58,777	24,112	64,260	26,362
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	0	0	0	0	0	0	0	0	0
Jackson	10	2,088	857	2,109	865	2,314	949	2,530	1,038
Jefferson	1,324	276,497	113,430	279,262	114,564	306,378	125,689	334,963	137,415
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	10	2,088	857	2,109	865	2,314	949	2,530	1,038
Marshall	0	0	0	0	0	0	0	0	0
Mobile	0	0	0	0	0	0	0	0	0
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	145	30,281	12,422	30,584	12,547	33,554	13,765	36,684	15,049
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	1,309	273,364	112,145	276,098	113,266	302,907	124,265	331,169	135,858
Walker	145	30,281	12,422	30,584	12,547	33,554	13,765	36,684	15,049
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	3,258	680,383	279,120	687,187	281,911	753,913	309,285	824,253	338,141

Figure A22 - NAICS 2121: Coal Mining

NAICS 113: Forestry & Logging				
	2002 Truckloads	2005 Truckloads	2010 Truckloads	2015 Truckloads
Autauga	1,560	1,622	1,510	1,554
Baldwin	2,966	3,085	2,870	2,954
Barbour	4,081	4,244	3,949	4,064
Bibb	2,323	2,416	2,247	2,313
Blount	1,481	1,540	1,433	1,475
Bullock	2,187	2,275	2,117	2,178
Butler	3,006	3,126	2,909	2,994
Calhoun	447	465	433	445
Chambers	2,828	2,942	2,737	2,817
Cherokee	1,730	1,799	1,674	1,723
Chilton	2,427	2,524	2,349	2,417
Choctaw	6,045	6,287	5,849	6,020
Clarke	7,186	7,473	6,953	7,156
Clay	1,768	1,839	1,711	1,761
Cleburne	2,058	2,141	1,992	2,050
Coffee	2,165	2,251	2,095	2,156
Colbert	1,695	1,762	1,640	1,688
Conecuh	5,357	5,572	5,184	5,335
Coosa	2,433	2,530	2,354	2,423
Covington	3,209	3,337	3,105	3,195
Crenshaw	1,831	1,904	1,772	1,823
Cullman	1,399	1,455	1,354	1,394
Dale	1,198	1,246	1,159	1,193
Dallas	2,809	2,921	2,718	2,797
De Kalb	524	545	508	522
Elmore	941	979	911	937
Escambia	3,698	3,846	3,578	3,683
Etowah	1,143	1,189	1,106	1,139
Fayette	2,613	2,718	2,529	2,603
Franklin	1,284	1,335	1,242	1,279
Geneva	1,312	1,365	1,270	1,307
Greene	1,431	1,489	1,385	1,425
Hale	2,438	2,535	2,359	2,427
Henry	1,419	1,476	1,373	1,413
Houston	927	964	897	923
Jackson	1,806	1,878	1,748	1,799
Jefferson	1,155	1,202	1,118	1,151
Lamar	3,529	3,670	3,415	3,514
Lauderdale	430	447	416	428
Lawrence	648	674	627	646
Lee	1,809	1,881	1,751	1,802
Limestone	203	211	196	202
Lowndes	1,589	1,653	1,538	1,583
Macon	1,337	1,391	1,294	1,332
Madison	298	309	288	296
Marengo	4,295	4,467	4,156	4,277
Marion	2,920	3,037	2,825	2,908
Marshall	674	701	652	671
Mobile	2,195	2,283	2,124	2,186
Monroe	5,822	6,055	5,633	5,798
Montgomery	3,616	3,760	3,499	3,601
Morgan	491	511	475	489
Perry	2,417	2,513	2,338	2,407
Pickens	2,774	2,885	2,684	2,762
Pike	1,481	1,540	1,433	1,475
Randolph	1,218	1,267	1,179	1,213
Russell	3,158	3,284	3,055	3,144
Shelby	2,303	2,395	2,228	2,293
St Clair	2,543	2,645	2,461	2,533
Sumter	4,169	4,335	4,034	4,151
Talladega	3,229	3,358	3,124	3,215
Tallapoosa	1,352	1,406	1,308	1,346
Tuscaloosa	4,625	4,810	4,475	4,606
Walker	4,413	4,590	4,270	4,395
Washington	3,847	4,000	3,722	3,831
Wilcox	4,192	4,360	4,057	4,175
Winston	2,121	2,206	2,052	2,112
Alabama	158,579	164,922	153,444	157,924

Figure A23 - NAICS 113: Forestry & Logging

NAICS 111: Crop Production				
	2002 Total Truckloads	2005 Total Truckloads	2010 Total Truckloads	2015 Total Truckloads
Autauga	163	163	163	163
Baldwin	863	863	863	863
Barbour	237	237	237	237
Bibb	6	6	6	6
Blount	114	114	114	114
Bullock	31	31	31	31
Butler	48	48	48	48
Calhoun	152	152	152	152
Chambers	6	6	6	6
Cherokee	445	445	445	445
Chilton	51	51	51	51
Choctaw	7	7	7	7
Clarke	13	13	13	13
Clay	10	10	10	10
Cleburne	26	26	26	26
Coffee	500	500	500	500
Colbert	943	943	943	943
Conecuh	86	86	86	86
Coosa	0	0	0	0
Covington	283	283	283	283
Crenshaw	78	78	78	78
Cullman	392	392	392	392
Dale	244	244	244	244
Dallas	330	330	330	330
DeKalb	1,168	1,168	1,168	1,168
Elmore	274	274	274	274
Escambia	347	347	347	347
Etowah	127	127	127	127
Fayette	210	210	210	210
Franklin	117	117	117	117
Geneva	719	719	719	719
Greene	12	12	12	12
Hale	167	167	167	167
Henry	432	432	432	432
Houston	663	663	663	663
Jackson	1,767	1,767	1,767	1,767
Jefferson	1	1	1	1
Lamar	138	138	138	138
Lauderdale	1,024	1,024	1,024	1,024
Lawrence	1,460	1,460	1,460	1,460
Lee	26	26	26	26
Limestone	1,532	1,532	1,532	1,532
Lowndes	110	110	110	110
Macon	165	165	165	165
Madison	2,130	2,130	2,130	2,130
Marengo	45	45	45	45
Marion	122	122	122	122
Marshall	379	379	379	379
Mobile	171	171	171	171
Monroe	236	236	236	236
Montgomery	90	90	90	90
Morgan	603	603	603	603
Perry	122	122	122	122
Pickens	174	174	174	174
Pike	278	278	278	278
Randolph	22	22	22	22
Russell	90	90	90	90
Shelby	39	39	39	39
St.Clair	3	3	3	3
Sumter	129	129	129	129
Talladega	749	749	749	749
Tallapoosa	8	8	8	8
Tuscaloosa	296	296	296	296
Walker	12	12	12	12
Washington	64	64	64	64
Wilcox	60	60	60	60
Winston	0	0	0	0
Alabama	21,309	21,309	21,309	21,309

Figure A24 - NAICS 111: Crop Production

NAICS 112: Animal Production				
County	2002 Total Truckloads	2005 Total Truckloads	2010 Total Truckloads	2015 Total Truckloads
Autauga	104	104	104	104
Baldwin	206	206	206	206
Barbour	2,412	2,412	2,412	2,412
Bibb	33	33	33	33
Blount	7,678	7,678	7,678	7,678
Bullock	562	562	562	562
Butler	2,831	2,831	2,831	2,831
Calhoun	1,640	1,640	1,640	1,640
Chambers	81	81	81	81
Cherokee	1,164	1,164	1,164	1,164
Chilton	103	103	103	103
Choctaw	359	359	359	359
Clarke	35	35	35	35
Clay	1,554	1,554	1,554	1,554
Cleburne	3,236	3,236	3,236	3,236
Coffee	7,644	7,644	7,644	7,644
Colbert	1,684	1,684	1,684	1,684
Conecuh	83	83	83	83
Coosa	30	30	30	30
Covington	3,030	3,030	3,030	3,030
Crenshaw	5,343	5,343	5,343	5,343
Cullman	20,823	20,823	20,823	20,823
Dale	2,777	2,777	2,777	2,777
Dallas	152	152	152	152
DeKalb	14,089	14,089	14,089	14,089
Elmore	91	91	91	91
Escambia	78	78	78	78
Etowah	2,903	2,903	2,903	2,903
Fayette	607	607	607	607
Franklin	6,796	6,796	6,796	6,796
Geneva	5,276	5,276	5,276	5,276
Greene	112	112	112	112
Hale	190	190	190	190
Henry	777	777	777	777
Houston	313	313	313	313
Jackson	3,516	3,516	3,516	3,516
Jefferson	52	52	52	52
Lamar	41	41	41	41
Lauderdale	636	636	636	636
Lawrence	4,202	4,202	4,202	4,202
Lee	50	50	50	50
Limestone	1,121	1,121	1,121	1,121
Lowndes	1,667	1,667	1,667	1,667
Macon	59	59	59	59
Madison	499	499	499	499
Marengo	155	155	155	155
Marion	3,261	3,261	3,261	3,261
Marshall	9,583	9,583	9,583	9,583
Mobile	154	154	154	154
Monroe	78	78	78	78
Montgomery	995	995	995	995
Morgan	4,244	4,244	4,244	4,244
Perry	91	91	91	91
Pickens	3,589	3,589	3,589	3,589
Pike	3,533	3,533	3,533	3,533
Randolph	3,299	3,299	3,299	3,299
Russell	39	39	39	39
Shelby	55	55	55	55
St.Clair	3,031	3,031	3,031	3,031
Sumter	148	148	148	148
Talladega	1,082	1,082	1,082	1,082
Tallapoosa	48	48	48	48
Tuscaloosa	953	953	953	953
Walker	3,166	3,166	3,166	3,166
Washington	877	877	877	877
Wilcox	106	106	106	106
Winston	3,623	3,623	3,623	3,623
Alabama	148,746	148,746	148,746	148,746

Figure A25 - NAICS 112: Animal Production

Appendix B

PRELIMINARY FREIGHT MODEL VALIDATION USING EXTREME-WORLD SCENARIO CONSTRUCTION

Heather Shar
University of Alabama in Huntsville
Huntsville, AL 35899

KEYWORDS: transportation, planning, discrete, freight, logistics

ACRONYMS: ATIM – Alabama Transportation Infrastructure Model
VITS – Virtual Intermodal Transportation System
ALDOT – Alabama Department of Transportation
v/c – volume-to-capacity ratio

ABSTRACT

The Alabama Transportation Infrastructure Model (ATIM) is a discrete event simulation model of the freight transportation infrastructure in Alabama. Scenarios involving changes in roadway, railway, and waterborne freight volumes and/or freight facilities can be evaluated to test their impact on travel time, roadway congestion levels, and system ton-miles generated. The ATIM is currently in the process of model validation. However, due to model conceptualization and limited data resources the most common method of model validation, comparison to real-world figures, is unavailable to test the ATIM's performance. To test that the model is behaving in the manner expected without the benefit of detailed baseline data, extreme-world scenarios were constructed for a five-year planning horizon. Best-case, worst-case, and status-quo freight growth scenarios were created based on the current trends in the overall freight industry and on key uncertainties specific to Alabama. The model's response to the three extreme-world scenarios indicates that the general behavior of the model is tracking expected real-world performance. Since the qualitative model behavior has been validated, the next step is to gather additional information on the real performance of the system and then check the model output on a quantitative basis.

INTRODUCTION

To date, transportation planning has largely relied on trend-line analysis of historical economic and population data to forecast future facility usage. However, industry growth and development in a region can create a much higher demand on the transportation infrastructure than would be indicated by historical data. The Alabama Transportation Infrastructure Model developed by researchers at the University of Alabama in Huntsville is a discrete event simulation to evaluate the impact of changing freight patterns in order to more accurately plan for future transportation infrastructure needs. The ATIM is a statewide freight transportation model that gives state officials the ability to rapidly evaluate the impact of various decisions on the state's freight transportation system including highway, rail, and water routes. In addition to these, the transportation network also includes intermodal transfers between truck, rail, and water at the transfer points in Huntsville, Birmingham, Montgomery, and Mobile, Alabama.

The ATIM is based on the Virtual Intermodal Transportation System (VITS) model developed at the National Center for Intermodal Transportation at Mississippi State University [1]. The VITS was developed as the first attempt to use discrete-event simulation to model multiple modes of transportation infrastructure in a single simulation. The ATIM is an extension and adaptation of the VITS to Alabama's transportation network. However, to gain plausibility as a tool for transportation planning and overall policy and decision making, the ATIM must be proven to accurately portray the real-world behavior. This paper describes the preliminary qualitative model validation process using extreme-world scenario construction to test plausible future states at the boundaries of expected performance.

WHY USE THE EXTREME-WORLD METHOD?

The ATIM is a scenario-modeling program focused on the high-level interactions between market forces driving freight production and movement and the response of public and private entities to the freight levels generated. As such, the ATIM serves best as a tool to evaluate the impact of policy decisions, large-scale capital construction and investment, or key component changes on the overall performance of Alabama's transportation infrastructure and its ability to move goods and people.

One of the inputs to the ATIM is the expected level of traffic that will be generated due to the industry clusters that are present in a geographical area. This expected level of traffic is generated using the TranPlan urban-planning software and is based on linear regression models of employment, payroll, and the value of shipments at the county level. Employment is an indicator of population growth in an area, which causes an increase in both passenger cars and freight traffic necessary to support the higher population. Payroll, or household income, is an indicator of economic activity that can drive an increase in population. The value of shipments is also an economic indicator which reflects productivity increases and also reflects the type of industry cluster found in a geographical area [2].

The most common method of model validation is to compare model output for a known set of input conditions to the real-world system performance for the same set of conditions. However, the model conceptualization of the ATIM and the limited availability of real-world performance data restrict this quantitative form of validation:

- The freight route network modeled in the ATIM is a subset of the actual roadway system in Alabama. All of the interstate road facilities are represented, but some US highways and many state and county highways were not included in the available choices for freight movement.
  - Some freight carriers, especially those who are familiar with the local road system, choose alternate routes for travel that are not represented in the model network.
- ALDOT does not regularly conduct freight surveys to estimate of the level of freight that moves on a given roadway facility.
  - Although a total traffic count is available to calibrate top level traffic counts, no data is available to compare model output of freight levels to real-world behavior.
- The structure of the ATIM is dependent on the free-flow speed being assigned to each road link; however, detailed roadway parameter data is unavailable to compute those free-flow speeds.
  - Roadway geometry, including number of lanes, width of lanes, width of lateral clearance, posted speed limits, divider types, and grade, are highly variable and impact how well traffic can flow through a facility; traffic flow directly impacts congestion levels and travel times.

Use of the TranPlan distribution of freight along inter-county routes also creates some key difficulties to model validation:

- The TranPlan software creates a gravity-model distribution, in which traffic is assigned equally to multiple routes based on estimated travel times. In cases of congestion, the gravity model off-loads traffic to less-preferred routes to minimize the travel time experienced by the system.
  - Real-world freight traffic will often remain on a pre-determined delivery route despite congestion-related travel delays.
  - TranPlan is an urban-planning software package; it assumes all traffic will behave as passenger car traffic in an urban area.
- Urban-planning models assume that each trip that leaves a location will return “home” to that location within a 24-hour period
  - Inter-city and inter-state freight trips usually do not return to their original location within 24 hours, if at all.

Within traffic planning, much lower levels of model fidelity are considered acceptable for decision-making purposes than are usually accepted in other disciplines. A model that provides outputs within approximately +/- 50% of the actual values is usually considered acceptable in practice. However, as the volume of traffic on a roadway grows closer to the facility’s capacity, it is more important for the model to provide values closer to actual system performance. There is no standard codification of what the acceptable model performance levels are for various roadway facilities.

Given these issues, the model validation process was split into phased tests requiring different levels of data intensity. Of these, the first step was to test the model’s qualitative response to a range of scenarios impacting the level of freight traffic on the roadway system. The extreme-world method was used to create scenarios that would test the boundaries of expected system performance, but were less data-intensive than a link-by-link analysis of model output traffic levels versus actual traffic counts.

EXTREME WORLD SCENARIO CONSTRUCTION

The extreme world scenarios were constructed following the method outlined by Goodwin and Wright [3], shown in Figure 1.

1. Identify the issue of concern and the horizon year which will be captured in the scenarios.
2. Identify predetermined trends that have some degree of impact on the issue of concern.
3. Identify critical uncertainties, which when resolved (one way or the other) have some degree of impact on the issue of concern.
4. Identify the degree to which the trends and unresolved uncertainties have a negative or positive impact on the issue of concern.
5. Create extreme worlds by putting all positively resolved uncertainties in one scenario and all negatively resolved uncertainties in another scenario.
6. Add the predetermined trends to both scenarios.
7. Check for internal coherence. Could the trends and resolved uncertainties co-exist in a plausible future scenario?
8. Add in the actions of individuals and/or organizations who will be impacted by the future described in a scenario. What actions would they take/have taken to satisfy their own interests?

Figure 1: Steps In Extreme World Scenario Construction [3]

In practice, the steps in scenario construction were found to less straightforward than Figure 1 would suggest. Steps 1 and 2 were followed by identifying the impact of the trends (part of Step 4). Then after Step 3, identifying the uncertainties, the impact of those uncertainties were evaluated (the second part of Step 4). The actual construction of the scenarios takes place in steps 5-8, and those actions were taken concurrently for each of the best-case, worst-case, and status-quo options.

The steps taken to create the scenarios for testing the ATIM are as follows:

Step 1: The overall issue of concern is the ability of Alabama's transportation system, roadways, waterways, and railways, to move goods and people throughout the state in order to promote economic activity and growth. The system's performance of this goal can be measured by the amount of congestion and associated delay that travelers experience. The volume of freight vehicles is currently the largest force driving changes in congestion levels and associated delays in travel time occurring between the metropolitan areas of the state. The level of freight traffic also directly impacts the life expectation for roadway surfaces, shortening maintenance cycles and forcing repaving more often. Thus, the level of freight vehicles in the system was chosen as the independent test variable to be manipulated in scenario construction. A higher volume of freight vehicles on the roadway is considered a negative impact, and a lower volume of freight vehicles is a positive impact. For the ATIM, the dependent variables that will be measured are the average speed on I-65 between Montgomery and Mobile, the average speed on I-10 between Mobile and the Mississippi state border, the average speed on I-10 between Mobile and the Florida state border, and the average zone utilization for each of the Alabama DOT traffic zones.
The most logical horizon year for testing the ATIM was current + 5 years, or 2012. When dealing with freight patterns, most manufacturing companies and freight shippers are fairly comfortable with predicting their growth 1-5 years in the future, but estimates of future activity past the 5 year horizon are unreliable.

Steps 2 and 4: Overall trends identified and their impacts on the level of freight on Alabama roadways are shown in Table 1. These trends represent the general consensus of the freight community on the outlook for freight movement at the national and global level. The impact of these trends on the level of freight vehicles in the system are shown in the last column of Table 1. Using Goodwin and Wright's notation, a positive or reinforcing impact is designated by "+ve"; a very positive or highly reinforcing impact is designated by "++ve". The opposite, a negative or decreasing impact, is designated by "-ve"; a strong negative or greatly decreasing impact is designated by "--ve."

Table 1: Predetermined Trends and Their Impact on Freight Volume

	Trends	Impact
T1	Increasing congestion at ports on the eastern and western coastlines	+ve
T2	Increasing volumes of containers handled in Chicago, Atlanta, Memphis, Dallas, and Tampa	+ve
T3	Rising gasoline and diesel prices	-ve
T4	Increased use of air freight to ship time-sensitive cargoes	-ve
T5	Increased levels of just-in-time shipments in manufacturing to retail supply chains	+ve
T6	Reduced federal funding for roadway maintenance and new construction	+ve
T7	Reduced federal funding for locks and dams and waterway dredging	-ve
T8	Increased production in China and other off-shore locations	+ve
T9	Low capital investment in constructing new railroad routes	+ve
T10	Decreasing ability of railroads to follow short-haul freight routes	+ve
T11	Increased use of globalized supply chains	+ve

Steps 3 and 4: Key uncertainties identified and their impacts on the level of freight on Alabama roadways are shown in Table 2. These key uncertainties are unique to Alabama and are expected to resolve within the 5-year planning horizon. The same designation from Table 1 is used in Table 2 to show the level of impact each uncertainty is expected to have on the level of freight vehicles in the system.

Table 2: Key Uncertainties and Their Impact on Freight Volume

	Key Uncertainties			Impact
U1	Level of container traffic through Choctaw Point at Port of Mobile	u11	Higher	++ve
		u12	As Is	+ve
U2	Level of freight traffic processed through Port of New Orleans	u21	Higher	--ve
		u22	As Is	+ve
		u23	Lower	++ve
U3	Implementation of freight-only toll lanes	u31	Implemented	-ve
		u32	Not Implemented	+ve
U4	Number of available truck drivers (due to legal requirements, economic growth, changing demographics, etc.)	u41	More	+ve
		u42	Current Level	-ve
		u43	Less	--ve
U5	Kia facility production in GA	u51	Higher	++ve
		u52	Lower	+ve
U6	Attraction of an international mega-economic development project	u61	Successful	++ve
		u62	Unsuccessful	-ve

Steps 5-8: The three extreme-world scenarios constructed from the uncertainties and trends identified are shown in Figure 2. These extreme scenarios were created by combining all positively resolved uncertainties into the worst-case scenario and all of the negatively resolved uncertainties into the best-case scenario. The overall trends in freight transportation were then added on top of the uncertainties and checked for internal coherence. Given that the ATIM tests high-level policy decisions, the actions of individuals and organizations who would be impacted were included in the impact of the trends and uncertainties rather than existing as a third level of data variation. The data sources and figures used to transform the scenarios into traffic levels are given in Appendix A.

Worst Case: High Freight Loads with No Roadway Improvements

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans fails to rebuild capacity back to pre-Katrina levels, leaving the Port of Mobile as the only deep-water port on the Gulf Coast between Houston and Tampa. The Choctaw Point container handling facility fully realizes volume projections of 800,000 additional container lifts each year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance, capacity improvements, locks and dams, and waterway dredging is reduced, leading to restricted facilities available to move freight. Railroad companies do not invest in building new Class I routes or maintaining current Class III services, forcing short-haul and low-profit margin products to be moved via truck instead. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is successful is attracting one of the international mega-development economic sites which effectively cuts Alabama DOT's budget in half to enable site development.

Best Case: Roadway Improvements and Freight Distribution Across Modes

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans rebuilds its freight handling capacity back to pre-Katrina levels, relieving the Port of Mobile of its overage of freight traffic. The Choctaw Point container facility comes online, reaching its conservative estimated volume of 200,000 lifts per year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance and capacity improvements is increased to levels sufficient to support the refurbishment of the interstate system and development of congestion-mitigation routes. Federal funding for locks and dams and waterway dredging is increased, leading to faster lock throughput times, adequate staffing levels, and waterway dredging sufficient to support heavier barge loads. Railroad companies invest in increasing Class I track capacity through double-tracking and in increasing Class III railroad facilities to handle 286-class cars. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is not successful is attracting one of the international mega-development economic sites which leaves Alabama DOT's budget as a source of funds for needed roadway maintenance and capacity improvement projects.

Status Quo Scenario: Gradual Growth

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans rebuilds its freight handling capacity back to pre-Katrina levels, relieving the Port of Mobile of its overage of freight traffic. The Choctaw Point container facility comes online, reaching its average estimated volume of 400,000 lifts per year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance and capacity improvements is maintained at current levels, effectively reducing the amount of available funds since the cost of building and maintaining roadway surfaces increases faster than inflation. Federal funding for locks and dams and waterway dredging is maintained at current levels, leading to slower lock throughput times, inadequate staffing levels, and a minimum amount of waterway dredging. Combined, these effects on the inland waterway system force more barge companies out of business and push shipments with a low value-to-weight ratio onto trucks. Railroad companies invest in increasing Class I track capacity through double-tracking. Class III railroad facilities are upgraded to handle 286-class cars in areas that have a high volume of rail shipments to support those investments, but other low-volume tracks are abandoned. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is not successful is attracting one of the international mega-development economic sites which leaves Alabama DOT's budget as a source of funds for needed roadway maintenance and capacity improvement projects.

Figure 2: Extreme Scenarios

ATIM RESULTS

The three extreme-world scenarios, best case, worst case, and status quo, all generated different levels of freight traffic based on the trends and uncertainties contained within. The ATIM was populated with the traffic levels generated from the three extreme-world scenarios and then executed for five days of simulated weekday time. At the end of each of the simulation runs output data was collected.

Several sets of variables were used to test the models response to changing input levels: the average speed on I-65 between Mobile and Montgomery (north- and south-bound separated), the average speed on I-10 between Florida and Mississippi (east- and west-bound separated), and the average zone utilization for each of the nine ALDOT traffic zones. Average speed was used as a variable to test the impact of congestion on traffic throughput. The expected response for average speed is a decrease as the volume of traffic rises, caused by congestion-induced slowdowns. Zone utilization was chosen because it is an aggregate measure of the volume-to-capacity ratio for a region. The expected response for zone utilization is an increase followed by a plateau as the volume of traffic fills up and eventually exceeds the available roadway capacity.
Figure 3 shows the average speeds experienced by traffic on the selected roadway segments during the three model runs. The I-65 and I-10 facilities examined as model output were chosen because they will bear the brunt of the container traffic generated by the Choctaw Point facility at the Port of Mobile. As expected, all highways showed decreased speeds between the best case and the worst case scenarios. I-65 northbound showed the greatest magnitude of decrease, 7.17%, which is to be expected since a high percentage of the traffic generated by the Choctaw Point container handling facility at the Port of Mobile will be using I-65 to reach the I-85 interchange in Atlanta and the I-20 and I-59 interchanges in Birmingham.

	I-65 Northbound	I-65 Southbound	I-10 West	I-10 East
Best Case	59.73	42.52	64.95	64.00
Status Quo	57.08	39.26	63.14	61.50
Worst Case	55.44	41.29	62.75	60.34

Figure 3: Average Speed (mph) of Selected Roadway Segments

There were two unexpected results from the average speed output variables. First, the I-65 southbound traffic is moving at a lower speed in all three cases than was expected. This could be caused by the increased level of freight generated within the state and in the southeastern US that is being transported to the Port of Mobile for outbound shipment, but this will need further research. To clarify, again on I-65 southbound, the status quo scenario shows a slower traffic speed than does the worst case scenario. It is possible that this is a random event based on the string of random numbers used in the model processes, but that is unlikely. Again, this will need further research to resolve.

The second variable, zone utilization, was based on the nine traffic regions designated by ALDOT. Alabama's counties are broken into nine regions by the state Department of Transportation for planning purposes, as shown in Figure 4. In the ATIM, the zone utilization is computed for each of these areas by computing the aggregate volume-to-capacity ratio for all the roadways in the region. The v/c ratio is defined as the total number of trucks in the zone divided by the roadway capacity of all roadway sections within the zone.

Figure 4: Alabama Department of Transportation Traffic Zones [12]

The results for zone utilization for each of the three cases are shown in Figure 5. As expected, the zone utilization increased for each of the zones as more traffic volume was added. The average utilization increase between the best case and status quo scenarios was 13.65% and the average increase between status quo and worst case was 3.81%. This tends to suggest that the capacity of the roadways are being filled and continuing to add traffic volume would no longer increase utilization.

	Best Case	Status Quo	Worst Case
Zone 1	1.17	1.38	1.44
Zone 2	0.42	0.51	0.54
Zone 3	2.09	2.36	2.45
Zone 4	0.90	1.08	1.16
Zone 5	1.43	1.62	1.69
Zone 6	1.32	1.49	1.55
Zone 7	0.47	0.53	0.55
Zone 8	0.53	0.61	0.62
Zone 9	2.44	2.92	2.92

Figure 5: Zone Utilizations (Volume to Capacity Ratios)

Zone 9, including Baldwin and Mobile counties where the Port of Mobile is located, saw no increase in utilization between the status quo and the worst case scenarios even though additional traffic was added to the roadway volume. This would suggest that Zone 9 has reached the saturation point where the roadways cannot accommodate additional vehicles, resulting in high levels of congestion and long travel delays.

CONCLUSIONS

The exercise of the ATIM using the three extreme-world scenarios resulted in model behavior consistent to expectations. Although detailed data-intensive model calibration and validation still need to be performed at the roadway link and corridor level, the general performance of the simulation demonstrates that the overall structure and logic of the model are appropriate for the research questions being asked. As a preliminary model validation step, extreme-world scenario building is a suitable tool.

FURTHER RESEARCH

Although the extreme-world scenarios can be used to show that the ATIM reacts as expected to large scale changes at the boundaries of expected model performance, there were several questions raised by the model output that need to be answered before more data-intensive validation is attempted.

- Why does I-65 southbound between Montgomery and Mobile experience slower average speeds than the northbound section under the same growth percentages?
- Why does the status-quo scenario result in lower average speeds on I-65 southbound than the worst case scenario?
- What are the appropriate replication parameters to obtain repeatable results? Is there a difference between running single replications of multiple-day time periods and running multiple replications of single-day time periods?
- At what level of traffic saturation does zone utilization stop increasing? Is that level the same for all zones, or does it depend on the mix of differing roadway types available in the prescribed area?
- If one zone reaches saturation, how does that affect the rest of the roadway system? Does it make a difference if the saturated zone contains a major freight generator or a major arterial?

After the questions about the model behavior are answered, more detailed validation is necessary to bring the ATIM to the performance level expected by Alabama's DOT and Metropolitan Planning Organizations (MPOs). With regard to continued model development and validation, the next steps for the ATIM are:

- Calibration of the model-generated traffic trips to known trip levels on Alabama roadways
- Research into the freight traffic levels on the waterway and railway systems and capacities of those facilities to handle additional freight traffic.
- Integration of urban freight data from the MPO's into the statewide model.
- Development of intermodal transfer volumes, mode-specific transfer facilities, and procedures.
- Further scenario refinement beyond the extreme cases to display the impact that point-changes can have on overall system behavior.

The ultimate goal of traffic and freight forecasting is to understand how transportation infrastructure is going to constrain or enable economic growth within a region. The PIE model developed by The University of Alabama in Huntsville Office for Economic Development shown in Figure 6 [4] shows conceptually how the availability of transportation infrastructure, congestion levels, and economic activity within a region are related.

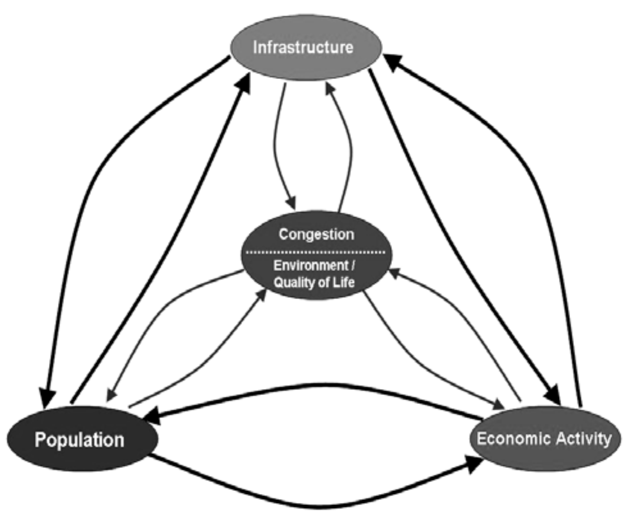

Figure 6: P-I-E Interrelationship Diagram

While the extreme-world view scenarios, and the ATIM itself, are concerned with freight volumes and transportation infrastructure resources, neither provides any feedback on how those two variables are connected to the economic activity of Alabama. High levels of freight are actually good – until they are bad. High freight levels indicate high economic activity and the distribution of goods and raw materials through the region and throughout the country. At some point, however, those high freight levels begin to discourage additional growth in a region because the system lacks the capability to absorb more vehicles. At that point, the freight level becomes an impediment that needs to be addressed rather than the symptom of a highly performing economy. Conversely, low freight levels are good because they encourage further expansion into an area, but if they grow too low they can be a symptom of a poorly functioning economy. Further research is needed to describe the conditions under which freight levels become a liability instead of an asset and also how pinpointed changes to the infrastructure can enable economic growth.

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APPENDIX A

Truck Volume Assumptions for Scenario Creation

1. Best Case (lowest volume):
    a. Base Truck Population Growth: according to Census Bureau projections, the population of Alabama is projected to grow at an average rate of 0.3% through 2015 [5], which will lead to a corresponding increase in freight traffic to supply goods such as clothing, food, and building supplies. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 0.3% value.
    b. U1: Choctaw Point conservative projections are 200,000 containers per year, 40% diverted to rail. Remainder is sent primarily north to Chicago and Memphis via truck. [6]
    c. U2: the Mississippi River Gulf Outlet is the deep-draft ‘shortcut’ that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. Dredging the channel to a 36-foot depth would allow ships supplying businesses along the industrial canal to continue to berth at the Port of New Orleans [7].
    d. U3: the presence of established toll lanes along I-65 and possibly I-20 and I-59 would increase the throughput speed of truck traffic.
    e. U4: a loss of truck drivers due to legal requirements, economic growth outstripping driver population, and changing demographics would limit the amount of drivers on the road system.
    f. U5: the Kia plant is expected to come online in 2009 [8] with a production projection of 300,000 vehicles per year. Unless additional plant capacity is added, that 300,000 volume should remain stable through 2012. A survey of automobile manufacturers and suppliers in Alabama has shown that 2008 projections were 1.88 Mil truck trips to produce 8 Mil vehicles [9]. Using this ratio, 300,000 vehicles for Kia will require 705,000 truck trips. Since the Kia plant is in Georgia, but will be using the same supplier base as its sister plant in Montgomery, approximately 1/3 of these trips will be expected to impact Alabama.
2. Status Quo (historical projections)
    a. Base Truck Population Growth: according to the Cambridge Systematics report on congestion, the US Gross National Product is expected to double by 2025 [10]. Interpolation of this figure showed an average growth of approximately 31.58% by 2012. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 31.58% value.
    b. U1: Choctaw Point conservative projections range from 200,000 containers per year to 800,000 containers per year with; 500,000 is the expected average volume with approximately 40% diverted to rail. The majority of these containers will be sent north to Chicago and Memphis via truck, with the remainder moving east and west along I-10 to Florida and Mississippi [6].
    c. U2: the Mississippi River Gulf Outlet is the deep-draft ‘shortcut’ that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. The MRGO remains closed due to lack of funds for dredging, forcing the businesses along the Industrial Canal that require deep-water berths to move shipments to Mobile [7].
    d. U3: it is unlikely that toll lanes will be established or built along the I-65 corridor during the planning horizon for this scenario, meaning that all additional truck traffic will be added to the existing facilities.
    e. U4: the existing number of drivers plus some newcomers to the industry minus some who leave because of demographic, personal choice, or legal issues will remain relatively stable with a slight upward trend due to increased wages. The upward trend will not satisfy the total demand for drivers, leaving some companies
    f. U5: the Kia plant is expected to come online in 2009 with a production projection of 300,000 vehicles per year [8]. Unless additional plant capacity is added, that 300,000 volume should remain stable through 2012. A survey of automobile manufacturers and suppliers in Alabama has shown that 2008 projections were 1.88 Mil truck trips to produce 8 Mil vehicles [9]. Using this ratio, 300,000 vehicles for Kia will require 705,000 truck trips. Since the Kia plant is in Georgia, but will be using the same supplier base as

its sister plant in Montgomery, approximately 1/3 of these trips will be expected to impact Alabama.

3. Worst Case (highest volume)
   a. Base Truck Population Growth: according to the US DOT, commercial truck travel has doubled over the last two decades [11]. If commercial truck traffic continues to grow at this rate, truck volumes will show an average growth of approximately 40% by 2012. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 40% value.
   b. U1: Port Authority personnel [6] have tentatively projected 800,000 container lifts per year as a high-end optimistic scenario, with about 40% of those containers diverted to rail. The containers placed on trucks will be sent north on I-65 to Chicago and Memphis via truck, east and west along I-10 to Florida, Mississippi, and Texas, east on I-85 to Atlanta.
   c. U2: the Mississippi River Gulf Outlet is the deep-draft 'shortcut' that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. The MRGO remains closed due to lack of funds for dredging, forcing the businesses along the Industrial Canal that require deep-water berths to move shipments to Mobile [7].
   d. U3: it is unlikely that toll lanes will be established or built along the I-65 corridor during the planning horizon for this scenario, meaning that all additional truck traffic will be added to the existing facilities.
   e. U4: increasing freight shipments create an increased need for drivers. Improved training programs and higher wages and incentives will attract more young drivers to the profession as well as attracting retirees to drive part- or full-time. This increased number of available drivers will not restrict freight shipments by truck, and in fact will encourage more companies to ship via fast, flexible truck schedules.
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Appendix C

ALABAMA

COMMISSION ON INFRASTRUCTURE

"Sustaining & Creating Economic Prosperity"

REPORT OF FINDINGS

PRESENTED TO
THE ALABAMA LEGISLATURE
THE OFFICE OF THE GOVERNOR
AND
ALABAMA'S CONGRESSIONAL DELEGATION

MONTGOMERY, ALABAMA
APRIL 2007

Report Prepared by:

University of Alabama in Huntsville
Office for Economic Development
Office for Freight, Logistics, and Transportation

Alabama Commission on Infrastructure
Report of Findings
April 2007

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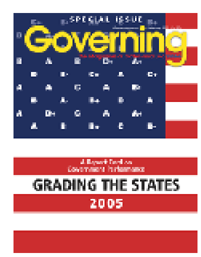
Introduction

Over the past five decades, the Alabama economy has experienced dramatic changes in composition and structure. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries. As an example, approximately 240,000 automobiles were assembled in Alabama in 2003. By 2008, the number is expected to exceed 800,000 arising from the consumer demand for autos made in Alabama by Mercedes, Honda, and Hyundai.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. Over the past twenty years, Alabama has transitioned rapidly into a manufacturing and knowledge economy from an agricultural and natural resource economy. The efficient and effective movement of people and freight is a critical component in the transformation and growth of the Alabama economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.



Alabama is not alone in facing these problems. Infrastructure to move people and products into and across the continental U.S. is an issue for virtually every state. In general, there are simply too few resources available to address the demands from economic growth and deteriorating assets. A funded report by The Pew Charitable Trusts released in *Governing* magazine's February 2005 issue on the Government Performance Project included a grade on each state's ability to maintain its infrastructure assets. At least a dozen states received a grade of C or less in their ability to plan for and manage their infrastructure. Alabama, with a rating of a "D", was identified as the state with the greatest challenge ahead. (Figure ES-1)

State Transportation Infrastructure Grades – 2005

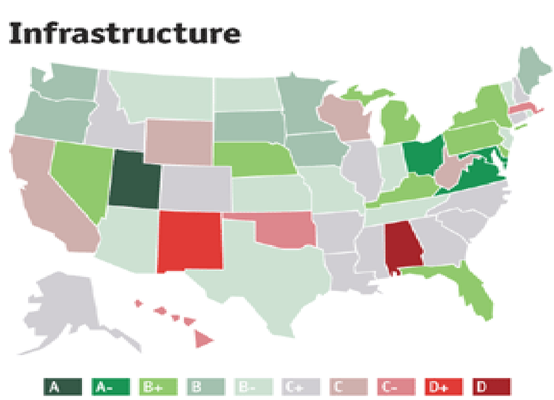


Figure ES-1
Source: Governing magazine, February 2005.

In discussing infrastructure, the Governing article concludes, "But no matter how carefully planned a project is, it will deteriorate if states shortchange maintenance. This happens with some frequency: It's easy to put off for a year or two of maintenance – especially when legislators are dealing with tight budgets…This issue of unfunded maintenance is unquestionably the biggest problem for states in their management of infrastructure."[2]

There are challenges within the U.S. transportation system that amplify the urgency to create and implement a plan to meet the needs of U.S. manufacturers and shippers. The reality today is that the vast majority of freight moves by truck in the U.S. The convergence of a truck shortage (driver & equipment) and increasing railroad congestion will boost the pressure for highway resolutions. The cost of transportation will continue to grow in importance to Alabama manufacturers as well as to the consumer.

There is a clear economic opportunity for any state, especially coastal states with inland infrastructure, to move freight consistently within and across its borders. Alabama has a significant opportunity for continued growth by strategically addressing its transportation infrastructure needs. The strategy must have a statewide focus, and broad non-partisan support. If successful, Alabama can become the freight gateway to the Midwest. If the opportunity is not pursued and more of Alabama's transportation infrastructure becomes inadequate to support industries' needs, sustaining job growth becomes even more difficult.

Infrastructure Commission Formed

The formation of the Alabama **Commission on Infrastructure** was initiated as one of thirty-five recommendations of the *Alabama Legislative Commission on Manufacturing.* Speaker of the Alabama House, Seth Hammett, was the chief sponsor of the Joint Resolution creating the Manufacturing Commission, which passed unanimously by the Legislature on September 26, 2003. The Alabama Legislature authorized the Commission on Manufacturing to develop recommendations to address a state manufacturing crisis that lost approximately 100,000 jobs in the previous ten years.

An efficient transportation infrastructure system was among the critical competitive needs of business and industry identified by the Manufacturing Commission. The recognition of this industry need caused the Manufacturing Commission to recommend formation of a "blue-ribbon panel" to address infrastructure issues. The need for such an entity was reinforced by a study, "*Transportation Infrastructure in Alabama: Meeting the Needs for Economic Growth"*, published by the Office for Economic Development at the University of Alabama in Huntsville.[3] The study correlates the relationship between industry growth, job creation and transportation congestion.

Speaker Seth Hammett announced the creation of the Alabama **Commission on Infrastructure** in November 2005. Speaker Hammett recognized the need for an overall vision of all elements of the state's infrastructure within a transportation system framework, which would incorporate all transportation modes: roads, rail, waterways and airports. The Alabama **Commission on Infrastructure** was charged with evaluating and recommending solutions to the challenges facing the state's infrastructure system.

Building on the original joint resolution, Speaker Hammett named 45 members to the Commission on Infrastructure and established five working committees organized around users of the transportation infrastructure. Members of the Commission on Infrastructure and its committees include a broad mix of business and industry leaders, legislators, state agency officials, academic infrastructure experts, and economic development officials from across the state.

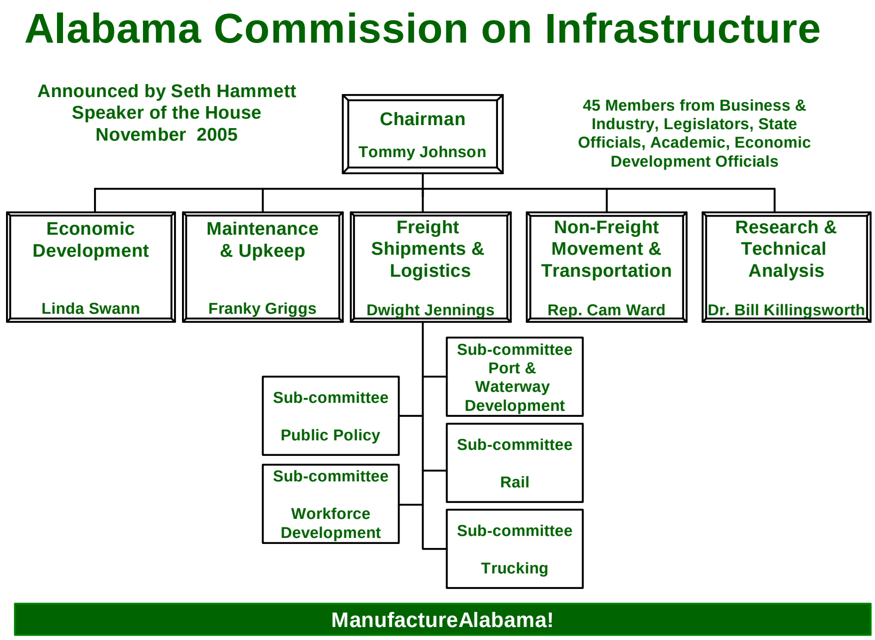


Figure ES-2
Source: Manufacture Alabama

The **Commission on Infrastructure** convened on February 13, 2006, for its initial meeting. The five working committees formed were:

- **Freight Shipments & Logistical Needs**
  - Chaired by Dwight Jennings
  Responsible for considering shipments of raw materials, component parts, and finished products by both existing and prospective new industries.
  Subcommittees:
  - Port & Waterway Development
  - Public Policy
  - Railroads
  - Trucking & Movement of Truck Freight
  - Workforce Development

- **Non-Freight Movement & Transportation Needs**
  - Chaired by Rep. Cam Ward
  Responsible for considering public travel needs including commuting issues, and challenges to public safety, convenience and economic impact.

