Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SWUTC/02/467504-1		

4. Title and Subtitle	5. Report Date
GIS to Identify Strategic Freight Corridors in Texas	February 2002
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Brian W. Craig and C. Michael Walton	Report 467504-1

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Center for Transportation Research University of Texas at Austin 3208 Red River, Suite 200 Austin, Texas 78705-2650	11. Contract or Grant No. 10727

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Southwest Region University Transportation Center Texas Transportation Institute Texas A&M University System College Station, Texas 77843-3135	14. Sponsoring Agency Code

15. Supplementary Notes

Supported by general revenues from the State of Texas.

16. Abstract

The goals of this report are to identify the strategic freight corridors (SFC) in the state of Texas. Freight corridors can be defined for various modes of transportation. For this project, however, only the truck mode was evaluated. A model was created to identify areas of economic significance within the state. For the purpose of data collection, the county was used as the analysis region.

The model developed identified the economically significant counties in the state using economic and non-economic data to capture the demand to move goods within a county. The economic data consisted of the county income date for the five largest industries in the state that required a significant demand to transport goods. The non-economic income data consisted of dummy variables that modeled the presence of intermodal and border crossing facilities. A final score for each county was computed by assigning the weighting factor to the scores for each criterion and summing up each criterion score. A cutoff value was calculated to determine the economic significance of a county.

Forty-six counties were determined to be economically significant. The SFC network was selected by identifying the economically significant counties and then interconnecting these counties with a minimal network that was not too circuitous.

A sensitivity test was performed to determine how the model's weighting scheme affected the selection of highways for the SFC network. This sensitivity test revealed that the weighting scheme had no effect on the selection of highways for the SFC network.

17. Key Words	18. Distribution Statement
ITS, GIS, Freight Corridors	No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif.(of this report)	20. Security Classif.(of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	140	

GIS TO IDENTIFY STRATEGIC FREIGHT CORRIDORS IN TEXAS

by

Brian W. Craig

and

C. Michael Walton

Research Report SWUTC/02/467504-1

Combined final report for the following two SWUTC projects:
Strategic Freight Corridors in Texas – 467504
&
Evaluation of the Integration of ITS, GIS and GPS – 467302

Southwest Region University Transportation Center

Center for Transportation Research

University of Texas at Austin

Austin, TX 78712

May 1998

Revised February 2002

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. Mention of trade names or commercial products does not constitute endorsement or recommendations for use.

ACKNOWLEDGEMENT

The authors recognize that support for this research was provided by a grant from the U.S. Department of Transportation, University Transportation Centers program to the Southwest Region University Transportation Center which is funded 50% with general revenue funds from the State of Texas.

ABSTRACT

The goals of this report are to identify the strategic freight corridors (SFC) in the state of Texas. Freight corridors can be defined for various modes of transportation. For this project, however, only the truck mode was evaluated. A model was created to identify areas of economic significance within the state. For the purpose of data collection, the county was used as the analysis region.

The model developed identified the economically significant counties in the state using economic and non-economic data to capture the demand to move goods within a county. The economic data consisted of the county income date for the five largest industries in the state that required a significant demand to transport goods. The non-economic income data consisted of dummy variables that modeled the presence of intermodal and border crossing facilities. A final score for each county was computed by assigning the weighting factor to the scores for each criterion and summing up each criterion score. A cutoff value was calculated to determine the economic significance of a county.

Forty-six counties were determined to be economically significant. The SFC network was selected by identifying the economically significant counties and then interconnecting these counties with a minimal network that was not too circuitous.

A sensitivity test was performed to determine how the model's weighting scheme affected the selection of highways for the SFC network. This sensitivity test revealed that the weighting scheme had no effect on the selection of highways for the SFC network.

EXECUTIVE SUMMARY

Highways in the U.S. have become increasingly more congested. This is a direct result of traffic growing at a faster rate than road capacity. Between 1980 and 1992, total urban vehicle miles traveled (VMT), increased by 61 percent while urban roadway mileage increased by only 26 percent. One indicator of congestion is VMT per lane mile. Between 1985 and 1994 VMT per lane mile on urban Interstates increased by 24 percent. Congestion results in many inconveniences to the driving public ranging from frustration to longer workdays. Excessive delay not only affects automobiles but also commercial vehicles. Freight shipments carried by truck travel on the same roadways as automobiles and as such are subjected to the same delays as automobiles. Fortunately, however, intelligent transportation systems (ITS) promise to reduce congestion and improve travel times on U.S. highways at a much lower cost than roadway construction.

While all ITS services promise to reduce delay and congestion, some ITS technologies and services address the special needs to commercial vehicle operators. These include but are not limited to WIM systems, electronic clearance systems, and AVL systems. Each of these systems allow operators to eliminate or reduce reoccurring delay associated with weigh stations, and toll collection. Additionally, commercial vehicle operators are able to reduce congestion delay by routing trucks around congested areas based on time of day and traffic conditions. The deployment of these ITS technologies require government and private funding. ITS must be deployed in areas where it will have the greatest impact. The identification of strategic freight corridors in the state of Texas is a first step to identify strategic roadways that should be considered for ITS deployment.

This study identifies the strategic freight corridors (SFC) within the state of Texas. The advantage of defining SFCs is that it encourages resources to be focused on a limited number of high-priority routes. This report identifies the counties of economic significance within the state. These counties have been identified based on the income data for the most important industries in the state. The efficient movement of goods to and from these counties is essential to maintaining the economic vitality of the state. It is for this reason that the main objective of the SFC network is to interconnect the most economically significant counties in the state.

The process of identifying the SFC network began with the development of a model to identify the economically significant counties in the state. Data essential to the model were identified and collected. The results of the model were input into a Geographic Information System (GIS) to be spatially analyzed. The strategic freight corridors were identified as highways that interconnect the most economically significant counties. The final SFC network meets this objective by interconnecting all but three of the most economically significant counties in the state. For the most part, the SFC network provides non-circuitous routes between all the economically significant counties. Approximately two thirds of the 254 counties in the state are located along a SFC. This represents approximately 90 percent of the income

for the five industries included in the study. Over 80 percent of the counties and 98 percent of the state income are located within 20 miles of a SFC.

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION 1
1.1 Background 1
1.2 Objective & Scope 2
1.3 Report Organization 2
CHAPTER 2 LITERATURE SEARCH 5
2.1 Federally Designated Corridors 5
2.1.1 National Highway System 5
2.1.2 High-Priority Highways 7
2.1.3 STRAHNET 7
2.2 State Designated Corridors 9
2.2.1 Wisconsin 9
2.2.2 Ohio 11
2.2.3 Western Transportation Trade Network (WTTN) 15
2.3 Academic Work 17
2.3.1 Yu 17
2.3.2 Shieh 18
2.4 Other 23
2.4.1 Port Authority of New York 23
2.4.2 Federal Highway Administration (FHWA) 25
CHAPTER 3 METHODOLOGY AND PROCEDURE 27
3.1 Criteria 27
3.2 Economic Criteria 29
3.2.1 Manufacturing 29
3.2.2 Farming 30
3.2.3 Mining 31
3.2.4 Retail 31
3.2.5 Wholesale 32
3.3 Indirect Economic Criteria 32
3.3.1 Marine Port 33
3.3.2 Airport 33
3.3.3 Rail/Truck 34
3.3.4 Border Crossing 34
3.4 Aggregation 35
3.5 Summary 35

CHAPTER 4 RESULTS 37
4.1 Manufacturing Income 37
4.2 Farming Income 38
4.3 Mining Income 38
4.4 Retail Income 38
4.5 Wholesale Income 39
4.6 Marine Port 39
4.7 Airport 45
4.8 Border Crossing 45
4.9 Rail/Truck 45
4.10 Aggregated Criteria 45
4.11 Highway Network 49
4.12 Overlay of Highway and Aggregated 49
4.13 Summary 57
CHAPTER 5 VALIDATION 59
5.1 Validation Methodology 59
5.2 Validation Results 59
5.2.1 Manufacturing 62
5.2.2 Wholesale 63
5.2.3 Retail 64
5.2.4 Farming 65
5.2.5 Mining 66
5.2.6 Border Crossing 67
5.2.7 Intermodal Facilities 68
5.3 Summary 69
CHAPTER 6 North American Free Trade Agreement 73
6.1 Background 73
6.2 Data Scope and Sources 74
6.2.1 Import Data 75
6.2.2 Export Data 76
6.3 Flow of Goods Through Texas 77
6.4 Flow of Goods Through Laredo 78
6.5 Travel Time Calculations 78
6.6 Travel Time Comparison 79
6.7 Summary 80
CHAPTER 7 SUMMARY, CONCLUSION, AND RECOMMENDATIONS 83
7.1 Summary 83

7.2 Conclusion 83
7.3 Recommendation 84
APPENDIX A COUNTY INCOME AND WEIGHTING INFORMATION 87
APPENDIX B INTERMODAL FACILITY LOCATIONS 99
APPENDIX C EXCEL MACROS 107
APPENDIX D U.S.-MEXICO TRADE DATA 119
REFERENCES 123