- **Maintenance & Upkeep of Infrastructure Assets**
  - Chaired by Franky Griggs

Responsible for considering critical repair and maintenance needs facing the various elements of Alabama's transportation system.

- **Economic Development**
  - Chaired by Linda Swann
  Responsible for identifying and evaluating the opportunities available through improved infrastructure systems, the economic development consequences of continued infrastructure system deterioration, and a failure to improve inter-modal coordination.

- **Research, Development & Technical Analysis**
  - Chaired by Bill Killingsworth, Ph.D.
  Responsible for providing the research, data, and other technical support to the commission and its committees while they are evaluating the state's infrastructure needs and propose solutions.

The Commission charged the committees to conduct their work with a focus on the statewide transportation systems rather than on the hundreds of locally important projects that have been identified or could be brought to the committee discussions. Therefore, many of these recommendations and issues recommendations remain conceptual in nature and without prioritization. In most cases, more research and analysis is still needed to understand how the project(s) referenced in a recommendation will affect Alabama's overall transportation system and economic future.

Recommended Near Term Actions

The Commission offers the numerous recommendations in this report acknowledging that funding and time are constraints with which Alabama must work. The Commission is suggesting in particular that the following recommendations be considered for near-term action.

1. **Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation**

   An Alabama Transportation Commission should be created with oversight responsibilities to provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports, has proven very successful.

2. **Expand Alabama Department of Transportation's roles in rail and waterways**

   ALDOT, with the oversight of a newly formed Alabama Transportation Commission discussed above, could better integrate the responsibility of

Alabama’s rail and waterways. The gains in efficiency and maintenance of Alabama’s airports could also be realized in the rail and waterway transportation modes.

3. Establish an analysis resource for Alabama’s transportation system

Modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. Utilization of Alabama research universities and other support organizations is strongly encouraged to provide this research.

4. Modify motor fuels tax law to address inflation erosion of generated funds

Modification of Alabama motor fuels tax laws should be considered to match more closely revenue generation with levels of use. Additionally, tax law modifications should incorporate methods to stem the buying power erosion due to inflation. A limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects should also be considered. Several fuel tax indexing and other revenue bills can be quickly accessed for evaluation.

5. Change the point of collection for motor fuels from the distributors to terminals

Collecting motor fuel taxes at the fuel terminals (“at the rack”), where distributors receive their supply will reduce the potential loss of taxable fuels revenue. The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of point-of-collection change.

6. Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs

The Commission recommends that any dollars generated from the Outer Continental Shelf leases be placed into a trust fund similar to all of Alabama’s other offshore oil and gas revenues. A trust fund would allow the interest to be spent but preserve the principle. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers our inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. Therefore, the Commission's recommendation is that the Legislature create a special Constitutional Trust Fund to administer and invest these revenues for the benefit of the citizens of the state, similar to the way we currently administer and invest our inshore oil and gas royalties through the Alabama Trust Fund. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

Background Research Considered by the Infrastructure Commission

The availability of transportation data such as traffic counts, mode capacity, maintenance status and more is almost limitless. Over the past year, the Commission, as part of its process, provided an extremely valuable service in reviewing and selecting relevant research with which to consider the transportation challenges, and more importantly, economic opportunities for Alabama. Information was gathered on each of the four transportation modes; road, rail, waterways and air (airports). Additionally, there was new information requested by the commission from both the public and private sectors.

The Multi-System Framework for Analysis

The commission adopted a framework to incorporate multiple systems affecting congestion. The Population, Infrastructure, and Economic Activity (P-I-E) model, developed and presented by the Office for Freight, Logistics and Transportation and the Office for Economic Development at the University of Alabama in Huntsville, was used for this purpose.[4] With this framework and the current research being conducted for the U.S. Department of Transportation, a new systems perspective has been used to view Alabama's transportation assets.

Population – Infrastructure – Economic Activity (P-I-E)

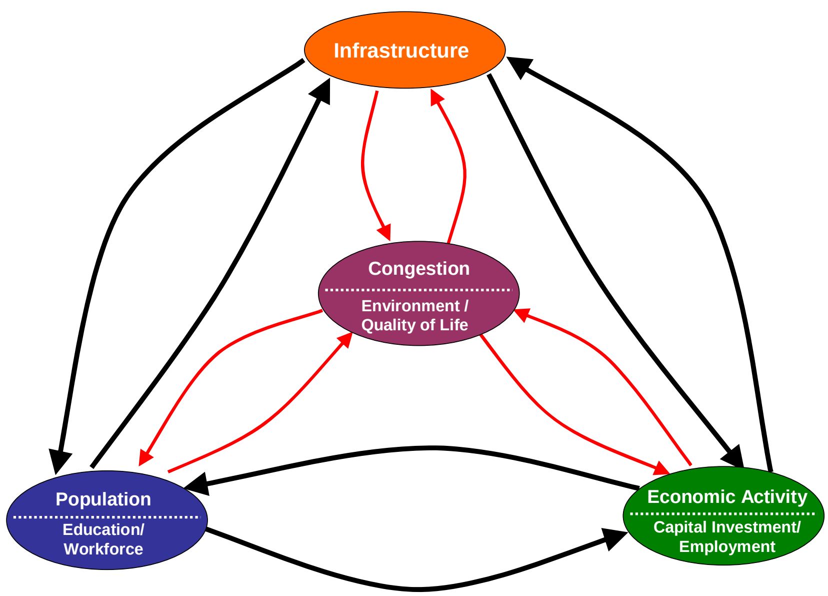


Figure ES-3
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

The P-I-E framework represented in Figure ES-3 recognizes the relationships that exist between population, infrastructure and economic activity, and more importantly, the resulting levels of congestion resulting from their interactions. Planning for and managing each of these elements can affect the resulting congestion as each element is a generator for the other two elements. While traffic congestion is often the focus of many efforts, this framework encourages a focus on the generators of congestion and alternative solutions.

Major Interstate Traffic Levels

It is clear that the Interstate 65 corridor represents the state's main transportation artery and is a primary economic engine for Alabama. The preponderance of freight and non-freight traffic moves north and south between Mobile and the Decatur-Huntsville region on I-65. Additional container freight will flow through Alabama with the early 2008 startup from the Alabama State Port Authority's container handling facility at Choctaw Point. By 2010, it is expected that containers handled at the Port will exceed 200,000 annually, almost eight times the level in 2005. [6]

Much of the state's industrial growth and economic activity has occurred, and probably will continue, to occur along or near I-65. For that reason, the state's most critical highway congestion points are located on I-65. Projections from the P-I-E and other analytic models show that congestion at these points will continue to worsen. Committee members generally agreed that addressing those issues on the state's main artery must be the first priority. While other highway projects are necessary and worthwhile, Commission members agreed it would be counter-productive to implement highway projects that feed more freight and non-freight traffic onto I-65, without first implementing the solutions needed to address the rapidly brewing I-65 congestion crisis.

Tracking growth in daily traffic volumes for Interstate 65 from mile markers 1 through 366 over a twenty-year time period shows that neither utilization nor growth is uniform. Changes in population, infrastructure and economic activity have placed greater demands on particular segments of roads. In some instances, sections of I-65 are approaching congestion levels that may threaten economic growth in some areas.

Figure ES-4 shows I-65 annual average daily traffic starting in Mobile on the left at mile marker 1 and ending on the right at mile marker 366 at the Alabama - Tennessee border. This chart clearly shows that between 1985 and 2004, traffic levels continued to rise higher and that the levels of high traffic continued to spread outward from city centers.

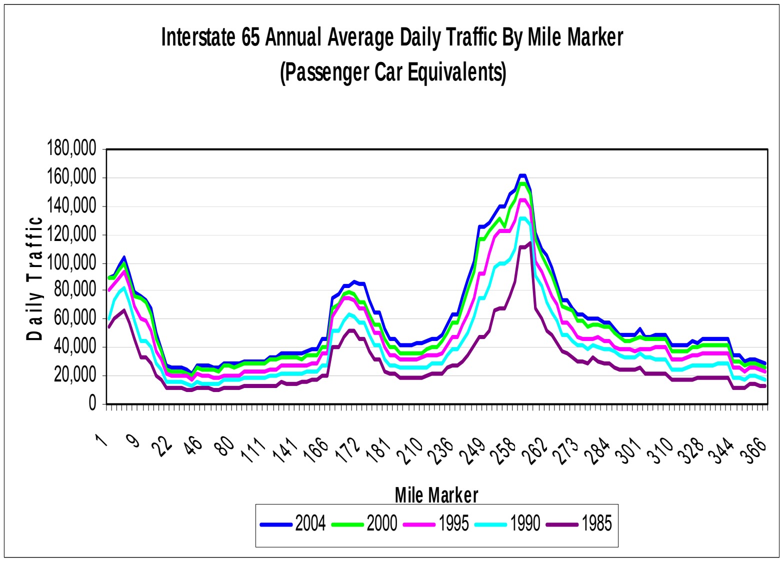


Figure ES-4

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Infrastructure Issues by Industry

Utilization of Alabama's transportation infrastructure varies by industry. A survey of Alabama manufacturing industries conducted by the UAH Office for Economic Development in 2004-05 found that trucking and road issues are major concerns. It is important to note that the issues were identified by each company from a broad inquiry rather than by transportation mode, i.e., truck, water, or railroad.[6] The three issues most often identified by Alabama companies were (1) road capacity and congestion, (2) truck availability, and (3) truck route access.

Growth in infrastructure utilization is anticipated to occur mostly on roads used by Alabama's production industries, e.g. automotive, aerospace, electronics, etc. The information gathered by the survey indicates that Alabama's industries are experiencing challenges with the current road infrastructure due to insufficient capacity and congestion. Additionally, it should be noted that many of Alabama's industries would increase their truck shipments if additional trucks were available.

Congestion ranking of major Southeastern cities

Growth in population and employment creates the challenge of meeting transportation needs with limited resources. Figure ES-5 presents urban area annual hours of delay per traveler for major southeastern U.S. cities. The chart shows that travel delay time in Birmingham is lower and is growing at a slower rate than larger, southern metropolitan areas like Atlanta and Austin. This beneficial position of lower congestion is an advantage for Alabama. An advantage such as this should not be allowed to deteriorate but it can only be maintained with infrastructure investment.

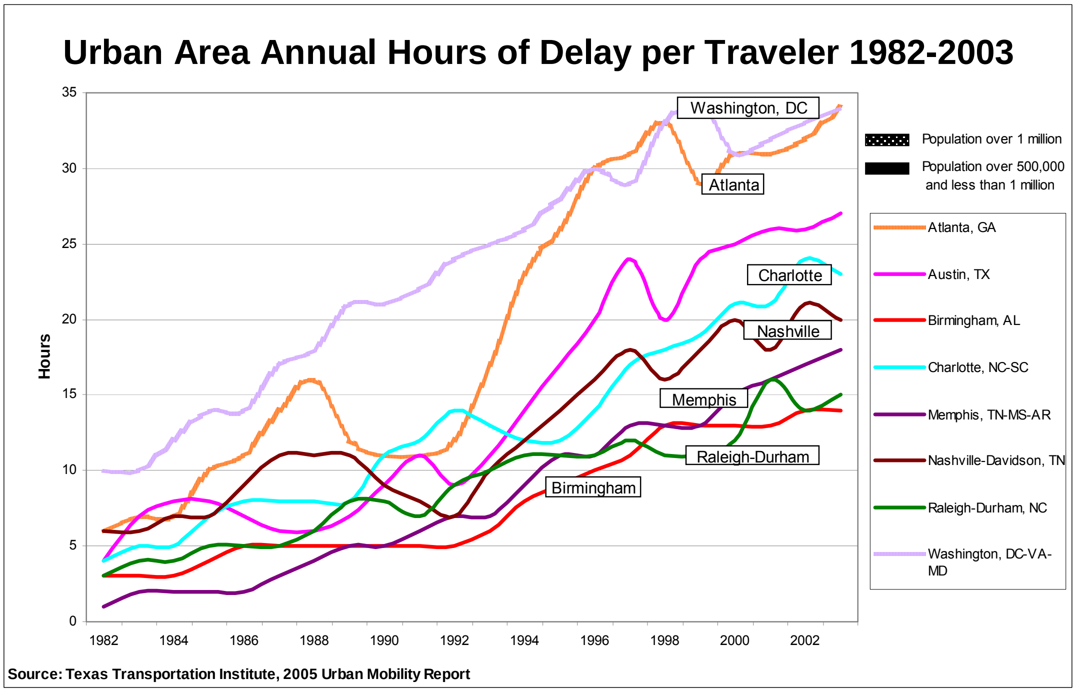


Figure ES-5

Transportation Research Resources Available

Understanding the current and probable future demands on transportation infrastructure is essential in Alabama's economic development strategy. There are several transportation research resources in Alabama that can be built upon. These include the Alabama Transportation Department's wealth of data, the state research universities with transportation research programs, and industry clusters that are willing and eager to share their needs.

Approaching transportation infrastructure planning from a "system of systems" perspective is possible and can better match limited resources with current and future needs. In fact, Alabama's transportation system is the collective interaction between the road system, rail system, water system, and air system. Especially in the transportation of freight in and through Alabama, the interaction of these systems determines flow rates and thereby overall congestion levels. In order for Alabama to continue to be a leader in advanced manufacturing, global trade, and economic development in general, transportation infrastructure must be managed as an enabler rather than a constraint to economic opportunity.

Infrastructure Commission Findings

Recommendations were developed by each of the five working committees of the Alabama Commission on Infrastructure. The Commission considered the committees' recommendations and approved the following ones on January 22, 2007.

To facilitate ease of presentation and discussion, the list of the recommendations below are grouped by subject matter rather than identifying them with individual committees. This listing format should in no way suggest that the Commission and its committees approached Alabama's infrastructure picture on a piecemeal asset-by-asset basis. To the contrary, the committees were diligent in addressing transportation needs from a strategic, intermodal perspective. An intermodal perspective is simply considering the interconnection of highway, rail, waterways, airports, and other infrastructure elements as outlined in the strategic charge of the Commission. Recommendations were developed on the premise that Alabama's major transportation infrastructure challenges are statewide, rather than local and must be identified and analyzed as such.

The Commission noted but did not attempt a review of the hundreds of projects that the Alabama Department of Transportation has underway or planned. Instead, the Commission charged its committees with generating innovative ideas within the multi-modal transportation system framework. Listed below are recommendations from the Commission related to highway projects. The list is not intended to be all-inclusive or necessarily presented in order of priority, other than to emphasize the significance of I-65 to the state. In particular, some of these recommendations illustrate the Commission's desire to consider innovative ideas to improve traffic flow rather than simply adding capacity.

Interstate 65 Corridor Recommendations

- Consider the addition of one lane in each direction on I-65.
- Study the feasibility of a four-lane truck-only toll highway parallel to I-65.
- Construct a northern by-pass in Birmingham to complete the outer loop.
- Construct the Montgomery Outer Loop connecting I-65 and I-85 south of the city.
- Encourage a resolution to address the bottleneck at the Interstate 10 Tunnel.
- Complete the corridor study and public hearings underway by ALDOT on a proposed new Western Alabama Freeway.

Non Interstate 65 Highway Recommendations

- Complete the Corridor X project in Alabama.
- Construct the southern by-pass and related projects in the Huntsville area.
- Complete the Dothan to I-10 connector route.
- Expand and improve Highway 84 to four lanes across south Alabama.
- Extend I-85 from Montgomery to connect with I-20/59 at the Alabama-Mississippi line.

Bridge Rehabilitations Recommendations

- Increase the priority of the county bridge replacement crisis by creating a funding mechanism to permit repair or replacement of deficient structures. Current estimation indicates there are approximately 1,750 county bridges and at least 560 state and city bridges that are declared deficient and must be replaced.

Railway Recommendations

- Explore strategies to promote and assist short-line railroads with infrastructure needs.
- Authorize funding for a study of the Alabama short-line railroad system.
- Form a coalition to explore the potential for an additional north-south rail line.

Waterways Recommendations

- Fund a study to develop strategies that could increase the use of Alabama's inland waterways.
- Encourage federal funding for the maintenance of Alabama's Intracoastal Waterway systems.

Intermodal Center Recommendations

- Pursue the establishment of an inland intermodal freight facility to dispatch inbound containerized freight and collect outbound containers.
- Enhance the Alabama Port container handling facility by funding a rail interchange yard and a ship-turning basin.

Mass Transit Recommendations

- Thoroughly evaluate the need, economic benefit and costs of mass transit system improvements in Birmingham, Mobile and other major areas of congestion. This evaluation should be conducted within the context of impact on the state transportation system. The Commission believes that urban area mass transit issues are critical and must be addressed in any comprehensive infrastructure strategy developed by Alabama.

Organizational Structure Recommendations

- Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation.
- Expand ALDOT's roles in rail and waterways.
- Establish an analysis resource for Alabama's transportation system.
- Extend the *Commission on Infrastructure* through the 2007-2010 Legislative quadrennium to perform further strategic analysis.

Infrastructure Funding Recommendations

- Explore opportunities for private investment through private construction and/or long-term leases of toll roads and bridges.
- Consider establishing a Lifecycle Maintenance Trust Fund to allocate maintenance funds with the approval of new construction projects.
- Modify motor fuels tax law to address inflation erosion of generated funds.
- Change the point of collection for motor fuels from the distributors to terminals.
- Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs.

Path Forward

The **Commission on Infrastructure** recommends that the Commission and its work be continued through the 2007-2010 legislative quadrennium. The Infrastructure Commission would perform strategic analysis and work with members of the legislature and administration enabling action on as many of the recommendations as possible. Much work remains and can be accomplished more effectively by bringing together many of the state's top transportation infrastructure experts. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on this vitally important role of state government.

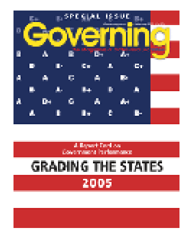
Concurrently, the expansion of research resources for analyzing Alabama's transportation systems should be initiated. Enhanced analytical and modeling tools are needed to integrate the multiple modes of roads, railways, waterways, and airports. A modern multi-mode research capability will assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. The modeling analysis will help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

The members of the Commission on Infrastructure wish to thank Speaker Seth Hammett and the members of the Alabama Legislature for the opportunity to focus on this extremely important issue. In addition, we would like to thank Manufacture Alabama and its members for supporting the day-to-day work of the Commission and committees. We offer these recommendations after much deliberation and stand ready to continue our service in assisting with preparing Alabama for a strong and prosperous economic future.

Alabama Commission on Infrastructure Report of Findings

1. Introduction

Over the past five decades, the Alabama economy has experienced dramatic changes in composition and structure. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries. As an example, approximately 240,000 automobiles were assembled in Alabama in 2003. By 2008, the number is expected to exceed 800,000 arising from the consumer demand for autos made in Alabama by Mercedes, Honda, and Hyundai.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. Over the past twenty years, Alabama has transitioned rapidly into a manufacturing and knowledge economy from an agricultural and natural resource economy. The efficient and effective movement of people and freight is a critical component in the transformation and growth of the Alabama economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.



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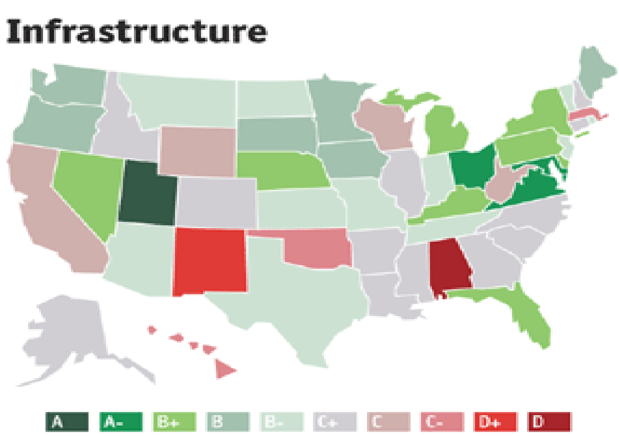

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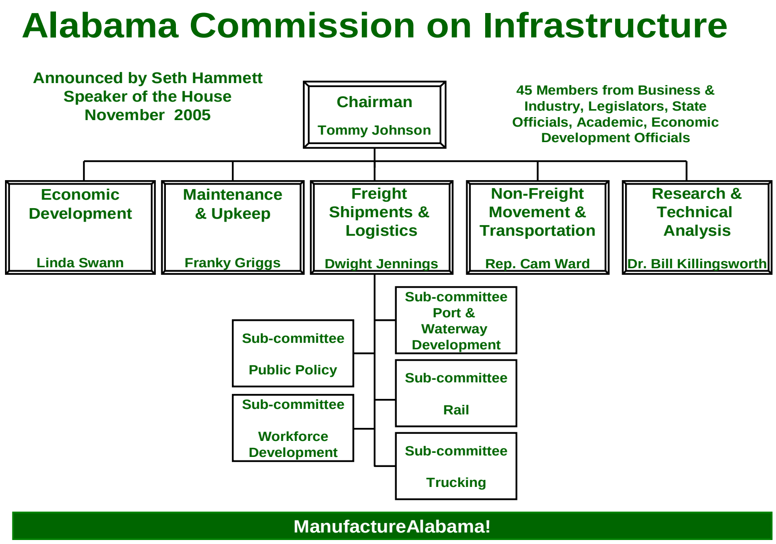


Figure 2-1

Source: Manufacture Alabama

Table 2-1

Alabama Commission on Transportation Infrastructure			
Committee Leadership			
Commission Chair	**Tommy Johnson**	**Frontier Yarns**	**President**
Economic Development	**Linda Swann**	**Alabama Development Office**	**Assistant Director**
Freight Shipments	**Dwight Jennings**	**Southern Shipping & Logistics**	**Owner/CEO**
Maintenance	**Franky Griggs**	**Nucor Steel - Birmingham**	**Vice President & General Manager**
Non-Freight Movement	**State Rep. Cam Ward**	**Industrial Development Board, City of Alabaster**	**Executive Director**
Research & Analysis	**Bill Killingsworth, Ph.D.**	**Office for Economic Development, University of Alabama in Huntsville**	**Director**

Source: Alabama Commission on Infrastructure, February 2006

Members of the Commission and others supporting the committees are listed in Exhibits A through E at the end of this report.

The **Commission on Infrastructure** convened on February 13, 2006, for its initial meeting. The five working committees formed were:

- **Freight Shipments & Logistical Needs**
  - Chaired by Dwight Jennings
  Responsible for considering shipments of raw materials, component parts, and finished products by both existing and prospective new industries.
  Subcommittees:
  - Port & Waterway Development
  - Public Policy
  - Railroads
  - Trucking & Movement of Truck Freight
  - Workforce Development

- **Non-Freight Movement & Transportation Needs**
  - Chaired by Rep. Cam Ward
  Responsible for considering public travel needs including commuting issues, and challenges to public safety, convenience and economic impact.

- **Maintenance & Upkeep of Infrastructure Assets**
  - Chaired by Franky Griggs
  Responsible for considering critical repair and maintenance needs facing the various elements of Alabama's transportation system.

- **Economic Development**
  - Chaired by Linda Swann
  Responsible for identifying and evaluating the opportunities available through improved infrastructure systems, the economic development consequences of continued infrastructure system deterioration, and a failure to improve inter-modal coordination.

- **Research, Development & Technical Analysis**
  - Chaired by Bill Killingsworth, Ph.D.
  Responsible for providing the research, data, and other technical support to the commission and its committees while they are evaluating the state's infrastructure needs and propose solutions.

The work of the Commission began immediately following its creation. The Commission held meetings in May and September 2006 to hear progress made in each of the committees. Meetings were held in November 2006 and January 2007 to consider recommendations.

Immediately after being established, committees organized and began their numerous meetings held throughout the year to identify and analyze Alabama's infrastructure challenges. Each committee developed a list of recommendations for the Commission's consideration.

During the Infrastructure Commission's initial year, Manufacture Alabama provided support for the Commission to implement the major transportation recommendation of the Alabama Legislative Commission on Manufacturing. Manufacture Alabama brought representatives from industry to support the work of the Infrastructure Commission in addition to hosting and handling meeting coordination for the Commission and its committees.

3. Background Research Considered by the Infrastructure Commission

The availability of transportation data such as traffic counts, mode capacity, maintenance status and more is almost limitless. Over the past year, the Commission, as part of its process, provided an extremely valuable service in reviewing and selecting relevant research with which to consider the transportation challenges, and more importantly, economic opportunities for Alabama. Information was gathered on each of the four transportation modes; road, rail, waterways and air (airports). Additionally, there was new information requested by the commission from both the public and private sectors.

3.1 The Multi-System Framework for Analysis

The commission adopted a framework to incorporate multiple systems affecting congestion. The Population, Infrastructure, and Economic Activity (P-I-E) model, developed and presented by the Office for Freight, Logistics and Transportation and the Office for Economic Development at the University of Alabama in Huntsville, was used.[4] With this framework and the current research being conducted for the U.S. Department of Transportation, a new systems perspective has been used to view Alabama's transportation assets.

Population – Infrastructure – Economic Activity (P-I-E) Framework

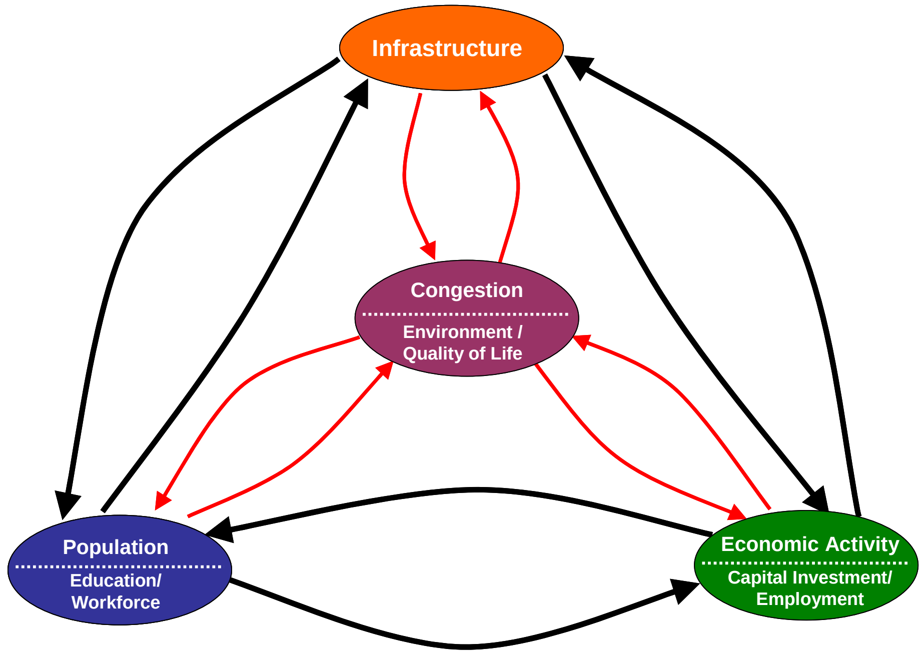


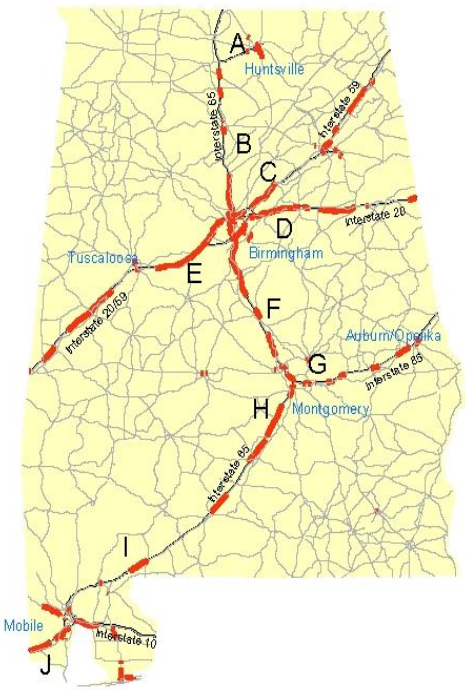
Figure 3-1
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

The P-I-E framework represented in Figure 3-1 recognizes the relationships that exist between population, infrastructure and economic activity, and more importantly, the resulting levels of congestion resulting from their interactions. Planning for, and managing, each of these elements can affect the resulting congestion, as each element is a generator for the other two elements. While traffic congestion is often the focus of many efforts, this framework encourages a focus on the generators of congestion and alternative solutions.

A simple example of how the P-I-E framework can enhance the understanding of transportation infrastructure utilization levels is with an impact from two of Alabama's larger industries, aerospace and automotive. Most would agree that Alabama's significance in the automobile industry has grown substantially over the past decade. The UAH research brought the anticipated near-term growth rates for automotive and aerospace industries into forecasting interstate utilization levels. Figure 3-2, shows the possible differential between using historical utilization growth factors versus incorporating into the model two of Alabama's most vibrant industries, which may not be adequately represented in the historical utilization levels.

In Figure 3-2, ten interstate locations are identified and labeled with letters A through J. For each of these locations, the 2002 average annual daily traffic volume is shown, as captured by the Alabama Department of Transportation (ALDOT). Additionally, a comparison is provided between a 2008 forecasted growth in traffic based on historical trends, and a 2008 forecast, which incorporates anticipated utilization rates of the automotive and aerospace clusters. Location H, just south of Montgomery, has a historical trend line forecast of traffic volume growth by 2008 to an average of 40,942 vehicles daily. A forecast for the same time period including aerospace and automotive specific industry characteristics indicates a daily traffic volume of 52,735 vehicles. The difference is significant with industry anticipated utilization levels being 34% higher than the historical trend line forecast.

2008 Volume to Capacity Ratios with Automotive and Aerospace Clusters Information Included



Map Location	2002 AADT	2008 AADT Historical Trend Forecast	% Increase from 2002 Using Trend Line Forecast	2008 AADT Forecast with Specific Cluster Growth	% Increase from 2002 Using Industry Cluster Analysis
A	57,121	67,842	18.8%	78,577	37.6%
B	48,901	58,080	18.8%	73,494	50.3%
C	29,680	35,251	18.8%	52,885	78.2%
D	61,773	73,367	18.8%	79,853	29.3%
E	53,117	63,087	18.8%	71,112	33.9%
F	43,591	51,773	18.8%	82,589	89.5%
G	84,332	100,148	18.8%	137,207	62.7%
H	34,427	40,942	18.9%	52,735	53.2%
I	26,082	30,978	18.8%	33,165	27.2%
J	53,729	63,814	18.8%	65,314	21.6%

Figure 3-2

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

3.2 Major Interstate Traffic Levels

Tracking growth in average annual daily traffic volumes for Interstate 65 from mile markers 1 through 366 over twenty years shows that neither utilization nor growth is uniform. Changes in population, infrastructure and economic activity have placed greater demands on particular segments of roads. In some instances, sections of I-65 are approaching congestion levels that may threaten economic growth in some areas.

Figure 3-3 shows I-65 annual average daily traffic starting in Mobile on the left at mile marker 1 and ending on the right at mile marker 366 at the Alabama - Tennessee border. The chart clearly shows that between 1985 and 2004 traffic levels continued to rise and that the levels of high traffic continued to spread outward from city centers.

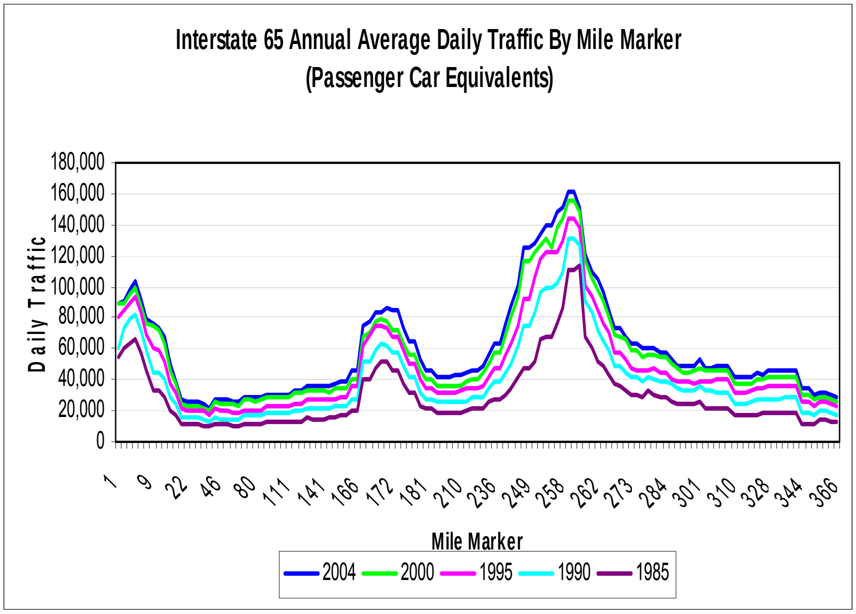


Figure 3-3
Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstate 20 crosses Alabama from west to east and shows a similar pattern over the same twenty-year period. (Figure 3-4) The largest volumes can be seen in areas of highest population density (Birmingham in the center of the chart). Economic impacts can be seen for Mercedes and suppliers between mile markers 70 and 110. Also, economic activity is reflected in the traffic volumes east of Birmingham for Honda (mile marker 165) and suppliers and continues at a 50,000-vehicle daily traffic level through the Anniston/Gadsden region.

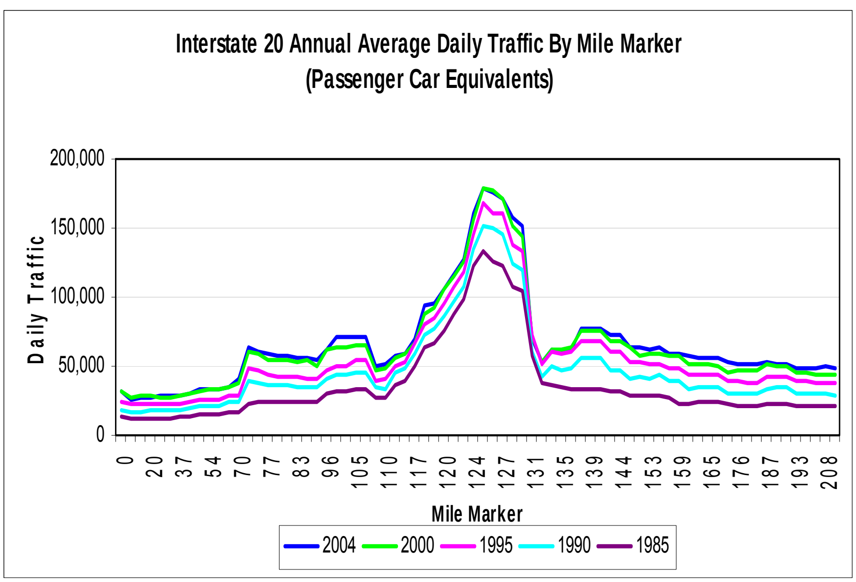


Figure 3-4
Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Chart 3-5 of Interstate 59 tracks Interstate 20 from mile marker 1 through 125. The traffic volume drops quickly as I-59 splits away from I-20 leaving Birmingham and heading toward Chattanooga.

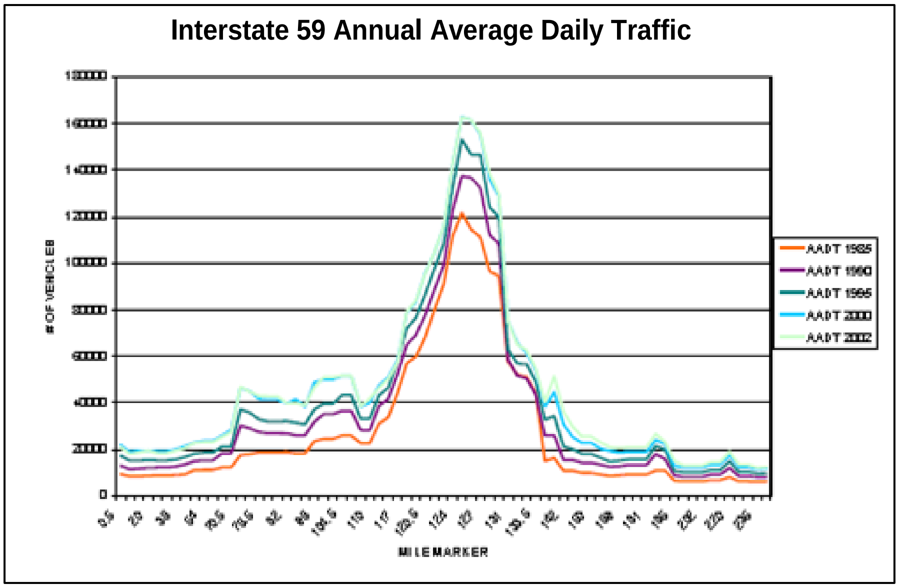


Figure 3-5

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstate 10 is much shorter inside Alabama's borders than other interstates but the traffic volumes over the twenty-year period documents that volume growth is steadily occurring and consuming virtually all available capacity. (Figure 3-6)

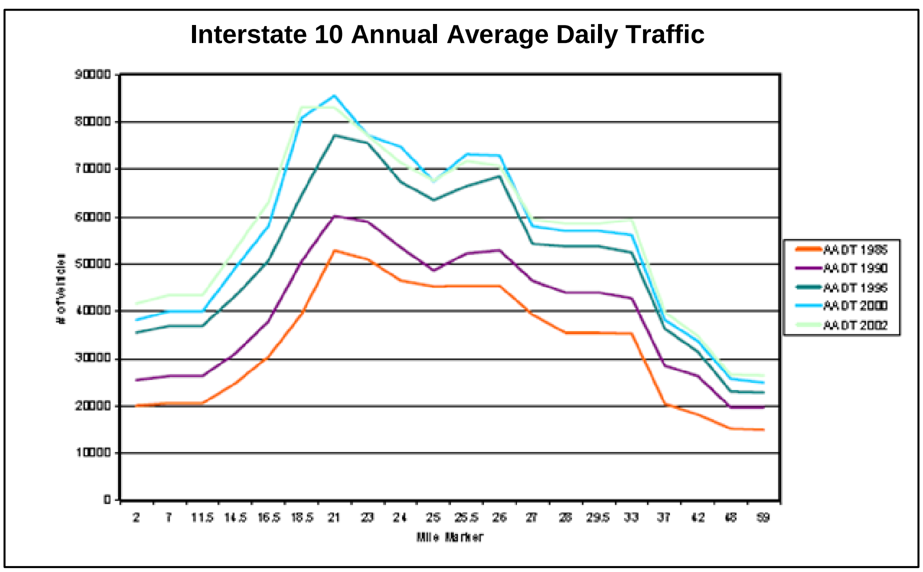


Figure 3-6

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstates 10 and 85 are similar in that relatively short sections located in Alabama are greatly impacted by traffic originating and terminating outside of Alabama's borders. The intersection of I-85 and I-65 in Montgomery is clearly seen in miles 2-10 in Figure 3-7**.** As I-85 heads east away from the population and economic activity of Montgomery, volumes drop quickly and growth is uniform.

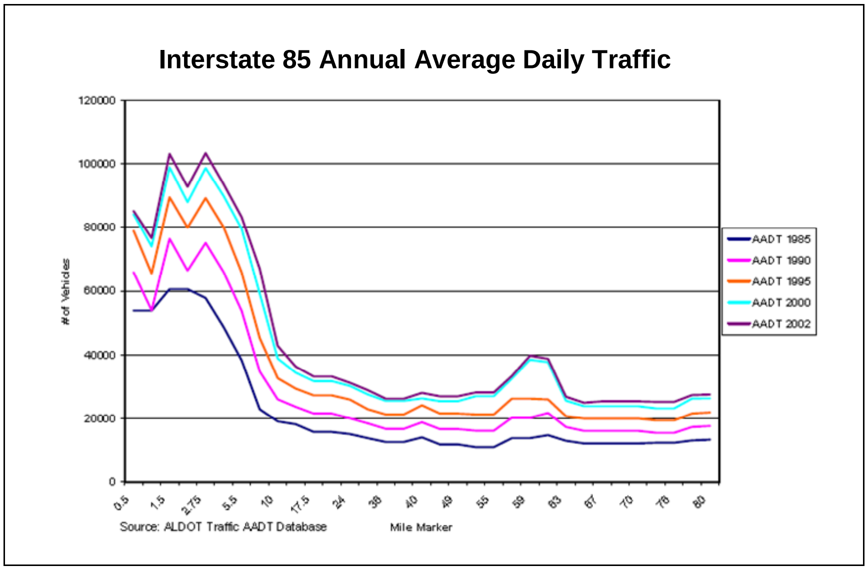


Figure 3-7
Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

The interstates shown in Figures 3-3 to 3-7 are representative of the growth patterns and utilization levels on many critical federal and state highways in Alabama. The lesson in this observation of traffic levels over time is that the traffic flow rate of Alabama's roadway system is just as important if not more as its average roadway system capacities. Significant improvements in road infrastructure capacities (defined by travel time) may be gained by better understanding the constraints and devising a plan, which considers near and long-term impacts on traffic flows for each road infrastructure project.

3.3 Infrastructure Issues by Industry

Utilization of Alabama's transportation infrastructure varies by industry. A survey of Alabama manufacturing industries conducted by the UAH Office for Economic Development in 2004-05 found that trucking and road issues are major concerns. (Table 3-1)

Issues outlined in Table 3-1 show commonalities across modes of transportation as well as the types of issues with Alabama's transportation system within a key industry. The three issues most often identified by Alabama companies were (1) road capacity and congestion, (2) truck availability, and (3) truck route access. The issues shown in this table were identified by each company from a broad inquiry rather than by mode, i.e., truck, water, or railroad.[5] Responses to the open-ended questions were then grouped by mode in similar categories of issues.

Growth in infrastructure utilization is anticipated to occur mostly on roads used by Alabama's production industries, e.g. automotive, aerospace, electronics, etc. This information indicates that Alabama's industries are experiencing challenges with the current road infrastructure due to insufficient capacity and congestion. Additionally it should be noted that, many of Alabama's industries would increase their truck shipments if additional trucks were available.

Table 3-1

Alabama Transportation Issues by Industry Cluster	Truck					Water			Railroad			Process		
	Road Capacity & Congestion	Truck Availability	Truck Route Access	Truck Permitting	Road Maintenance	Barge Access	Ocean Freight Carriers	Service to Ocean Ports	Rail Access	Rail Availability	Air Freight availability	Int'l Cargo Freight Services	Freight Damage	Slow Freight movement
Aerospace	√	√	√	√	√								√	
Apparel & Textiles							√					√		
Automotive	√	√			√			√				√	√	
Chemicals	√								√					
Electronics & Equipment	√	√										√	√	
Fabricated Metal	√													√
Food Products		√	√											
Furniture	√													
Industrial Machinery	√	√	√									√		
Lumber & Wood Products		√	√							√				
Paper	√	√												
Primary Metal	√	√												
Printing & Publishing	√										√			
Rubber & Plastics		√	√											
Stone, Clay, Glass	√					√			√					
Textile Mills		√	√											
Transportation Equipment												√		

Source: Requirements for Infrastructure and Transportation to Support the Transformation of the Alabama Economy, UAH, 2007

Eleven of the seventeen industry clusters represented in Table 3-1 indicated some type of challenge with capacity/congestion. The economic reality resulting from the transportation capacity challenges of these industries is that lack of capacity could limit job growth for existing Alabama industries.

3.4 Congestion ranking of major Southern cities

Growth in population and employment creates the challenge of meeting transportation needs with limited resources. Figure 3-8 presents urban area annual hours of delay per traveler for major southeastern U.S. cities. The chart shows that travel delay time in Birmingham is lower and is growing at a slower rate than larger, southern metropolitan areas like Atlanta and Austin. This beneficial position of lower congestion is an advantage for Alabama. An advantage such as this should not be allowed to deteriorate but it can only be maintained with infrastructure investment.

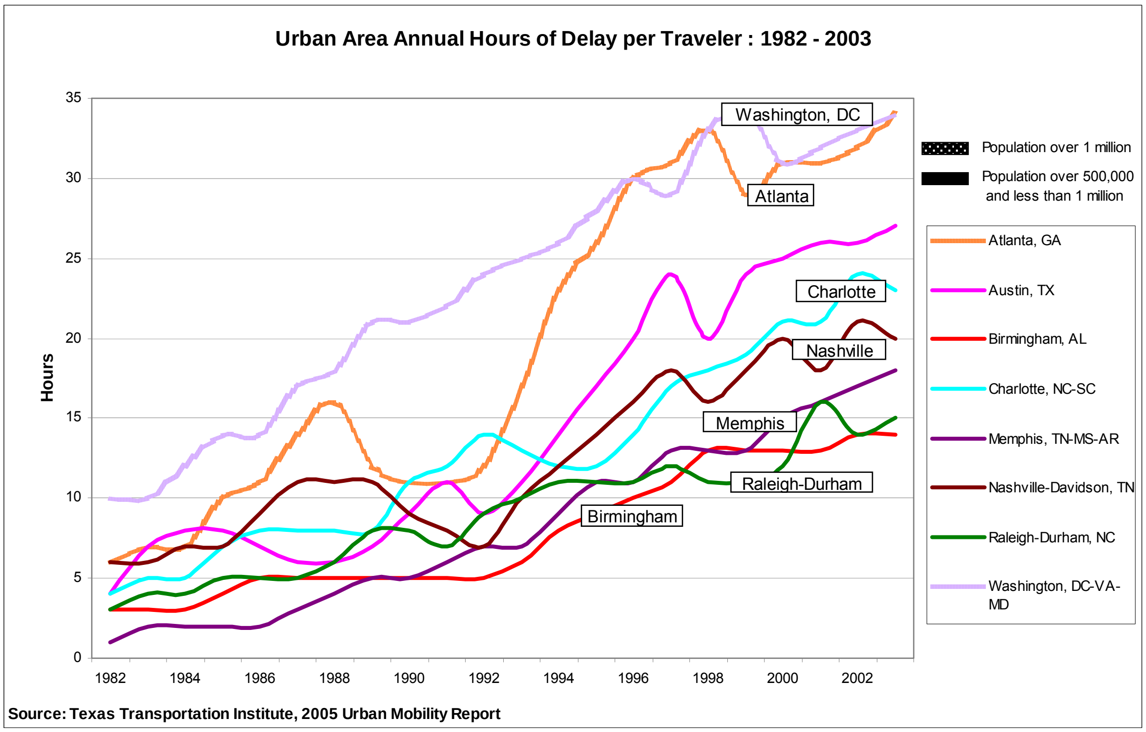


Figure 3-8

3.5 Transportation Research Resources Available

Understanding the current and probable future demands on transportation infrastructure is essential in Alabama's economic development strategy. There are several transportation research resources in Alabama that can be built upon. These include the Alabama Transportation Department's wealth of data, the state research universities with transportation research programs, and industry clusters that are willing and eager to share their needs.

Approaching transportation infrastructure planning from a “system of systems” perspective is possible and can better match limited resources with current and future needs. In fact, Alabama’s transportation system is the collective interaction between the road system, rail system, water system, and air system. Especially in the transportation of freight in and through Alabama, the interaction of these systems determines flow rates and thereby overall congestion levels. In order for Alabama to continue to be a leader in advanced manufacturing, global trade, and economic development in general, transportation infrastructure must be managed as an enabler rather than a constraint to economic opportunity.

4. Infrastructure Commission Recommendations

The Commission charged the committees to conduct their work with a focus on the statewide transportation systems rather than on the hundreds of locally important projects that have been identified or could be brought to the committee discussions. Therefore, many of these proposed recommendations remain conceptual in nature and without prioritization. In most cases, more research and analysis is still needed to understand how the project(s) referenced in a recommendation will affect Alabama’s overall transportation system and economic future.

Recommendations were developed by each of the five working committees of the Alabama Commission on Infrastructure. The Commission considered the committees’ recommendations and approved the following on January 22, 2007.

Significant supporting material and data was gathered and utilized by the commission. Some of this material is referenced in this report but much more is available for those interested in helping with implementation of the recommendations.

To facilitate ease of presentation and discussion, the list of the recommendations below are grouped by subject matter rather than identifying them with individual committees. This listing format should in no way suggest that the Commission and its committees approached Alabama’s infrastructure picture on a piecemeal asset-by-asset basis. To the contrary, the committees were diligent in addressing transportation needs from a strategic, intermodal perspective. The intermodal perspective is simply considering how the interconnection of highway, rail, waterways, airports, and other infrastructure elements relate as outlined in the strategic charge of the Commission. Recommendations were developed on the premise that Alabama’s major transportation infrastructure challenges are statewide, rather than local and must be identified and analyzed as such.

4.1 Highways/Bridges Issues & Recommendations

Recommendation: Address congestion points on I-65 to protect the main artery of Alabama's transportation system and economic growth

It is clear that the Interstate 65 corridor represents the state's main transportation artery and is a primary economic engine for Alabama. The preponderance of freight and non-freight traffic moves north and south between Mobile and the Decatur-Huntsville region on I-65. Additional container freight will flow through Alabama with the early 2008 startup from the Alabama State Port Authority's Mobile container terminal. By 2010, it is expected that containers handled at the Port will exceed 200,000 annually, almost eight times the level in 2005. [6]

Much of the state's industrial growth and economic activity has occurred, and probably will continue to occur along or near I-65. For that reason, the state's most critical highway congestion points are located on I-65. Projections from the P-I-E and other analytic models show that congestion at these points will continue to worsen. Committee members generally agreed that addressing those issues on the state's main artery must be the first priority. While other highway projects are necessary and worthwhile, Commission members agreed it would be counter-productive to implement highway projects that feed more freight and non-freight traffic onto I-65, without first implementing the solutions needed to address the rapidly brewing I-65 congestion crisis.

The Commission and its committees identified and considered a number of specific highway projects, including many already on ALDOT's short-range and long-range plans. Analysis was done with statewide, rather than regional or local, benefit criteria. Although specific highway projects were considered, the Commission on Infrastructure believed that it should attempt to neither rewrite nor endorse ALDOT's project plans or planning schedules. Rather, the Commission strongly agreed that its work should enhance insight by ALDOT and others on those projects most crucial to statewide strategic economic and job growth.

Listed below are recommendations from the Commission related to highway projects. This list is not intended to be all-inclusive or necessarily presented in order of priority, other than to emphasize the significance of I-65 to the state. Some of these recommendations specifically illustrate the Commission's desire to consider innovative ideas to improve traffic flow rather than just adding capacity.

4.1.1 Interstate 65 Corridor Recommendations

- Consider the addition of one lane in each direction on I-65, beginning with the sections identified as most congested and proceeding to other stretches of the interstate as funding permits. Exploration of concepts like designing the additional lane as a toll lane or restricting trucks to the two right-hand lanes on a three-lane stretch of highway to improve traffic flow. The areas indicated in red on the highway map in Figure 4-1, show areas where expected utilization will exceed ALDOT congestion guidelines by 2008.

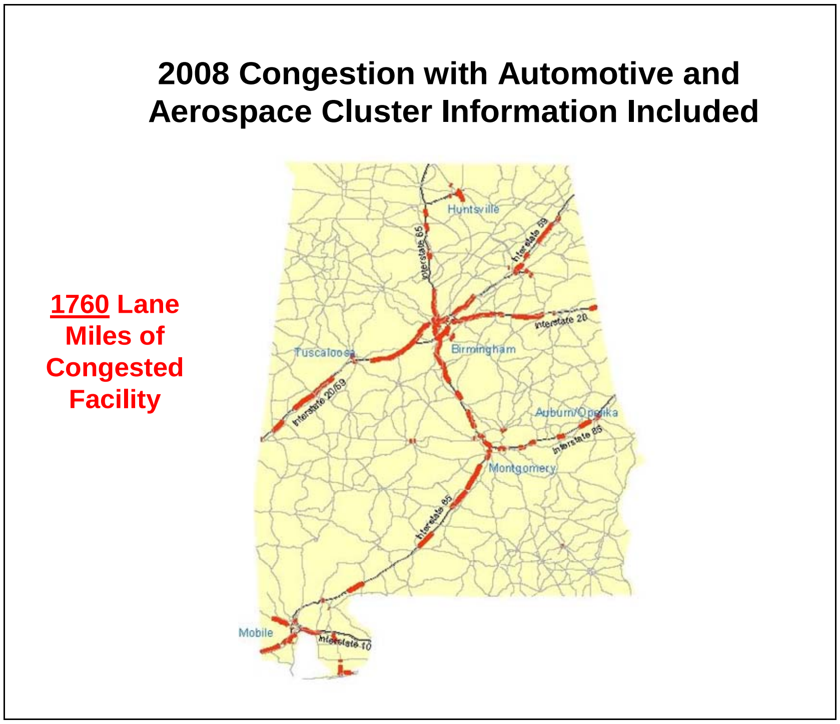


Figure 4-1
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

- Study the feasibility of a truck-only toll highway parallel to I-65. This freight alternative could improve traffic flows and safety for all users of the highways. The project could be developed in sections, beginning with the most critical traffic flow/congestion stretches.

- Construct a northern by-pass in Birmingham to complete the outer loop on which through traffic and freight could better flow. According to the Birmingham Chamber of Commerce, the city is now the largest in America without a complete outer loop highway system, adding significantly to congestion problems on I-65, I-59/20 and other important routes.[7]

- Construct the Montgomery Outer Loop connecting I-65 and I-85 south of the city. I-65, I-85, and Highway 231 all intersect within a distance of approximately one mile inside Montgomery, which creates a major choke point in traffic flow on I-65.

- Encourage a resolution to address the bottleneck at the Interstate 10 Tunnel. The Mobile I-10 congestion at the tunnel affects the movement of passengers and freight across and through the state. The congestion affects north-south shipments of containers and other goods from the Alabama State Docks as well as east-west traffic flow across the entire Gulf States region. Committee members urge stakeholders in the issue including local, state, and federal governments to move ahead quickly with a consensus plan that identifies the best solution that facilitates, rather than hinders, the movement of containers and other freight out of Alabama's seaport.

- Complete the corridor study and public hearings underway by ALDOT on a proposed new Western Alabama Freeway. The opportunity capitalizes on the regional freight transportation growth and the resulting economic opportunities provided by the new Mobile container terminal and should continue forward. The proposed routes being considered for the West Alabama Freeway would connect I-20/I-59 to I-10 in either Mobile County or Baldwin County. This route could efficiently service both the growing port dependent industries, as well as relieve freight congestion on I-65. Industries utilizing the Alabama port such as forest products, poultry, furniture manufacturing, automotive and electronics located in Western Alabama, Mississippi, Tennessee and Arkansas, could gain significant transportation competitive advantages. Additionally, potential economic development opportunities could be created in an economically depressed, undeveloped rural area of Alabama.

4.1.2 Non Interstate 65 Highway Recommendations

- Complete the Corridor X project in Alabama. Understanding the relationship between Highway 280 congestion and the congestion on I-65 and I-59/20 in the Birmingham area is vital in addressing the I-65 Corridor issue. Current and proposed studies by the chambers of commerce and other economic development groups in the region could be incorporated into the planning process.

- Construct the southern by-pass and related projects in the Huntsville area to deal with infrastructure strain, which will be caused by the imminent influx of thousands of new jobs and residents moving into the area due to the Department of Defense Base Realignment and Closure Commission's ("BRAC") actions. The effective preparation to handle this sudden growth is necessary to fulfill the expanded missions of Redstone Arsenal required by the BRAC realignment.

- Complete the Dothan to I-10 connector route. This route has both economic and public safety implications related to its hurricane evacuation route.

- Expand and improve Highway 84 to four lanes across south Alabama. Additionally, stretches of trucker "rest area" lanes should be designed into the route to facilitate the flow of freight across this vital southwest Alabama east-west route. There is significant documentation on the statewide economic and public safety significance of this project that was compiled by the Commission's Economic Development Committee.

- Extend I-85 from Montgomery to connect with I-20/59 at the Alabama-Mississippi line. Since this is a virtually new stretch of interstate, committee members suggested that this would be an ideal highway proposal to evaluate using economic benefit modeling. This analysis would incorporate projected statewide economic value measured against cost as a major variable in planning prioritization.

4.1.3 Bridge Rehabilitations Recommendations

Weight-restricted bridges and the lengthy detours they cause represent a huge problem for Alabama school districts and for pupils who must spend inordinate amounts of time on school buses each day. Numerous rural-based industries rely on trucks for incoming materials and outgoing finished product are experiencing the costs associated with the circuitous routes necessary to avoid functionally closed bridges.

- Increase the priority of the county bridge replacement crisis by creating a funding mechanism to permit repair or replacement of deficient structures. The estimated replacement cost per bridge is $367,000. The five-year GARVEE Bond Amendment program, which has ended, replaced almost 600 bridges. A return of $2 for every $1 invested has been calculated in savings to autos, trucks and school buses. Current estimation indicates there are approximately 1,750 county bridges that need replacement. Additionally, there are at least 560 state and city bridges declared deficient and must be replaced before they can adequately re-enter Alabama's transportation system.

4.2 Railway Recommendations

Railroads are essential to many Alabama industries and therefore many jobs. Railroads represent an important transportation mode as both an alternative and complement to truck freight. If any of today's rail freight were moved to trucks due to rail freight capacity shortages, the result on the transportation system would be increased congestion. Conversely, a portion of today's truck freight could be moved from the highways to railroads if issues of capacity, cost, and schedules are addressed. This could decrease the overall levels of congestion. However, Alabama faces significant challenges in rail service that limit these potential benefits.

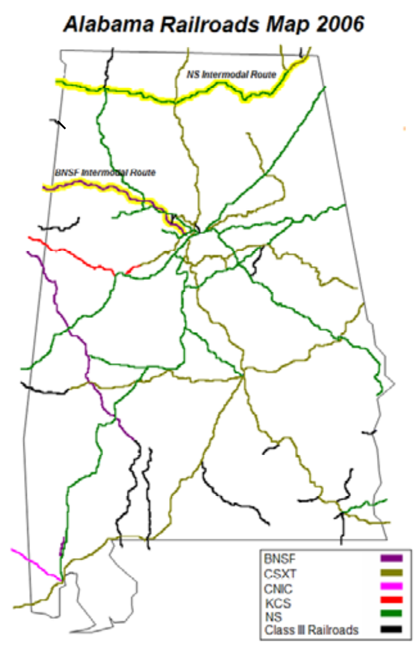


Figure 4-2
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

In 2006, there were five Class I railroads (main lines) and 23 Class III (short-line) railroads operating in Alabama.

Alabama short-line railroads, in many cases, are the lifeline for manufacturing sites as they link the plants with the Class I rail lines. Additionally, short-line operations are facing track and equipment upgrades to meet the new higher industry standard car weight requirements of 286,000 pounds. Critical short-line track and bridge improvement needs, coupled with the pending equipment upgrades, amplify the threat of losing essential transportation routes to much of Alabama's manufacturing base.

The Commission proposes the following railroad recommendations:

Recommendation: Explore strategies to promote and assist short-line railroads with infrastructure needs

The needs include repair and maintenance of existing rail, bridges, and grade level crossings plus improvement to handle the increasing railcar weights. Programs adopted in neighboring states such as Tennessee and Georgia could be used as models to create a short-line railroad sustainability plan. A blueprint for such an initiative has been developed for the Infrastructure Commission. It is titled *"State of Alabama, Short-line Railroad Program for Rehabilitation".*[9]

Recommendation: Authorize funding for a study of the Alabama short-line railroad system

A thorough understanding of the current state of Alabama's short-line railroad system is needed. Funding is requested to conduct a study of the business conditions and rail infrastructure needs of Alabama's Class III railroads. The study would quantify the economic contribution of the short-line railroads, the costs that would result from short-line operation cessation, and the funding needed to address infrastructure maintenance and improvement needs. The study could also evaluate creation of new short-line railroads to connect local economic development project sites with existing Class I main lines. These connectors could potentially be publicly owned or financed through private-public partnership ventures.

Recommendation: Form a coalition to explore the potential for an additional north-south rail line

Efficient freight movement through Alabama involves the critical need for an "intermodal" designated north-south rail line going from the state docks in Mobile through North Alabama. The current (east-west oriented) intermodal-designated rail lines of Northfolk Southern (NS) and Burlington Northern Santa Fe (BNSF) are highlighted in Figure 4-2 on page 17. An intermodal rail "lane" is the equivalent of a highway express lane enabling freight coming into the state or heading to out of state destinations to move more rapidly. These intermodal rail lines make Alabama's port and freight industries more attractive to shippers. The absence of an Alabama north-south intermodal rail "lane" increases the time required to move freight through the state from less than one day to three or more days. Adding a new north-south rail lane, potentially along the I-65 corridor, could enhance the attractiveness of the Alabama State Docks, make the use of rail for containerized freight a viable alternative, and create economic advantages for Alabama industries. There are two Class I railroads currently operating on an existing line along this north-south corridor. Committees propose that a coalition be formed, to explore the issue with the railroads and other appropriate parties, to encourage intermodal designations of existing routes, and explore the possibility of a new north-south rail line. The recommendation also includes exploring the appropriate role in this venture for ALDOT and the proposed Alabama Transportation Commission.

4.3 Waterways Issues & Recommendations

Alabama contains more navigable inland waterways than all but one other state in the continental U.S. This resource could potentially give Alabama and its industries advantages in competing with other states for economic development projects. Alabama's waterways are underutilized. The Commission acknowledged that there is potential for Alabama to take greater advantage of this abundant natural resource.

Figure 4-3
Source: ALDOT

Recommendation: Fund a study to develop strategies that could increase the use of Alabama's inland waterways

A comprehensive business model study should be commissioned to identify and evaluate strategies to encourage increased utilization of Alabama's inland waterways for freight shipments. The study should determine if waterborne freight could become a viable freight mode for industries and shippers in Alabama. Specifically, the study should encompass how waterways can be better linked to road and rail freight. Short-term opportunities and longer-term strategies, such as the European use of high-speed barges could be considered in the analysis.

Recommendation: Encourage federal funding for the maintenance of Alabama's intracoastal waterway systems

The State of Alabama's inland and intracoastal waterway systems will become more critical to the state as the highways and railways become more congested. Since maintenance of the locks, dams, navigational aids and water depth are the responsibility of the federal government, the Commission recommends that the State of Alabama coordinate and maximize its political influence and resources in Washington D.C. to ensure that such maintenance and dredging is adequately funded.

4.4 Intermodal Center Issues & Recommendations

As noted above, the success of a multi-mode transportation system depends heavily on the flow at the intersections of transportation modes. Infrastructure developed at these intersections is commonly known as intermodal centers. The Commission recommends the following specific intermodal center projects based on the significant benefit that each could bring to Alabama's statewide transportation system.

Recommendation: Pursue the establishment of an inland intermodal freight facility to dispatch inbound containerized freight and collect outbound containers

Growth in container handling capacity, especially with the 2008 start up of the new Alabama State Port Authority's Mobile container terminal, offers an opportunity to capture significant freight business in Alabama that currently passes through congested east and west coast ports. An inland intermodal freight facility would greatly improve freight velocity through the Mobile container terminal, reduce congestion on Alabama's highways, and create attractive economic development opportunities. The center is envisioned as a distribution center for containers into the Southeast and Midwest as well as a collection point for the containers returning from those destinations. According to logistics experts, a general rule for maximizing benefits of an inland container intermodal center is to locate it an optimum distance of approximately 300 to 400 miles from a seaport. From Mobile, a 300-mile distance would land an inland container facility in either north Alabama or a neighboring state. While no specific location for such a container facility was identified by the Commission, it is important to consider tying into existing intermodal infrastructure, such as in the Huntsville-Decatur region. Several locations on the northern end of Alabama, including Birmingham, could also be considered. A successful site must have easy access to truck, rail and waterway modes. Connection to air cargo would be even more advantageous.

Recommendation: Enhance the Mobile container terminal handling facility by funding a rail interchange yard and a ship turning basin

The expansion of the Alabama State Port Authority's Mobile container terminal is a major economic opportunity for Alabama. Making the port more attractive to shipping companies should be a priority if Alabama is to maximize economic benefit from the container facility investment. The Commission recommends that priority funding be authorized for two enhancements, which could bring significant, immediate economic returns at the port.

- A new Rail Interchange Yard built at a projected cost of $84 million would accommodate the efficient loading and distribution of containers.

- A Turning Basin at a projected cost of $26 million that would allow the Port to accommodate larger ships and thus to compete for new freight business with other ports.

4.5 Mass Transit Issues

Transportation infrastructure is important to freight shippers as well as passengers traveling in and through the state. A thorough evaluation of need, economic benefit and costs of mass transit system improvements in Birmingham, Mobile and other major areas of congestion should be conducted within the context of impact on the state "transportation system". Chambers of commerce and other economic development organizations in Birmingham and Mobile have done extensive analysis on this issue. The evaluation of benefits to the statewide transportation system from mass transit projects should incorporate their mass transit knowledge and participation. The Commission believes that urban area mass transit issues are critical and must be addressed in any comprehensive infrastructure strategy developed by Alabama.

4.6 Organizational Structure Issues & Recommendations

The Commission and committee indicated that ALDOT is doing an admirable job performing their duties with a chronic shortage of funding and the inevitable influence of politics. The planning and execution of transportation infrastructure construction and maintenance projects can suffer as short-term "band-aids" compete with investments in long-term strategic solutions. Additionally, when each transportation mode (road, rail, waterway, airports) operates independently, optimization of the overall transportation system is virtually impossible. There is strong support by the Commission to enhance the organizational structure of Alabama's transportation infrastructure administration.

The Commission gathered summary information on the transportation oversight structure of contiguous states. Figure 4-4 below shows that Mississippi, Georgia, and Florida have a transportation commission-type oversight body. Tennessee is similar to Alabama with a single cabinet member overseeing the transportation operations for the state.

Forms of Transportation Oversight in Southeastern States

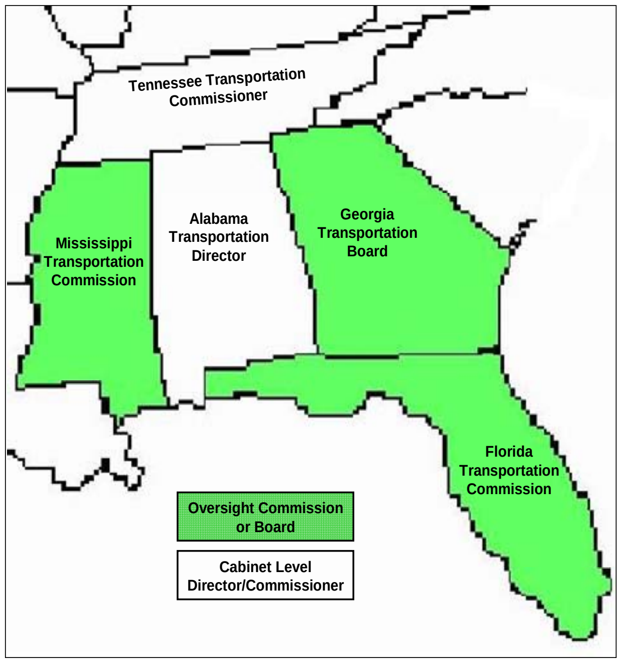


Figure 4-4
Source: UAH Office for Economic Development,
Office for Freight, Logistics, and Transportation

Several recommendations are proposed to help improve planning and operational performance that will benefit the Alabama's overall transportation strategies.

Recommendation: Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation

An Alabama Transportation Commission should be created with oversight responsibilities. This commission would provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning, and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports has proven very successful. More than half of the states in the U.S. have such an entity (commission, board, authority, etc.) to administer the planning and operations of their transportation departments. This recommendation strongly urges that the transportation commission be as independent of political pressures as possible, with members appointed by the Governor (with possible legislative involvement) on a staggered-term basis. A bill is being drafted for introduction in the 2007 Legislative Session.

Recommendation: Expand ALDOT's roles in rail and waterways

A recommendation to consider giving ALDOT, with the oversight of the Alabama Transportation Commission discussed above, expanded administrative responsibilities in appropriate areas, i.e., areas of state responsibility, like the Alabama's rail and waterways transportation activities. Committee members cited the need for a "state-level champion" for waterways and short-line railroads and felt that expanding the multi-modal responsibilities of ALDOT would help improve coordination of Alabama's transportation infrastructure assets.

There are designs in other states that could benefit the design of an expanded ALDOT program organizational structure. Practices and policies of other states are being researched. Efficiency and maintenance of Alabama's airports have improved by the placement of the Aeronautics Bureau under ALDOT's jurisdiction. The Commission suggests that similar benefits could be realized in the rail and waterway transportation modes.

The establishment of a trust fund within ALDOT should be considered to promote utilization and improvement of Alabama's inland waterways and railroads. Additionally, a trust fund could provide more stable funding to support waterway and rail infrastructure projects.

Recommendation: Establish an analysis resource for Alabama's transportation system

A recommendation to provide ALDOT with the enhanced analytical and modeling tools needed to integrate the multiple modes of roads, railways, waterways, and airports. Utilization of modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. It is suggested that a major element of this analysis involve development by Alabama universities and other support organizations of economic benefit modeling. The resulting analysis could guide strategic project prioritization to ensure that with limited funds, Alabama maximizes economic development and job growth. The modeling analysis would help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

4.7 Commission on Infrastructure

Recommendation: Extend the *Commission on Infrastructure* through the 2007-2010 Legislative quadrennium to perform further strategic analysis

The recommendation recognizes that the Commission has existed for less than a year and has only begun to identify and analyze potential solutions to address Alabama's infrastructure needs. Much more can be done to continue to bring together many of the state's top experts in the transportation infrastructure field. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on the process.

4.8 Infrastructure Funding Issues & Recommendations

Clearly, meaningful solutions to the state's infrastructure challenges will be expensive and will require new, reliable sources of funding. Alabama annually faces the decision of diverting maintenance funds to qualify for its share of federal matching highway dollars. This year-to-year game interrupts progress on critical projects and can lead to additional cost and extensive repairs of critical links in Alabama's transportation system.

Total Maintenance Needs vs. Appropriated Funds

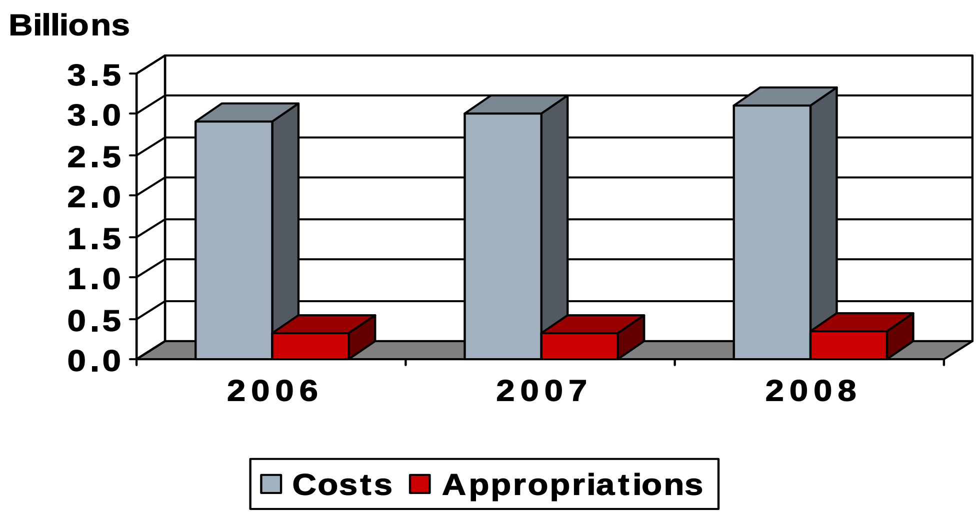


Figure 4-5

Source: Manufacture Alabama

Current maintenance and repair funding generated by Alabama's fuel tax has not kept pace with the costs. The current 18-cent gas tax level was established in 1992. In today's dollars, that 18-cent gas tax is worth only 12 cents due to inflation. The state's transportation purchasing power has declined by 37 percent. In studying the critical need for transportation funding, the Commission noted that the available funds could not be allowed to be eroded by inflation. Implementation of the new, more efficient transportation organizational structures proposed in previous recommendations will be of little benefit if the new structure is not adequately funded. The Commission recommends consideration of several funding-related options:

Recommendation: Explore opportunities for private investment through private construction and/or long-term leases of toll roads and bridges

The trend of partnering with private operators of transportation infrastructure is becoming increasingly common throughout the country. The practice can provide a state with significant up-front lease revenues, while shifting maintenance responsibilities and costs to the investor. Alabama should thoroughly evaluate the benefits and disadvantages for Alabama of private investment in long-term leases of toll roads and bridges. Current statutes for toll roads and bridges are being analyzed to determine if enabling legislation is needed for this type of private investment. The Aging Infrastructure Systems Center of Excellence at the University of Alabama is researching relevant models in other states.

Recommendation: Consider establishing a Lifecycle Maintenance Trust Fund to allocate maintenance funds with the approval of new construction projects

The state should consider establishment of an ALDOT Lifecycle Maintenance Trust Fund to allocate maintenance funds for new capital projects at the time of project approval, thus assuring the investment in new infrastructure is maintained and not lost due to financial neglect. A funding formula could incorporate the cost of construction, projected maintenance schedules, and interest earnings adjusted for inflation. Today, ALDOT estimates that fifty-eight cents would need to be placed in the trust fund for each dollar of investment in new assets.

Recommendation: Modify motor fuels tax law to address inflation erosion of generated funds

The Commission recognizes that funds available for transportation infrastructure development and maintenance are inadequate today and will be less adequate as more demands are placed on Alabama's transportation infrastructure. Modification of Alabama motor fuels tax laws should be considered, making revenue generation match closer with levels of use. Additionally, tax law modifications should incorporate methods to reduce the buying power erosion due to inflation. Options in addition to a straight fuel tax increase could involve a fuel tax indexing mechanism similar to those in other states.

Consideration could also be given to a limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects. Alabama should analyze the highly successful North Carolina model in this regard. The North Carolina program raised and allocated additional gas tax revenues for specific projects recommended by a body similar to this Commission on Infrastructure. Several fuel tax indexing and other revenue bills can also be quickly accessed for evaluation.

Recommendation: Change the point of collection for motor fuels from the distributors to terminals

Legislation should be enacted to move the collection point for Alabama motor fuels taxes from each of the licensed distributors to fuel terminals. A number of states have enacted this “at the rack” tax collection procedure and have subsequently collected millions of additional revenues from distributed fuel on which no tax was previously remitted. Collecting motor fuel taxes at the fuel terminals where distributors receive their supply will reduce the potential loss of taxable fuels revenue. A Birmingham News story in August 2005 discussed a federal report that indicated that Alabama Department of Transportation is not collecting $24 million and is losing the accompanying federal matching funds.[10] The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of change in the point of collection. A bill previously drafted is being updated for introduction in the 2007 Legislative Session.

Recommendation: Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs

The Commission recommends that any dollars generated from the Outer Continental Shelf leases be placed into a trust fund similar to all of Alabama’s other offshore oil and gas revenues. A trust fund would allow the interest to be spent but preserve the principle. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers Alabama’s inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. Therefore, the Commission's recommendation is that the Legislature create a special Constitutional Trust Fund to administer and invest these revenues for the benefit of the citizens of the state, similar to the way we currently administer and invest Alabama’s inshore oil and gas royalties through the Alabama Trust Fund. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

5. Near Term Actions

The Commission charged its committees with generating as many innovative ideas as possible without the constraint of time or funding. This unencumbered creativity resulted in many new ideas from which the Commission could develop recommendations. The numerous recommendations detailed above were selected acknowledging that funding and time are constraints with which Alabama must work. The Commission is suggesting that the following recommendations be considered for near-term action.

1. **Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation**

An Alabama Transportation Commission should be created with oversight responsibilities to provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports, has proven very successful. A bill is being drafted for introduction in the 2007 Legislative Session.

2. **Expand ALDOT's roles in rail and waterways**

ALDOT, with the oversight of a newly formed Alabama Transportation Commission discussed above, could better integrate the responsibility of Alabama's rail and waterways. An Alabama Waterways Bureau should be established under ALDOT to promote utilization and improvement of Alabama's inland waterways. An organizational design similar to the one used to place of the Aeronautics Bureau under ALDOT's jurisdiction could be incorporated. The gains in efficiency and maintenance of Alabama's airports could also be realized in the rail and waterway transportation modes.

3. **Establish an analysis resource for Alabama's transportation system**

Modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. Utilization of Alabama research universities and other support organizations is strongly encouraged to provide this research.

4. **Modify motor fuels tax law to address inflation erosion of generated funds**

Modification of Alabama motor fuels tax laws should be considered to match more closely revenue generation with levels of use. Additionally, tax law modifications should incorporate methods to stem the buying power erosion due to inflation. A limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects should also be considered. Several fuel tax indexing and other revenue bills can be quickly accessed for evaluation.

5. **Change the point of collection for motor fuels from the distributors to terminals**

Collecting motor fuel taxes at the fuel terminals ("at the rack"), where distributors receive their supply will reduce the potential loss of taxable fuels revenue. The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of point of collection change. A bill previously drafted is being updated for introduction in the 2007 Legislative Session.

6. **Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs**

The Commission recommends that the Legislature create a special Constitutional Trust Fund to administer and invest any dollars generated from the Outer Continental Shelf leases for the benefit of the citizens of the state, similar to the way we currently administer and invest our inshore oil and gas royalties through the Alabama Trust Fund. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers Alabama's inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

6. Path Forward

The **Commission on Infrastructure** recommends that the Commission and its work be continued through the 2007-2010 legislative quadrennium. The Infrastructure Commission would perform strategic analysis and work with members of the legislature and administration enabling action on as many of the recommendations as possible. Much work remains and can be accomplished more effectively by bringing together many of the state's top transportation infrastructure experts. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on this vitally important role of state government.

Concurrently, the expansion of research resources for analyzing Alabama's transportation systems should be initiated. Enhanced analytical and modeling tools are needed to integrate the multiple modes of roads, railways, waterways, and airports. A modern multi-mode research capability will assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. The modeling analysis will help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

The members of the Commission on Infrastructure wish to thank Speaker Seth Hammett and the members of the Alabama Legislature for the opportunity to focus on this extremely important issue. In addition, we would like to thank Manufacture Alabama and its members for supporting the day-to-day work of the Commission and committees. We offer these recommendations after much deliberation and stand ready to continue our service in assisting with preparing Alabama for a strong and prosperous economic future.

Table of Tables

Table of Figures

Exhibits

References

1. Killingsworth, William R., and Gregory A. Harris. *Transportation Infrastructure in Alabama – Meeting the Needs for Economic Growth.* 2005 Report to the U.S. Department of Transportation. University of Alabama in Huntsville Office for Economic Development, 2005, pgs 112-120. <http://www.uaheconomicdevelopment.org/pdfdetails.php?pdf_id=42>

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9. "State of Alabama, short-line Railroad program for Rehabilitation." September q4, 2006.

10. "Fuel tax Evasion said to cost State $56 million." Birmingham News, August 20, 2005, pg 401.

Dr. Bill Killingsworth, Chairman of the Commission's Research & Technical Analysis Committee, in conjunction with Manufacture Alabama representatives directed the creation of this report. Dr. Greg Harris, Director of the UAH Office for Freight, Logistics, and Transportation, provided oversight of the final edits performed by Jeff Thompson and Karen Yarbrough of the UAH Office for Economic Development. Questions regarding this report may be sent to jeff.thompson@uah.edu. Other questions related to the Alabama Commission on Infrastructure may be directed to Manufacture Alabama, 401 Adams Avenue, Montgomery, AL 36104, (334) 386-3000.

Exhibit A

Alabama Commission on Infrastructure
Members 2006

Seth Hammett, Speaker
Alabama House of Representatives

Larry Armstead
Hyundai Motor Corporation

John Baker
Norfolk-Southern Railway

Greg Barker
Alabama Power Company

Thomas Bates
Degussa Corporation

Kay Batey
Federal Highway Administration

Fred Blackwell
Michelin North America

John Bradley
Tennessee Valley Authority

Ron Davis
ZF Lemforder Corporation

Dr. John Eagerton, IV
Alabama Department of Transportation

Dallas Fanning
City of Huntsville

Ronnie Flippo
R.G. Flippo & Associates

Crum Foshee
Crum Foshee & Associates

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Alabama State Senate

Carol Gordy
Natural Decorations, Inc.

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Frontier Yarns, LLC

Franky Griggs
Nucor Steel
Maintenance & Upkeep
Committee Chair

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University of Alabama

Mike Harper
Alabama Department of Transportation

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Alabama Electric Cooperative

Dwight Jennings
Southern Shipping & Logistics
Freight Shipments & Logistics
Committee Chair

Kent Kelly
Kelly Aerospace Group

Bill Killingsworth, Ph.D.
UAH
Research & Technical Assistance
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Alabama House of Representatives

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CBL Enterprises

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Waterways & Port Development
Sub-committee Chair

Commission Members, Continued

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McClain Engineering

Rep. Frank McDaniel
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Parker Towing Company

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Alabama State Senate

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Weyerhaeuser Company - Pine Hill Operation

Jerry Sailors
Coosa-Alabama River Improvement Association

Jimmy Shumock
Thompson Engineering

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SEARP&DC

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Department of Agriculture & Industries

Sherman Suitts
Vulcan Materials Company

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ADO
Economic Development
Committee Chair

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Port of Huntsville

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Non-Freight Movement & Transportation
Committee Chair

Bill Watson
B.R. Williams Trucking

Bruce Windham
The Drummond Company, Inc.

Rep. Greg Wren
Alabama House of Representatives
Wren and Associates

Exhibit B

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ADO

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Alabama Power Company

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Michelin North America

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Tennessee Valley Authority

Victor Burns
Nucor Steel Birmingham, Inc.

Dr. John Eagerton, IV
Alabama Department of Transportation

Rosemary Elebash, NFIB

Ronnie Flippo
R.G. Flippo & Associates

Sen. Steve French
Alabama State Senate

Carol Gordy
Natural Decorations, Inc.

John Harrell
Bradley Arant Rose & White

Horace Horn
Alabama Electric Cooperative

Samuel Kanter
Bradley Arant Rose & White LLP

Jim Key
Warren, Averett, Kimbrough & Marino, LLC

William Killingsworth, Ph.D., UAH

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Alabama House of Representatives

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Chris Lewis
CBL Enterprises

Lori Lindsey
CenturyTel

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McClain Engineering

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Alabama House of Representatives

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Alagasco

Marty Parker
Boise Paper

Deepa Rawls
Weyerhaeuser Company - Pine Hill Operation

Jerry Sailors
Coosa-Alabama River Improvement Association

Heather Shar, UAH

Jimmy Shumock
Thompson Engineering

Tom Solomon
SEARP&DC

Ron Sparks
Department of Agriculture & Industries

Andy Steele
CMC Steel Alabama

Richard Swanson
National Packaging Co., Inc.

Jeff Thompson, UAH

Larry Watts

Bruce Windham
The Drummond Company, Inc.

Rep. Greg Wren
Alabama House of Representatives
Wren and Associates

Exhibit C

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John Baker
Norfolk-Southern Railway

Kenan Boswell
Sabel Steel

David Collins
Holcim (US) Inc.

Rosemary Elebash
NFIB

Sen. Steve French
Alabama State Senate

David Hale, Ph.D.
University of Alabama

Mike Harper
Alabama Department of Transportation

William Killingsworth, Ph.D.
UAH

Ken Ledbetter
CMC Steel Alabama

Bill McClain
McClain Engineering

Billy Norrell
Alabama Road Builders' Association

Tim Parker
Parker Towing Company

Jerry Sailors
Coosa-Alabama River Improvement Association

Heather Shar
UAH

Jimmy Shumock
Thompson Engineering

Richard Swanson
National Packaging Co., Inc.

Jeff Thompson
UAH

Paul Vercher
Birmingham Regional Chamber of Commerce

Bruce Windham
The Drummond Company, Inc.

Gary Young
Nucor Steel Birmingham, Inc.

Exhibit D
Infrastructure Commission Committee
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Alabama State Port Authority
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Alabama House of Representatives

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Subcommittee Chair

Randy McRae
International Paper
Public Policy
Subcommittee Chair

Tim Parker
Parker Towing Company

Deepa Rawls
Weyerhaeuser Company - Pine Hill Operation

Darlene Rotch
Panorama Public Relations

Heather Shar, UAH

Rick Snow
Parker Towing Company, Inc.

Jeff Thompson, UAH

Richard Tucker
Port of Huntsville

Bill Watson
B.R. Williams Trucking

Bruce Windham
The Drummond Company, Inc.

Exhibit E

Infrastructure Commission Committee

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UAH

Taylor Blackwell
Walker Printing

Sonny Brasfield
Association of County Commissions of Alabama

Robert Chappelle, Jr.
Mobile Area Chamber of Commerce

Randy Cole
Shelby County Engineering Department

Dr. John Eagerton, IV
Alabama Department of Transportation

Wayne Echols
Greater Shelby County Chamber of Commerce

Dallas Fanning
City of Huntsville

Mike Harper
Alabama Department of Transportation

William Killingsworth, Ph.D.
UAH

Bill McClain
McClain Engineering

Billy Norrell
Alabama Road Builders' Association

Heather Shar
UAH

Jimmy Shumock
Thompson Engineering

Ron Sparks
Department of Agriculture & Industries

Sherman Suitts
Vulcan Materials Company

Linda Swann
ADO

Jeff Thompson
UAH

Paul Vercher
Birmingham Regional Chamber of Commerce

Larry Watts

Rep. Greg Wren
Alabama House of Representatives
Wren and Associates

Glen Zorn
Department of Agriculture & Industries

Appendix D

Transportation Legislation Introduced

Transportation bills introduced and passed by the House of Representatives based upon the recommendations coming from the Commission on Infrastructure.

- HB 064 – Establishing the Alabama Transportation Commission
- HB119 – Establishing coordination and planning for Alabama inland waterways in the Alabama Department of Transportation
- HB121 – To provide further for the powers of the Alabama Toll Road, Bridge, and Tunnel Authority
- HB280 - to administer a statewide comprehensive program of shortline railroad rehabilitation and improvement
- HB748 – County Bridge Replacement and Road Repair Bond
- HB749 - revise the motor fuel tax laws and tax collection and enforcement processes

Transportation bills introduced and passed out of committee by the Senate based upon the recommendations coming from the Commission on Infrastructure.

- SB040 – Establishing the State Transportation Commission

Appendix E

Papers Submitted and Published

Articles submitted to peer review journals

- **"Using Industry Clusters to Develop a Statewide Freight Flow Model for Alabama,"** Submission to The *Journal of the Transportation Research Forum (JTRF)*. Michael Anderson, Alisha Youngblood, and Gregory Harris.

- **" Preliminary Freight Model Validation Using Extreme-World Scenario Construction,"** Submission to The *Journal of the Transportation Research Forum (JTRF)*. Heather R. Shar, Paul J. Componation, Michael D. Anderson, and Alisha D. Youngblood.

Papers submitted to the Transportation Research Board Annual conference.

- **"A Freight Planning Framework,"** Harris, Gregory A. and Michael D. Anderson. Submitted to the Transportation Research Record, July 2007.

- **"Developing Freight Analysis Zones at a State Level: A Cluster Analysis Approach,"** Harris, Gregory A., Phillip A. Farrington, Michael D. Anderson, Niles Schoening, and James Swain. Submitted to the Transportation Research Record, July 2007.