LIST OF FIGURES

Figure 2.1	National Highway System	6
Figure 2.2	Strategic Highway Corridor Network (STRAHNET)	8
Figure 2.3	Wisconsin's Corridor 2020 Plan	10
Figure 2.4	Ohio Weighted Point Map	14
Figure 2.5	Western Trade Network (WTTN) Map	16
Figure 2.6	National ITR Network	19
Figure 2.7	Texas ITR Network	20
Figure 2.8	Minimum Highway Network Map	22
Figure 4.1	Manufacturing County Ranking	40
Figure 4.2	Farm County Ranking	41
Figure 4.3	Mining County Ranking	42
Figure 4.4	Retail County Ranking	43
Figure 4.5	Wholesale County Ranking	44
Figure 4.6A	Marine Port Ranking	46
Figure 4.6B	Airport Ranking	46
Figure 4.7A	Border Crossing Ranking	47
Figure 4.7B	Rail/Truck Ranking	47
Figure 4.8	Final County Ranking	48
Figure 4.9	Texas Highway System	50
Figure 4.10	County Ranking Highway Overlay	51
Figure 4.11	Tier 1 Interstate Overlay	53
Figure 4.12	Tier 1 SFC Overlay	54
Figure 4.13	Tier 2 SFC Overlay	55
Figure 4.14	Tier 2 SFC Final Overlay	56
Figure 4.15	Final SFC Network	58
Figure 5.1	Economically Significant Counties	61
Figure 5.2	Manufacturing Counties	62
Figure 5.3	Wholesale Counties	63
Figure 5.4	Retail Counties	64
Figure 5.5	Farming Counties	65
Figure 5.6	Mining Counties	66
Figure 5.7	Border Crossing Counties	67
Figure 5.8	Intermodal Facility Counties	68
Figure 5.9	Economically Significant Counties (Base Case)	70

Figure 5.10 Economically Significant Counties (Additional Counties) 71
Figure 6.1 U.S. 59 Lane Widths 74
Figure 7.1 Final SFC Network 85

LIST OF TABLES

Table 2.1	Criteria Weighting	12
Table 2.3	Example Criteria Ranking	13
Table 3.1	Criteria Weighting	28
Table 3.2	Texas Gross State Product (GSP)	29
Table 3.3	Manufacturing Income Criteria Ranking	30
Table 3.4	Farming Income Criteria Ranking	30
Table 3.5	Mining Income Criteria Ranking	31
Table 3.6	Retail Income Criteria	32
Table 3.7	Wholesale Criteria Ranking	32
Table 3.8	Marine Port Criteria Ranking	33
Table 3.9	Airport Criteria Ranking	34
Table 3.10	Rail/Truck Transfer Criteria Ranking	34
Table 3.11	Border Crossing Criteria Ranking	35
Table 3.12	Example Data Aggregation for Harris County	35
Table 4.1	Corridor Selection Criteria	37
Table 4.2	Mode Share of U.S.-World Trade	39
Table 5.1	Weighting Scheme Effects	60
Table 5.2	Criteria Weighting Affect on Economically Significant Counties	69
Table 6.1	U.S.-Mexico Truck Trade Through Texas	75
Table 6.2	Content of Import Files with Geographic Detail (Jan.-Dec. 1996)	75
Table 6.3	Geographic Regions	76
Table 6.4	Content of Export Files with Geographic Detail (Jan.-Dec. 1996)	77
Table 6.5	U.S.-Mexico Truck Trade through Texas	77
Table 6.6	U.S.-Mexico Truck Trade through Laredo, TX	78
Table 6.7	IH 35 vs. U.S. 59 Travel Time	81
Table A-1	County Population and Income Data	89
Table A-2	County Weighting Data	94
Table B-1	Rail/Truck Intermodal Facilities	101
Table B-2	Marine Ports in Texas	102
Table B-3	Air Cargo at U.S. Airports	103
Table B-4	Enplanements at Texas Airports	105
Table D-1	Imports through Texas	121
Table D-2	Exports through Texas	122

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

Over the last two decades, U.S urban highways have become increasingly more congested. This is a direct result of traffic growing at a faster rate than road capacity. Between 1980 and 1992, total urban vehicle miles traveled (VMT), increased by 61 percent while urban roadway mileage increased by only 26 percent (Ref. 1). One indicator of congestion is VMT per lane mile. Between 1985 and 1994 VMT per lane mile on urban Interstates increased by 24 percent (Ref. 2). Congestion results in many inconveniences to the driving public ranging from frustration to longer workdays. Two well-documented costs of congested are wasted time and fuel.

Congestion resulted in delay that cost Americans 43 billion dollars in 1990 (Ref. 3). In Texas, highway vehicles in the largest urban areas: Austin, Corpus, Dallas, El Paso, Fort Worth, Houston, and San Antonio, experienced over 940,000 hours of delay per day in 1992 (Ref. 4). This represented an increase of over 24 percent from 1986. Excessive delay not only affects automobiles but also commercial vehicles. Freight shipments carried by truck travel on the same roadways as automobiles and as such are subjected to the same delays as automobiles.