- **"A Methodology to Use FAF2 Data to Forecast Statewide External-External Trips,"** Anderson, Michael D., Mallikarjuna Kenchapagoudra, Mary Catherine Dondapati and Gregory A. Harris. Submitted to the Transportation Research Record, July 2007.

- **"Using FAF2 Data to Analyze Freight Impact of Interstate 22,"** Anderson, Michael D., Mary Catherine Dondapati and Gregory A. Harris. Submitted to the Transportation Research Record, July 2007.

Papers submitted and accepted to other conferences.

- **"Container Terminal Simulation,"** Gregory A. Harris, Lauren Jennings, Bernard J. Schroer, and Dietmar P.F. Moeller. The Huntsville Simulation Conference, October 2007.

- **"Coal Terminal Simulation,"** Gregory A. Harris, Anthony Holden, Bernard J. Schroer, and Dietmar P.F. Moeller. The Huntsville Simulation Conference, October 2007.

- **"A Freight Planning Framework,"** Gregory A. Harris and Michael D. Anderson. Research Issues in Freight Conference, October 2007, Washington, D.C., Poster presentation.

- **“Using Simulation to Evaluate and Improve the Operations of a Seaport Container Terminal,”** Gregory A. Harris, Lauren Jennings, Bernard J. Schroer, and Dietmar P.F. Moeller. National Urban Freight Conference, December 2007.

- **“Developing Freight Analysis Zones at a State Level: A Cluster Analysis Approach,”** Gregory A. Harris, Ph.D., P.E., Phillip A. Farrington, Ph.D., Michael D. Anderson, Ph.D., P.E., Niles Schoening, Ph.D., James Swain, Ph.D. Transportation Research Forum Annual Conference, May 2008.

- **“Cost Analysis of Proposed Truck-Only Highway Segments in Alabama,”** Alisha Youngblood, Ph.D., Michael Anderson, Ph.D., P.E., and Gregory A. Harris, Ph.D., P.E. Transportation Research Forum Annual Conference, May 2008.

Appendix A

Figures A1 – A22 show the 2002 Employment, Value of Shipments, and Total Truckloads for each county in Alabama by NAICS industry code. The tables also include value of shipments and total truckloads projections for 2005, 2010 and 2015. The NAICS codes shown in the figures include:

- Food Manufacturing
- Beverage & Tobacco Product Manufacturing
- Textile Mills
- Textile Product Mills
- Apparel Manufacturing
- Wood Product Manufacturing
- Paper Manufacturing
- Printed and Related Support Materials
- Petroleum & Coal Products Manufacturing
- Chemical Manufacturing
- Plastics & Rubber Products Manufacturing
- Nonmetallic Mineral Products Manufacturing
- Primary Metal Manufacturing
- Fabricated Metal Product Manufacturing
- Machinery Manufacturing
- Computer & Electronic Products Manufacturing
- Electrical Equipment, Appliance, and Component Manufacturing
- Transportation Equipment Manufacturing
- Furniture & Related Product Manufacturing
- Miscellaneous Manufacturing
- Oil & Gas Extraction
- Coal Mining

Figures A23 – A25 show 2002 total truckload data by county and projections for 2005, 2010, and 2015. This data includes the following NAICS industries:

- Forestry & Logging
- Crop Production
- Animal Production

NAICS 311: Food Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	10	2,140	132	2,187	135	2,412	149	2,658	164
Baldwin	250	52,848	3,255	54,016	3,326	59,580	3,669	65,652	4,043
Barbour	1,498	316,234	19,475	323,223	19,905	356,516	21,955	392,852	24,193
Bibb	3	642	40	656	40	724	45	797	49
Blount	1,152	243,060	14,968	248,431	15,299	274,021	16,875	301,948	18,595
Bullock	953	201,123	12,386	205,568	12,659	226,742	13,963	249,851	15,387
Butler	0	0	0	0	0	0	0	0	0
Calhoun	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Chambers	10	2,140	132	2,187	135	2,412	149	2,658	164
Cherokee	35	7,489	461	7,654	471	8,443	520	9,303	573
Chilton	10	2,140	132	2,187	135	2,412	149	2,658	164
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	279	58,839	3,623	60,140	3,704	66,334	4,085	73,095	4,501
Cleburne	329	69,537	4,282	71,074	4,377	78,395	4,828	86,385	5,320
Coffee	1,713	285,565	17,586	291,876	17,975	321,940	19,826	354,752	21,847
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	61	12,838	791	13,121	808	14,473	891	15,948	982
Coosa	0	0	0	0	0	0	0	0	0
Covington	61	12,838	791	13,121	808	14,473	891	15,948	982
Crenshaw	289	60,979	3,755	62,327	3,838	68,746	4,234	75,753	4,665
Cullman	611	129,018	7,945	131,870	8,121	145,453	8,957	160,277	9,870
Dale	17	3,637	224	3,718	229	4,101	253	4,519	278
Dallas	507	106,980	6,588	109,345	6,734	120,608	7,427	132,900	8,184
De Kalb	1,014	213,961	13,176	218,689	13,468	241,215	14,855	265,799	16,369
Elmore	0	0	0	0	0	0	0	0	0
Escambia	0	0	0	0	0	0	0	0	0
Etowah	1,675	375,492	23,124	383,790	23,635	423,322	26,069	466,466	28,726
Fayette	10	2,140	132	2,187	135	2,412	149	2,658	164
Franklin	1,989	419,791	25,852	429,069	26,423	473,264	29,145	521,498	32,115
Geneva	60	12,624	777	12,903	795	14,232	876	15,682	966
Greene	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Hale	836	176,518	10,870	180,419	11,111	199,003	12,255	219,285	13,504
Henry	253	53,490	3,294	54,672	3,367	60,304	3,714	66,450	4,092
Houston	1,635	345,119	21,253	352,746	21,723	389,080	23,961	428,734	26,403
Jackson	10	2,140	132	2,187	135	2,412	149	2,658	164
Jefferson	5,125	836,632	51,522	855,122	52,661	943,202	58,085	1,039,331	64,005
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	507	106,980	6,588	109,345	6,734	120,608	7,427	132,900	8,184
Lawrence	10	2,140	132	2,187	135	2,412	149	2,658	164
Lee	405	85,584	5,271	87,476	5,387	96,486	5,942	106,320	6,547
Limestone	988	208,612	12,847	213,222	13,131	235,185	14,483	259,154	15,959
Lowndes	20	4,279	264	4,374	269	4,824	297	5,316	327
Macon	0	0	0	0	0	0	0	0	0
Madison	628	132,656	8,169	135,587	8,350	149,553	9,210	164,796	10,149
Marengo	203	42,792	2,635	43,738	2,694	48,243	2,971	53,160	3,274
Marion	101	21,396	1,318	21,869	1,347	24,122	1,485	26,580	1,637
Marshall	5,183	993,996	61,213	1,015,963	62,566	1,120,611	69,010	1,234,821	76,044
Mobile	1,277	137,527	8,469	140,566	8,656	155,045	9,548	170,847	10,521
Monroe	5	1,070	66	1,093	67	1,206	74	1,329	82
Montgomery	1,853	391,121	24,086	399,764	24,619	440,942	27,154	485,881	29,922
Morgan	1,326	279,861	17,235	286,046	17,616	315,510	19,430	347,666	21,410
Perry	329	69,537	4,282	71,074	4,377	78,395	4,828	86,385	5,320
Pickens	20	4,279	264	4,374	269	4,824	297	5,316	327
Pike	245	51,779	3,189	52,923	3,259	58,374	3,595	64,323	3,961
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	249	52,634	3,241	53,798	3,313	59,339	3,654	65,387	4,027
St.Clair	101	21,396	1,318	21,869	1,347	24,122	1,485	26,580	1,637
Sumter	6	1,284	79	1,312	81	1,447	89	1,595	98
Talladega	405	85,584	5,271	87,476	5,387	96,486	5,942	106,320	6,547
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	964	203,477	12,531	207,974	12,808	229,396	14,127	252,775	15,567
Walker	591	124,739	7,682	127,496	7,852	140,629	8,660	154,961	9,543
Washington	0	0	0	0	0	0	0	0	0
Wilcox	10	2,140	132	2,187	135	2,412	149	2,658	164
Winston	61	12,838	791	13,121	808	14,473	891	15,948	982
Alabama	36,393	7,150,635	440,356	7,308,664	450,088	8,061,483	496,449	8,883,091	547,046

Figure A1 - NAICS 311: Food Manufacturing

NAICS 312: Beverage & Tobacco Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	10	3,590	612	3,958	674	4,292	731	4,629	789
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	3,590	612	3,958	674	4,292	731	4,629	789
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Dallas	225	80,775	13,761	89,054	15,171	96,580	16,453	104,142	17,741
De Kalb	0	0	0	0	0	0	0	0	0
Elmore	10	3,590	612	3,958	674	4,292	731	4,629	789
Escambia	0	0	0	0	0	0	0	0	0
Etowah	10	3,590	612	3,958	674	4,292	731	4,629	789
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	375	134,625	22,934	148,424	25,285	160,966	27,422	173,570	29,569
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	819	293,449	49,991	323,528	55,000	350,866	59,773	378,338	64,453
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	188	67,492	11,498	74,410	12,676	80,698	13,747	87,016	14,824
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	60	21,540	3,670	23,748	4,046	25,755	4,387	27,771	4,731
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	175	62,825	10,703	69,265	11,800	75,117	12,797	80,999	13,799
Morgan	10	3,590	612	3,958	674	4,292	731	4,629	789
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	10	3,590	612	3,958	674	4,292	731	4,629	789
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	0	0	0	0	0	0	0	0	0
Walker	10	3,590	612	3,958	674	4,292	731	4,629	789
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	2,092	750,456	127,848	827,378	140,835	897,291	152,861	967,549	164,829

Figure A2- NAICS 312: Beverage & Tobacco Product Manufacturing

NAICS 313: Textile Mills									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	161	28,905	221	26,044	199	20,618	157	15,242	116
Baldwin	206	37,164	284	33,486	256	26,509	202	19,597	150
Barbour	780	140,397	1,072	126,501	966	100,146	765	74,035	565
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	413	74,328	568	66,971	512	53,018	405	39,195	299
Chambers	2,894	520,956	3,979	469,394	3,585	371,601	2,838	274,713	2,098
Cherokee	383	68,877	526	62,060	474	49,130	375	36,321	277
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	123	22,133	169	19,943	152	15,788	121	11,671	89
Coosa	170	30,557	233	27,533	210	21,796	166	16,113	123
Covington	918	165,173	1,262	148,825	1,137	117,819	900	87,100	665
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	389	79,495	607	71,627	547	56,704	433	41,920	320
Elmore	727	130,817	999	117,869	900	93,313	713	68,983	527
Escambia	55	9,910	76	8,930	68	7,069	54	5,226	40
Etowah	0	0	0	0	0	0	0	0	0
Fayette	175	31,548	241	28,426	217	22,503	172	16,636	127
Franklin	0	0	0	0	0	0	0	0	0
Geneva	9	1,652	13	1,488	11	1,178	9	871	7
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	459	82,587	631	74,413	568	58,909	450	43,550	333
Jackson	459	82,587	631	74,413	568	58,909	450	43,550	333
Jefferson	18	3,303	25	2,977	23	2,356	18	1,742	13
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	229	41,293	315	37,206	284	29,455	225	21,775	166
Lawrence	0	0	0	0	0	0	0	0	0
Lee	734	132,138	1,009	119,060	909	94,255	720	69,680	532
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	18	3,303	25	2,977	23	2,356	18	1,742	13
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	551	99,104	757	89,295	682	70,691	540	52,260	399
Mobile	0	0	0	0	0	0	0	0	0
Monroe	138	24,776	189	22,324	171	17,673	135	13,065	100
Montgomery	138	24,776	189	22,324	171	17,673	135	13,065	100
Morgan	5	826	6	744	6	589	4	435	3
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	593	89,360	683	80,516	615	63,741	487	47,122	360
Russell	358	64,417	492	58,042	443	45,949	351	33,969	259
Shelby	697	125,531	959	113,107	864	89,542	684	66,196	506
St.Clair	313	56,324	430	50,749	388	40,176	307	29,701	227
Sumter	0	0	0	0	0	0	0	0	0
Talladega	1,446	298,213	2,278	268,697	2,052	212,717	1,625	157,255	1,201
Tallapoosa	1,632	293,843	2,244	264,760	2,022	209,600	1,601	154,951	1,184
Tuscaloosa	5	826	6	744	6	589	4	435	3
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	15,195	2,765,120	21,121	2,491,443	19,030	1,972,376	15,066	1,458,118	11,137

Figure A3 - NAICS 313: Textile Mills

NAICS 314: Textile Product Mills									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	30	5,787	42	5,215	38	4,128	30	3,052	22
Baldwin	9	1,654	12	1,490	11	1,179	8	872	6
Barbour	9	1,654	12	1,490	11	1,179	8	872	6
Bibb	0	0	0	0	0	0	0	0	0
Blount	3	496	4	447	3	354	3	262	2
Bullock	0	0	0	0	0	0	0	0	0
Butler	225	43,324	312	39,035	281	30,902	223	22,845	165
Calhoun	793	152,955	1,102	137,814	993	109,102	786	80,656	581
Chambers	150	28,937	208	26,073	188	20,641	149	15,259	110
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	86	16,536	119	14,899	107	11,795	85	8,720	63
Clay	17	3,307	24	2,980	21	2,359	17	1,744	13
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	13	2,480	18	2,235	16	1,769	13	1,308	9
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	43	8,268	60	7,449	54	5,897	42	4,360	31
Dale	0	0	0	0	0	0	0	0	0
Dallas	257	49,607	357	44,696	322	35,384	255	26,159	188
De Kalb	9	1,654	12	1,490	11	1,179	8	872	6
Elmore	4	827	6	745	5	590	4	436	3
Escambia	214	41,339	298	37,247	268	29,487	212	21,799	157
Etowah	9	1,654	12	1,490	11	1,179	8	872	6
Fayette	0	0	0	0	0	0	0	0	0
Franklin	51	9,921	71	8,939	64	7,077	51	5,232	38
Geneva	9	1,654	12	1,490	11	1,179	8	872	6
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	600	115,750	834	104,292	751	82,564	595	61,037	440
Houston	95	18,355	132	16,538	119	13,092	94	9,679	70
Jackson	2,250	434,062	3,127	391,094	2,817	309,614	2,230	228,888	1,649
Jefferson	428	82,678	596	74,494	537	58,974	425	43,598	314
Lamar	4	827	6	745	5	590	4	436	3
Lauderdale	43	8,268	60	7,449	54	5,897	42	4,360	31
Lawrence	0	0	0	0	0	0	0	0	0
Lee	86	16,536	119	14,899	107	11,795	85	8,720	63
Limestone	4	827	6	745	5	590	4	436	3
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	117	22,489	162	20,262	146	16,041	116	11,859	85
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	428	82,678	596	74,494	537	58,974	425	43,598	314
Monroe	17	3,307	24	2,980	21	2,359	17	1,744	13
Montgomery	171	33,071	238	29,798	215	23,590	170	17,439	126
Morgan	857	165,357	1,191	148,988	1,073	117,948	850	87,195	628
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	43	8,268	60	7,449	54	5,897	42	4,360	31
Shelby	9	1,654	12	1,490	11	1,179	8	872	6
St.Clair	4	827	6	745	5	590	4	436	3
Sumter	0	0	0	0	0	0	0	0	0
Talladega	86	16,536	119	14,899	107	11,795	85	8,720	63
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	15	2,976	21	2,682	19	2,123	15	1,570	11
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	17	3,307	24	2,980	21	2,359	17	1,744	13
Alabama	7,203	1,389,825	10,012	1,252,246	9,021	991,353	7,142	732,878	5,280

Figure A4 - NAICS 314: Textile Product Mills

NAICS 315: Apparel Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	55	6,543	247	6,118	231	4,934	187	4,126	156
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	92	10,905	412	10,196	386	8,223	311	6,876	260
Calhoun	385	45,801	1,732	42,824	1,619	34,538	1,306	28,881	1,092
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	128	15,267	577	14,275	540	11,513	435	9,627	364
Chilton	9	1,090	41	1,020	39	822	31	688	26
Choctaw	137	16,357	618	15,294	578	12,335	466	10,314	390
Clarke	252	29,989	1,134	28,039	1,060	22,614	855	18,910	715
Clay	0	0	0	0	0	0	0	0	0
Cleburne	374	44,492	1,682	41,600	1,573	33,552	1,269	28,055	1,061
Coffee	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	545	21	510	19	411	16	344	13
Crenshaw	192	22,900	866	21,412	810	17,269	653	14,440	546
Cullman	64	7,633	289	7,137	270	5,756	218	4,813	182
Dale	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Dallas	275	32,715	1,237	30,588	1,157	24,670	933	20,629	780
De Kalb	6,901	821,360	31,056	767,971	29,037	619,387	23,419	517,925	19,583
Elmore	5	545	21	510	19	411	16	344	13
Escambia	55	6,543	247	6,118	231	4,934	187	4,126	156
Etowah	82	9,814	371	9,177	347	7,401	280	6,189	234
Fayette	321	38,167	1,443	35,686	1,349	28,782	1,088	24,067	910
Franklin	5	545	21	510	19	411	16	344	13
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	49	5,780	219	5,404	204	4,358	165	3,644	138
Henry	0	0	0	0	0	0	0	0	0
Houston	9	1,090	41	1,020	39	822	31	688	26
Jackson	44	5,234	198	4,894	185	3,947	149	3,301	125
Jefferson	18	2,181	82	2,039	77	1,645	62	1,375	52
Lamar	5	545	21	510	19	411	16	344	13
Lauderdale	508	60,413	2,284	56,486	2,136	45,558	1,723	38,095	1,440
Lawrence	9	1,090	41	1,020	39	822	31	688	26
Lee	46	5,452	206	5,098	193	4,112	155	3,438	130
Limestone	46	5,452	206	5,098	193	4,112	155	3,438	130
Lowndes	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Macon	0	0	0	0	0	0	0	0	0
Madison	18	2,181	82	2,039	77	1,645	62	1,375	52
Marengo	344	40,894	1,546	38,235	1,446	30,838	1,166	25,786	975
Marion	5	545	21	510	19	411	16	344	13
Marshall	92	10,905	412	10,196	386	8,223	311	6,876	260
Mobile	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Monroe	458	54,525	2,062	50,981	1,928	41,117	1,555	34,382	1,300
Montgomery	13	1,527	58	1,427	54	1,151	44	963	36
Morgan	183	21,810	825	20,392	771	16,447	622	13,753	520
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	367	43,620	1,649	40,784	1,542	32,894	1,244	27,505	1,040
Russell	18	2,181	82	2,039	77	1,645	62	1,375	52
Shelby	9	1,090	41	1,020	39	822	31	688	26
St.Clair	18	2,181	82	2,039	77	1,645	62	1,375	52
Sumter	0	0	0	0	0	0	0	0	0
Talladega	229	27,262	1,031	25,490	964	20,559	777	17,191	650
Tallapoosa	550	65,430	2,474	61,177	2,313	49,340	1,866	41,258	1,560
Tuscaloosa	13	1,527	58	1,427	54	1,151	44	963	36
Walker	0	0	0	0	0	0	0	0	0
Washington	5	545	21	510	19	411	16	344	13
Wilcox	0	0	0	0	0	0	0	0	0
Winston	10	1,200	45	1,122	42	905	34	756	29
Alabama	13,775	1,639,448	61,988	1,532,884	57,958	1,236,308	46,745	1,033,787	39,088

Figure A5 - NAICS 315: Apparel Manufacturing

NAICS 321: Wood Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	174	31,062	145	31,969	149	29,535	138	32,413	151
Barbour	532	81,346	379	83,723	390	77,348	360	84,884	395
Bibb	241	43,161	201	44,422	207	41,040	191	45,039	210
Blount	60	10,655	50	10,966	51	10,131	47	11,118	52
Bullock	0	0	0	0	0	0	0	0	0
Butler	542	89,257	416	91,865	428	84,871	395	93,139	434
Calhoun	451	80,724	376	83,083	387	76,757	357	84,236	392
Chambers	190	33,951	158	34,943	163	32,283	150	35,428	165
Cherokee	3	542	3	558	3	515	2	565	3
Chilton	471	84,336	393	86,800	404	80,192	373	88,005	410
Choctaw	124	22,213	103	22,862	106	21,121	98	23,179	108
Clarke	600	127,421	593	131,144	611	121,159	564	132,963	619
Clay	15	2,709	13	2,788	13	2,576	12	2,827	13
Cleburne	10	1,806	8	1,859	9	1,717	8	1,884	9
Coffee	5	903	4	929	4	859	4	942	4
Colbert	528	94,449	440	97,209	453	89,808	418	98,558	459
Conecuh	505	90,296	420	92,934	433	85,858	400	94,223	439
Coosa	97	17,337	81	17,843	83	16,485	77	18,091	84
Covington	5	903	4	929	4	859	4	942	4
Crenshaw	61	10,835	50	11,152	52	10,303	48	11,307	53
Cullman	233	41,717	194	42,936	200	39,666	185	43,531	203
Dale	0	0	0	0	0	0	0	0	0
Dallas	385	68,805	320	70,816	330	65,424	305	71,798	334
De Kalb	73	13,003	61	13,382	62	12,364	58	13,568	63
Elmore	107	19,143	89	19,702	92	18,202	85	19,975	93
Escambia	484	81,662	380	84,048	391	77,649	362	85,214	397
Etowah	467	83,614	389	86,057	401	79,505	370	87,251	406
Fayette	224	40,091	187	41,263	192	38,121	178	41,835	195
Franklin	391	69,889	325	71,931	335	66,454	309	72,929	340
Geneva	10	1,806	8	1,859	9	1,717	8	1,884	9
Greene	65	11,558	54	11,896	55	10,990	51	12,061	56
Hale	262	46,954	219	48,326	225	44,646	208	48,996	228
Henry	217	38,827	181	39,962	186	36,919	172	40,516	189
Houston	187	33,409	156	34,386	160	31,768	148	34,863	162
Jackson	66	11,738	55	12,081	56	11,162	52	12,249	57
Jefferson	119	21,310	99	21,932	102	20,263	94	22,237	104
Lamar	515	92,102	429	94,793	441	87,575	408	96,108	448
Lauderdale	244	43,703	204	44,980	209	41,555	194	45,604	212
Lawrence	30	5,418	25	5,576	26	5,151	24	5,653	26
Lee	280	50,024	233	51,485	240	47,565	221	52,200	243
Limestone	20	3,612	17	3,717	17	3,434	16	3,769	18
Lowndes	5	903	4	929	4	859	4	942	4
Macon	5	903	4	929	4	859	4	942	4
Madison	203	36,299	169	37,359	174	34,515	161	37,878	176
Marengo	750	76,400	356	78,632	366	72,645	338	79,723	371
Marion	1,305	195,413	910	201,123	937	185,810	865	203,913	950
Marshall	1,090	124,083	578	127,709	595	117,985	549	129,480	603
Mobile	1,213	248,267	1,156	255,521	1,190	236,066	1,099	259,066	1,206
Monroe	812	163,148	760	167,915	782	155,130	722	170,244	793
Montgomery	594	106,188	494	109,290	509	100,969	470	110,807	516
Morgan	503	89,934	419	92,562	431	85,515	398	93,846	437
Perry	0	0	0	0	0	0	0	0	0
Pickens	502	88,936	414	91,535	426	84,565	394	92,804	432
Pike	190	33,951	158	34,943	163	32,283	150	35,428	165
Randolph	101	18,059	84	18,587	87	17,172	80	18,845	88
Russell	177	31,603	147	32,527	151	30,050	140	32,978	154
Shelby	475	84,878	395	87,358	407	80,707	376	88,570	412
St.Clair	117	20,949	98	21,561	100	19,919	93	21,860	102
Sumter	159	28,353	132	29,181	136	26,959	126	29,586	138
Talladega	404	72,237	336	74,347	346	68,687	320	75,379	351
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	685	122,441	570	126,019	587	116,424	542	127,767	595
Walker	227	40,633	189	41,820	195	38,636	180	42,400	197
Washington	61	10,835	50	11,152	52	10,303	48	11,307	53
Wilcox	252	45,148	210	46,467	216	42,929	200	47,112	219
Winston	2,233	372,941	1,737	383,838	1,787	354,613	1,651	389,163	1,812
Alabama	21,053	3,614,791	16,833	3,720,412	17,325	3,437,145	16,006	3,772,024	17,565

Figure A6 - NAICS 321: Wood Product Manufacturing

NAICS 322: Paper Manufacturing

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	771	317,619	116,849	356,559	131,175	391,335	143,968	412,926	151,912
Baldwin	239	98,674	36,301	110,771	40,752	121,575	44,726	128,282	47,194
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Chambers	180	74,111	27,265	83,197	30,607	91,311	33,593	96,349	35,446
Cherokee	3	1,270	467	1,426	525	1,565	576	1,652	608
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	1,285	529,364	194,748	594,264	218,624	652,224	239,947	688,211	253,186
Clarke	750	309,149	113,733	347,050	127,677	380,899	140,129	401,915	147,861
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	168	69,029	25,395	77,492	28,509	85,050	31,289	89,743	33,015
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	458	127,130	46,770	142,716	52,504	156,636	57,625	165,278	60,804
Dale	0	0	0	0	0	0	0	0	0
Dallas	822	338,793	124,639	380,329	139,920	417,424	153,566	440,455	162,039
De Kalb	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Elmore	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Escambia	527	217,251	79,925	243,886	89,723	267,673	98,474	282,442	103,908
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	208	85,545	31,471	96,033	35,330	105,399	38,775	111,215	40,915
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	99	40,655	14,957	45,640	16,790	50,091	18,428	52,855	19,445
Jackson	514	211,746	77,899	237,706	87,450	260,890	95,979	275,284	101,274
Jefferson	478	196,924	72,446	221,066	81,328	242,628	89,260	256,014	94,185
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	37	15,246	5,609	17,115	6,296	18,784	6,910	19,820	7,292
Lawrence	1,285	529,364	194,748	594,264	218,624	652,224	239,947	688,211	253,186
Lee	915	376,907	138,661	423,116	155,660	464,384	170,842	490,006	180,269
Limestone	103	42,349	15,580	47,541	17,490	52,178	19,196	55,057	20,255
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	303	124,930	45,961	140,246	51,595	153,925	56,628	162,418	59,752
Marengo	653	268,917	98,932	301,886	111,061	331,330	121,893	349,611	128,619
Marion	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Marshall	103	42,349	15,580	47,541	17,490	52,178	19,196	55,057	20,255
Mobile	1,410	581,030	213,756	652,265	239,962	715,882	263,366	755,380	277,897
Monroe	514	211,746	77,899	237,706	87,450	260,890	95,979	275,284	101,274
Montgomery	154	63,524	23,370	71,312	26,235	78,267	28,794	82,585	30,382
Morgan	105	43,196	15,891	48,492	17,840	53,222	19,580	56,158	20,660
Perry	62	25,409	9,348	28,525	10,494	31,307	11,517	33,034	12,153
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	31	12,705	4,674	14,262	5,247	15,653	5,759	16,517	6,076
St.Clair	5	2,117	779	2,377	874	2,609	960	2,753	1,013
Sumter	118	48,702	17,917	54,672	20,113	60,005	22,075	63,315	23,293
Talladega	565	232,920	85,689	261,476	96,195	286,979	105,577	302,813	111,402
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	257	105,873	38,950	118,853	43,725	130,445	47,989	137,642	50,637
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	925	381,142	140,219	427,870	157,409	469,602	172,762	495,512	182,294
Winston	0	0	0	0	0	0	0	0	0
Alabama	14,178	5,780,741	2,126,680	6,489,460	2,387,411	7,122,393	2,620,261	7,515,368	2,764,833

Figure A7 - NAICS 322: Paper Manufacturing

NAICS 323: Printing & Related Support Activities									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	3	394	58	380	56	425	63	466	69
Baldwin	189	25,089	3,704	24,181	3,570	27,036	3,991	29,675	4,381
Barbour	10	1,314	194	1,266	187	1,416	209	1,554	229
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	3	394	58	380	56	425	63	466	69
Calhoun	385	51,097	7,543	49,248	7,270	55,063	8,128	60,438	8,922
Chambers	19	2,496	368	2,405	355	2,689	397	2,952	436
Cherokee	10	1,314	194	1,266	187	1,416	209	1,554	229
Chilton	11	1,445	213	1,393	206	1,557	230	1,709	252
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	5	657	97	633	93	708	104	777	115
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	69	9,195	1,357	8,862	1,308	9,909	1,463	10,876	1,605
Colbert	37	4,860	717	4,684	691	5,237	773	5,749	849
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	657	97	633	93	708	104	777	115
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	46	6,042	892	5,824	860	6,511	961	7,147	1,055
Dale	0	0	0	0	0	0	0	0	0
Dallas	40	5,254	776	5,064	748	5,662	836	6,215	917
De Kalb	43	5,648	834	5,444	804	6,087	899	6,681	986
Elmore	6	788	116	760	112	849	125	932	138
Escambia	8	1,051	155	1,013	150	1,132	167	1,243	183
Etowah	42	5,517	814	5,317	785	5,945	878	6,525	963
Fayette	10	1,314	194	1,266	187	1,416	209	1,554	229
Franklin	5	657	97	633	93	708	104	777	115
Geneva	5	657	97	633	93	708	104	777	115
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	98	13,004	1,920	12,534	1,850	14,014	2,069	15,381	2,271
Jackson	40	5,254	776	5,064	748	5,662	836	6,215	917
Jefferson	2,175	288,453	42,581	278,016	41,040	310,845	45,887	341,185	50,365
Lamar	5	657	97	633	93	708	104	777	115
Lauderdale	96	12,741	1,881	12,280	1,813	13,730	2,027	15,071	2,225
Lawrence	99	13,135	1,939	12,660	1,869	14,155	2,090	15,537	2,294
Lee	126	16,682	2,463	16,078	2,373	17,977	2,654	19,732	2,913
Limestone	10	1,314	194	1,266	187	1,416	209	1,554	229
Lowndes	5	657	97	633	93	708	104	777	115
Macon	10	1,314	194	1,266	187	1,416	209	1,554	229
Madison	228	30,211	4,460	29,118	4,298	32,557	4,806	35,734	5,275
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	129	17,076	2,521	16,458	2,430	18,402	2,716	20,198	2,982
Mobile	283	37,567	5,546	36,208	5,345	40,483	5,976	44,435	6,559
Monroe	10	1,314	194	1,266	187	1,416	209	1,554	229
Montgomery	449	59,503	8,784	57,350	8,466	64,122	9,466	70,381	10,390
Morgan	130	17,207	2,540	16,585	2,448	18,543	2,737	20,353	3,004
Perry	5	657	97	633	93	708	104	777	115
Pickens	20	2,627	388	2,532	374	2,831	418	3,107	459
Pike	14	1,839	271	1,772	262	1,982	293	2,175	321
Randolph	0	0	0	0	0	0	0	0	0
Russell	5	657	97	633	93	708	104	777	115
Shelby	251	33,232	4,906	32,030	4,728	35,812	5,287	39,308	5,803
St.Clair	23	3,021	446	2,912	430	3,256	481	3,573	528
Sumter	5	657	97	633	93	708	104	777	115
Talladega	272	36,122	5,332	34,815	5,139	38,926	5,746	42,726	6,307
Tallapoosa	5	657	97	633	93	708	104	777	115
Tuscaloosa	126	16,682	2,463	16,078	2,373	17,977	2,654	19,732	2,913
Walker	11	1,445	213	1,393	206	1,557	230	1,709	252
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	5	657	97	633	93	708	104	777	115
Alabama	5,580	740,178	109,264	713,398	105,311	797,638	117,746	875,490	129,239

Figure A8 - NAICS 323: Printing & Related Support Activities

NAICS 324: Petroleum & Coal Products Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	10	9,890	417	10,697	451	11,287	476	12,051	508
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	10	9,890	417	10,697	451	11,287	476	12,051	508
Dallas	10	9,890	417	10,697	451	11,287	476	12,051	508
DeKalb	10	9,890	417	10,697	451	11,287	476	12,051	508
Elmore	0	0	0	0	0	0	0	0	0
Escambia	10	9,890	417	10,697	451	11,287	476	12,051	508
Etowah	10	9,890	417	10,697	451	11,287	476	12,051	508
Fayette	0	0	0	0	0	0	0	0	0
Franklin	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Geneva	0	0	0	0	0	0	0	0	0
Greene	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Hale	0	0	0	0	0	0	0	0	0
Henry	10	9,890	417	10,697	451	11,287	476	12,051	508
Houston	60	59,340	2,504	64,182	2,708	67,725	2,858	72,303	3,051
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	592	585,488	24,704	633,264	4,155	668,220	28,195	713,392	30,101
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	10	9,890	417	10,697	451	11,287	476	12,051	508
Lee	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	383	378,787	15,983	409,696	17,287	432,311	18,241	461,535	19,474
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	10	9,890	417	10,697	451	11,287	476	12,051	508
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	10	9,890	417	10,697	451	11,287	476	12,051	508
St.Clair	30	29,670	1,252	32,091	1,354	33,862	1,429	36,152	1,525
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	10	9,890	417	10,697	451	11,287	476	12,051	508
Tuscaloosa	809	800,407	33,772	865,720	36,528	913,508	38,545	975,261	41,150
Walker	10	9,890	417	10,697	451	11,287	476	12,051	508
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	2,174	2,150,392	90,731	2,325,864	75,573	2,454,252	103,555	2,620,159	110,555

Figure A9 - NAICS 324: Petroleum & Coal Products Manufacturing

NAICS 325: Chemical Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	101	48,776	2,793	58,114	3,327	65,810	3,768	74,313	4,255
Barbour	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Bibb	0	0	0	0	0	0	0	0	0
Blount	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	151	73,164	4,189	87,171	4,991	98,716	5,652	111,470	6,382
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	50	24,388	1,396	29,057	1,664	32,905	1,884	37,157	2,127
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	5	2,439	140	2,906	166	3,291	188	3,716	213
Clarke	5	2,439	140	2,906	166	3,291	188	3,716	213
Clay	0	0	0	0	0	0	0	0	0
Cleburne	5	2,439	140	2,906	166	3,291	188	3,716	213
Coffee	40	19,510	1,117	23,246	1,331	26,324	1,507	29,725	1,702
Colbert	417	201,444	11,534	240,011	13,742	271,797	15,562	306,913	17,572
Conecuh	5	2,439	140	2,906	166	3,291	188	3,716	213
Coosa	0	0	0	0	0	0	0	0	0
Covington	1,392	672,132	38,483	800,812	45,850	906,867	51,922	1,024,033	58,630
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	99	47,800	2,737	56,952	3,261	64,494	3,693	72,827	4,170
Dale	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Dallas	5	2,439	140	2,906	166	3,291	188	3,716	213
De Kalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Etowah	81	39,021	2,234	46,491	2,662	52,648	3,014	59,450	3,404
Fayette	0	0	0	0	0	0	0	0	0
Franklin	5	2,439	140	2,906	166	3,291	188	3,716	213
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	7	3,414	195	4,068	233	4,607	264	5,202	298
Houston	101	48,776	2,793	58,114	3,327	65,810	3,768	74,313	4,255
Jackson	629	303,874	17,398	362,051	20,729	409,999	23,474	462,970	26,507
Jefferson	650	314,117	17,985	374,255	21,428	423,819	24,266	478,576	27,401
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Lawrence	10	4,878	279	5,811	333	6,581	377	7,431	425
Lee	41	19,998	1,145	23,827	1,364	26,982	1,545	30,468	1,744
Limestone	10	4,878	279	5,811	333	6,581	377	7,431	425
Lowndes	822	397,036	22,732	473,048	27,084	535,697	30,671	604,908	34,634
Macon	0	0	0	0	0	0	0	0	0
Madison	596	287,778	16,477	342,873	19,631	388,281	22,231	438,447	25,103
Marengo	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Marion	30	14,633	838	17,434	998	19,743	1,130	22,294	1,276
Marshall	119	57,556	3,295	68,575	3,926	77,656	4,446	87,689	5,021
Mobile	3,404	1,580,991	90,519	1,883,672	107,849	2,133,136	122,131	2,408,735	137,911
Monroe	10	4,878	279	5,811	333	6,581	377	7,431	425
Montgomery	126	60,970	3,491	72,643	4,159	82,263	4,710	92,891	5,318
Morgan	2,503	1,209,155	69,229	1,440,647	82,483	1,631,440	93,407	1,842,220	105,475
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	151	73,164	4,189	87,171	4,991	98,716	5,652	111,470	6,382
Randolph	5	2,439	140	2,906	166	3,291	188	3,716	213
Russell	252	121,940	6,982	145,285	8,318	164,526	9,420	185,783	10,637
Shelby	74	35,606	2,039	42,423	2,429	48,042	2,751	54,249	3,106
St.Clair	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Sumter	0	0	0	0	0	0	0	0	0
Talladega	325	157,058	8,992	187,127	10,714	211,910	12,133	239,288	13,700
Tallapoosa	30	14,633	838	17,434	998	19,743	1,130	22,294	1,276
Tuscaloosa	250	120,964	6,926	144,123	8,252	163,210	9,344	184,296	10,552
Walker	61	29,266	1,676	34,868	1,996	39,486	2,261	44,588	2,553
Washington	1,201	579,945	33,204	690,976	39,561	782,486	44,801	883,582	50,589
Wilcox	5	2,439	140	2,906	166	3,291	188	3,716	213
Winston	0	0	0	0	0	0	0	0	0
Alabama	14,201	6,796,111	389,107	8,097,226	463,602	9,169,585	524,999	10,354,283	592,828

Figure A10 - NAICS 325: Chemical Manufacturing

NAICS 326: Plastics & Rubber Products Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	248	39,835	1,593	43,825	1,752	48,242	1,929	53,787	2,150
Baldwin	125	19,997	799	22,000	880	24,217	968	27,001	1,079
Barbour	371	59,514	2,379	65,476	2,618	72,074	2,881	80,359	3,213
Bibb	0	0	0	0	0	0	0	0	0
Blount	59	9,522	381	10,476	419	11,532	461	12,858	514
Bullock	0	0	0	0	0	0	0	0	0
Butler	59	9,522	381	10,476	419	11,532	461	12,858	514
Calhoun	30	4,761	190	5,238	209	5,766	231	6,429	257
Chambers	198	31,741	1,269	34,921	1,396	38,440	1,537	42,858	1,713
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	137	22,060	882	24,270	970	26,716	1,068	29,787	1,191
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	222	35,709	1,428	39,286	1,571	43,245	1,729	48,216	1,928
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	10	1,587	63	1,746	70	1,922	77	2,143	86
Colbert	595	77,818	3,111	85,613	3,423	94,241	3,768	105,074	4,201
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	5	794	32	873	35	961	38	1,071	43
Crenshaw	5	794	32	873	35	961	38	1,071	43
Cullman	652	104,587	4,181	115,063	4,600	126,659	5,064	141,218	5,646
Dale	10	1,587	63	1,746	70	1,922	77	2,143	86
Dallas	10	1,587	63	1,746	70	1,922	77	2,143	86
De Kalb	187	29,995	1,199	33,000	1,319	36,326	1,452	40,501	1,619
Elmore	789	126,647	5,063	139,333	5,570	153,374	6,132	171,005	6,836
Escambia	5	794	32	873	35	961	38	1,071	43
Etowah	1,264	202,984	8,115	223,317	8,928	245,822	9,828	274,079	10,957
Fayette	0	0	0	0	0	0	0	0	0
Franklin	59	9,522	381	10,476	419	11,532	461	12,858	514
Geneva	5	794	32	873	35	961	38	1,071	43
Greene	0	0	0	0	0	0	0	0	0
Hale	5	794	32	873	35	961	38	1,071	43
Henry	0	0	0	0	0	0	0	0	0
Houston	786	126,171	5,044	138,809	5,549	152,798	6,109	170,362	6,811
Jackson	10	1,587	63	1,746	70	1,922	77	2,143	86
Jefferson	972	156,007	6,237	171,635	6,862	188,931	7,553	210,649	8,421
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	361	57,927	2,316	63,730	2,548	70,152	2,805	78,217	3,127
Lawrence	5	794	32	873	35	961	38	1,071	43
Lee	1,671	301,765	12,064	331,993	13,272	365,450	14,610	407,458	16,289
Limestone	134	21,584	863	23,746	949	26,139	1,045	29,144	1,165
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	2,253	469,424	18,767	516,446	20,647	568,491	22,727	633,840	25,340
Marengo	59	9,522	381	10,476	419	11,532	461	12,858	514
Marion	445	71,417	2,855	78,571	3,141	86,489	3,458	96,431	3,855
Marshall	511	82,051	3,280	90,270	3,609	99,367	3,973	110,789	4,429
Mobile	318	51,103	2,043	56,222	2,248	61,888	2,474	69,002	2,759
Monroe	10	1,587	63	1,746	70	1,922	77	2,143	86
Montgomery	1,138	233,208	9,323	256,568	10,257	282,424	11,291	314,889	12,589
Morgan	411	66,021	2,639	72,635	2,904	79,955	3,196	89,145	3,564
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	667	107,126	4,283	117,857	4,712	129,734	5,187	144,647	5,783
Randolph	5	794	32	873	35	961	38	1,071	43
Russell	0	0	0	0	0	0	0	0	0
Shelby	171	27,456	1,098	30,206	1,208	33,250	1,329	37,072	1,482
St.Clair	92	14,760	590	16,238	649	17,874	715	19,929	797
Sumter	0	0	0	0	0	0	0	0	0
Talladega	133	21,425	857	23,571	942	25,947	1,037	28,929	1,157
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	2,875	461,515	18,451	507,745	20,299	558,913	22,344	623,161	24,913
Walker	5	794	32	873	35	961	38	1,071	43
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	119	19,045	761	20,952	838	23,064	922	25,715	1,028
Alabama	18,202	3,096,027	123,774	3,406,156	136,172	3,749,413	149,895	4,180,410	167,126

Figure A11 - NAICS 326: Plastics & Rubber Products Manufacturing

NAICS 327: Nonmetallic Mineral Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	29	5,944	1,031	6,114	1,060	6,842	1,186	7,502	1,301
Baldwin	162	33,285	5,772	34,236	5,937	38,313	6,644	42,010	7,285
Barbour	10	1,981	344	2,038	353	2,281	395	2,501	434
Bibb	3	594	103	611	106	684	119	750	130
Blount	11	2,179	378	2,242	389	2,509	435	2,751	477
Bullock	10	1,981	344	2,038	353	2,281	395	2,501	434
Butler	10	1,981	344	2,038	353	2,281	395	2,501	434
Calhoun	108	22,190	3,848	22,824	3,958	25,542	4,429	28,007	4,857
Chambers	314	64,390	11,166	66,231	11,486	74,117	12,853	81,269	14,094
Cherokee	3	594	103	611	106	684	119	750	130
Chilton	14	2,972	515	3,057	530	3,421	593	3,751	650
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	1,981	344	2,038	353	2,281	395	2,501	434
Clay	10	1,981	344	2,038	353	2,281	395	2,501	434
Cleburne	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Coffee	5	991	172	1,019	177	1,140	198	1,250	217
Colbert	33	6,736	1,168	6,929	1,202	7,754	1,345	8,502	1,474
Conecuh	19	3,962	687	4,076	707	4,561	791	5,001	867
Coosa	0	0	0	0	0	0	0	0	0
Covington	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	19	3,962	687	4,076	707	4,561	791	5,001	867
Dale	37	7,529	1,306	7,744	1,343	8,666	1,503	9,502	1,648
Dallas	182	37,247	6,459	38,312	6,644	42,874	7,435	47,011	8,153
De Kalb	43	8,916	1,546	9,170	1,590	10,262	1,780	11,253	1,951
Elmore	158	32,492	5,635	33,421	5,796	37,401	6,486	41,010	7,112
Escambia	58	11,887	2,062	12,227	2,120	13,683	2,373	15,004	2,602
Etowah	291	59,635	10,342	61,340	10,637	68,644	11,904	75,268	13,053
Fayette	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Franklin	193	39,625	6,872	40,757	7,068	45,611	7,910	50,012	8,673
Geneva	10	1,981	344	2,038	353	2,281	395	2,501	434
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Jackson	97	19,812	3,436	20,379	3,534	22,805	3,955	25,006	4,336
Jefferson	1,407	379,140	65,750	389,976	67,629	436,413	75,682	478,524	82,985
Lamar	10	1,981	344	2,038	353	2,281	395	2,501	434
Lauderdale	77	15,850	2,749	16,303	2,827	18,244	3,164	20,005	3,469
Lawrence	10	1,981	344	2,038	353	2,281	395	2,501	434
Lee	107	21,992	3,814	22,620	3,923	25,314	4,390	27,757	4,813
Limestone	68	13,869	2,405	14,265	2,474	15,964	2,768	17,504	3,036
Lowndes	0	0	0	0	0	0	0	0	0
Macon	15	3,170	550	3,261	565	3,649	633	4,001	694
Madison	906	204,430	35,452	210,273	36,465	235,311	40,807	258,017	44,745
Marengo	128	26,351	4,570	27,104	4,700	30,331	5,260	33,258	5,768
Marion	23	4,755	825	4,891	848	5,473	949	6,001	1,041
Marshall	187	38,436	6,666	39,535	6,856	44,242	7,672	48,511	8,413
Mobile	727	156,780	27,189	161,261	27,966	180,463	31,296	197,877	34,315
Monroe	466	95,496	16,561	98,225	17,034	109,922	19,062	120,528	20,902
Montgomery	218	44,776	7,765	46,056	7,987	51,540	8,938	56,513	9,800
Morgan	96	19,614	3,401	20,175	3,499	22,577	3,915	24,756	4,293
Perry	0	0	0	0	0	0	0	0	0
Pickens	48	9,906	1,718	10,189	1,767	11,403	1,977	12,503	2,168
Pike	10	1,981	344	2,038	353	2,281	395	2,501	434
Randolph	10	1,981	344	2,038	353	2,281	395	2,501	434
Russell	402	82,420	14,293	84,775	14,702	94,870	16,452	104,025	18,040
Shelby	940	192,775	33,431	198,285	34,386	221,896	38,481	243,307	42,194
St.Clair	217	44,578	7,731	45,852	7,952	51,312	8,898	56,263	9,757
Sumter	5	991	172	1,019	177	1,140	198	1,250	217
Talladega	72	14,859	2,577	15,284	2,651	17,104	2,966	18,754	3,252
Tallapoosa	29	5,944	1,031	6,114	1,060	6,842	1,186	7,502	1,301
Tuscaloosa	281	57,654	9,998	59,302	10,284	66,364	11,509	72,767	12,619
Walker	45	9,312	1,615	9,578	1,661	10,719	1,859	11,753	2,038
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	10	1,981	344	2,038	353	2,281	395	2,501	434
Alabama	8,690	1,899,181	329,353	1,953,460	338,766	2,186,071	379,105	2,397,013	415,686

Figure A12 - NAICS 327: Nonmetallic Mineral Product Manufacturing

NAICS 331: Primary Metal Manufacturing

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	927	273,891	35,170	265,283	34,064	292,480	37,557	293,918	37,741
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	9	2,739	352	2,653	341	2,925	376	2,939	377
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	1,109	176,108	22,614	170,573	21,903	188,060	24,148	188,985	24,267
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Colbert	1,177	347,842	44,666	336,909	43,262	371,450	47,697	373,276	47,931
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	5	1,369	176	1,326	170	1,462	188	1,470	189
Dale	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Dallas	153	45,192	5,803	43,772	5,621	48,259	6,197	48,496	6,227
De Kalb	37	10,956	1,407	10,611	1,363	11,699	1,502	11,757	1,510
Elmore	5	1,369	176	1,326	170	1,462	188	1,470	189
Escambia	278	82,167	10,551	79,585	10,219	87,744	11,267	88,175	11,322
Etowah	56	16,433	2,110	15,917	2,044	17,549	2,253	17,635	2,264
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	5	1,369	176	1,326	170	1,462	188	1,470	189
Henry	0	0	0	0	0	0	0	0	0
Houston	93	27,389	3,517	26,528	3,406	29,248	3,756	29,392	3,774
Jackson	9	2,739	352	2,653	341	2,925	376	2,939	377
Jefferson	7,980	2,280,038	292,774	2,208,376	283,572	2,434,784	312,645	2,446,754	314,182
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	335	99,149	12,731	96,032	12,331	105,878	13,596	106,398	13,662
Lawrence	0	0	0	0	0	0	0	0	0
Lee	162	47,931	6,155	46,424	5,961	51,184	6,572	51,436	6,605
Limestone	5	1,369	176	1,326	170	1,462	188	1,470	189
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	481	142,150	18,253	137,682	17,679	151,797	19,492	152,544	19,588
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	463	136,946	17,585	132,641	17,032	146,240	18,778	146,959	18,871
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	375	110,926	14,244	107,440	13,796	118,454	15,210	119,037	15,285
Morgan	940	511,984	65,743	495,892	63,676	546,732	70,205	549,420	70,550
Perry	145	42,727	5,486	41,384	5,314	45,627	5,859	45,851	5,888
Pickens	46	13,695	1,758	13,264	1,703	14,624	1,878	14,696	1,887
Pike	284	83,811	10,762	81,177	10,424	89,499	11,492	89,939	11,549
Randolph	0	0	0	0	0	0	0	0	0
Russell	5	1,369	176	1,326	170	1,462	188	1,470	189
Shelby	541	159,952	20,539	154,925	19,894	170,808	21,933	171,648	22,041
St.Clair	56	16,433	2,110	15,917	2,044	17,549	2,253	17,635	2,264
Sumter	0	0	0	0	0	0	0	0	0
Talladega	263	63,818	8,195	61,812	7,937	68,149	8,751	68,484	8,794
Tallapoosa	162	47,931	6,155	46,424	5,961	51,184	6,572	51,436	6,605
Tuscaloosa	668	197,476	25,357	191,269	24,560	210,878	27,078	211,915	27,211
Walker	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	5	1,369	176	1,326	170	1,462	188	1,470	189
Alabama	17,054	5,030,806	645,994	4,872,688	625,690	5,372,247	689,837	5,398,659	693,229

Figure A13 - NAICS 331: Primary Metal Manufacturing

NAICS 332: Fabricated Metal Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	92	10,696	4,049	10,482	3,968	11,855	4,488	12,684	4,801
Baldwin	226	26,183	9,911	25,659	9,713	29,021	10,985	31,048	11,753
Barbour	481	55,709	21,087	54,594	20,665	61,747	23,373	66,060	25,006
Bibb	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Blount	115	13,259	5,019	12,993	4,918	14,696	5,563	15,722	5,951
Bullock	5	557	211	546	207	617	234	661	250
Butler	10	1,114	422	1,092	413	1,235	467	1,321	500
Calhoun	2,629	494,658	187,243	484,755	183,494	548,269	207,536	586,570	222,034
Chambers	139	16,044	6,073	15,723	5,952	17,783	6,731	19,025	7,202
Cherokee	3	334	127	328	124	370	140	396	150
Chilton	131	15,153	5,736	14,849	5,621	16,795	6,357	17,968	6,802
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Clay	10	1,114	422	1,092	413	1,235	467	1,321	500
Cleburne	10	1,114	422	1,092	413	1,235	467	1,321	500
Coffee	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Colbert	462	53,481	20,244	52,410	19,839	59,277	22,438	63,418	24,006
Conecuh	37	4,234	1,603	4,149	1,571	4,693	1,776	5,021	1,900
Coosa	10	1,114	422	1,092	413	1,235	467	1,321	500
Covington	19	2,228	843	2,184	827	2,470	935	2,642	1,000
Crenshaw	5	557	211	546	207	617	234	661	250
Cullman	928	152,366	57,675	149,316	56,520	168,879	63,926	180,677	68,392
Dale	143	16,601	6,284	16,269	6,158	18,400	6,965	19,686	7,452
Dallas	48	5,571	2,109	5,459	2,067	6,175	2,337	6,606	2,501
De Kalb	1,105	186,789	70,705	183,050	69,290	207,033	78,368	221,496	83,843
Elmore	867	100,276	37,957	98,269	37,198	111,144	42,071	118,908	45,010
Escambia	79	9,136	3,458	8,953	3,389	10,126	3,833	10,834	4,101
Etowah	1,139	154,304	58,409	151,215	57,239	171,027	64,739	182,975	69,262
Fayette	39	4,457	1,687	4,367	1,653	4,940	1,870	5,285	2,000
Franklin	372	43,007	16,280	42,146	15,954	47,668	18,044	50,998	19,304
Geneva	543	62,840	23,787	61,582	23,310	69,650	26,365	74,516	28,206
Greene	0	0	0	0	0	0	0	0	0
Hale	24	2,785	1,054	2,730	1,033	3,087	1,169	3,303	1,250
Henry	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Houston	823	95,262	36,060	93,355	35,338	105,587	39,968	112,963	42,760
Jackson	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Jefferson	4,816	693,400	262,473	679,518	257,218	768,551	290,919	822,241	311,243
Lamar	15	1,783	675	1,747	661	1,976	748	2,114	800
Lauderdale	96	11,142	4,217	10,919	4,133	12,349	4,675	13,212	5,001
Lawrence	19	2,228	843	2,184	827	2,470	935	2,642	1,000
Lee	315	36,434	13,791	35,704	13,515	40,382	15,286	43,203	16,354
Limestone	215	24,846	9,405	24,349	9,217	27,539	10,424	29,463	11,153
Lowndes	5	557	211	546	207	617	234	661	250
Macon	0	0	0	0	0	0	0	0	0
Madison	1,646	206,402	78,129	202,270	76,565	228,772	86,597	244,754	92,647
Marengo	10	1,114	422	1,092	413	1,235	467	1,321	500
Marion	315	36,434	13,791	35,704	13,515	40,382	15,286	43,203	16,354
Marshall	1,075	188,513	71,358	184,739	69,929	208,944	79,092	223,541	84,617
Mobile	1,570	203,906	77,184	199,824	75,639	226,005	85,550	241,794	91,526
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	1,303	261,859	99,121	256,617	97,137	290,239	109,864	310,515	117,539
Morgan	1,365	157,990	59,804	154,827	58,607	175,113	66,286	187,347	70,916
Perry	5	557	211	546	207	617	234	661	250
Pickens	5	557	211	546	207	617	234	661	250
Pike	0	0	0	0	0	0	0	0	0
Randolph	11	1,226	464	1,201	455	1,358	514	1,453	550
Russell	65	7,465	2,826	7,316	2,769	8,274	3,132	8,852	3,351
Shelby	816	181,218	68,596	177,590	67,223	200,858	76,031	214,890	81,342
St.Clair	880	141,839	53,690	138,999	52,615	157,212	59,509	168,194	63,666
Sumter	0	0	0	0	0	0	0	0	0
Talladega	490	56,712	21,467	55,576	21,037	62,858	23,794	67,249	25,456
Tallapoosa	119	13,816	5,230	13,539	5,125	15,313	5,796	16,383	6,201
Tuscaloosa	584	78,660	29,775	77,085	29,179	87,185	33,002	93,276	35,308
Walker	214	24,735	9,363	24,240	9,175	27,416	10,378	29,331	11,103
Washington	5	557	211	546	207	617	234	661	250
Wilcox	29	3,343	1,265	3,276	1,240	3,705	1,402	3,964	1,500
Winston	131	15,153	5,736	14,849	5,621	16,795	6,357	17,968	6,802
Alabama	26,976	3,925,728	1,486,005	3,847,135	1,456,255	4,351,198	1,647,058	4,655,168	1,762,120

Figure A14 - NAICS 332: Fabricated Metal Product Manufacturing

NAICS 333: Machinery Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	162	29,060	738	30,931	785	33,258	844	37,445	951
Baldwin	334	59,967	1,523	63,829	1,621	68,631	1,743	77,270	1,962
Barbour	0	0	0	0	0	0	0	0	0
Bibb	9	1,680	43	1,788	45	1,922	49	2,164	55
Blount	24	4,367	111	4,649	118	4,998	127	5,628	143
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	81	14,446	367	15,376	390	16,533	420	18,614	473
Chambers	3	504	13	536	14	577	15	649	16
Cherokee	3	504	13	536	14	577	15	649	16
Chilton	5	840	21	894	23	961	24	1,082	27
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	9	1,680	43	1,788	45	1,922	49	2,164	55
Cleburne	5	840	21	894	23	961	24	1,082	27
Coffee	9	1,680	43	1,788	45	1,922	49	2,164	55
Colbert	301	53,920	1,369	57,392	1,457	61,710	1,567	69,478	1,764
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	66	11,758	299	12,515	318	13,457	342	15,151	385
Crenshaw	5	840	21	894	23	961	24	1,082	27
Cullman	583	104,649	2,657	111,387	2,828	119,768	3,041	134,844	3,424
Dale	0	0	0	0	0	0	0	0	0
Dallas	1,877	336,792	8,552	358,478	9,102	385,448	9,787	433,969	11,019
De Kalb	490	87,851	2,231	93,508	2,374	100,543	2,553	113,200	2,874
Elmore	13	2,352	60	2,503	64	2,691	68	3,030	77
Escambia	94	16,798	427	17,879	454	19,224	488	21,644	550
Etowah	501	61,359	1,558	65,310	1,658	70,224	1,783	79,064	2,008
Fayette	47	8,399	213	8,940	227	9,612	244	10,822	275
Franklin	5	840	21	894	23	961	24	1,082	27
Geneva	5	840	21	894	23	961	24	1,082	27
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	94	16,798	427	17,879	454	19,224	488	21,644	550
Jackson	258	46,361	1,177	49,347	1,253	53,059	1,347	59,738	1,517
Jefferson	1,436	310,367	7,881	330,352	8,388	355,206	9,019	399,920	10,154
Lamar	662	118,759	3,015	126,406	3,210	135,916	3,451	153,026	3,886
Lauderdale	464	83,316	2,115	88,681	2,252	95,353	2,421	107,356	2,726
Lawrence	0	0	0	0	0	0	0	0	0
Lee	546	97,930	2,487	104,236	2,647	112,078	2,846	126,187	3,204
Limestone	641	115,063	2,922	122,472	3,110	131,687	3,344	148,264	3,765
Lowndes	9	1,680	43	1,788	45	1,922	49	2,164	55
Macon	0	0	0	0	0	0	0	0	0
Madison	449	80,628	2,047	85,820	2,179	92,277	2,343	103,893	2,638
Marengo	0	0	0	0	0	0	0	0	0
Marion	464	83,316	2,115	88,681	2,252	95,353	2,421	107,356	2,726
Marshall	567	113,683	2,887	121,003	3,072	130,107	3,304	146,485	3,719
Mobile	215	38,634	981	41,122	1,044	44,216	1,123	49,782	1,264
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	635	113,888	2,892	121,221	3,078	130,341	3,310	146,749	3,726
Morgan	1,354	309,598	7,861	329,533	8,367	354,326	8,997	398,929	10,129
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	9	1,680	43	1,788	45	1,922	49	2,164	55
Russell	19	3,360	85	3,576	91	3,845	98	4,329	110
Shelby	504	95,239	2,418	101,371	2,574	108,998	2,768	122,719	3,116
St.Clair	185	33,259	844	35,401	899	38,064	966	42,856	1,088
Sumter	0	0	0	0	0	0	0	0	0
Talladega	140	25,196	640	26,819	681	28,837	732	32,467	824
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	13	2,352	60	2,503	64	2,691	68	3,030	77
Walker	9	1,680	43	1,788	45	1,922	49	2,164	55
Washington	0	0	0	0	0	0	0	0	0
Wilcox	5	840	21	894	23	961	24	1,082	27
Winston	56	10,079	256	10,728	272	11,535	293	12,987	330
Alabama	13,367	2,505,670	63,622	2,667,010	67,719	2,867,664	72,813	3,228,656	81,979

Figure A15 - NAICS 333: Machinery Manufacturing

NAICS 334: Computer & Electronic Product Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	310	89,904	340	113,302	428	212,743	804	398,585	1,507
Barbour	169	49,013	185	61,769	234	115,981	439	217,297	822
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	58	16,804	64	21,178	80	39,765	150	74,502	282
Calhoun	97	28,007	106	35,297	133	66,275	251	124,170	470
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	97	28,007	106	35,297	133	66,275	251	124,170	470
Colbert	5	1,400	5	1,765	7	3,314	13	6,208	23
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	97	28,007	106	35,297	133	66,275	251	124,170	470
Dale	19	5,601	21	7,059	27	13,255	50	24,834	94
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	5	1,400	5	1,765	7	3,314	13	6,208	23
Elmore	483	140,037	530	176,483	667	331,375	1,253	620,849	2,348
Escambia	0	0	0	0	0	0	0	0	0
Etowah	48	14,004	53	17,648	67	33,138	125	62,085	235
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	879	255,148	965	321,552	1,216	603,766	2,283	1,131,187	4,277
Jackson	10	2,801	11	3,530	13	6,628	25	12,417	47
Jefferson	69	20,165	76	25,414	96	47,718	180	89,402	338
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	550	159,642	604	201,191	761	377,768	1,428	707,768	2,676
Limestone	81	23,526	89	29,649	112	55,671	211	104,303	394
Lowndes	0	0	0	0	0	0	0	0	0
Macon	19	5,601	21	7,059	27	13,255	50	24,834	94
Madison	6,887	1,998,329	7,556	2,518,414	9,523	4,728,727	17,881	8,859,513	33,500
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	241	70,019	265	88,242	334	165,688	627	310,424	1,174
Mobile	476	138,077	522	174,012	658	326,736	1,235	612,157	2,315
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	173	50,133	190	63,181	239	118,632	449	222,264	840
Morgan	71	20,725	78	26,120	99	49,044	185	91,886	347
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	58	16,804	64	21,178	80	39,765	150	74,502	282
Randolph	58	16,804	64	21,178	80	39,765	150	74,502	282
Russell	5	1,400	5	1,765	7	3,314	13	6,208	23
Shelby	180	52,374	198	66,005	250	123,934	469	232,197	878
St.Clair	5	1,400	5	1,765	7	3,314	13	6,208	23
Sumter	0	0	0	0	0	0	0	0	0
Talladega	241	70,019	265	88,242	334	165,688	627	310,424	1,174
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	965	280,074	1,059	352,966	1,335	662,751	2,506	1,241,698	4,695
Walker	5	1,400	5	1,765	7	3,314	13	6,208	23
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	12,360	3,586,630	13,562	4,520,086	17,092	8,487,186	32,092	15,901,181	60,126

Figure A16 - NAICS 334: Computer & Electronic Product Manufacturing

NAICS 335: Electrical Equipment, Appliance & Component Manufacturing

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	3	636	3	634	3	729	3	821	4
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	448	106,075	494	105,707	493	121,569	566	136,874	638
Bibb	0	0	0	0	0	0	0	0	0
Blount	90	21,215	99	21,141	99	24,314	113	27,375	128
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	54	12,729	59	12,685	59	14,588	68	16,425	77
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	157	37,126	173	36,997	172	42,549	198	47,906	223
Coffee	0	0	0	0	0	0	0	0	0
Colbert	18	4,243	20	4,228	20	4,863	23	5,475	26
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	18	4,243	20	4,228	20	4,863	23	5,475	26
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
De Kalb	18	4,243	20	4,228	20	4,863	23	5,475	26
Elmore	0	0	0	0	0	0	0	0	0
Escambia	4	1,061	5	1,057	5	1,216	6	1,369	6
Etowah	45	10,607	49	10,571	49	12,157	57	13,687	64
Fayette	0	0	0	0	0	0	0	0	0
Franklin	9	2,121	10	2,114	10	2,431	11	2,737	13
Geneva	4	1,061	5	1,057	5	1,216	6	1,369	6
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	224	53,037	247	52,853	246	60,784	283	68,437	319
Jackson	224	53,037	247	52,853	246	60,784	283	68,437	319
Jefferson	717	135,891	633	135,419	631	155,741	726	175,348	817
Lamar	224	53,037	247	52,853	246	60,784	283	68,437	319
Lauderdale	179	42,430	198	42,283	197	48,628	227	54,750	255
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	108	25,670	120	25,581	119	29,420	137	33,124	154
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	282	66,827	311	66,595	310	76,588	357	86,231	402
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	358	84,860	395	84,565	394	97,255	453	109,500	510
Mobile	18	4,243	20	4,228	20	4,863	23	5,475	26
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	1,732	410,296	1,912	408,873	1,905	470,229	2,191	529,430	2,467
Morgan	1,987	498,413	2,322	496,684	2,314	571,216	2,662	643,132	2,997
Perry	4	1,061	5	1,057	5	1,216	6	1,369	6
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	9	2,121	10	2,114	10	2,431	11	2,737	13
Shelby	295	70,009	326	69,766	325	80,235	374	90,337	421
St.Clair	9	2,121	10	2,114	10	2,431	11	2,737	13
Sumter	0	0	0	0	0	0	0	0	0
Talladega	4	1,061	5	1,057	5	1,216	6	1,369	6
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	4	1,061	5	1,057	5	1,216	6	1,369	6
Walker	54	12,729	59	12,685	59	14,588	68	16,425	77
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	7,300	1,723,266	8,030	1,717,286	8,002	1,974,983	9,203	2,223,634	10,362

Figure A17 - NAICS 335: Electrical Equipment, Appliance & Component Manufacturing

NAICS 336: Transportation Equipment Manufacturing									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	307	131,378	1,162	144,116	1,274	165,919	1,467	175,737	1,554
Baldwin	686	293,073	2,592	321,489	2,843	370,128	3,273	392,029	3,467
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	9	4,042	36	4,434	39	5,105	45	5,407	48
Bullock	0	0	0	0	0	0	0	0	0
Butler	236	101,060	894	110,858	980	127,630	1,129	135,182	1,195
Calhoun	1,329	609,426	5,389	668,516	5,912	769,656	6,806	815,199	7,209
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	166	70,742	626	77,601	686	89,341	790	94,628	837
Chilton	95	40,424	357	44,343	392	51,052	451	54,073	478
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	5	2,021	18	2,217	20	2,553	23	2,704	24
Clay	0	0	0	0	0	0	0	0	0
Cleburne	5	2,021	18	2,217	20	2,553	23	2,704	24
Coffee	227	97,017	858	106,424	941	122,525	1,084	129,775	1,148
Colbert	76	32,339	286	35,475	314	40,842	361	43,258	383
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	19	8,085	71	8,869	78	10,210	90	10,815	96
Cullman	723	114,213	1,010	125,287	1,108	144,242	1,276	152,777	1,351
Dale	200	85,294	754	93,564	827	107,720	953	114,094	1,009
Dallas	189	80,848	715	88,687	784	102,104	903	108,146	956
De Kalb	473	202,119	1,787	221,717	1,961	255,261	2,257	270,365	2,391
Elmore	9	4,042	36	4,434	39	5,105	45	5,407	48
Escambia	19	8,085	71	8,869	78	10,210	90	10,815	96
Etowah	103	44,062	390	48,334	427	55,647	492	58,940	521
Fayette	297	126,931	1,122	139,238	1,231	160,304	1,418	169,789	1,501
Franklin	236	101,060	894	110,858	980	127,630	1,129	135,182	1,195
Geneva	5	2,021	18	2,217	20	2,553	23	2,704	24
Greene	0	0	0	0	0	0	0	0	0
Hale	5	2,021	18	2,217	20	2,553	23	2,704	24
Henry	57	24,254	214	26,606	235	30,631	271	32,444	287
Houston	946	404,239	3,575	443,434	3,921	510,521	4,515	540,730	4,782
Jackson	95	40,424	357	44,343	392	51,052	451	54,073	478
Jefferson	1,713	732,076	6,474	803,058	7,102	924,554	8,176	979,262	8,660
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	61	26,276	232	28,823	255	33,184	293	35,147	311
Lawrence	0	0	0	0	0	0	0	0	0
Lee	5	2,021	18	2,217	20	2,553	23	2,704	24
Limestone	2,798	1,196,142	10,578	1,312,120	11,603	1,510,632	13,359	1,600,020	14,149
Lowndes	95	40,424	357	44,343	392	51,052	451	54,073	478
Macon	0	0	0	0	0	0	0	0	0
Madison	4,453	1,903,560	16,834	2,088,129	18,466	2,404,044	21,260	2,546,297	22,517
Marengo	5	2,021	18	2,217	20	2,553	23	2,704	24
Marion	57	24,254	214	26,606	235	30,631	271	32,444	287
Marshall	592	271,710	2,403	298,055	2,636	343,148	3,035	363,453	3,214
Mobile	4,181	565,448	5,000	620,274	5,485	714,116	6,315	756,371	6,689
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	518	221,523	1,959	243,002	11,935	279,766	13,740	296,320	14,553
Morgan	77	32,743	290	35,918	318	41,352	366	43,799	387
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	266	113,591	1,005	124,605	1,102	143,456	1,269	151,945	1,344
Randolph	0	0	0	0	0	0	0	0	0
Russell	28	12,127	107	13,303	118	15,316	135	16,222	143
Shelby	0	0	0	0	0	0	0	0	0
St.Clair	142	60,636	536	66,515	588	76,578	677	81,109	717
Sumter	0	0	0	0	0	0	0	0	0
Talladega	2,268	294,527	2,605	323,084	2,857	371,964	3,289	393,974	3,484
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	2,235	955,216	8,447	1,047,834	9,266	1,206,361	10,668	1,277,745	11,299
Walker	19	8,085	71	8,869	78	10,210	90	10,815	96
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	395	168,972	1,494	185,355	1,639	213,398	1,887	226,025	1,999
Alabama	26,423	9,262,593	81,911	10,160,694	99,639	11,697,914	114,713	12,390,108	121,501

Figure A18 - NAICS 336: Transportation Equipment Manufacturing

NAICS 337: Furniture & Related Product Manufacturing								
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	10	1,260	8	1,252	8	1,369	9	1,488	10
Baldwin	1,185	151,147	983	150,220	977	164,235	1,068	178,502	1,161
Barbour	0	0	0	0	0	0	0	0	0
Bibb	7	882	6	876	6	958	6	1,041	7
Blount	60	7,683	50	7,636	50	8,349	54	9,074	59
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	501	67,766	441	67,351	438	73,634	479	80,030	520
Chambers	3	378	2	376	2	411	3	446	3
Cherokee	20	2,519	16	2,504	16	2,737	18	2,975	19
Chilton	142	18,138	118	18,026	117	19,708	128	21,420	139
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	130	16,626	108	16,524	107	18,066	117	19,635	128
Clay	2,332	297,382	1,934	295,559	1,922	323,132	2,102	351,202	2,284
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	10	1,260	8	1,252	8	1,369	9	1,488	10
Colbert	62	7,935	52	7,887	51	8,622	56	9,371	61
Conecuh	10	1,260	8	1,252	8	1,369	9	1,488	10
Coosa	395	50,382	328	50,073	326	54,745	356	59,501	387
Covington	22	2,771	18	2,754	18	3,011	20	3,273	21
Crenshaw	5	630	4	626	4	684	4	744	5
Cullman	297	37,913	247	37,680	245	41,196	268	44,774	291
Dale	15	1,889	12	1,878	12	2,053	13	2,231	15
Dallas	58	7,431	48	7,386	48	8,075	53	8,776	57
De Kalb	95	12,092	79	12,018	78	13,139	85	14,280	93
Elmore	173	22,042	143	21,907	142	23,951	156	26,031	169
Escambia	14	1,763	11	1,753	11	1,916	12	2,083	14
Etowah	111	14,107	92	14,021	91	15,329	100	16,660	108
Fayette	5	630	4	626	4	684	4	744	5
Franklin	49	6,298	41	6,259	41	6,843	45	7,438	48
Geneva	59	7,557	49	7,511	49	8,212	53	8,925	58
Greene	0	0	0	0	0	0	0	0	0
Hale	10	1,260	8	1,252	8	1,369	9	1,488	10
Henry	59	7,557	49	7,511	49	8,212	53	8,925	58
Houston	148	18,893	123	18,778	122	20,529	134	22,313	145
Jackson	494	62,978	410	62,592	407	68,431	445	74,376	484
Jefferson	1,066	131,090	853	130,286	847	142,441	926	154,815	1,007
Lamar	321	40,936	266	40,685	265	44,480	289	48,344	314
Lauderdale	538	68,646	446	68,225	444	74,590	485	81,069	527
Lawrence	0	0	0	0	0	0	0	0	0
Lee	416	53,027	345	52,702	343	57,619	375	62,624	407
Limestone	494	62,978	410	62,592	407	68,431	445	74,376	484
Lowndes	0	0	0	0	0	0	0	0	0
Macon	5	630	4	626	4	684	4	744	5
Madison	124	15,870	103	15,773	103	17,245	112	18,743	122
Marengo	5	630	4	626	4	684	4	744	5
Marion	123	15,744	102	15,648	102	17,108	111	18,594	121
Marshall	62	7,935	52	7,887	51	8,622	56	9,371	61
Mobile	378	48,241	314	47,945	312	52,418	341	56,972	371
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	419	53,405	347	53,078	345	58,030	377	63,071	410
Morgan	172	21,916	143	21,782	142	23,814	155	25,883	168
Perry	0	0	0	0	0	0	0	0	0
Pickens	5	630	4	626	4	684	4	744	5
Pike	10	1,260	8	1,252	8	1,369	9	1,488	10
Randolph	529	67,512	439	67,098	436	73,358	477	79,731	519
Russell	30	3,779	25	3,756	24	4,106	27	4,463	29
Shelby	92	11,714	76	11,642	76	12,728	83	13,834	90
St.Clair	296	37,787	246	37,555	244	41,059	267	44,625	290
Sumter	0	0	0	0	0	0	0	0	0
Talladega	395	50,382	328	50,073	326	54,745	356	59,501	387
Tallapoosa	123	15,744	102	15,648	102	17,108	111	18,594	121
Tuscaloosa	131	16,752	109	16,649	108	18,203	118	19,784	129
Walker	203	25,947	169	25,788	168	28,194	183	30,643	199
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	1,779	163,502	1,063	162,500	1,057	177,660	1,155	193,093	1,256
Alabama	14,198	1,746,486	11,358	1,735,780	11,289	1,897,714	12,342	2,062,565	13,414

Figure A19 - NAICS 337: Furniture & Related Product Manufacturing

County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
NAICS 339: Miscellaneous Manufacturing									
Autauga	41	6,970	654	7,505	705	8,646	812	10,187	956
Baldwin	392	66,640	6,257	71,751	6,737	82,665	7,761	97,396	9,144
Barbour	161	27,370	2,570	29,469	2,767	33,952	3,188	40,002	3,756
Bibb	0	0	0	0	0	0	0	0	0
Blount	43	7,310	686	7,871	739	9,068	851	10,684	1,003
Bullock	10	1,700	160	1,830	172	2,109	198	2,485	233
Butler	30	5,100	479	5,491	516	6,326	594	7,454	700
Calhoun	347	58,990	5,538	63,515	5,963	73,175	6,870	86,215	8,095
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	111	18,870	1,772	20,317	1,908	23,408	2,198	27,579	2,589
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	10	1,700	160	1,830	172	2,109	198	2,485	233
Clay	0	0	0	0	0	0	0	0	0
Cleburne	10	1,700	160	1,830	172	2,109	198	2,485	233
Coffee	39	6,630	622	7,139	670	8,224	772	9,690	910
Colbert	15	2,550	239	2,746	258	3,163	297	3,727	350
Conecuh	325	55,194	5,182	59,427	5,580	68,466	6,428	80,667	7,574
Coosa	10	1,700	160	1,830	172	2,109	198	2,485	233
Covington	30	5,100	479	5,491	516	6,326	594	7,454	700
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	12	2,040	192	2,196	206	2,531	238	2,981	280
Dale	10	1,700	160	1,830	172	2,109	198	2,485	233
Dallas	18	3,060	287	3,295	309	3,796	356	4,472	420
DeKalb	305	51,850	4,868	55,827	5,241	64,318	6,039	75,780	7,115
Elmore	82	13,940	1,309	15,009	1,409	17,292	1,624	20,374	1,913
Escambia	10	1,700	160	1,830	172	2,109	198	2,485	233
Etowah	30	5,100	479	5,491	516	6,326	594	7,454	700
Fayette	10	1,700	160	1,830	172	2,109	198	2,485	233
Franklin	0	0	0	0	0	0	0	0	0
Geneva	30	5,100	479	5,491	516	6,326	594	7,454	700
Greene	0	0	0	0	0	0	0	0	0
Hale	30	5,100	479	5,491	516	6,326	594	7,454	700
Henry	26	4,420	415	4,759	447	5,483	515	6,460	607
Houston	673	114,410	10,742	123,185	11,566	141,922	13,325	167,212	15,699
Jackson	20	3,400	319	3,661	344	4,218	396	4,969	467
Jefferson	1,142	146,212	13,728	157,426	14,780	181,371	17,029	213,691	20,063
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	36	6,120	575	6,589	619	7,592	713	8,944	840
Lawrence	30	5,100	479	5,491	516	6,326	594	7,454	700
Lee	26	4,420	415	4,759	447	5,483	515	6,460	607
Limestone	524	89,080	8,364	95,912	9,005	110,501	10,375	130,192	12,223
Lowndes	225	38,250	3,591	41,184	3,867	47,448	4,455	55,903	5,249
Macon	0	0	0	0	0	0	0	0	0
Madison	342	58,140	5,459	62,599	5,877	72,121	6,771	84,973	7,978
Marengo	10	1,700	160	1,830	172	2,109	198	2,485	233
Marion	10	1,700	160	1,830	172	2,109	198	2,485	233
Marshall	205	34,850	3,272	37,523	3,523	43,230	4,059	50,934	4,782
Mobile	164	27,880	2,618	30,018	2,818	34,584	3,247	40,747	3,826
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	491	83,470	7,837	89,872	8,438	103,542	9,721	121,993	11,454
Morgan	368	62,560	5,874	67,358	6,324	77,604	7,286	91,433	8,584
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	172	29,240	2,745	31,483	2,956	36,271	3,405	42,735	4,012
St.Clair	10	1,700	160	1,830	172	2,109	198	2,485	233
Sumter	0	0	0	0	0	0	0	0	0
Talladega	30	5,100	479	5,491	516	6,326	594	7,454	700
Tallapoosa	11	1,870	176	2,013	189	2,320	218	2,733	257
Tuscaloosa	130	22,100	2,075	23,795	2,234	27,414	2,574	32,300	3,033
Walker	12	2,040	192	2,196	206	2,531	238	2,981	280
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	30	5,100	479	5,491	516	6,326	594	7,454	700
Alabama	6,798	1,107,676	104,005	1,192,635	111,974	1,374,034	129,005	1,618,887	151,994

Figure A20 - NAICS 339: Miscellaneous Manufacturing

NAICS 211: Oil & Gas Extraction									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Total Truckloads	2010 Total Value of Shipments ($1000)	2010 Total Truckloads	2015 Total Value of Shipments ($1000)	2015 Total Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	0	0	0	0	0	0	0	0	0
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
DeKalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	71	91,289	3,804	94,028	3,918	91,800	3,825	90,000	3,750
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	0	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0	0
Jefferson	174	223,723	9,322	230,435	9,601	224,974	9,374	220,564	9,190
Lamar	10	12,858	536	13,243	552	12,930	539	12,676	528
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0	0
Mobile	393	505,306	21,054	520,465	21,686	508,130	21,172	498,171	20,757
Monroe	70	90,004	3,750	92,704	3,863	90,507	3,771	88,733	3,697
Montgomery	10	12,858	536	13,243	552	12,930	539	12,676	528
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	0	0	0	0	0	0	0	0	0
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	83	106,719	4,447	109,920	4,580	107,315	4,471	105,212	4,384
Walker	10	12,858	536	13,243	552	12,930	539	12,676	528
Washington	10	12,858	536	13,243	552	12,930	539	12,676	528
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	831	1,068,472	44,521	1,100,526	45,855	1,074,444	44,768	1,053,385	43,891

Figure A21 - NAICS 211: Oil and Gas Extraction

NAICS 2121: Coal Mining									
County	2002 Employment	2002 Total Value of Shipments ($1000)	2002 Total Truckloads	2005 Total Value of Shipments ($1000)	2005 Truckloads	2010 Total Value of Shipments ($1000)	2010 Truckloads	2015 Total Value of Shipments ($1000)	2015 Truckloads
Autauga	0	0	0	0	0	0	0	0	0
Baldwin	0	0	0	0	0	0	0	0	0
Barbour	0	0	0	0	0	0	0	0	0
Bibb	0	0	0	0	0	0	0	0	0
Blount	0	0	0	0	0	0	0	0	0
Bullock	0	0	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0	0
Chilton	0	0	0	0	0	0	0	0	0
Choctaw	0	0	0	0	0	0	0	0	0
Clarke	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0
Cleburne	0	0	0	0	0	0	0	0	0
Coffee	0	0	0	0	0	0	0	0	0
Colbert	0	0	0	0	0	0	0	0	0
Conecuh	0	0	0	0	0	0	0	0	0
Coosa	0	0	0	0	0	0	0	0	0
Covington	0	0	0	0	0	0	0	0	0
Crenshaw	0	0	0	0	0	0	0	0	0
Cullman	61	12,739	5,226	12,866	5,278	14,116	5,791	15,433	6,331
Dale	0	0	0	0	0	0	0	0	0
Dallas	0	0	0	0	0	0	0	0	0
DeKalb	0	0	0	0	0	0	0	0	0
Elmore	0	0	0	0	0	0	0	0	0
Escambia	0	0	0	0	0	0	0	0	0
Etowah	0	0	0	0	0	0	0	0	0
Fayette	0	0	0	0	0	0	0	0	0
Franklin	254	53,044	21,761	53,574	21,978	58,777	24,112	64,260	26,362
Geneva	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0
Hale	0	0	0	0	0	0	0	0	0
Henry	0	0	0	0	0	0	0	0	0
Houston	0	0	0	0	0	0	0	0	0
Jackson	10	2,088	857	2,109	865	2,314	949	2,530	1,038
Jefferson	1,324	276,497	113,430	279,262	114,564	306,378	125,689	334,963	137,415
Lamar	0	0	0	0	0	0	0	0	0
Lauderdale	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0	0
Limestone	0	0	0	0	0	0	0	0	0
Lowndes	0	0	0	0	0	0	0	0	0
Macon	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0
Marengo	0	0	0	0	0	0	0	0	0
Marion	10	2,088	857	2,109	865	2,314	949	2,530	1,038
Marshall	0	0	0	0	0	0	0	0	0
Mobile	0	0	0	0	0	0	0	0	0
Monroe	0	0	0	0	0	0	0	0	0
Montgomery	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0
Pickens	0	0	0	0	0	0	0	0	0
Pike	0	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0	0
Russell	0	0	0	0	0	0	0	0	0
Shelby	145	30,281	12,422	30,584	12,547	33,554	13,765	36,684	15,049
St.Clair	0	0	0	0	0	0	0	0	0
Sumter	0	0	0	0	0	0	0	0	0
Talladega	0	0	0	0	0	0	0	0	0
Tallapoosa	0	0	0	0	0	0	0	0	0
Tuscaloosa	1,309	273,364	112,145	276,098	113,266	302,907	124,265	331,169	135,858
Walker	145	30,281	12,422	30,584	12,547	33,554	13,765	36,684	15,049
Washington	0	0	0	0	0	0	0	0	0
Wilcox	0	0	0	0	0	0	0	0	0
Winston	0	0	0	0	0	0	0	0	0
Alabama	3,258	680,383	279,120	687,187	281,911	753,913	309,285	824,253	338,141

Figure A22 - NAICS 2121: Coal Mining

NAICS 113: Forestry & Logging				
	2002 Truckloads	2005 Truckloads	2010 Truckloads	2015 Truckloads
Autauga	1,560	1,622	1,510	1,554
Baldwin	2,966	3,085	2,870	2,954
Barbour	4,081	4,244	3,949	4,064
Bibb	2,323	2,416	2,247	2,313
Blount	1,481	1,540	1,433	1,475
Bullock	2,187	2,275	2,117	2,178
Butler	3,006	3,126	2,909	2,994
Calhoun	447	465	433	445
Chambers	2,828	2,942	2,737	2,817
Cherokee	1,730	1,799	1,674	1,723
Chilton	2,427	2,524	2,349	2,417
Choctaw	6,045	6,287	5,849	6,020
Clarke	7,186	7,473	6,953	7,156
Clay	1,768	1,839	1,711	1,761
Cleburne	2,058	2,141	1,992	2,050
Coffee	2,165	2,251	2,095	2,156
Colbert	1,695	1,762	1,640	1,688
Conecuh	5,357	5,572	5,184	5,335
Coosa	2,433	2,530	2,354	2,423
Covington	3,209	3,337	3,105	3,195
Crenshaw	1,831	1,904	1,772	1,823
Cullman	1,399	1,455	1,354	1,394
Dale	1,198	1,246	1,159	1,193
Dallas	2,809	2,921	2,718	2,797
De Kalb	524	545	508	522
Elmore	941	979	911	937
Escambia	3,698	3,846	3,578	3,683
Etowah	1,143	1,189	1,106	1,139
Fayette	2,613	2,718	2,529	2,603
Franklin	1,284	1,335	1,242	1,279
Geneva	1,312	1,365	1,270	1,307
Greene	1,431	1,489	1,385	1,425
Hale	2,438	2,535	2,359	2,427
Henry	1,419	1,476	1,373	1,413
Houston	927	964	897	923
Jackson	1,806	1,878	1,748	1,799
Jefferson	1,155	1,202	1,118	1,151
Lamar	3,529	3,670	3,415	3,514
Lauderdale	430	447	416	428
Lawrence	648	674	627	646
Lee	1,809	1,881	1,751	1,802
Limestone	203	211	196	202
Lowndes	1,589	1,653	1,538	1,583
Macon	1,337	1,391	1,294	1,332
Madison	298	309	288	296
Marengo	4,295	4,467	4,156	4,277
Marion	2,920	3,037	2,825	2,908
Marshall	674	701	652	671
Mobile	2,195	2,283	2,124	2,186
Monroe	5,822	6,055	5,633	5,798
Montgomery	3,616	3,760	3,499	3,601
Morgan	491	511	475	489
Perry	2,417	2,513	2,338	2,407
Pickens	2,774	2,885	2,684	2,762
Pike	1,481	1,540	1,433	1,475
Randolph	1,218	1,267	1,179	1,213
Russell	3,158	3,284	3,055	3,144
Shelby	2,303	2,395	2,228	2,293
St Clair	2,543	2,645	2,461	2,533
Sumter	4,169	4,335	4,034	4,151
Talladega	3,229	3,358	3,124	3,215
Tallapoosa	1,352	1,406	1,308	1,346
Tuscaloosa	4,625	4,810	4,475	4,606
Walker	4,413	4,590	4,270	4,395
Washington	3,847	4,000	3,722	3,831
Wilcox	4,192	4,360	4,057	4,175
Winston	2,121	2,206	2,052	2,112
Alabama	158,579	164,922	153,444	157,924

Figure A23 - NAICS 113: Forestry & Logging

NAICS 111: Crop Production				
	2002 Total Truckloads	2005 Total Truckloads	2010 Total Truckloads	2015 Total Truckloads
Autauga	163	163	163	163
Baldwin	863	863	863	863
Barbour	237	237	237	237
Bibb	6	6	6	6
Blount	114	114	114	114
Bullock	31	31	31	31
Butler	48	48	48	48
Calhoun	152	152	152	152
Chambers	6	6	6	6
Cherokee	445	445	445	445
Chilton	51	51	51	51
Choctaw	7	7	7	7
Clarke	13	13	13	13
Clay	10	10	10	10
Cleburne	26	26	26	26
Coffee	500	500	500	500
Colbert	943	943	943	943
Conecuh	86	86	86	86
Coosa	0	0	0	0
Covington	283	283	283	283
Crenshaw	78	78	78	78
Cullman	392	392	392	392
Dale	244	244	244	244
Dallas	330	330	330	330
DeKalb	1,168	1,168	1,168	1,168
Elmore	274	274	274	274
Escambia	347	347	347	347
Etowah	127	127	127	127
Fayette	210	210	210	210
Franklin	117	117	117	117
Geneva	719	719	719	719
Greene	12	12	12	12
Hale	167	167	167	167
Henry	432	432	432	432
Houston	663	663	663	663
Jackson	1,767	1,767	1,767	1,767
Jefferson	1	1	1	1
Lamar	138	138	138	138
Lauderdale	1,024	1,024	1,024	1,024
Lawrence	1,460	1,460	1,460	1,460
Lee	26	26	26	26
Limestone	1,532	1,532	1,532	1,532
Lowndes	110	110	110	110
Macon	165	165	165	165
Madison	2,130	2,130	2,130	2,130
Marengo	45	45	45	45
Marion	122	122	122	122
Marshall	379	379	379	379
Mobile	171	171	171	171
Monroe	236	236	236	236
Montgomery	90	90	90	90
Morgan	603	603	603	603
Perry	122	122	122	122
Pickens	174	174	174	174
Pike	278	278	278	278
Randolph	22	22	22	22
Russell	90	90	90	90
Shelby	39	39	39	39
St.Clair	3	3	3	3
Sumter	129	129	129	129
Talladega	749	749	749	749
Tallapoosa	8	8	8	8
Tuscaloosa	296	296	296	296
Walker	12	12	12	12
Washington	64	64	64	64
Wilcox	60	60	60	60
Winston	0	0	0	0
Alabama	21,309	21,309	21,309	21,309

Figure A24 - NAICS 111: Crop Production

NAICS 112: Animal Production				
County	2002 Total Truckloads	2005 Total Truckloads	2010 Total Truckloads	2015 Total Truckloads
Autauga	104	104	104	104
Baldwin	206	206	206	206
Barbour	2,412	2,412	2,412	2,412
Bibb	33	33	33	33
Blount	7,678	7,678	7,678	7,678
Bullock	562	562	562	562
Butler	2,831	2,831	2,831	2,831
Calhoun	1,640	1,640	1,640	1,640
Chambers	81	81	81	81
Cherokee	1,164	1,164	1,164	1,164
Chilton	103	103	103	103
Choctaw	359	359	359	359
Clarke	35	35	35	35
Clay	1,554	1,554	1,554	1,554
Cleburne	3,236	3,236	3,236	3,236
Coffee	7,644	7,644	7,644	7,644
Colbert	1,684	1,684	1,684	1,684
Conecuh	83	83	83	83
Coosa	30	30	30	30
Covington	3,030	3,030	3,030	3,030
Crenshaw	5,343	5,343	5,343	5,343
Cullman	20,823	20,823	20,823	20,823
Dale	2,777	2,777	2,777	2,777
Dallas	152	152	152	152
DeKalb	14,089	14,089	14,089	14,089
Elmore	91	91	91	91
Escambia	78	78	78	78
Etowah	2,903	2,903	2,903	2,903
Fayette	607	607	607	607
Franklin	6,796	6,796	6,796	6,796
Geneva	5,276	5,276	5,276	5,276
Greene	112	112	112	112
Hale	190	190	190	190
Henry	777	777	777	777
Houston	313	313	313	313
Jackson	3,516	3,516	3,516	3,516
Jefferson	52	52	52	52
Lamar	41	41	41	41
Lauderdale	636	636	636	636
Lawrence	4,202	4,202	4,202	4,202
Lee	50	50	50	50
Limestone	1,121	1,121	1,121	1,121
Lowndes	1,667	1,667	1,667	1,667
Macon	59	59	59	59
Madison	499	499	499	499
Marengo	155	155	155	155
Marion	3,261	3,261	3,261	3,261
Marshall	9,583	9,583	9,583	9,583
Mobile	154	154	154	154
Monroe	78	78	78	78
Montgomery	995	995	995	995
Morgan	4,244	4,244	4,244	4,244
Perry	91	91	91	91
Pickens	3,589	3,589	3,589	3,589
Pike	3,533	3,533	3,533	3,533
Randolph	3,299	3,299	3,299	3,299
Russell	39	39	39	39
Shelby	55	55	55	55
St.Clair	3,031	3,031	3,031	3,031
Sumter	148	148	148	148
Talladega	1,082	1,082	1,082	1,082
Tallapoosa	48	48	48	48
Tuscaloosa	953	953	953	953
Walker	3,166	3,166	3,166	3,166
Washington	877	877	877	877
Wilcox	106	106	106	106
Winston	3,623	3,623	3,623	3,623
Alabama	148,746	148,746	148,746	148,746

Figure A25 - NAICS 112: Animal Production

Appendix B

PRELIMINARY FREIGHT MODEL VALIDATION USING EXTREME-WORLD SCENARIO CONSTRUCTION

Heather Shar
University of Alabama in Huntsville
Huntsville, AL 35899

KEYWORDS: transportation, planning, discrete, freight, logistics

ACRONYMS: ATIM – Alabama Transportation Infrastructure Model
VITS – Virtual Intermodal Transportation System
ALDOT – Alabama Department of Transportation
v/c – volume-to-capacity ratio

ABSTRACT

The Alabama Transportation Infrastructure Model (ATIM) is a discrete event simulation model of the freight transportation infrastructure in Alabama. Scenarios involving changes in roadway, railway, and waterborne freight volumes and/or freight facilities can be evaluated to test their impact on travel time, roadway congestion levels, and system ton-miles generated. The ATIM is currently in the process of model validation. However, due to model conceptualization and limited data resources the most common method of model validation, comparison to real-world figures, is unavailable to test the ATIM's performance. To test that the model is behaving in the manner expected without the benefit of detailed baseline data, extreme-world scenarios were constructed for a five-year planning horizon. Best-case, worst-case, and status-quo freight growth scenarios were created based on the current trends in the overall freight industry and on key uncertainties specific to Alabama. The model's response to the three extreme-world scenarios indicates that the general behavior of the model is tracking expected real-world performance. Since the qualitative model behavior has been validated, the next step is to gather additional information on the real performance of the system and then check the model output on a quantitative basis.

INTRODUCTION

To date, transportation planning has largely relied on trend-line analysis of historical economic and population data to forecast future facility usage. However, industry growth and development in a region can create a much higher demand on the transportation infrastructure than would be indicated by historical data. The Alabama Transportation Infrastructure Model developed by researchers at the University of Alabama in Huntsville is a discrete event simulation to evaluate the impact of changing freight patterns in order to more accurately plan for future transportation infrastructure needs. The ATIM is a statewide freight transportation model that gives state officials the ability to rapidly evaluate the impact of various decisions on the state's freight transportation system including highway, rail, and water routes. In addition to these, the transportation network also includes intermodal transfers between truck, rail, and water at the transfer points in Huntsville, Birmingham, Montgomery, and Mobile, Alabama.

The ATIM is based on the Virtual Intermodal Transportation System (VITS) model developed at the National Center for Intermodal Transportation at Mississippi State University [1]. The VITS was developed as the first attempt to use discrete-event simulation to model multiple modes of transportation infrastructure in a single simulation. The ATIM is an extension and adaptation of the VITS to Alabama's transportation network. However, to gain plausibility as a tool for transportation planning and overall policy and decision making, the ATIM must be proven to accurately portray the real-world behavior. This paper describes the preliminary qualitative model validation process using extreme-world scenario construction to test plausible future states at the boundaries of expected performance.

WHY USE THE EXTREME-WORLD METHOD?

The ATIM is a scenario-modeling program focused on the high-level interactions between market forces driving freight production and movement and the response of public and private entities to the freight levels generated. As such, the ATIM serves best as a tool to evaluate the impact of policy decisions, large-scale capital construction and investment, or key component changes on the overall performance of Alabama's transportation infrastructure and its ability to move goods and people.

One of the inputs to the ATIM is the expected level of traffic that will be generated due to the industry clusters that are present in a geographical area. This expected level of traffic is generated using the TranPlan urban-planning software and is based on linear regression models of employment, payroll, and the value of shipments at the county level. Employment is an indicator of population growth in an area, which causes an increase in both passenger cars and freight traffic necessary to support the higher population. Payroll, or household income, is an indicator of economic activity that can drive an increase in population. The value of shipments is also an economic indicator which reflects productivity increases and also reflects the type of industry cluster found in a geographical area [2].

The most common method of model validation is to compare model output for a known set of input conditions to the real-world system performance for the same set of conditions. However, the model conceptualization of the ATIM and the limited availability of real-world performance data restrict this quantitative form of validation:

- The freight route network modeled in the ATIM is a subset of the actual roadway system in Alabama. All of the interstate road facilities are represented, but some US highways and many state and county highways were not included in the available choices for freight movement.
    - Some freight carriers, especially those who are familiar with the local road system, choose alternate routes for travel that are not represented in the model network.
- ALDOT does not regularly conduct freight surveys to estimate of the level of freight that moves on a given roadway facility.
    - Although a total traffic count is available to calibrate top level traffic counts, no data is available to compare model output of freight levels to real-world behavior.
- The structure of the ATIM is dependent on the free-flow speed being assigned to each road link; however, detailed roadway parameter data is unavailable to compute those free-flow speeds.
    - Roadway geometry, including number of lanes, width of lanes, width of lateral clearance, posted speed limits, divider types, and grade, are highly variable and impact how well traffic can flow through a facility; traffic flow directly impacts congestion levels and travel times.

Use of the TranPlan distribution of freight along inter-county routes also creates some key difficulties to model validation:

- The TranPlan software creates a gravity-model distribution, in which traffic is assigned equally to multiple routes based on estimated travel times. In cases of congestion, the gravity model off-loads traffic to less-preferred routes to minimize the travel time experienced by the system.
    - Real-world freight traffic will often remain on a pre-determined delivery route despite congestion-related travel delays.
    - TranPlan is an urban-planning software package; it assumes all traffic will behave as passenger car traffic in an urban area.
- Urban-planning models assume that each trip that leaves a location will return "home" to that location within a 24-hour period
    - Inter-city and inter-state freight trips usually do not return to their original location within 24 hours, if at all.

Within traffic planning, much lower levels of model fidelity are considered acceptable for decision-making purposes than are usually accepted in other disciplines. A model that provides outputs within approximately +/- 50% of the actual values is usually considered acceptable in practice. However, as the volume of traffic on a roadway grows closer to the facility's capacity, it is more important for the model to provide values closer to actual system performance. There is no standard codification of what the acceptable model performance levels are for various roadway facilities.

Given these issues, the model validation process was split into phased tests requiring different levels of data intensity. Of these, the first step was to test the model's qualitative response to a range of scenarios impacting the level of freight traffic on the roadway system. The extreme-world method was used to create scenarios that would test the boundaries of expected system performance, but were less data-intensive than a link-by-link analysis of model output traffic levels versus actual traffic counts.

EXTREME WORLD SCENARIO CONSTRUCTION

The extreme world scenarios were constructed following the method outlined by Goodwin and Wright [3], shown in Figure 1.

1. Identify the issue of concern and the horizon year which will be captured in the scenarios.
2. Identify predetermined trends that have some degree of impact on the issue of concern.
3. Identify critical uncertainties, which when resolved (one way or the other) have some degree of impact on the issue of concern.
4. Identify the degree to which the trends and unresolved uncertainties have a negative or positive impact on the issue of concern.
5. Create extreme worlds by putting all positively resolved uncertainties in one scenario and all negatively resolved uncertainties in another scenario.
6. Add the predetermined trends to both scenarios.
7. Check for internal coherence. Could the trends and resolved uncertainties co-exist in a plausible future scenario?
8. Add in the actions of individuals and/or organizations who will be impacted by the future described in a scenario. What actions would they take/have taken to satisfy their own interests?

Figure 1: Steps In Extreme World Scenario Construction [3]

In practice, the steps in scenario construction were found to less straightforward than Figure 1 would suggest. Steps 1 and 2 were followed by identifying the impact of the trends (part of Step 4). Then after Step 3, identifying the uncertainties, the impact of those uncertainties were evaluated (the second part of Step 4). The actual construction of the scenarios takes place in steps 5-8, and those actions were taken concurrently for each of the best-case, worst-case, and status-quo options.

The steps taken to create the scenarios for testing the ATIM are as follows:

Step 1: The overall issue of concern is the ability of Alabama's transportation system, roadways, waterways, and railways, to move goods and people throughout the state in order to promote economic activity and growth. The system's performance of this goal can be measured by the amount of congestion and associated delay that travelers experience. The volume of freight vehicles is currently the largest force driving changes in congestion levels and associated delays in travel time occurring between the metropolitan areas of the state. The level of freight traffic also directly impacts the life expectation for roadway surfaces, shortening maintenance cycles and forcing repaving more often. Thus, the level of freight vehicles in the system was chosen as the independent test variable to be manipulated in scenario construction. A higher volume of freight vehicles on the roadway is considered a negative impact, and a lower volume of freight vehicles is a positive impact. For the ATIM, the dependent variables that will be measured are the average speed on I-65 between Montgomery and Mobile, the average speed on I-10 between Mobile and the Mississippi state border, the average speed on I-10 between Mobile and the Florida state border, and the average zone utilization for each of the Alabama DOT traffic zones.
The most logical horizon year for testing the ATIM was current + 5 years, or 2012. When dealing with freight patterns, most manufacturing companies and freight shippers are fairly comfortable with predicting their growth 1-5 years in the future, but estimates of future activity past the 5 year horizon are unreliable.

Steps 2 and 4: Overall trends identified and their impacts on the level of freight on Alabama roadways are shown in Table 1. These trends represent the general consensus of the freight community on the outlook for freight movement at the national and global level. The impact of these trends on the level of freight vehicles in the system are shown in the last column of Table 1. Using Goodwin and Wright's notation, a positive or reinforcing impact is designated by "+ve"; a very positive or highly reinforcing impact is designated by "++ve". The opposite, a negative or decreasing impact, is designated by "-ve"; a strong negative or greatly decreasing impact is designated by "--ve."

Table 1: Predetermined Trends and Their Impact on Freight Volume

	Trends	Impact
T1	Increasing congestion at ports on the eastern and western coastlines	+ve
T2	Increasing volumes of containers handled in Chicago, Atlanta, Memphis, Dallas, and Tampa	+ve
T3	Rising gasoline and diesel prices	-ve
T4	Increased use of air freight to ship time-sensitive cargoes	-ve
T5	Increased levels of just-in-time shipments in manufacturing to retail supply chains	+ve
T6	Reduced federal funding for roadway maintenance and new construction	+ve
T7	Reduced federal funding for locks and dams and waterway dredging	-ve
T8	Increased production in China and other off-shore locations	+ve
T9	Low capital investment in constructing new railroad routes	+ve
T10	Decreasing ability of railroads to follow short-haul freight routes	+ve
T11	Increased use of globalized supply chains	+ve

Steps 3 and 4: Key uncertainties identified and their impacts on the level of freight on Alabama roadways are shown in Table 2. These key uncertainties are unique to Alabama and are expected to resolve within the 5-year planning horizon. The same designation from Table 1 is used in Table 2 to show the level of impact each uncertainty is expected to have on the level of freight vehicles in the system.

Table 2: Key Uncertainties and Their Impact on Freight Volume

	Key Uncertainties			Impact
U1	Level of container traffic through Choctaw Point at Port of Mobile	u11	Higher	++ve
		u12	As Is	+ve
U2	Level of freight traffic processed through Port of New Orleans	u21	Higher	--ve
		u22	As Is	+ve
		u23	Lower	++ve
U3	Implementation of freight-only toll lanes	u31	Implemented	-ve
		u32	Not Implemented	+ve
U4	Number of available truck drivers (due to legal requirements, economic growth, changing demographics, etc.)	u41	More	+ve
		u42	Current Level	-ve
		u43	Less	--ve
U5	Kia facility production in GA	u51	Higher	++ve
		u52	Lower	+ve
U6	Attraction of an international mega-economic development project	u61	Successful	++ve
		u62	Unsuccessful	-ve

Steps 5-8: The three extreme-world scenarios constructed from the uncertainties and trends identified are shown in Figure 2. These extreme scenarios were created by combining all positively resolved uncertainties into the worst-case scenario and all of the negatively resolved uncertainties into the best-case scenario. The overall trends in freight transportation were then added on top of the uncertainties and checked for internal coherence. Given that the ATIM tests high-level policy decisions, the actions of individuals and organizations who would be impacted were included in the impact of the trends and uncertainties rather than existing as a third level of data variation. The data sources and figures used to transform the scenarios into traffic levels are given in Appendix A.

Worst Case: High Freight Loads with No Roadway Improvements

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans fails to rebuild capacity back to pre-Katrina levels, leaving the Port of Mobile as the only deep-water port on the Gulf Coast between Houston and Tampa. The Choctaw Point container handling facility fully realizes volume projections of 800,000 additional container lifts each year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance, capacity improvements, locks and dams, and waterway dredging is reduced, leading to restricted facilities available to move freight. Railroad companies do not invest in building new Class I routes or maintaining current Class III services, forcing short-haul and low-profit margin products to be moved via truck instead. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is successful is attracting one of the international mega-development economic sites which effectively cuts Alabama DOT's budget in half to enable site development.

Best Case: Roadway Improvements and Freight Distribution Across Modes

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans rebuilds its freight handling capacity back to pre-Katrina levels, relieving the Port of Mobile of its overage of freight traffic. The Choctaw Point container facility comes online, reaching its conservative estimated volume of 200,000 lifts per year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance and capacity improvements is increased to levels sufficient to support the refurbishment of the interstate system and development of congestion-mitigation routes. Federal funding for locks and dams and waterway dredging is increased, leading to faster lock throughput times, adequate staffing levels, and waterway dredging sufficient to support heavier barge loads. Railroad companies invest in increasing Class I track capacity through double-tracking and in increasing Class III railroad facilities to handle 286-class cars. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is not successful is attracting one of the international mega-development economic sites which leaves Alabama DOT's budget as a source of funds for needed roadway maintenance and capacity improvement projects.

Status Quo Scenario: Gradual Growth

Increasing congestion at east and west coast ports drives international shippers to ocean ports along the Gulf of Mexico. The Port of New Orleans rebuilds its freight handling capacity back to pre-Katrina levels, relieving the Port of Mobile of its overage of freight traffic. The Choctaw Point container facility comes online, reaching its average estimated volume of 400,000 lifts per year. Logistics center hubs in Chicago, Atlanta, Memphis, Dallas, and Texas absorb additional container and bulk freight handling operations, creating more truck traffic moving to these centers from the coast and also creating more cross-country truck traffic moving from distribution centers to their final destinations. Domestic manufacturers move increasingly to just-in-time supply chains, creating a large demand for short-haul, time-sensitive deliveries. Federal funding for roadway maintenance and capacity improvements is maintained at current levels, effectively reducing the amount of available funds since the cost of building and maintaining roadway surfaces increases faster than inflation. Federal funding for locks and dams and waterway dredging is maintained at current levels, leading to slower lock throughput times, inadequate staffing levels, and a minimum amount of waterway dredging. Combined, these effects on the inland waterway system force more barge companies out of business and push shipments with a low value-to-weight ratio onto trucks. Railroad companies invest in increasing Class I track capacity through double-tracking. Class III railroad facilities are upgraded to handle 286-class cars in areas that have a high volume of rail shipments to support those investments, but other low-volume tracks are abandoned. The Kia manufacturing facility in Georgia, sister plant to Montgomery's Hyundai plant, comes on line at full production rates. Alabama is not successful is attracting one of the international mega-development economic sites which leaves Alabama DOT's budget as a source of funds for needed roadway maintenance and capacity improvement projects.

Figure 2: Extreme Scenarios

ATIM RESULTS

The three extreme-world scenarios, best case, worst case, and status quo, all generated different levels of freight traffic based on the trends and uncertainties contained within. The ATIM was populated with the traffic levels generated from the three extreme-world scenarios and then executed for five days of simulated weekday time. At the end of each of the simulation runs output data was collected.

Several sets of variables were used to test the models response to changing input levels: the average speed on I-65 between Mobile and Montgomery (north- and south-bound separated), the average speed on I-10 between Florida and Mississippi (east- and west-bound separated), and the average zone utilization for each of the nine ALDOT traffic zones. Average speed was used as a variable to test the impact of congestion on traffic throughput. The expected response for average speed is a decrease as the volume of traffic rises, caused by congestion-induced slowdowns. Zone utilization was chosen because it is an aggregate measure of the volume-to-capacity ratio for a region. The expected response for zone utilization is an increase followed by a plateau as the volume of traffic fills up and eventually exceeds the available roadway capacity.
Figure 3 shows the average speeds experienced by traffic on the selected roadway segments during the three model runs. The I-65 and I-10 facilities examined as model output were chosen because they will bear the brunt of the container traffic generated by the Choctaw Point facility at the Port of Mobile. As expected, all highways showed decreased speeds between the best case and the worst case scenarios. I-65 northbound showed the greatest magnitude of decrease, 7.17%, which is to be expected since a high percentage of the traffic generated by the Choctaw Point container handling facility at the Port of Mobile will be using I-65 to reach the I-85 interchange in Atlanta and the I-20 and I-59 interchanges in Birmingham.

	I-65 Northbound	**I-65 Southbound**	**I-10 West**	**I-10 East**
Best Case	59.73	42.52	64.95	64.00
Status Quo	57.08	39.26	63.14	61.50
Worst Case	55.44	41.29	62.75	60.34

Figure 3: Average Speed (mph) of Selected Roadway Segments

There were two unexpected results from the average speed output variables. First, the I-65 southbound traffic is moving at a lower speed in all three cases than was expected. This could be caused by the increased level of freight generated within the state and in the southeastern US that is being transported to the Port of Mobile for outbound shipment, but this will need further research. To clarify, again on I-65 southbound, the status quo scenario shows a slower traffic speed than does the worst case scenario. It is possible that this is a random event based on the string of random numbers used in the model processes, but that is unlikely. Again, this will need further research to resolve.

The second variable, zone utilization, was based on the nine traffic regions designated by ALDOT. Alabama's counties are broken into nine regions by the state Department of Transportation for planning purposes, as shown in Figure 4. In the ATIM, the zone utilization is computed for each of these areas by computing the aggregate volume-to-capacity ratio for all the roadways in the region. The v/c ratio is defined as the total number of trucks in the zone divided by the roadway capacity of all roadway sections within the zone.

Figure 4: Alabama Department of Transportation Traffic Zones [12]

The results for zone utilization for each of the three cases are shown in Figure 5. As expected, the zone utilization increased for each of the zones as more traffic volume was added. The average utilization increase between the best case and status quo scenarios was 13.65% and the average increase between status quo and worst case was 3.81%. This tends to suggest that the capacity of the roadways are being filled and continuing to add traffic volume would no longer increase utilization.

	Best Case	Status Quo	Worst Case
Zone 1	1.17	1.38	1.44
Zone 2	0.42	0.51	0.54
Zone 3	2.09	2.36	2.45
Zone 4	0.90	1.08	1.16
Zone 5	1.43	1.62	1.69
Zone 6	1.32	1.49	1.55
Zone 7	0.47	0.53	0.55
Zone 8	0.53	0.61	0.62
Zone 9	2.44	2.92	2.92

Figure 5: Zone Utilizations (Volume to Capacity Ratios)

Zone 9, including Baldwin and Mobile counties where the Port of Mobile is located, saw no increase in utilization between the status quo and the worst case scenarios even though additional traffic was added to the roadway volume. This would suggest that Zone 9 has reached the saturation point where the roadways cannot accommodate additional vehicles, resulting in high levels of congestion and long travel delays.

CONCLUSIONS

The exercise of the ATIM using the three extreme-world scenarios resulted in model behavior consistent to expectations. Although detailed data-intensive model calibration and validation still need to be performed at the roadway link and corridor level, the general performance of the simulation demonstrates that the overall structure and logic of the model are appropriate for the research questions being asked. As a preliminary model validation step, extreme-world scenario building is a suitable tool.

FURTHER RESEARCH

Although the extreme-world scenarios can be used to show that the ATIM reacts as expected to large scale changes at the boundaries of expected model performance, there were several questions raised by the model output that need to be answered before more data-intensive validation is attempted.

- Why does I-65 southbound between Montgomery and Mobile experience slower average speeds than the northbound section under the same growth percentages?
- Why does the status-quo scenario result in lower average speeds on I-65 southbound than the worst case scenario?
- What are the appropriate replication parameters to obtain repeatable results? Is there a difference between running single replications of multiple-day time periods and running multiple replications of single-day time periods?
- At what level of traffic saturation does zone utilization stop increasing? Is that level the same for all zones, or does it depend on the mix of differing roadway types available in the prescribed area?
- If one zone reaches saturation, how does that affect the rest of the roadway system? Does it make a difference if the saturated zone contains a major freight generator or a major arterial?

After the questions about the model behavior are answered, more detailed validation is necessary to bring the ATIM to the performance level expected by Alabama's DOT and Metropolitan Planning Organizations (MPOs). With regard to continued model development and validation, the next steps for the ATIM are:

- Calibration of the model-generated traffic trips to known trip levels on Alabama roadways
- Research into the freight traffic levels on the waterway and railway systems and capacities of those facilities to handle additional freight traffic.
- Integration of urban freight data from the MPO's into the statewide model.
- Development of intermodal transfer volumes, mode-specific transfer facilities, and procedures.
- Further scenario refinement beyond the extreme cases to display the impact that point-changes can have on overall system behavior.

The ultimate goal of traffic and freight forecasting is to understand how transportation infrastructure is going to constrain or enable economic growth within a region. The PIE model developed by The University of Alabama in Huntsville Office for Economic Development shown in Figure 6 [4] shows conceptually how the availability of transportation infrastructure, congestion levels, and economic activity within a region are related.

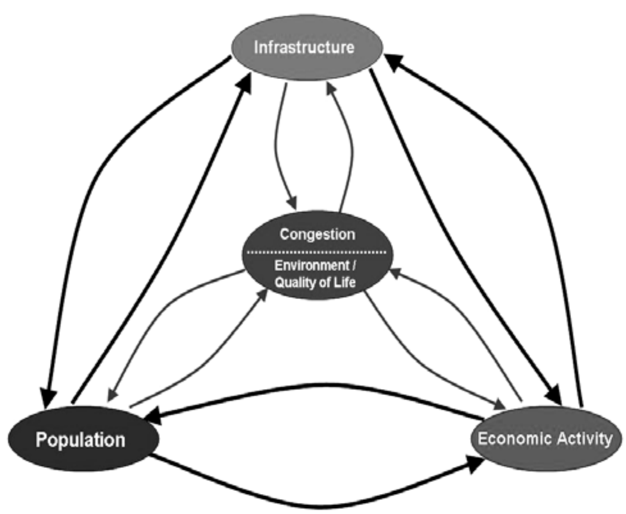

Figure 6: P-I-E Interrelationship Diagram

While the extreme-world view scenarios, and the ATIM itself, are concerned with freight volumes and transportation infrastructure resources, neither provides any feedback on how those two variables are connected to the economic activity of Alabama. High levels of freight are actually good – until they are bad. High freight levels indicate high economic activity and the distribution of goods and raw materials through the region and throughout the country. At some point, however, those high freight levels begin to discourage additional growth in a region because the system lacks the capability to absorb more vehicles. At that point, the freight level becomes an impediment that needs to be addressed rather than the symptom of a highly performing economy. Conversely, low freight levels are good because they encourage further expansion into an area, but if they grow too low they can be a symptom of a poorly functioning economy. Further research is needed to describe the conditions under which freight levels become a liability instead of an asset and also how pinpointed changes to the infrastructure can enable economic growth.

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APPENDIX A

<u>Truck Volume Assumptions for Scenario Creation</u>

1. Best Case (lowest volume):
    a. Base Truck Population Growth: according to Census Bureau projections, the population of Alabama is projected to grow at an average rate of 0.3% through 2015 [5], which will lead to a corresponding increase in freight traffic to supply goods such as clothing, food, and building supplies. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 0.3% value.
    b. U1: Choctaw Point conservative projections are 200,000 containers per year, 40% diverted to rail. Remainder is sent primarily north to Chicago and Memphis via truck. [6]
    c. U2: the Mississippi River Gulf Outlet is the deep-draft ‘shortcut' that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. Dredging the channel to a 36-foot depth would allow ships supplying businesses along the industrial canal to continue to berth at the Port of New Orleans [7].
    d. U3: the presence of established toll lanes along I-65 and possibly I-20 and I-59 would increase the throughput speed of truck traffic.
    e. U4: a loss of truck drivers due to legal requirements, economic growth outstripping driver population, and changing demographics would limit the amount of drivers on the road system.
    f. U5: the Kia plant is expected to come online in 2009 [8] with a production projection of 300,000 vehicles per year. Unless additional plant capacity is added, that 300,000 volume should remain stable through 2012. A survey of automobile manufacturers and suppliers in Alabama has shown that 2008 projections were 1.88 Mil truck trips to produce 8 Mil vehicles [9]. Using this ratio, 300,000 vehicles for Kia will require 705,000 truck trips. Since the Kia plant is in Georgia, but will be using the same supplier base as its sister plant in Montgomery, approximately 1/3 of these trips will be expected to impact Alabama.
2. Status Quo (historical projections)
    a. Base Truck Population Growth: according to the Cambridge Systematics report on congestion, the US Gross National Product is expected to double by 2025 [10]. Interpolation of this figure showed an average growth of approximately 31.58% by 2012. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 31.58% value.
    b. U1: Choctaw Point conservative projections range from 200,000 containers per year to 800,000 containers per year with; 500,000 is the expected average volume with approximately 40% diverted to rail. The majority of these containers will be sent north to Chicago and Memphis via truck, with the remainder moving east and west along I-10 to Florida and Mississippi [6].
    c. U2: the Mississippi River Gulf Outlet is the deep-draft ‘shortcut' that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. The MRGO remains closed due to lack of funds for dredging, forcing the businesses along the Industrial Canal that require deep-water berths to move shipments to Mobile [7].
    d. U3: it is unlikely that toll lanes will be established or built along the I-65 corridor during the planning horizon for this scenario, meaning that all additional truck traffic will be added to the existing facilities.
    e. U4: the existing number of drivers plus some newcomers to the industry minus some who leave because of demographic, personal choice, or legal issues will remain relatively stable with a slight upward trend due to increased wages. The upward trend will not satisfy the total demand for drivers, leaving some companies
    f. U5: the Kia plant is expected to come online in 2009 with a production projection of 300,000 vehicles per year [8]. Unless additional plant capacity is added, that 300,000 volume should remain stable through 2012. A survey of automobile manufacturers and suppliers in Alabama has shown that 2008 projections were 1.88 Mil truck trips to produce 8 Mil vehicles [9]. Using this ratio, 300,000 vehicles for Kia will require 705,000 truck trips. Since the Kia plant is in Georgia, but will be using the same supplier base as

its sister plant in Montgomery, approximately 1/3 of these trips will be expected to impact Alabama.

3. Worst Case (highest volume)
    a. Base Truck Population Growth: according to the US DOT, commercial truck travel has doubled over the last two decades [11]. If commercial truck traffic continues to grow at this rate, truck volumes will show an average growth of approximately 40% by 2012. Original freight projections were computed by Dr. Michael Anderson using the TranPlan gravity distribution model and then scaled by the 40% value.
    b. U1: Port Authority personnel [6] have tentatively projected 800,000 container lifts per year as a high-end optimistic scenario, with about 40% of those containers diverted to rail. The containers placed on trucks will be sent north on I-65 to Chicago and Memphis via truck, east and west along I-10 to Florida, Mississippi, and Texas, east on I-85 to Atlanta.
    c. U2: the Mississippi River Gulf Outlet is the deep-draft ‘shortcut’ that allows large vessels to travel directly to the Industrial Canal from the Gulf of Mexico. The MRGO remains closed due to lack of funds for dredging, forcing the businesses along the Industrial Canal that require deep-water berths to move shipments to Mobile [7].
    d. U3: it is unlikely that toll lanes will be established or built along the I-65 corridor during the planning horizon for this scenario, meaning that all additional truck traffic will be added to the existing facilities.
    e. U4: increasing freight shipments create an increased need for drivers. Improved training programs and higher wages and incentives will attract more young drivers to the profession as well as attracting retirees to drive part- or full-time. This increased number of available drivers will not restrict freight shipments by truck, and in fact will encourage more companies to ship via fast, flexible truck schedules.
    f. U5: the Kia plant is expected to come online in 2009 with a production projection of 300,000 vehicles per year [8]. Unless additional plant capacity is added, that 300,000 volume should remain stable through 2012A survey of automobile manufacturers and suppliers in Alabama has shown that 2008 projections were 1.88 Mil truck trips to produce 8 Mil vehicles [9]. Using this ratio, 300,000 vehicles for Kia will require 705,000 truck trips. Since the Kia plant is in Georgia, but will be using the same supplier base as its sister plant in Montgomery, approximately 1/3 of these trips will be expected to impact Alabama.

Appendix C

ALABAMA

COMMISSION ON INFRASTRUCTURE

"Sustaining & Creating Economic Prosperity"

REPORT OF FINDINGS

PRESENTED TO
THE ALABAMA LEGISLATURE
THE OFFICE OF THE GOVERNOR
AND
ALABAMA'S CONGRESSIONAL DELEGATION

MONTGOMERY, ALABAMA
APRIL 2007

Report Prepared by:

University of Alabama in Huntsville
Office for Economic Development
Office for Freight, Logistics, and Transportation

Alabama Commission on Infrastructure
Report of Findings
April 2007

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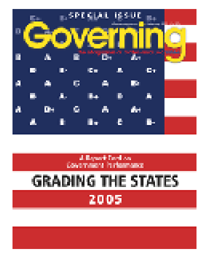
Introduction

Over the past five decades, the Alabama economy has experienced dramatic changes in composition and structure. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries. As an example, approximately 240,000 automobiles were assembled in Alabama in 2003. By 2008, the number is expected to exceed 800,000 arising from the consumer demand for autos made in Alabama by Mercedes, Honda, and Hyundai.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. Over the past twenty years, Alabama has transitioned rapidly into a manufacturing and knowledge economy from an agricultural and natural resource economy. The efficient and effective movement of people and freight is a critical component in the transformation and growth of the Alabama economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.



Alabama is not alone in facing these problems. Infrastructure to move people and products into and across the continental U.S. is an issue for virtually every state. In general, there are simply too few resources available to address the demands from economic growth and deteriorating assets. A funded report by The Pew Charitable Trusts released in *Governing* magazine's February 2005 issue on the Government Performance Project included a grade on each state's ability to maintain its infrastructure assets. At least a dozen states received a grade of C or less in their ability to plan for and manage their infrastructure. Alabama, with a rating of a "D", was identified as the state with the greatest challenge ahead. (Figure ES-1)

State Transportation Infrastructure Grades – 2005

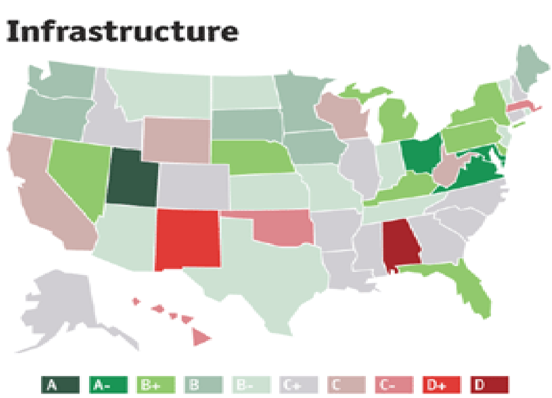


Figure ES-1
Source: Governing magazine, February 2005.

In discussing infrastructure, the Governing article concludes, "But no matter how carefully planned a project is, it will deteriorate if states shortchange maintenance. This happens with some frequency: It's easy to put off for a year or two of maintenance – especially when legislators are dealing with tight budgets…This issue of unfunded maintenance is unquestionably the biggest problem for states in their management of infrastructure."[2]

There are challenges within the U.S. transportation system that amplify the urgency to create and implement a plan to meet the needs of U.S. manufacturers and shippers. The reality today is that the vast majority of freight moves by truck in the U.S. The convergence of a truck shortage (driver & equipment) and increasing railroad congestion will boost the pressure for highway resolutions. The cost of transportation will continue to grow in importance to Alabama manufacturers as well as to the consumer.

There is a clear economic opportunity for any state, especially coastal states with inland infrastructure, to move freight consistently within and across its borders. Alabama has a significant opportunity for continued growth by strategically addressing its transportation infrastructure needs. The strategy must have a statewide focus, and broad non-partisan support. If successful, Alabama can become the freight gateway to the Midwest. If the opportunity is not pursued and more of Alabama's transportation infrastructure becomes inadequate to support industries' needs, sustaining job growth becomes even more difficult.

Infrastructure Commission Formed

The formation of the Alabama **Commission on Infrastructure** was initiated as one of thirty-five recommendations of the *Alabama Legislative Commission on Manufacturing.* Speaker of the Alabama House, Seth Hammett, was the chief sponsor of the Joint Resolution creating the Manufacturing Commission, which passed unanimously by the Legislature on September 26, 2003. The Alabama Legislature authorized the Commission on Manufacturing to develop recommendations to address a state manufacturing crisis that lost approximately 100,000 jobs in the previous ten years.

An efficient transportation infrastructure system was among the critical competitive needs of business and industry identified by the Manufacturing Commission. The recognition of this industry need caused the Manufacturing Commission to recommend formation of a "blue-ribbon panel" to address infrastructure issues. The need for such an entity was reinforced by a study, "*Transportation Infrastructure in Alabama: Meeting the Needs for Economic Growth*", published by the Office for Economic Development at the University of Alabama in Huntsville.[3] The study correlates the relationship between industry growth, job creation and transportation congestion.

Speaker Seth Hammett announced the creation of the Alabama **Commission on Infrastructure** in November 2005. Speaker Hammett recognized the need for an overall vision of all elements of the state's infrastructure within a transportation system framework, which would incorporate all transportation modes: roads, rail, waterways and airports. The Alabama **Commission on Infrastructure** was charged with evaluating and recommending solutions to the challenges facing the state's infrastructure system.

Building on the original joint resolution, Speaker Hammett named 45 members to the Commission on Infrastructure and established five working committees organized around users of the transportation infrastructure. Members of the Commission on Infrastructure and its committees include a broad mix of business and industry leaders, legislators, state agency officials, academic infrastructure experts, and economic development officials from across the state.

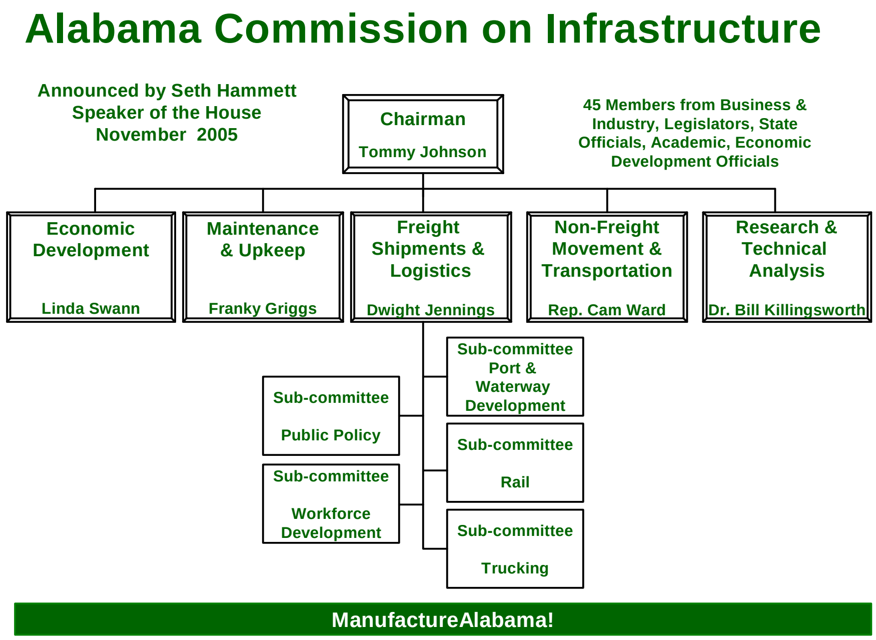


Figure ES-2
Source: Manufacture Alabama

The **Commission on Infrastructure** convened on February 13, 2006, for its initial meeting. The five working committees formed were:

- **Freight Shipments & Logistical Needs**
  - Chaired by Dwight Jennings
  Responsible for considering shipments of raw materials, component parts, and finished products by both existing and prospective new industries.
  Subcommittees:
  - Port & Waterway Development
  - Public Policy
  - Railroads
  - Trucking & Movement of Truck Freight
  - Workforce Development

- **Non-Freight Movement & Transportation Needs**
  - Chaired by Rep. Cam Ward
  Responsible for considering public travel needs including commuting issues, and challenges to public safety, convenience and economic impact.

- **Maintenance & Upkeep of Infrastructure Assets**
  - Chaired by Franky Griggs

Responsible for considering critical repair and maintenance needs facing the various elements of Alabama's transportation system.

- **Economic Development**
  - Chaired by Linda Swann
  Responsible for identifying and evaluating the opportunities available through improved infrastructure systems, the economic development consequences of continued infrastructure system deterioration, and a failure to improve inter-modal coordination.

- **Research, Development & Technical Analysis**
  - Chaired by Bill Killingsworth, Ph.D.
  Responsible for providing the research, data, and other technical support to the commission and its committees while they are evaluating the state's infrastructure needs and propose solutions.

The Commission charged the committees to conduct their work with a focus on the statewide transportation systems rather than on the hundreds of locally important projects that have been identified or could be brought to the committee discussions. Therefore, many of these recommendations and issues recommendations remain conceptual in nature and without prioritization. In most cases, more research and analysis is still needed to understand how the project(s) referenced in a recommendation will affect Alabama's overall transportation system and economic future.

Recommended Near Term Actions

The Commission offers the numerous recommendations in this report acknowledging that funding and time are constraints with which Alabama must work. The Commission is suggesting in particular that the following recommendations be considered for near-term action.

1. **Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation**

   An Alabama Transportation Commission should be created with oversight responsibilities to provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports, has proven very successful.

2. **Expand Alabama Department of Transportation's roles in rail and waterways**

   ALDOT, with the oversight of a newly formed Alabama Transportation Commission discussed above, could better integrate the responsibility of

Alabama's rail and waterways. The gains in efficiency and maintenance of Alabama's airports could also be realized in the rail and waterway transportation modes.

3. Establish an analysis resource for Alabama's transportation system

Modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. Utilization of Alabama research universities and other support organizations is strongly encouraged to provide this research.

4. Modify motor fuels tax law to address inflation erosion of generated funds

Modification of Alabama motor fuels tax laws should be considered to match more closely revenue generation with levels of use. Additionally, tax law modifications should incorporate methods to stem the buying power erosion due to inflation. A limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects should also be considered. Several fuel tax indexing and other revenue bills can be quickly accessed for evaluation.

5. Change the point of collection for motor fuels from the distributors to terminals

Collecting motor fuel taxes at the fuel terminals ("at the rack"), where distributors receive their supply will reduce the potential loss of taxable fuels revenue. The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of point-of-collection change.

6. Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs

The Commission recommends that any dollars generated from the Outer Continental Shelf leases be placed into a trust fund similar to all of Alabama's other offshore oil and gas revenues. A trust fund would allow the interest to be spent but preserve the principle. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers our inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. Therefore, the Commission's recommendation is that the Legislature create a special Constitutional Trust Fund to administer and invest these revenues for the benefit of the citizens of the state, similar to the way we currently administer and invest our inshore oil and gas royalties through the Alabama Trust Fund. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

Background Research Considered by the Infrastructure Commission

The availability of transportation data such as traffic counts, mode capacity, maintenance status and more is almost limitless. Over the past year, the Commission, as part of its process, provided an extremely valuable service in reviewing and selecting relevant research with which to consider the transportation challenges, and more importantly, economic opportunities for Alabama. Information was gathered on each of the four transportation modes; road, rail, waterways and air (airports). Additionally, there was new information requested by the commission from both the public and private sectors.

The Multi-System Framework for Analysis

The commission adopted a framework to incorporate multiple systems affecting congestion. The Population, Infrastructure, and Economic Activity (P-I-E) model, developed and presented by the Office for Freight, Logistics and Transportation and the Office for Economic Development at the University of Alabama in Huntsville, was used for this purpose. [4] With this framework and the current research being conducted for the U.S. Department of Transportation, a new systems perspective has been used to view Alabama's transportation assets.

Population – Infrastructure – Economic Activity (P-I-E)

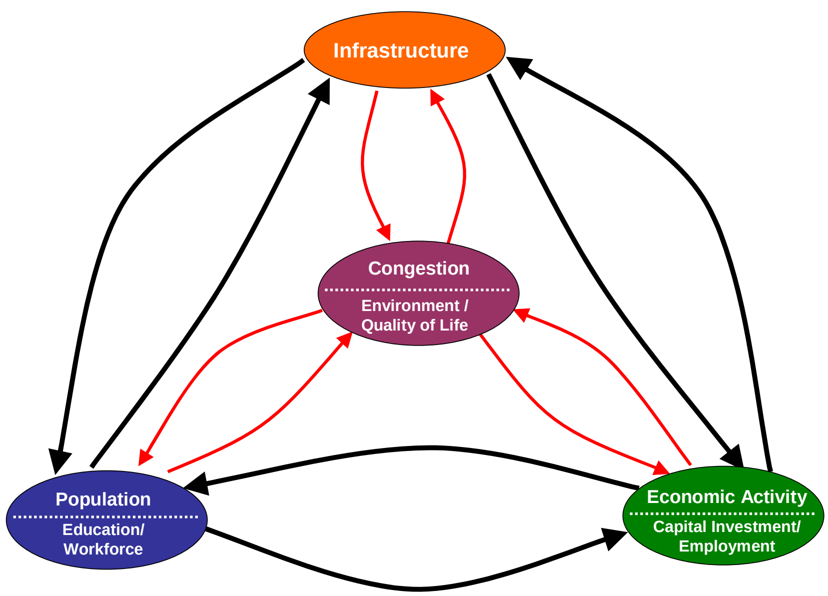


Figure ES-3

Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

The P-I-E framework represented in Figure ES-3 recognizes the relationships that exist between population, infrastructure and economic activity, and more importantly, the resulting levels of congestion resulting from their interactions. Planning for and managing each of these elements can affect the resulting congestion as each element is a generator for the other two elements. While traffic congestion is often the focus of many efforts, this framework encourages a focus on the generators of congestion and alternative solutions.

Major Interstate Traffic Levels

It is clear that the Interstate 65 corridor represents the state's main transportation artery and is a primary economic engine for Alabama. The preponderance of freight and non-freight traffic moves north and south between Mobile and the Decatur-Huntsville region on I-65. Additional container freight will flow through Alabama with the early 2008 startup from the Alabama State Port Authority's container handling facility at Choctaw Point. By 2010, it is expected that containers handled at the Port will exceed 200,000 annually, almost eight times the level in 2005. [6]

Much of the state's industrial growth and economic activity has occurred, and probably will continue, to occur along or near I-65. For that reason, the state's most critical highway congestion points are located on I-65. Projections from the P-I-E and other analytic models show that congestion at these points will continue to worsen. Committee members generally agreed that addressing those issues on the state's main artery must be the first priority. While other highway projects are necessary and worthwhile, Commission members agreed it would be counter-productive to implement highway projects that feed more freight and non-freight traffic onto I-65, without first implementing the solutions needed to address the rapidly brewing I-65 congestion crisis.

Tracking growth in daily traffic volumes for Interstate 65 from mile markers 1 through 366 over a twenty-year time period shows that neither utilization nor growth is uniform. Changes in population, infrastructure and economic activity have placed greater demands on particular segments of roads. In some instances, sections of I-65 are approaching congestion levels that may threaten economic growth in some areas.

Figure ES-4 shows I-65 annual average daily traffic starting in Mobile on the left at mile marker 1 and ending on the right at mile marker 366 at the Alabama - Tennessee border. This chart clearly shows that between 1985 and 2004, traffic levels continued to rise higher and that the levels of high traffic continued to spread outward from city centers.

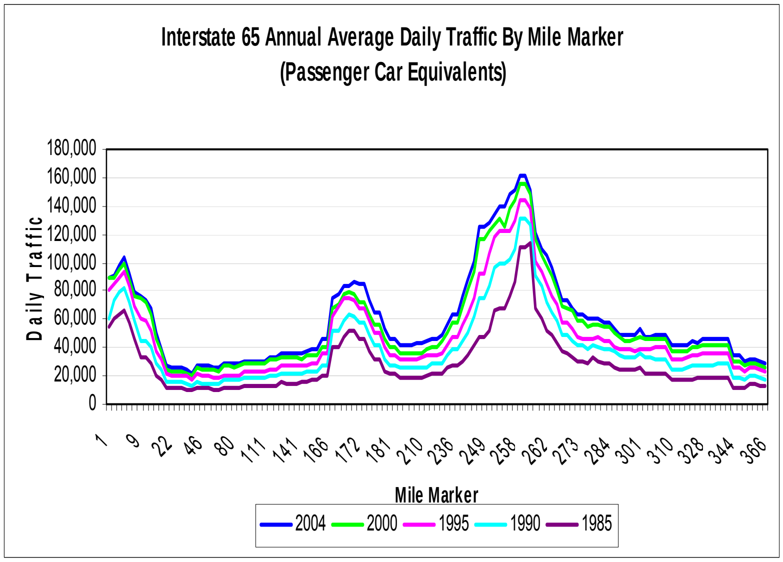


Figure ES-4

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Infrastructure Issues by Industry

Utilization of Alabama's transportation infrastructure varies by industry. A survey of Alabama manufacturing industries conducted by the UAH Office for Economic Development in 2004-05 found that trucking and road issues are major concerns. It is important to note that the issues were identified by each company from a broad inquiry rather than by transportation mode, i.e., truck, water, or railroad.[6] The three issues most often identified by Alabama companies were (1) road capacity and congestion, (2) truck availability, and (3) truck route access.

Growth in infrastructure utilization is anticipated to occur mostly on roads used by Alabama's production industries, e.g. automotive, aerospace, electronics, etc. The information gathered by the survey indicates that Alabama's industries are experiencing challenges with the current road infrastructure due to insufficient capacity and congestion. Additionally, it should be noted that many of Alabama's industries would increase their truck shipments if additional trucks were available.

Congestion ranking of major Southeastern cities

Growth in population and employment creates the challenge of meeting transportation needs with limited resources. Figure ES-5 presents urban area annual hours of delay per traveler for major southeastern U.S. cities. The chart shows that travel delay time in Birmingham is lower and is growing at a slower rate than larger, southern metropolitan areas like Atlanta and Austin. This beneficial position of lower congestion is an advantage for Alabama. An advantage such as this should not be allowed to deteriorate but it can only be maintained with infrastructure investment.

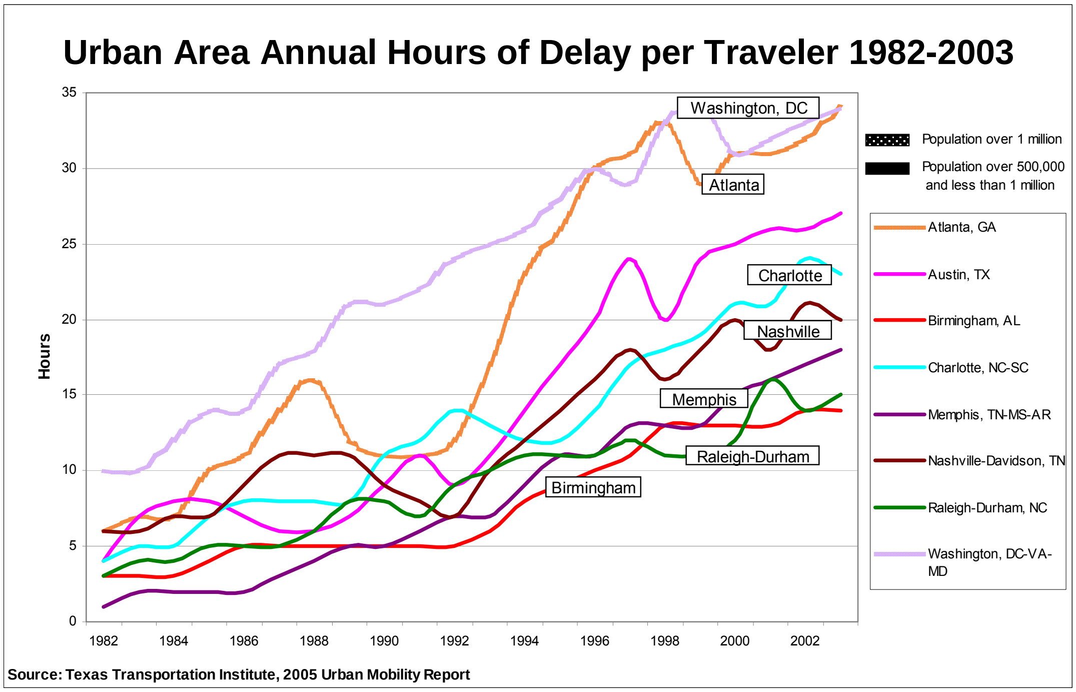


Figure ES-5

Transportation Research Resources Available

Understanding the current and probable future demands on transportation infrastructure is essential in Alabama's economic development strategy. There are several transportation research resources in Alabama that can be built upon. These include the Alabama Transportation Department's wealth of data, the state research universities with transportation research programs, and industry clusters that are willing and eager to share their needs.

Approaching transportation infrastructure planning from a "system of systems" perspective is possible and can better match limited resources with current and future needs. In fact, Alabama's transportation system is the collective interaction between the road system, rail system, water system, and air system. Especially in the transportation of freight in and through Alabama, the interaction of these systems determines flow rates and thereby overall congestion levels. In order for Alabama to continue to be a leader in advanced manufacturing, global trade, and economic development in general, transportation infrastructure must be managed as an enabler rather than a constraint to economic opportunity.

Infrastructure Commission Findings

Recommendations were developed by each of the five working committees of the Alabama Commission on Infrastructure. The Commission considered the committees' recommendations and approved the following ones on January 22, 2007.

To facilitate ease of presentation and discussion, the list of the recommendations below are grouped by subject matter rather than identifying them with individual committees. This listing format should in no way suggest that the Commission and its committees approached Alabama's infrastructure picture on a piecemeal asset-by-asset basis. To the contrary, the committees were diligent in addressing transportation needs from a strategic, intermodal perspective. An intermodal perspective is simply considering the interconnection of highway, rail, waterways, airports, and other infrastructure elements as outlined in the strategic charge of the Commission. Recommendations were developed on the premise that Alabama's major transportation infrastructure challenges are statewide, rather than local and must be identified and analyzed as such.

The Commission noted but did not attempt a review of the hundreds of projects that the Alabama Department of Transportation has underway or planned. Instead, the Commission charged its committees with generating innovative ideas within the multi-modal transportation system framework. Listed below are recommendations from the Commission related to highway projects. The list is not intended to be all-inclusive or necessarily presented in order of priority, other than to emphasize the significance of I-65 to the state. In particular, some of these recommendations illustrate the Commission's desire to consider innovative ideas to improve traffic flow rather than simply adding capacity.

Interstate 65 Corridor Recommendations

- Consider the addition of one lane in each direction on I-65.
- Study the feasibility of a four-lane truck-only toll highway parallel to I-65.
- Construct a northern by-pass in Birmingham to complete the outer loop.
- Construct the Montgomery Outer Loop connecting I-65 and I-85 south of the city.
- Encourage a resolution to address the bottleneck at the Interstate 10 Tunnel.
- Complete the corridor study and public hearings underway by ALDOT on a proposed new Western Alabama Freeway.

Non Interstate 65 Highway Recommendations

- Complete the Corridor X project in Alabama.
- Construct the southern by-pass and related projects in the Huntsville area.
- Complete the Dothan to I-10 connector route.
- Expand and improve Highway 84 to four lanes across south Alabama.
- Extend I-85 from Montgomery to connect with I-20/59 at the Alabama-Mississippi line.

Bridge Rehabilitations Recommendations

- Increase the priority of the county bridge replacement crisis by creating a funding mechanism to permit repair or replacement of deficient structures. Current estimation indicates there are approximately 1,750 county bridges and at least 560 state and city bridges that are declared deficient and must be replaced.

Railway Recommendations

- Explore strategies to promote and assist short-line railroads with infrastructure needs.
- Authorize funding for a study of the Alabama short-line railroad system.
- Form a coalition to explore the potential for an additional north-south rail line.

Waterways Recommendations

- Fund a study to develop strategies that could increase the use of Alabama's inland waterways.
- Encourage federal funding for the maintenance of Alabama's Intracoastal Waterway systems.

Intermodal Center Recommendations

- Pursue the establishment of an inland intermodal freight facility to dispatch inbound containerized freight and collect outbound containers.
- Enhance the Alabama Port container handling facility by funding a rail interchange yard and a ship-turning basin.

Mass Transit Recommendations

- Thoroughly evaluate the need, economic benefit and costs of mass transit system improvements in Birmingham, Mobile and other major areas of congestion. This evaluation should be conducted within the context of impact on the state transportation system. The Commission believes that urban area mass transit issues are critical and must be addressed in any comprehensive infrastructure strategy developed by Alabama.

Organizational Structure Recommendations

- Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation.
- Expand ALDOT's roles in rail and waterways.
- Establish an analysis resource for Alabama's transportation system.
- Extend the *Commission on Infrastructure* through the 2007-2010 Legislative quadrennium to perform further strategic analysis.

Infrastructure Funding Recommendations

- Explore opportunities for private investment through private construction and/or long-term leases of toll roads and bridges.
- Consider establishing a Lifecycle Maintenance Trust Fund to allocate maintenance funds with the approval of new construction projects.
- Modify motor fuels tax law to address inflation erosion of generated funds.
- Change the point of collection for motor fuels from the distributors to terminals.
- Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs.

Path Forward

The **Commission on Infrastructure** recommends that the Commission and its work be continued through the 2007-2010 legislative quadrennium. The Infrastructure Commission would perform strategic analysis and work with members of the legislature and administration enabling action on as many of the recommendations as possible. Much work remains and can be accomplished more effectively by bringing together many of the state's top transportation infrastructure experts. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on this vitally important role of state government.

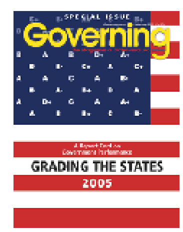
Concurrently, the expansion of research resources for analyzing Alabama's transportation systems should be initiated. Enhanced analytical and modeling tools are needed to integrate the multiple modes of roads, railways, waterways, and airports. A modern multi-mode research capability will assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. The modeling analysis will help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

The members of the Commission on Infrastructure wish to thank Speaker Seth Hammett and the members of the Alabama Legislature for the opportunity to focus on this extremely important issue. In addition, we would like to thank Manufacture Alabama and its members for supporting the day-to-day work of the Commission and committees. We offer these recommendations after much deliberation and stand ready to continue our service in assisting with preparing Alabama for a strong and prosperous economic future.

Alabama Commission on Infrastructure
Report of Findings

1. Introduction

Over the past five decades, the Alabama economy has experienced dramatic changes in composition and structure. In recent years, the changes have been most evident in the rapid growth of the automotive, aerospace, and life science industries. As an example, approximately 240,000 automobiles were assembled in Alabama in 2003. By 2008, the number is expected to exceed 800,000 arising from the consumer demand for autos made in Alabama by Mercedes, Honda, and Hyundai.[1] In addition to the rapid growth of the automotive industry, tomorrow's economy will likely include biomedical, robotics, advanced logistics, and other knowledge-based industries. Over the past twenty years, Alabama has transitioned rapidly into a manufacturing and knowledge economy from an agricultural and natural resource economy. The efficient and effective movement of people and freight is a critical component in the transformation and growth of the Alabama economy. The continued transition and growth of the Alabama economy cannot occur without adequate and appropriate transportation infrastructure.



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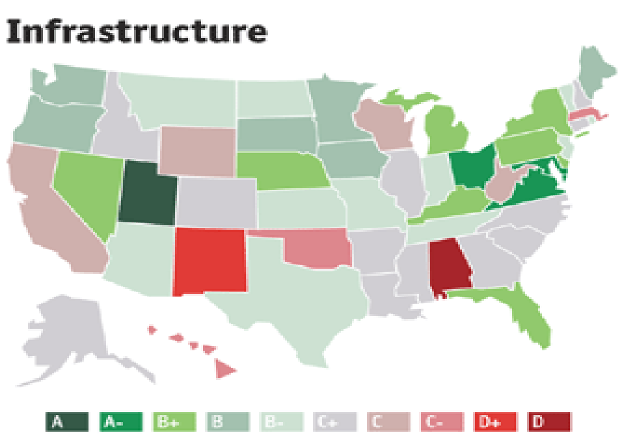

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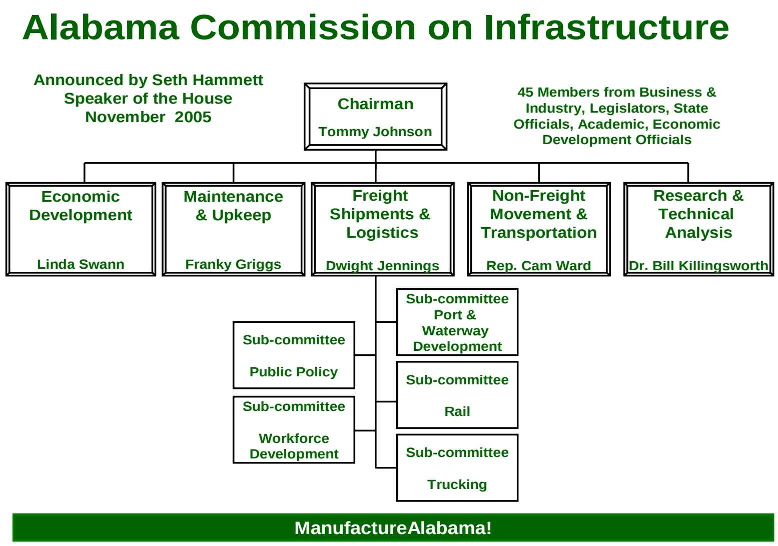

Figure 2-1

Source: Manufacture Alabama

Table 2-1

Alabama Commission on Transportation Infrastructure			
Committee Leadership			
Commission Chair	**Tommy Johnson**	**Frontier Yarns**	**President**
Economic Development	**Linda Swann**	**Alabama Development Office**	**Assistant Director**
Freight Shipments	**Dwight Jennings**	**Southern Shipping & Logistics**	**Owner/CEO**
Maintenance	**Franky Griggs**	**Nucor Steel - Birmingham**	**Vice President & General Manager**
Non-Freight Movement	**State Rep. Cam Ward**	**Industrial Development Board, City of Alabaster**	**Executive Director**
Research & Analysis	**Bill Killingsworth, Ph.D.**	**Office for Economic Development, University of Alabama in Huntsville**	**Director**

Source: Alabama Commission on Infrastructure, February 2006

Members of the Commission and others supporting the committees are listed in Exhibits A through E at the end of this report.

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- **Research, Development & Technical Analysis**
  - Chaired by Bill Killingsworth, Ph.D.
  Responsible for providing the research, data, and other technical support to the commission and its committees while they are evaluating the state's infrastructure needs and propose solutions.

The work of the Commission began immediately following its creation. The Commission held meetings in May and September 2006 to hear progress made in each of the committees. Meetings were held in November 2006 and January 2007 to consider recommendations.

Immediately after being established, committees organized and began their numerous meetings held throughout the year to identify and analyze Alabama's infrastructure challenges. Each committee developed a list of recommendations for the Commission's consideration.

During the Infrastructure Commission's initial year, Manufacture Alabama provided support for the Commission to implement the major transportation recommendation of the Alabama Legislative Commission on Manufacturing. Manufacture Alabama brought representatives from industry to support the work of the Infrastructure Commission in addition to hosting and handling meeting coordination for the Commission and its committees.

3. Background Research Considered by the Infrastructure Commission

The availability of transportation data such as traffic counts, mode capacity, maintenance status and more is almost limitless. Over the past year, the Commission, as part of its process, provided an extremely valuable service in reviewing and selecting relevant research with which to consider the transportation challenges, and more importantly, economic opportunities for Alabama. Information was gathered on each of the four transportation modes; road, rail, waterways and air (airports). Additionally, there was new information requested by the commission from both the public and private sectors.

3.1 The Multi-System Framework for Analysis

The commission adopted a framework to incorporate multiple systems affecting congestion. The Population, Infrastructure, and Economic Activity (P-I-E) model, developed and presented by the Office for Freight, Logistics and Transportation and the Office for Economic Development at the University of Alabama in Huntsville, was used.[4] With this framework and the current research being conducted for the U.S. Department of Transportation, a new systems perspective has been used to view Alabama's transportation assets.

Population – Infrastructure – Economic Activity (P-I-E) Framework

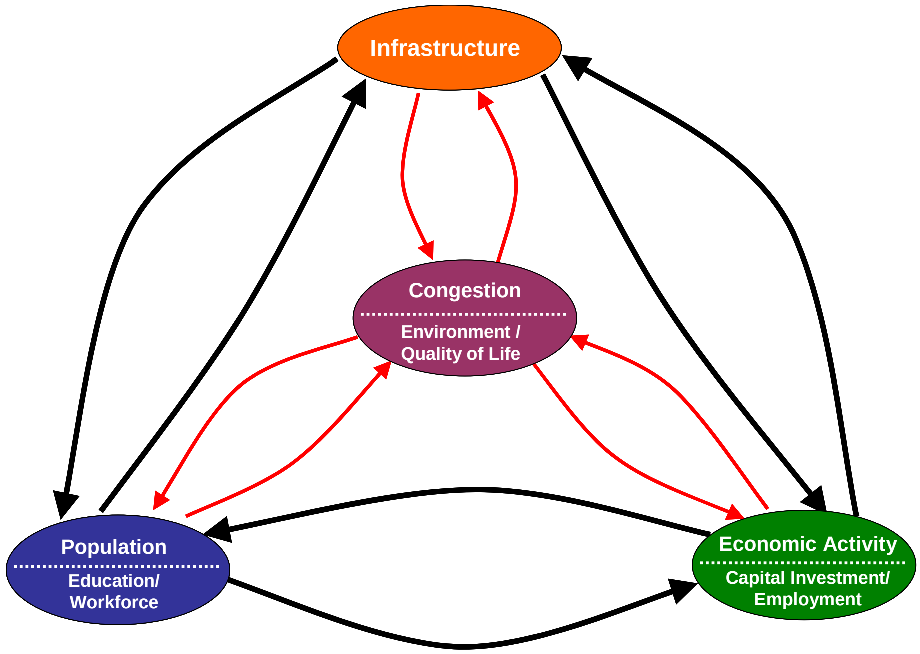


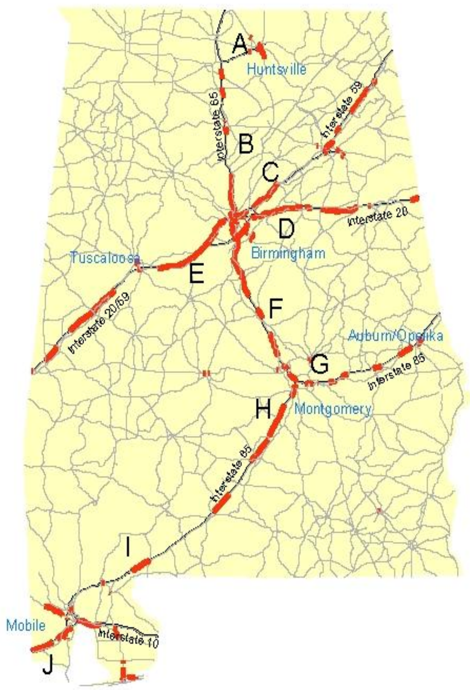
Figure 3-1
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

The P-I-E framework represented in Figure 3-1 recognizes the relationships that exist between population, infrastructure and economic activity, and more importantly, the resulting levels of congestion resulting from their interactions. Planning for, and managing, each of these elements can affect the resulting congestion, as each element is a generator for the other two elements. While traffic congestion is often the focus of many efforts, this framework encourages a focus on the generators of congestion and alternative solutions.

A simple example of how the P-I-E framework can enhance the understanding of transportation infrastructure utilization levels is with an impact from two of Alabama's larger industries, aerospace and automotive. Most would agree that Alabama's significance in the automobile industry has grown substantially over the past decade. The UAH research brought the anticipated near-term growth rates for automotive and aerospace industries into forecasting interstate utilization levels. Figure 3-2, shows the possible differential between using historical utilization growth factors versus incorporating into the model two of Alabama's most vibrant industries, which may not be adequately represented in the historical utilization levels.

In Figure 3-2, ten interstate locations are identified and labeled with letters A through J. For each of these locations, the 2002 average annual daily traffic volume is shown, as captured by the Alabama Department of Transportation (ALDOT). Additionally, a comparison is provided between a 2008 forecasted growth in traffic based on historical trends, and a 2008 forecast, which incorporates anticipated utilization rates of the automotive and aerospace clusters. Location H, just south of Montgomery, has a historical trend line forecast of traffic volume growth by 2008 to an average of 40,942 vehicles daily. A forecast for the same time period including aerospace and automotive specific industry characteristics indicates a daily traffic volume of 52,735 vehicles. The difference is significant with industry anticipated utilization levels being 34% higher than the historical trend line forecast.

2008 Volume to Capacity Ratios with Automotive and Aerospace Clusters Information Included



Map Location	2002 AADT	2008 AADT Historical Trend Forecast	% Increase from 2002 Using Trend Line Forecast	2008 AADT Forecast with Specific Cluster Growth	% Increase from 2002 Using Industry Cluster Analysis
A	57,121	67,842	18.8%	78,577	37.6%
B	48,901	58,080	18.8%	73,494	50.3%
C	29,680	35,251	18.8%	52,885	78.2%
D	61,773	73,367	18.8%	79,853	29.3%
E	53,117	63,087	18.8%	71,112	33.9%
F	43,591	51,773	18.8%	82,589	89.5%
G	84,332	100,148	18.8%	137,207	62.7%
H	34,427	40,942	18.9%	52,735	53.2%
I	26,082	30,978	18.8%	33,165	27.2%
J	53,729	63,814	18.8%	65,314	21.6%

Figure 3-2

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

3.2 Major Interstate Traffic Levels

Tracking growth in average annual daily traffic volumes for Interstate 65 from mile markers 1 through 366 over twenty years shows that neither utilization nor growth is uniform. Changes in population, infrastructure and economic activity have placed greater demands on particular segments of roads. In some instances, sections of I-65 are approaching congestion levels that may threaten economic growth in some areas.

Figure 3-3 shows I-65 annual average daily traffic starting in Mobile on the left at mile marker 1 and ending on the right at mile marker 366 at the Alabama - Tennessee border. The chart clearly shows that between 1985 and 2004 traffic levels continued to rise and that the levels of high traffic continued to spread outward from city centers.

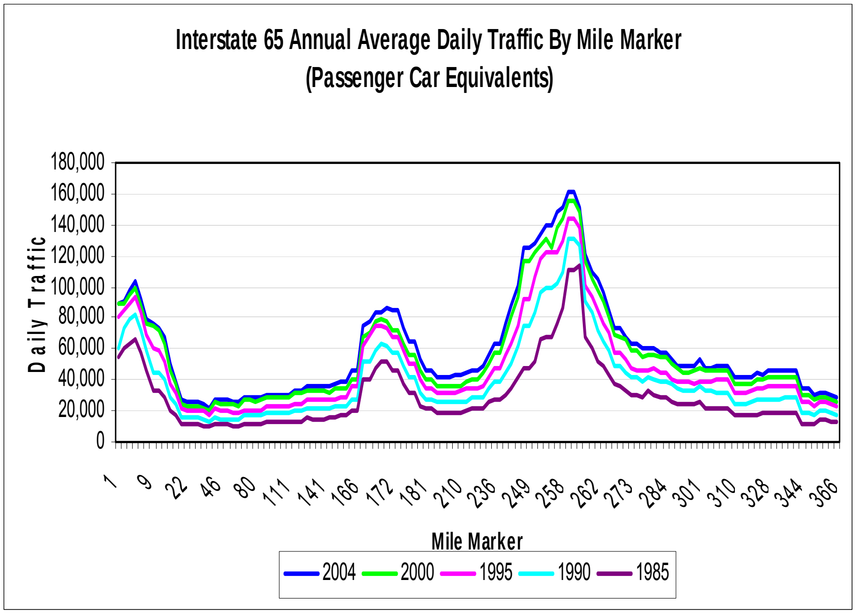


Figure 3-3

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstate 20 crosses Alabama from west to east and shows a similar pattern over the same twenty-year period. (Figure 3-4) The largest volumes can be seen in areas of highest population density (Birmingham in the center of the chart). Economic impacts can be seen for Mercedes and suppliers between mile markers 70 and 110. Also, economic activity is reflected in the traffic volumes east of Birmingham for Honda (mile marker 165) and suppliers and continues at a 50,000-vehicle daily traffic level through the Anniston/Gadsden region.

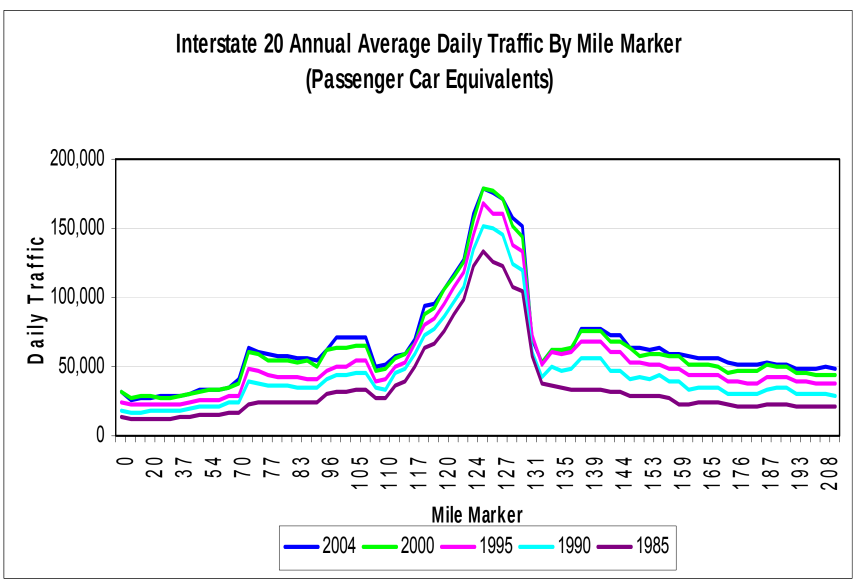


Figure 3-4

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Chart 3-5 of Interstate 59 tracks Interstate 20 from mile marker 1 through 125. The traffic volume drops quickly as I-59 splits away from I-20 leaving Birmingham and heading toward Chattanooga.

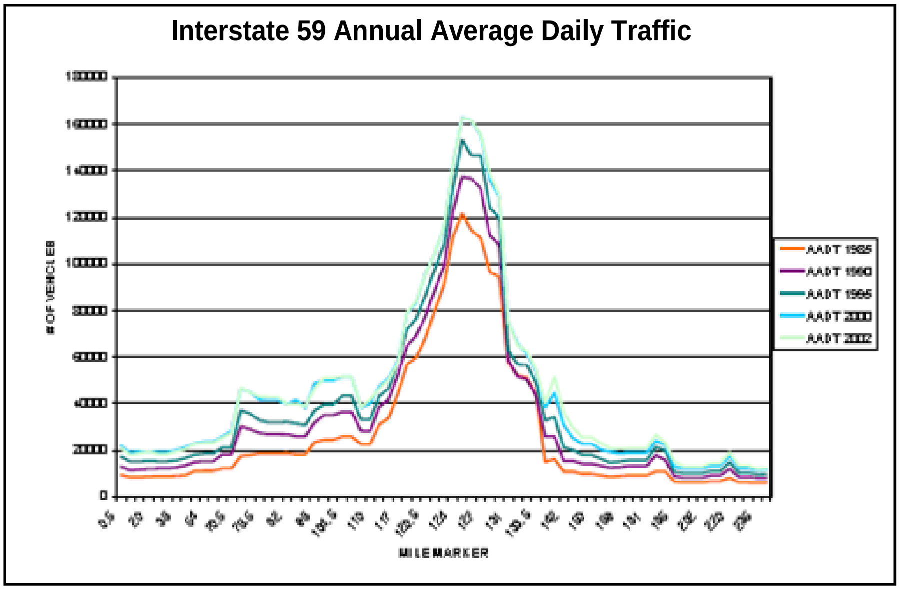


Figure 3-5

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstate 10 is much shorter inside Alabama's borders than other interstates but the traffic volumes over the twenty-year period documents that volume growth is steadily occurring and consuming virtually all available capacity. (Figure 3-6)

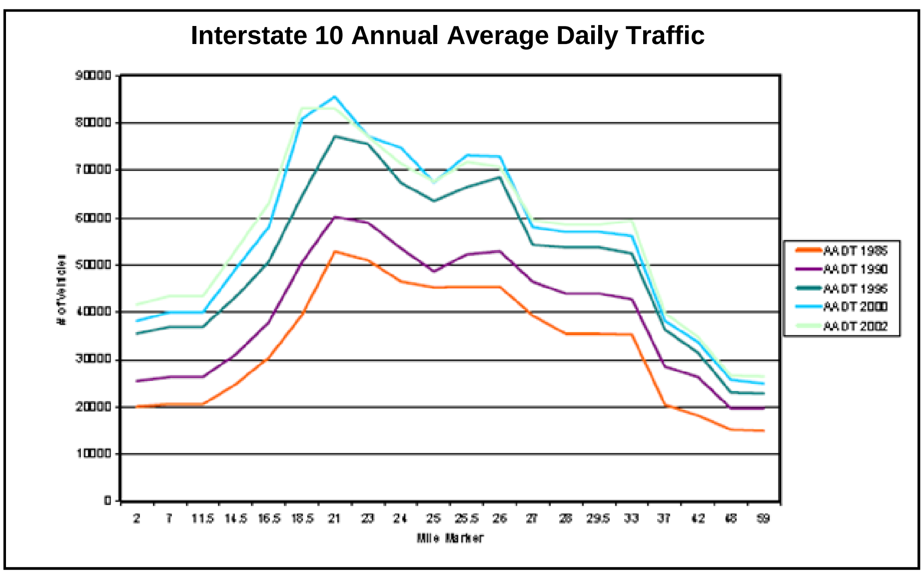


Figure 3-6

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

Interstates 10 and 85 are similar in that relatively short sections located in Alabama are greatly impacted by traffic originating and terminating outside of Alabama's borders. The intersection of I-85 and I-65 in Montgomery is clearly seen in miles 2-10 in Figure 3-7**.** As I-85 heads east away from the population and economic activity of Montgomery, volumes drop quickly and growth is uniform.

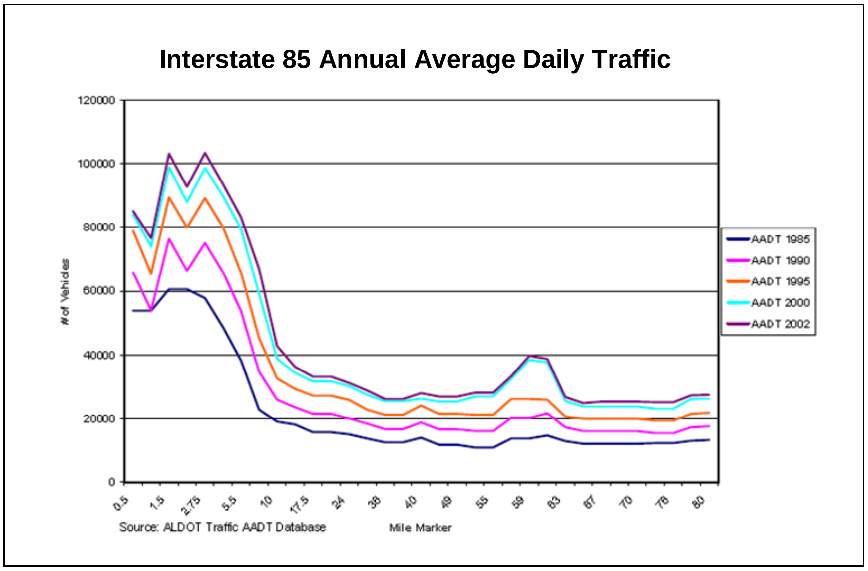


Figure 3-7

Source: Transportation Infrastructure in Alabama, Meeting the Needs for Economic Growth, UAH, 2005

The interstates shown in Figures 3-3 to 3-7 are representative of the growth patterns and utilization levels on many critical federal and state highways in Alabama. The lesson in this observation of traffic levels over time is that the traffic flow rate of Alabama's roadway system is just as important if not more as its average roadway system capacities. Significant improvements in road infrastructure capacities (defined by travel time) may be gained by better understanding the constraints and devising a plan, which considers near and long-term impacts on traffic flows for each road infrastructure project.

3.3 Infrastructure Issues by Industry

Utilization of Alabama's transportation infrastructure varies by industry. A survey of Alabama manufacturing industries conducted by the UAH Office for Economic Development in 2004-05 found that trucking and road issues are major concerns. (Table 3-1)

Issues outlined in Table 3-1 show commonalities across modes of transportation as well as the types of issues with Alabama's transportation system within a key industry. The three issues most often identified by Alabama companies were (1) road capacity and congestion, (2) truck availability, and (3) truck route access. The issues shown in this table were identified by each company from a broad inquiry rather than by mode, i.e., truck, water, or railroad.[5] Responses to the open-ended questions were then grouped by mode in similar categories of issues.

Growth in infrastructure utilization is anticipated to occur mostly on roads used by Alabama's production industries, e.g. automotive, aerospace, electronics, etc. This information indicates that Alabama's industries are experiencing challenges with the current road infrastructure due to insufficient capacity and congestion. Additionally it should be noted that, many of Alabama's industries would increase their truck shipments if additional trucks were available.

Table 3-1

Alabama Transportation Issues by Industry Cluster	Truck					Water			Railroad			Process		
	Road Capacity & Congestion	Truck Availability	Truck Route Access	Truck Permitting	Road Maintenance	Barge Access	Ocean Freight Carriers	Service to Ocean Ports	Rail Access	Rail Availability	Air Freight availability	Int'l Cargo Freight Services	Freight Damage	Slow Freight movement
Aerospace	√	√	√	√	√								√	
Apparel & Textiles							√					√		
Automotive	√	√			√			√				√	√	
Chemicals	√								√					
Electronics & Equipment	√	√										√	√	
Fabricated Metal	√													√
Food Products		√	√											
Furniture	√													
Industrial Machinery	√	√	√									√		
Lumber & Wood Products		√	√							√				
Paper	√	√												
Primary Metal	√	√												
Printing & Publishing	√										√			
Rubber & Plastics		√	√											
Stone, Clay, Glass	√					√			√					
Textile Mills		√	√											
Transportation Equipment												√		

Source: Requirements for Infrastructure and Transportation to Support the Transformation of the Alabama Economy, UAH, 2007

Eleven of the seventeen industry clusters represented in Table 3-1 indicated some type of challenge with capacity/congestion. The economic reality resulting from the transportation capacity challenges of these industries is that lack of capacity could limit job growth for existing Alabama industries.

3.4 Congestion ranking of major Southern cities

Growth in population and employment creates the challenge of meeting transportation needs with limited resources. Figure 3-8 presents urban area annual hours of delay per traveler for major southeastern U.S. cities. The chart shows that travel delay time in Birmingham is lower and is growing at a slower rate than larger, southern metropolitan areas like Atlanta and Austin. This beneficial position of lower congestion is an advantage for Alabama. An advantage such as this should not be allowed to deteriorate but it can only be maintained with infrastructure investment.

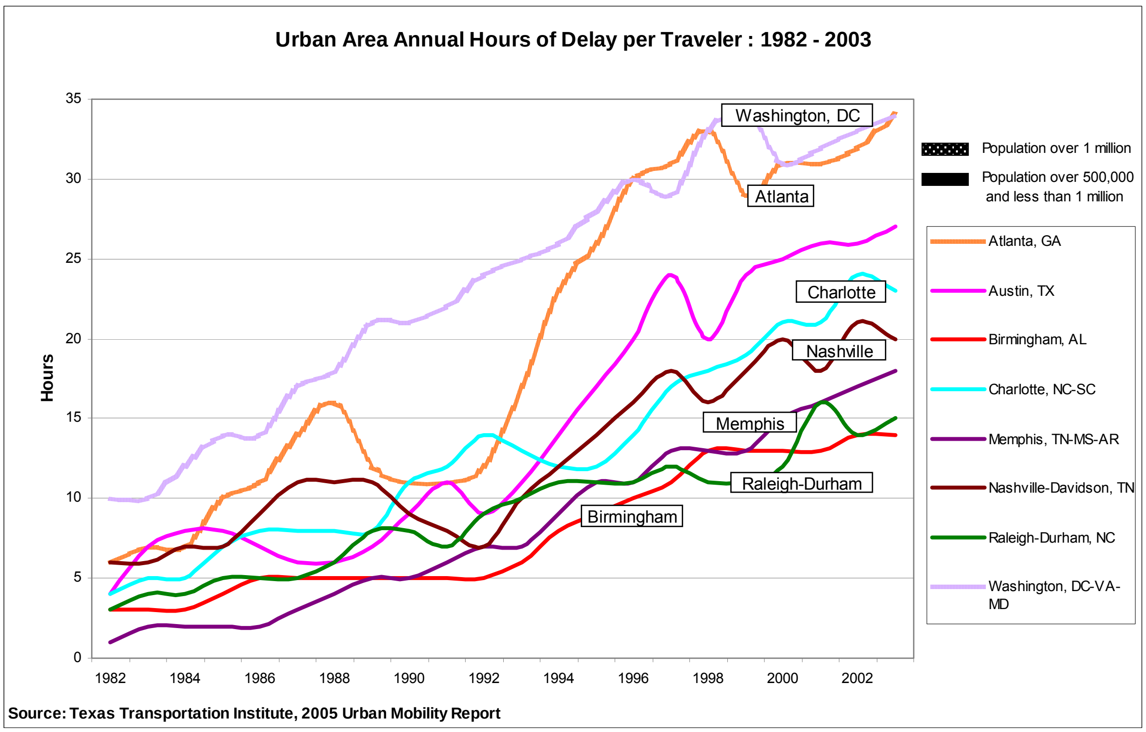


Figure 3-8

3.5 Transportation Research Resources Available

Understanding the current and probable future demands on transportation infrastructure is essential in Alabama's economic development strategy. There are several transportation research resources in Alabama that can be built upon. These include the Alabama Transportation Department's wealth of data, the state research universities with transportation research programs, and industry clusters that are willing and eager to share their needs.

Approaching transportation infrastructure planning from a "system of systems" perspective is possible and can better match limited resources with current and future needs. In fact, Alabama's transportation system is the collective interaction between the road system, rail system, water system, and air system. Especially in the transportation of freight in and through Alabama, the interaction of these systems determines flow rates and thereby overall congestion levels. In order for Alabama to continue to be a leader in advanced manufacturing, global trade, and economic development in general, transportation infrastructure must be managed as an enabler rather than a constraint to economic opportunity.

4. Infrastructure Commission Recommendations

The Commission charged the committees to conduct their work with a focus on the statewide transportation systems rather than on the hundreds of locally important projects that have been identified or could be brought to the committee discussions. Therefore, many of these proposed recommendations remain conceptual in nature and without prioritization. In most cases, more research and analysis is still needed to understand how the project(s) referenced in a recommendation will affect Alabama's overall transportation system and economic future.

Recommendations were developed by each of the five working committees of the Alabama Commission on Infrastructure. The Commission considered the committees' recommendations and approved the following on January 22, 2007.

Significant supporting material and data was gathered and utilized by the commission. Some of this material is referenced in this report but much more is available for those interested in helping with implementation of the recommendations.

To facilitate ease of presentation and discussion, the list of the recommendations below are grouped by subject matter rather than identifying them with individual committees. This listing format should in no way suggest that the Commission and its committees approached Alabama's infrastructure picture on a piecemeal asset-by-asset basis. To the contrary, the committees were diligent in addressing transportation needs from a strategic, intermodal perspective. The intermodal perspective is simply considering how the interconnection of highway, rail, waterways, airports, and other infrastructure elements relate as outlined in the strategic charge of the Commission. Recommendations were developed on the premise that Alabama's major transportation infrastructure challenges are statewide, rather than local and must be identified and analyzed as such.

4.1 Highways/Bridges Issues & Recommendations

Recommendation: Address congestion points on I-65 to protect the main artery of Alabama's transportation system and economic growth

It is clear that the Interstate 65 corridor represents the state's main transportation artery and is a primary economic engine for Alabama. The preponderance of freight and non-freight traffic moves north and south between Mobile and the Decatur-Huntsville region on I-65. Additional container freight will flow through Alabama with the early 2008 startup from the Alabama State Port Authority's Mobile container terminal. By 2010, it is expected that containers handled at the Port will exceed 200,000 annually, almost eight times the level in 2005. [6]

Much of the state's industrial growth and economic activity has occurred, and probably will continue to occur along or near I-65. For that reason, the state's most critical highway congestion points are located on I-65. Projections from the P-I-E and other analytic models show that congestion at these points will continue to worsen. Committee members generally agreed that addressing those issues on the state's main artery must be the first priority. While other highway projects are necessary and worthwhile, Commission members agreed it would be counter-productive to implement highway projects that feed more freight and non-freight traffic onto I-65, without first implementing the solutions needed to address the rapidly brewing I-65 congestion crisis.

The Commission and its committees identified and considered a number of specific highway projects, including many already on ALDOT's short-range and long-range plans. Analysis was done with statewide, rather than regional or local, benefit criteria. Although specific highway projects were considered, the Commission on Infrastructure believed that it should attempt to neither rewrite nor endorse ALDOT's project plans or planning schedules. Rather, the Commission strongly agreed that its work should enhance insight by ALDOT and others on those projects most crucial to statewide strategic economic and job growth.

Listed below are recommendations from the Commission related to highway projects. This list is not intended to be all-inclusive or necessarily presented in order of priority, other than to emphasize the significance of I-65 to the state. Some of these recommendations specifically illustrate the Commission's desire to consider innovative ideas to improve traffic flow rather than just adding capacity.

4.1.1 Interstate 65 Corridor Recommendations

- Consider the addition of one lane in each direction on I-65, beginning with the sections identified as most congested and proceeding to other stretches of the interstate as funding permits. Exploration of concepts like designing the additional lane as a toll lane or restricting trucks to the two right-hand lanes on a three-lane stretch of highway to improve traffic flow. The areas indicated in red on the highway map in Figure 4-1, show areas where expected utilization will exceed ALDOT congestion guidelines by 2008.

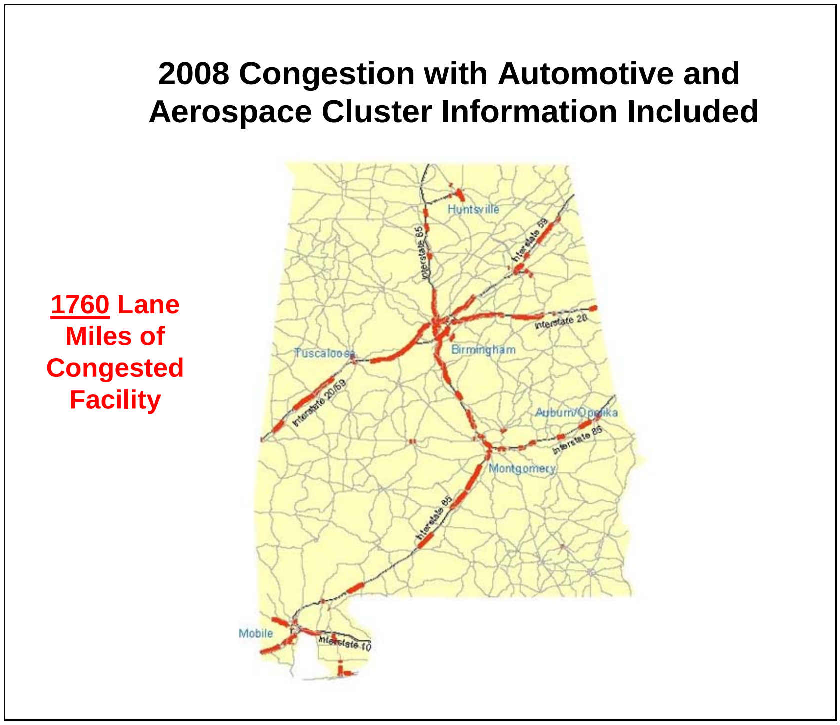


Figure 4-1
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

- Study the feasibility of a truck-only toll highway parallel to I-65. This freight alternative could improve traffic flows and safety for all users of the highways. The project could be developed in sections, beginning with the most critical traffic flow/congestion stretches.

- Construct a northern by-pass in Birmingham to complete the outer loop on which through traffic and freight could better flow. According to the Birmingham Chamber of Commerce, the city is now the largest in America without a complete outer loop highway system, adding significantly to congestion problems on I-65, I-59/20 and other important routes.[7]

- Construct the Montgomery Outer Loop connecting I-65 and I-85 south of the city. I-65, I-85, and Highway 231 all intersect within a distance of approximately one mile inside Montgomery, which creates a major choke point in traffic flow on I-65.

- Encourage a resolution to address the bottleneck at the Interstate 10 Tunnel. The Mobile I-10 congestion at the tunnel affects the movement of passengers and freight across and through the state. The congestion affects north-south shipments of containers and other goods from the Alabama State Docks as well as east-west traffic flow across the entire Gulf States region. Committee members urge stakeholders in the issue including local, state, and federal governments to move ahead quickly with a consensus plan that identifies the best solution that facilitates, rather than hinders, the movement of containers and other freight out of Alabama's seaport.

- Complete the corridor study and public hearings underway by ALDOT on a proposed new Western Alabama Freeway. The opportunity capitalizes on the regional freight transportation growth and the resulting economic opportunities provided by the new Mobile container terminal and should continue forward. The proposed routes being considered for the West Alabama Freeway would connect I-20/I-59 to I-10 in either Mobile County or Baldwin County. This route could efficiently service both the growing port dependent industries, as well as relieve freight congestion on I-65. Industries utilizing the Alabama port such as forest products, poultry, furniture manufacturing, automotive and electronics located in Western Alabama, Mississippi, Tennessee and Arkansas, could gain significant transportation competitive advantages. Additionally, potential economic development opportunities could be created in an economically depressed, undeveloped rural area of Alabama.

4.1.2 Non Interstate 65 Highway Recommendations

- Complete the Corridor X project in Alabama. Understanding the relationship between Highway 280 congestion and the congestion on I-65 and I-59/20 in the Birmingham area is vital in addressing the I-65 Corridor issue. Current and proposed studies by the chambers of commerce and other economic development groups in the region could be incorporated into the planning process.

- Construct the southern by-pass and related projects in the Huntsville area to deal with infrastructure strain, which will be caused by the imminent influx of thousands of new jobs and residents moving into the area due to the Department of Defense Base Realignment and Closure Commission's ("BRAC") actions. The effective preparation to handle this sudden growth is necessary to fulfill the expanded missions of Redstone Arsenal required by the BRAC realignment.

- Complete the Dothan to I-10 connector route. This route has both economic and public safety implications related to its hurricane evacuation route.

- Expand and improve Highway 84 to four lanes across south Alabama. Additionally, stretches of trucker "rest area" lanes should be designed into the route to facilitate the flow of freight across this vital southwest Alabama east-west route. There is significant documentation on the statewide economic and public safety significance of this project that was compiled by the Commission's Economic Development Committee.

- Extend I-85 from Montgomery to connect with I-20/59 at the Alabama-Mississippi line. Since this is a virtually new stretch of interstate, committee members suggested that this would be an ideal highway proposal to evaluate using economic benefit modeling. This analysis would incorporate projected statewide economic value measured against cost as a major variable in planning prioritization.

4.1.3 Bridge Rehabilitations Recommendations

Weight-restricted bridges and the lengthy detours they cause represent a huge problem for Alabama school districts and for pupils who must spend inordinate amounts of time on school buses each day. Numerous rural-based industries rely on trucks for incoming materials and outgoing finished product are experiencing the costs associated with the circuitous routes necessary to avoid functionally closed bridges.

- Increase the priority of the county bridge replacement crisis by creating a funding mechanism to permit repair or replacement of deficient structures. The estimated replacement cost per bridge is $367,000. The five-year GARVEE Bond Amendment program, which has ended, replaced almost 600 bridges. A return of $2 for every $1 invested has been calculated in savings to autos, trucks and school buses. Current estimation indicates there are approximately 1,750 county bridges that need replacement. Additionally, there are at least 560 state and city bridges declared deficient and must be replaced before they can adequately re-enter Alabama's transportation system.

4.2 Railway Recommendations

Railroads are essential to many Alabama industries and therefore many jobs. Railroads represent an important transportation mode as both an alternative and complement to truck freight. If any of today's rail freight were moved to trucks due to rail freight capacity shortages, the result on the transportation system would be increased congestion. Conversely, a portion of today's truck freight could be moved from the highways to railroads if issues of capacity, cost, and schedules are addressed. This could decrease the overall levels of congestion. However, Alabama faces significant challenges in rail service that limit these potential benefits.

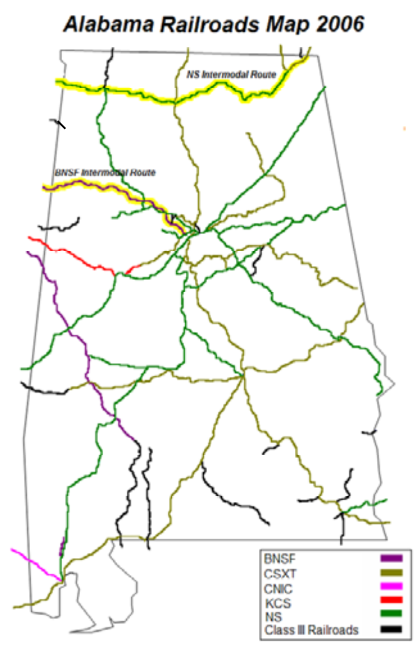


Figure 4-2
Source: UAH Office for Economic Development, Office for Freight, Logistics, and Transportation

In 2006, there were five Class I railroads (main lines) and 23 Class III (short-line) railroads operating in Alabama.

Alabama short-line railroads, in many cases, are the lifeline for manufacturing sites as they link the plants with the Class I rail lines. Additionally, short-line operations are facing track and equipment upgrades to meet the new higher industry standard car weight requirements of 286,000 pounds. Critical short-line track and bridge improvement needs, coupled with the pending equipment upgrades, amplify the threat of losing essential transportation routes to much of Alabama's manufacturing base.

The Commission proposes the following railroad recommendations:

Recommendation: Explore strategies to promote and assist short-line railroads with infrastructure needs

The needs include repair and maintenance of existing rail, bridges, and grade level crossings plus improvement to handle the increasing railcar weights. Programs adopted in neighboring states such as Tennessee and Georgia could be used as models to create a short-line railroad sustainability plan. A blueprint for such an initiative has been developed for the Infrastructure Commission. It is titled *"State of Alabama, Short-line Railroad Program for Rehabilitation"*.[9]

Recommendation: Authorize funding for a study of the Alabama short-line railroad system

A thorough understanding of the current state of Alabama's short-line railroad system is needed. Funding is requested to conduct a study of the business conditions and rail infrastructure needs of Alabama's Class III railroads. The study would quantify the economic contribution of the short-line railroads, the costs that would result from short-line operation cessation, and the funding needed to address infrastructure maintenance and improvement needs. The study could also evaluate creation of new short-line railroads to connect local economic development project sites with existing Class I main lines. These connectors could potentially be publicly owned or financed through private-public partnership ventures.

Recommendation: Form a coalition to explore the potential for an additional north-south rail line

Efficient freight movement through Alabama involves the critical need for an "intermodal" designated north-south rail line going from the state docks in Mobile through North Alabama. The current (east-west oriented) intermodal-designated rail lines of Northfolk Southern (NS) and Burlington Northern Santa Fe (BNSF) are highlighted in Figure 4-2 on page 17. An intermodal rail "lane" is the equivalent of a highway express lane enabling freight coming into the state or heading to out of state destinations to move more rapidly. These intermodal rail lines make Alabama's port and freight industries more attractive to shippers. The absence of an Alabama north-south intermodal rail "lane" increases the time required to move freight through the state from less than one day to three or more days. Adding a new north-south rail lane, potentially along the I-65 corridor, could enhance the attractiveness of the Alabama State Docks, make the use of rail for containerized freight a viable alternative, and create economic advantages for Alabama industries. There are two Class I railroads currently operating on an existing line along this north-south corridor. Committees propose that a coalition be formed, to explore the issue with the railroads and other appropriate parties, to encourage intermodal designations of existing routes, and explore the possibility of a new north-south rail line. The recommendation also includes exploring the appropriate role in this venture for ALDOT and the proposed Alabama Transportation Commission.

4.3 Waterways Issues & Recommendations

Alabama contains more navigable inland waterways than all but one other state in the continental U.S. This resource could potentially give Alabama and its industries advantages in competing with other states for economic development projects. Alabama's waterways are underutilized. The Commission acknowledged that there is potential for Alabama to take greater advantage of this abundant natural resource.

Figure 4-3
Source: ALDOT

Recommendation: Fund a study to develop strategies that could increase the use of Alabama's inland waterways

A comprehensive business model study should be commissioned to identify and evaluate strategies to encourage increased utilization of Alabama's inland waterways for freight shipments. The study should determine if waterborne freight could become a viable freight mode for industries and shippers in Alabama. Specifically, the study should encompass how waterways can be better linked to road and rail freight. Short-term opportunities and longer-term strategies, such as the European use of high-speed barges could be considered in the analysis.

Recommendation: Encourage federal funding for the maintenance of Alabama's intracoastal waterway systems

The State of Alabama's inland and intracoastal waterway systems will become more critical to the state as the highways and railways become more congested. Since maintenance of the locks, dams, navigational aids and water depth are the responsibility of the federal government, the Commission recommends that the State of Alabama coordinate and maximize its political influence and resources in Washington D.C. to ensure that such maintenance and dredging is adequately funded.

4.4 Intermodal Center Issues & Recommendations

As noted above, the success of a multi-mode transportation system depends heavily on the flow at the intersections of transportation modes. Infrastructure developed at these intersections is commonly known as intermodal centers. The Commission recommends the following specific intermodal center projects based on the significant benefit that each could bring to Alabama's statewide transportation system.

Recommendation: Pursue the establishment of an inland intermodal freight facility to dispatch inbound containerized freight and collect outbound containers

Growth in container handling capacity, especially with the 2008 start up of the new Alabama State Port Authority's Mobile container terminal, offers an opportunity to capture significant freight business in Alabama that currently passes through congested east and west coast ports. An inland intermodal freight facility would greatly improve freight velocity through the Mobile container terminal, reduce congestion on Alabama's highways, and create attractive economic development opportunities. The center is envisioned as a distribution center for containers into the Southeast and Midwest as well as a collection point for the containers returning from those destinations. According to logistics experts, a general rule for maximizing benefits of an inland container intermodal center is to locate it an optimum distance of approximately 300 to 400 miles from a seaport. From Mobile, a 300-mile distance would land an inland container facility in either north Alabama or a neighboring state. While no specific location for such a container facility was identified by the Commission, it is important to consider tying into existing intermodal infrastructure, such as in the Huntsville-Decatur region. Several locations on the northern end of Alabama, including Birmingham, could also be considered. A successful site must have easy access to truck, rail and waterway modes. Connection to air cargo would be even more advantageous.

Recommendation: Enhance the Mobile container terminal handling facility by funding a rail interchange yard and a ship turning basin

The expansion of the Alabama State Port Authority's Mobile container terminal is a major economic opportunity for Alabama. Making the port more attractive to shipping companies should be a priority if Alabama is to maximize economic benefit from the container facility investment. The Commission recommends that priority funding be authorized for two enhancements, which could bring significant, immediate economic returns at the port.

- A new Rail Interchange Yard built at a projected cost of $84 million would accommodate the efficient loading and distribution of containers.

- A Turning Basin at a projected cost of $26 million that would allow the Port to accommodate larger ships and thus to compete for new freight business with other ports.

4.5 Mass Transit Issues

Transportation infrastructure is important to freight shippers as well as passengers traveling in and through the state. A thorough evaluation of need, economic benefit and costs of mass transit system improvements in Birmingham, Mobile and other major areas of congestion should be conducted within the context of impact on the state "transportation system". Chambers of commerce and other economic development organizations in Birmingham and Mobile have done extensive analysis on this issue. The evaluation of benefits to the statewide transportation system from mass transit projects should incorporate their mass transit knowledge and participation. The Commission believes that urban area mass transit issues are critical and must be addressed in any comprehensive infrastructure strategy developed by Alabama.

4.6 Organizational Structure Issues & Recommendations

The Commission and committee indicated that ALDOT is doing an admirable job performing their duties with a chronic shortage of funding and the inevitable influence of politics. The planning and execution of transportation infrastructure construction and maintenance projects can suffer as short-term "band-aids" compete with investments in long-term strategic solutions. Additionally, when each transportation mode (road, rail, waterway, airports) operates independently, optimization of the overall transportation system is virtually impossible. There is strong support by the Commission to enhance the organizational structure of Alabama's transportation infrastructure administration.

The Commission gathered summary information on the transportation oversight structure of contiguous states. Figure 4-4 below shows that Mississippi, Georgia, and Florida have a transportation commission-type oversight body. Tennessee is similar to Alabama with a single cabinet member overseeing the transportation operations for the state.

Forms of Transportation Oversight in Southeastern States

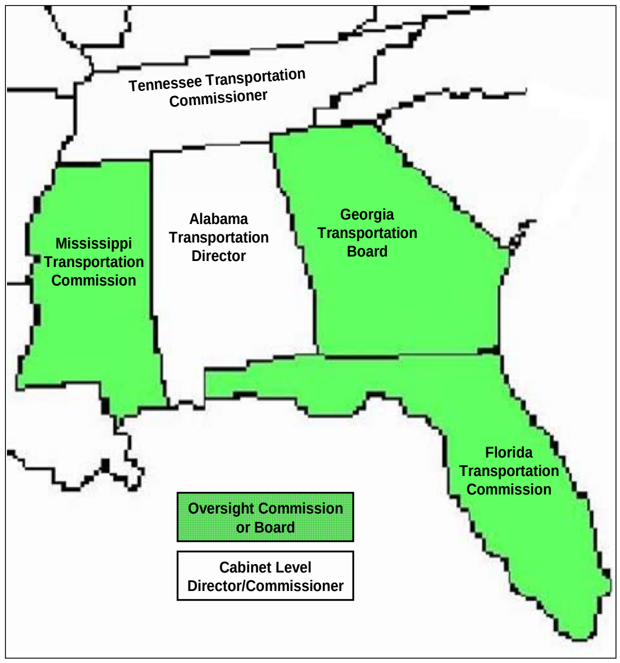


Figure 4-4
Source: UAH Office for Economic Development,
Office for Freight, Logistics, and Transportation

Several recommendations are proposed to help improve planning and operational performance that will benefit the Alabama's overall transportation strategies.

Recommendation: Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation

An Alabama Transportation Commission should be created with oversight responsibilities. This commission would provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning, and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports has proven very successful. More than half of the states in the U.S. have such an entity (commission, board, authority, etc.) to administer the planning and operations of their transportation departments. This recommendation strongly urges that the transportation commission be as independent of political pressures as possible, with members appointed by the Governor (with possible legislative involvement) on a staggered-term basis. A bill is being drafted for introduction in the 2007 Legislative Session.

Recommendation: Expand ALDOT's roles in rail and waterways

A recommendation to consider giving ALDOT, with the oversight of the Alabama Transportation Commission discussed above, expanded administrative responsibilities in appropriate areas, i.e., areas of state responsibility, like the Alabama's rail and waterways transportation activities. Committee members cited the need for a "state-level champion" for waterways and short-line railroads and felt that expanding the multi-modal responsibilities of ALDOT would help improve coordination of Alabama's transportation infrastructure assets.

There are designs in other states that could benefit the design of an expanded ALDOT program organizational structure. Practices and policies of other states are being researched. Efficiency and maintenance of Alabama's airports have improved by the placement of the Aeronautics Bureau under ALDOT's jurisdiction. The Commission suggests that similar benefits could be realized in the rail and waterway transportation modes.

The establishment of a trust fund within ALDOT should be considered to promote utilization and improvement of Alabama's inland waterways and railroads. Additionally, a trust fund could provide more stable funding to support waterway and rail infrastructure projects.

Recommendation: Establish an analysis resource for Alabama's transportation system

A recommendation to provide ALDOT with the enhanced analytical and modeling tools needed to integrate the multiple modes of roads, railways, waterways, and airports. Utilization of modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. It is suggested that a major element of this analysis involve development by Alabama universities and other support organizations of economic benefit modeling. The resulting analysis could guide strategic project prioritization to ensure that with limited funds, Alabama maximizes economic development and job growth. The modeling analysis would help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

4.7 Commission on Infrastructure

Recommendation: Extend the *Commission on Infrastructur*e through the 2007-2010 Legislative quadrennium to perform further strategic analysis

The recommendation recognizes that the Commission has existed for less than a year and has only begun to identify and analyze potential solutions to address Alabama's infrastructure needs. Much more can be done to continue to bring together many of the state's top experts in the transportation infrastructure field. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on the process.

4.8 Infrastructure Funding Issues & Recommendations

Clearly, meaningful solutions to the state's infrastructure challenges will be expensive and will require new, reliable sources of funding. Alabama annually faces the decision of diverting maintenance funds to qualify for its share of federal matching highway dollars. This year-to-year game interrupts progress on critical projects and can lead to additional cost and extensive repairs of critical links in Alabama's transportation system.

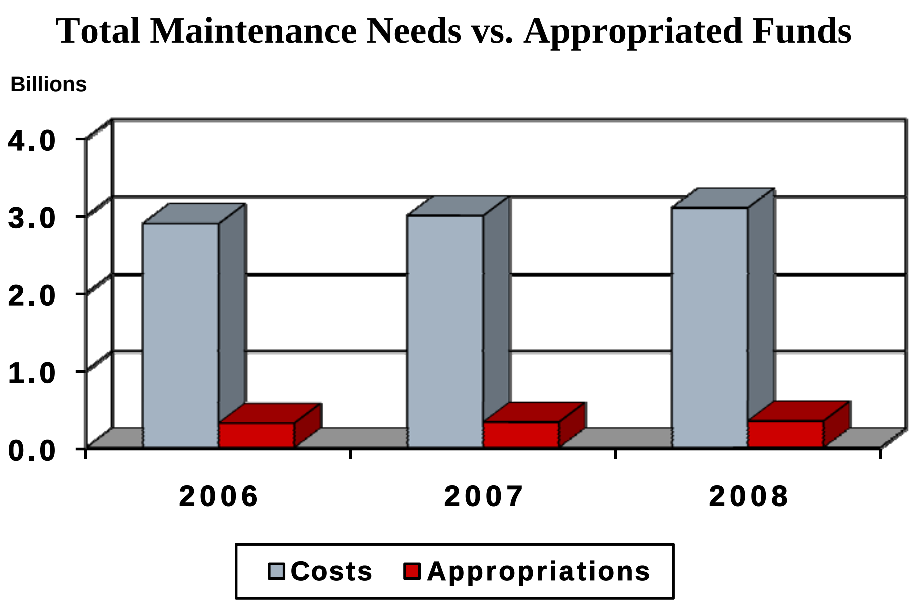


Figure 4-5

Source: Manufacture Alabama

Current maintenance and repair funding generated by Alabama's fuel tax has not kept pace with the costs. The current 18-cent gas tax level was established in 1992. In today's dollars, that 18-cent gas tax is worth only 12 cents due to inflation. The state's transportation purchasing power has declined by 37 percent. In studying the critical need for transportation funding, the Commission noted that the available funds could not be allowed to be eroded by inflation. Implementation of the new, more efficient transportation organizational structures proposed in previous recommendations will be of little benefit if the new structure is not adequately funded. The Commission recommends consideration of several funding-related options:

Recommendation: Explore opportunities for private investment through private construction and/or long-term leases of toll roads and bridges

The trend of partnering with private operators of transportation infrastructure is becoming increasingly common throughout the country. The practice can provide a state with significant up-front lease revenues, while shifting maintenance responsibilities and costs to the investor. Alabama should thoroughly evaluate the benefits and disadvantages for Alabama of private investment in long-term leases of toll roads and bridges. Current statutes for toll roads and bridges are being analyzed to determine if enabling legislation is needed for this type of private investment. The Aging Infrastructure Systems Center of Excellence at the University of Alabama is researching relevant models in other states.

Recommendation: Consider establishing a Lifecycle Maintenance Trust Fund to allocate maintenance funds with the approval of new construction projects

The state should consider establishment of an ALDOT Lifecycle Maintenance Trust Fund to allocate maintenance funds for new capital projects at the time of project approval, thus assuring the investment in new infrastructure is maintained and not lost due to financial neglect. A funding formula could incorporate the cost of construction, projected maintenance schedules, and interest earnings adjusted for inflation. Today, ALDOT estimates that fifty-eight cents would need to be placed in the trust fund for each dollar of investment in new assets.

Recommendation: Modify motor fuels tax law to address inflation erosion of generated funds

The Commission recognizes that funds available for transportation infrastructure development and maintenance are inadequate today and will be less adequate as more demands are placed on Alabama's transportation infrastructure. Modification of Alabama motor fuels tax laws should be considered, making revenue generation match closer with levels of use. Additionally, tax law modifications should incorporate methods to reduce the buying power erosion due to inflation. Options in addition to a straight fuel tax increase could involve a fuel tax indexing mechanism similar to those in other states.

Consideration could also be given to a limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects. Alabama should analyze the highly successful North Carolina model in this regard. The North Carolina program raised and allocated additional gas tax revenues for specific projects recommended by a body similar to this Commission on Infrastructure. Several fuel tax indexing and other revenue bills can also be quickly accessed for evaluation.

Recommendation: Change the point of collection for motor fuels from the distributors to terminals

Legislation should be enacted to move the collection point for Alabama motor fuels taxes from each of the licensed distributors to fuel terminals. A number of states have enacted this "at the rack" tax collection procedure and have subsequently collected millions of additional revenues from distributed fuel on which no tax was previously remitted. Collecting motor fuel taxes at the fuel terminals where distributors receive their supply will reduce the potential loss of taxable fuels revenue. A Birmingham News story in August 2005 discussed a federal report that indicated that Alabama Department of Transportation is not collecting $24 million and is losing the accompanying federal matching funds.[10] The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of change in the point of collection. A bill previously drafted is being updated for introduction in the 2007 Legislative Session.

Recommendation: Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs

The Commission recommends that any dollars generated from the Outer Continental Shelf leases be placed into a trust fund similar to all of Alabama's other offshore oil and gas revenues. A trust fund would allow the interest to be spent but preserve the principle. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers Alabama's inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. Therefore, the Commission's recommendation is that the Legislature create a special Constitutional Trust Fund to administer and invest these revenues for the benefit of the citizens of the state, similar to the way we currently administer and invest Alabama's inshore oil and gas royalties through the Alabama Trust Fund. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

5. Near Term Actions

The Commission charged its committees with generating as many innovative ideas as possible without the constraint of time or funding. This unencumbered creativity resulted in many new ideas from which the Commission could develop recommendations. The numerous recommendations detailed above were selected acknowledging that funding and time are constraints with which Alabama must work. The Commission is suggesting that the following recommendations be considered for near-term action.

1. **Establish an Alabama Transportation Commission with oversight of Alabama's Department of Transportation**

An Alabama Transportation Commission should be created with oversight responsibilities to provide guidance to the Alabama Department of Transportation in areas like policy development, long-range planning and budget matters. As an example, the Alabama State Port Authority, which oversees the operations of the state docks in Mobile and other inland ports, has proven very successful. A bill is being drafted for introduction in the 2007 Legislative Session.

2. **Expand ALDOT's roles in rail and waterways**

ALDOT, with the oversight of a newly formed Alabama Transportation Commission discussed above, could better integrate the responsibility of Alabama's rail and waterways. An Alabama Waterways Bureau should be established under ALDOT to promote utilization and improvement of Alabama's inland waterways. An organizational design similar to the one used to place of the Aeronautics Bureau under ALDOT's jurisdiction could be incorporated. The gains in efficiency and maintenance of Alabama's airports could also be realized in the rail and waterway transportation modes.

3. **Establish an analysis resource for Alabama's transportation system**

Modern multi-mode system dynamics research can assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. Utilization of Alabama research universities and other support organizations is strongly encouraged to provide this research.

4. **Modify motor fuels tax law to address inflation erosion of generated funds**

Modification of Alabama motor fuels tax laws should be considered to match more closely revenue generation with levels of use. Additionally, tax law modifications should incorporate methods to stem the buying power erosion due to inflation. A limited Gas Tax Trust Fund program with a pre-determined duration to fund specific priority projects should also be considered. Several fuel tax indexing and other revenue bills can be quickly accessed for evaluation.

5. **Change the point of collection for motor fuels from the distributors to terminals**

Collecting motor fuel taxes at the fuel terminals ("at the rack"), where distributors receive their supply will reduce the potential loss of taxable fuels revenue. The Alabama Department of Revenue, ALDOT and others in Alabama have evaluated this type of point of collection change. A bill previously drafted is being updated for introduction in the 2007 Legislative Session.

6. Capture revenues from Outer Continental Shelf royalties for transportation infrastructure needs

The Commission recommends that the Legislature create a special Constitutional Trust Fund to administer and invest any dollars generated from the Outer Continental Shelf leases for the benefit of the citizens of the state, similar to the way we currently administer and invest our inshore oil and gas royalties through the Alabama Trust Fund. The Legislative Reference Service, an entity of the Alabama Legislature, has determined that the Alabama Trust Fund, which invests and administers Alabama's inshore oil and gas royalties, does not capture the revenues that will be generated by the OCS Act. The Commission also recommends consideration of long-term bond funding mechanisms as a potential financial bridge until the OCS royalties can be collected from new offshore oil and gas exploration.

6. Path Forward

The **Commission on Infrastructure** recommends that the Commission and its work be continued through the 2007-2010 legislative quadrennium. The Infrastructure Commission would perform strategic analysis and work with members of the legislature and administration enabling action on as many of the recommendations as possible. Much work remains and can be accomplished more effectively by bringing together many of the state's top transportation infrastructure experts. Continuation of the initiative, with re-appointments and additional appointments as appropriate, would keep a necessary focus on this vitally important role of state government.

Concurrently, the expansion of research resources for analyzing Alabama's transportation systems should be initiated. Enhanced analytical and modeling tools are needed to integrate the multiple modes of roads, railways, waterways, and airports. A modern multi-mode research capability will assist with the planning, strategic prioritization, and implementation of transportation infrastructure projects. The modeling analysis will help focus transportation infrastructure investments in areas supporting the state's economic well-being for the long-term.

The members of the Commission on Infrastructure wish to thank Speaker Seth Hammett and the members of the Alabama Legislature for the opportunity to focus on this extremely important issue. In addition, we would like to thank Manufacture Alabama and its members for supporting the day-to-day work of the Commission and committees. We offer these recommendations after much deliberation and stand ready to continue our service in assisting with preparing Alabama for a strong and prosperous economic future.

Table of Tables

Table of Figures

Exhibits

References

1. Killingsworth, William R., and Gregory A. Harris. *Transportation Infrastructure in Alabama – Meeting the Needs for Economic Growth.* 2005 Report to the U.S. Department of Transportation. University of Alabama in Huntsville Office for Economic Development, 2005, pgs 112-120. <http://www.uaheconomicdevelopment.org/pdfdetails.php?pdf_id=42>

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8. "Current Bridge Needs." Alabama Department of Transportation, 2006.

9. "State of Alabama, short-line Railroad program for Rehabilitation." September q4, 2006.

10. "Fuel tax Evasion said to cost State $56 million." Birmingham News, August 20, 2005, pg 401.

Dr. Bill Killingsworth, Chairman of the Commission's Research & Technical Analysis Committee, in conjunction with Manufacture Alabama representatives directed the creation of this report. Dr. Greg Harris, Director of the UAH Office for Freight, Logistics, and Transportation, provided oversight of the final edits performed by Jeff Thompson and Karen Yarbrough of the UAH Office for Economic Development. Questions regarding this report may be sent to jeff.thompson@uah.edu. Other questions related to the Alabama Commission on Infrastructure may be directed to Manufacture Alabama, 401 Adams Avenue, Montgomery, AL 36104, (334) 386-3000.

Exhibit A

Alabama Commission on Infrastructure Members 2006

Seth Hammett, Speaker
Alabama House of Representatives

Larry Armstead
Hyundai Motor Corporation

John Baker
Norfolk-Southern Railway

Greg Barker
Alabama Power Company

Thomas Bates
Degussa Corporation

Kay Batey
Federal Highway Administration

Fred Blackwell
Michelin North America

John Bradley
Tennessee Valley Authority

Ron Davis
ZF Lemforder Corporation

Dr. John Eagerton, IV
Alabama Department of Transportation

Dallas Fanning
City of Huntsville

Ronnie Flippo
R.G. Flippo & Associates

Crum Foshee
Crum Foshee & Associates

Sen. Steve French
Alabama State Senate

Carol Gordy
Natural Decorations, Inc.

Tommy Johnson, Chair
Frontier Yarns, LLC

Franky Griggs
Nucor Steel
Maintenance & Upkeep
Committee Chair

David Hale, Ph.D.
University of Alabama

Mike Harper
Alabama Department of Transportation

Horace Horn
Alabama Electric Cooperative

Dwight Jennings
Southern Shipping & Logistics
Freight Shipments & Logistics
Committee Chair

Kent Kelly
Kelly Aerospace Group

Bill Killingsworth, Ph.D.
UAH
Research & Technical Assistance
Committee Chair

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Alabama House of Representatives

Chris Lewis
CBL Enterprises

Billy Norrell
Alabama Road Builders' Association

Jimmy Lyons
Alabama State Port Authority
Waterways & Port Development
Sub-committee Chair

Commission Members, Continued

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McClain Engineering

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Holcim (US) Inc.
Trucking & Truck Freight Movement
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Parker Towing Company

Sen. Myron Penn
Alabama State Senate

Deepa Rawls
Weyerhaeuser Company - Pine Hill Operation

Jerry Sailors
Coosa-Alabama River Improvement Association

Jimmy Shumock
Thompson Engineering

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SEARP&DC

Ron Sparks
Department of Agriculture & Industries

Sherman Suitts
Vulcan Materials Company

Linda Swann
ADO
Economic Development
Committee Chair

Richard Tucker
Port of Huntsville

Rep. Cam Ward
Alabama House of Representatives
Non-Freight Movement & Transportation
Committee Chair

Bill Watson
B.R. Williams Trucking

Bruce Windham
The Drummond Company, Inc.

Rep. Greg Wren
Alabama House of Representatives
Wren and Associates

Exhibit B

Infrastructure Commission Committee

Economic Development

Linda Swann, *Chair*
ADO

Greg Barker
Alabama Power Company

Fred Blackwell
Michelin North America

John Bradley
Tennessee Valley Authority

Victor Burns
Nucor Steel Birmingham, Inc.

Dr. John Eagerton, IV
Alabama Department of Transportation

Rosemary Elebash, NFIB

Ronnie Flippo
R.G. Flippo & Associates

Sen. Steve French
Alabama State Senate

Carol Gordy
Natural Decorations, Inc.

John Harrell
Bradley Arant Rose & White

Horace Horn
Alabama Electric Cooperative

Samuel Kanter
Bradley Arant Rose & White LLP

Jim Key
Warren, Averett, Kimbrough & Marino, LLC

William Killingsworth, Ph.D., UAH

Rep. John Knight
Alabama House of Representatives

Michael Kumpf, BP

Chris Lewis
CBL Enterprises

Lori Lindsey
CenturyTel

Bill McClain
McClain Engineering

Rep. Frank McDaniel
Alabama House of Representatives

Steve Murphy
Alagasco

Marty Parker
Boise Paper

Deepa Rawls
Weyerhaeuser Company - Pine Hill Operation

Jerry Sailors
Coosa-Alabama River Improvement Association

Heather Shar, UAH

Jimmy Shumock
Thompson Engineering

Tom Solomon
SEARP&DC

Ron Sparks
Department of Agriculture & Industries

Andy Steele
CMC Steel Alabama

Richard Swanson
National Packaging Co., Inc.

Jeff Thompson, UAH

Larry Watts

Bruce Windham
The Drummond Company, Inc.

Rep. Greg Wren
Alabama House of Representatives
Wren and Associates

Exhibit C

Infrastructure Commission Committee

Maintenance & Upkeep of Infrastructure Assets

Franky Griggs, *Chair*
Nucor Steel

John Baker
Norfolk-Southern Railway

Kenan Boswell
Sabel Steel

David Collins
Holcim (US) Inc.

Rosemary Elebash
NFIB

Sen. Steve French
Alabama State Senate

David Hale, Ph.D.
University of Alabama

Mike Harper
Alabama Department of Transportation

William Killingsworth, Ph.D.
UAH

Ken Ledbetter
CMC Steel Alabama

Bill McClain
McClain Engineering

Billy Norrell
Alabama Road Builders' Association

Tim Parker
Parker Towing Company

Jerry Sailors
Coosa-Alabama River Improvement Association

Heather Shar
UAH

Jimmy Shumock
Thompson Engineering

Richard Swanson
National Packaging Co., Inc.

Jeff Thompson
UAH

Paul Vercher
Birmingham Regional Chamber of Commerce

Bruce Windham
The Drummond Company, Inc.

Gary Young
Nucor Steel Birmingham, Inc.

Exhibit D

Infrastructure Commission Committee

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Dwight Jennings, *Chair*
Southern Shipping & Logistics

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Parker Towing Company, Inc.

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Norfolk-Southern Railway

John Baker, III
Thompson Engineering

Thomas Bates
Degussa Corporation

Kay Batey
Federal Highway Administration

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Russell Corporation

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Nucor Steel Tuscaloosa, Inc.
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Parker Towing Company, Inc.

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Forrest King
Jensen Shipping Company, Inc.

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BP
Rail Subcommittee Chair

Jimmy Lyons
Alabama State Port Authority
Waterways & Port Development
Subcommittee Chair

Rep. Frank McDaniel
Alabama House of Representatives

Joe McFalls
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Trucking & Truck Movement of Freight
Subcommittee Chair

Randy McRae
International Paper
Public Policy
Subcommittee Chair

Tim Parker
Parker Towing Company

Deepa Rawls
Weyerhaeuser Company - Pine Hill Operation

Darlene Rotch
Panorama Public Relations

Heather Shar, UAH

Rick Snow
Parker Towing Company, Inc.

Jeff Thompson, UAH

Richard Tucker
Port of Huntsville

Bill Watson
B.R. Williams Trucking

Bruce Windham
The Drummond Company, Inc

Exhibit E

Infrastructure Commission Committee
Non-freight Movement & Transportation Needs

Rep. Cam Ward, Chair
Alabama House of Representatives

Michael Anderson
UAH

Taylor Blackwell
Walker Printing

Sonny Brasfield
Assoc. of County Commissions of Alabama

Robert Chappelle, Jr.
Mobile Area Chamber of Commerce

Randy Cole
Shelby County Engineering Dept.

Dr. John Eagerton, IV
Alabama DOT

Wayne Echols
Greater Shelby County Chamber of Commerce

Dallas Fanning
City of Huntsville

Mike Harper
Alabama DOT

William Killingsworth, Ph.D.
UAH

Bill McClain
McClain Engineering

Billy Norrell
Alabama Road Builders Assoc.

Heather Shar
UAH

Jimmy Schumock
Thompson Engineering

Ron Sparks
Dept. of Agriculture and Industries

Sherman Suitts
Vulcan Materials Company

Linda Swain
ADO

Jeff Thompson
UAH

Paul Vercher
Birmingham Regional Chamber of Commerce

Larry Watts

Rep. Greg Wren
Alabama House of Representatives
Wren & Associates

Glen Zorn
Dept of Agriculture and Industries

Appendix D

Transportation Legislation Introduced

Transportation bills introduced and passed by the House of Representatives based upon the recommendations coming from the Commission on Infrastructure.

- HB 064 – Establishing the Alabama Transportation Commission
- HB119 – Establishing coordination and planning for Alabama inland waterways in the Alabama Department of Transportation
- HB121 – To provide further for the powers of the Alabama Toll Road, Bridge, and Tunnel Authority
- HB280 - to administer a statewide comprehensive program of shortline railroad rehabilitation and improvement
- HB748 – County Bridge Replacement and Road Repair Bond
- HB749 - revise the motor fuel tax laws and tax collection and enforcement processes

Transportation bills introduced and passed out of committee by the Senate based upon the recommendations coming from the Commission on Infrastructure.

- SB040 – Establishing the State Transportation Commission

Appendix E

Papers Submitted and Published

Articles submitted to peer review journals

- **"Using Industry Clusters to Develop a Statewide Freight Flow Model for Alabama,"** Submission to The *Journal of the Transportation Research Forum (JTRF)*. Michael Anderson, Alisha Youngblood, and Gregory Harris.

- **" Preliminary Freight Model Validation Using Extreme-World Scenario Construction,"** Submission to The *Journal of the Transportation Research Forum (JTRF)*. Heather R. Shar, Paul J. Componation, Michael D. Anderson, and Alisha D. Youngblood.

Papers submitted to the Transportation Research Board Annual conference.

- **"A Freight Planning Framework,"** Harris, Gregory A. and Michael D. Anderson. Submitted to the Transportation Research Record, July 2007.

- **"Developing Freight Analysis Zones at a State Level: A Cluster Analysis Approach,"** Harris, Gregory A., Phillip A. Farrington, Michael D. Anderson, Niles Schoening, and James Swain. Submitted to the Transportation Research Record, July 2007.

- **"A Methodology to Use FAF2 Data to Forecast Statewide External-External Trips,"** Anderson, Michael D., Mallikarjuna Kenchapagoudra, Mary Catherine Dondapati and Gregory A. Harris. Submitted to the Transportation Research Record, July 2007.

- **"Using FAF2 Data to Analyze Freight Impact of Interstate 22,"** Anderson, Michael D., Mary Catherine Dondapati and Gregory A. Harris. Submitted to the Transportation Research Record, July 2007.

Papers submitted and accepted to other conferences.

- **"Container Terminal Simulation,"** Gregory A. Harris, Lauren Jennings, Bernard J. Schroer, and Dietmar P.F. Moeller. The Huntsville Simulation Conference, October 2007.

- **"Coal Terminal Simulation,"** Gregory A. Harris, Anthony Holden, Bernard J. Schroer, and Dietmar P.F. Moeller. The Huntsville Simulation Conference, October 2007.

- **"A Freight Planning Framework,"** Gregory A. Harris and Michael D. Anderson. Research Issues in Freight Conference, October 2007, Washington, D.C., Poster presentation.

- **“Using Simulation to Evaluate and Improve the Operations of a Seaport Container Terminal,”** Gregory A. Harris, Lauren Jennings, Bernard J. Schroer, and Dietmar P.F. Moeller. National Urban Freight Conference, December 2007.

- **“Developing Freight Analysis Zones at a State Level: A Cluster Analysis Approach,”** Gregory A. Harris, Ph.D., P.E., Phillip A. Farrington, Ph.D., Michael D. Anderson, Ph.D., P.E., Niles Schoening, Ph.D., James Swain, Ph.D. Transportation Research Forum Annual Conference, May 2008.

- **“Cost Analysis of Proposed Truck-Only Highway Segments in Alabama,”** Alisha Youngblood, Ph.D., Michael Anderson, Ph.D., P.E., and Gregory A. Harris, Ph.D., P.E. Transportation Research Forum Annual Conference, May 2008.