Since World War II, the United States has become the world economic super power. One factor that has helped the U.S establish itself as such a power has been its ability to rapidly move people and goods, particularly over the interstate highway system begun in 1956 (Ref. 5). This competitive advantage, however, is being eroded by the ever-increasing congestion in U.S cities through out the country (Ref. 5). Once confined to the peak hours, many cities have seen “rush hour” consume the entire day (Ref. 6). As congestion worsens, so does the reliability of travel times. In the United States, the average duration of a one way commute is 24 minutes, the standard deviation, however, is 30.4 minutes. This indicates commute times vary widely and can in fact take twice as long as the average (Ref. 6). Unfortunately, building additional highway miles is not guaranteed to relieve congestion problems in U.S urban areas because most urban areas experience latent travel demand. In these cases, the demand to use existing transportation facilities is artificially deflated because of highway congestion. Increasing capacity through the construction of new facilities would only result in the latent demand travelers utilizing the additional capacity. If the additional capacity is not greater than the latent demand, the system will reach congestion levels prior to construction. Fortunately, however, intelligent transportation systems (ITS) promise to reduce congestion and improve travel times on U.S highways at a much lower cost than roadway construction.

Intelligent transportation systems are information technologies that, when implemented in vehicles, on roadways, or centrally, can lead to savings in journey time, improve driver safety and convenience, and significant reductions in energy consumption and pollution (Ref. 5). The implementation of certain ITS technologies could reduce total delay by as much as 35% (Ref. 5). An example of the many ITS technologies available that promise to reduce delay and ease congestion are: Advance traffic

management systems (ATMS), advanced traveler information systems (ATIS), electronic payment systems , weigh-in-motion systems (WIM), and automatic vehicle location systems (AVL).

While all ITS services promise to reduce delay and congestion, some ITS technologies and services address the special needs of commercial vehicle operators. These include but are not limited to WIM systems, electronic clearance systems, and AVL systems. Each of these systems allow operators to eliminate or reduce reoccurring delay associated with weigh stations, and toll collection. Additionally, commercial vehicle operators are able to reduce congestion delay by routing trucks around congested areas based on time of day and traffic conditions.

The deployment of many ITS technologies remain expensive and require a significant capital investment in infrastructure. The deployment of these ITS technologies require government and private funding. Unfortunately, the cost of deployment prohibits ITS from being implemented wherever delay occurs. As such the deployment of ITS using government dollars needs to be systematically evaluated. ITS must be deployed in areas where it will have the greatest impact. The identification of strategic freight corridors in the state of Texas is a first step to identify strategic roadways that should be considered for ITS deployment.

1.2 OBJECTIVE AND SCOPE

Simply stated, the objective of this study is to identify the strategic freight corridors (SFC) within the state of Texas. The advantage of defining SFCs is that it encourages resources to be focused on a limited number of high-priority routes. This report identifies the counties of economic significance within the state. These counties have been identified based on the income data for the most important industries in the state. The efficient movement of goods to and from these counties is essential to maintaining the economic vitality of the state. It is for this reason that the main objective of the SFC network is to interconnect the most economically significant counties in the state.

The process of identifying the SFC network began with the development of a model to identify the economically significant counties in the state. Data essential to the model were identified and collected. The results of the model were input into a Geographic Information System (GIS) to be spatially analyzed. The strategic freight corridors were identified as highways that interconnect the most economically significant counties.

1.3 REPORT ORGANIZATION

This report comprises seven chapters including this introduction. The second chapter is a brief literature review on the work that has been done on strategic freight corridors and corridor designation. A number of states have identified freight or trade corridors. The methodology used by each will be presented. Additionally, other research at the federal and academic level will be examined.

The third chapter deals with the methodology and procedure this study used to identify the strategic freight corridors in the state of Texas. A model to identify the economically significant counties in the state and subsequently the strategic freight corridors is developed and presented in this chapter.

The fourth chapter is a discussion of the results. The economically significant counties in the state are identified based on the model results. The strategic freight corridor network is also identified based on an overlay of the Texas highway system and the economically significant counties.

The fifth chapter is a discussion of the process used to validate the results. A sensitivity analysis is performed to test the significance of each variable in the model and to determine how the weighting scheme of the model affects the selection of the strategic freight corridor network.

The sixth chapter mentions the potential effects of the North American Free Trade Agreement (NAFTA). Surface trade data were analyzed to determine the origin and destination of U.S. - Mexico trade and to determine if any additional highways should be included as strategic freight corridors based on that information.

A summary, brief conclusion and recommendations are provided in chapter 7. Supporting data are included in an appendix at the end of this report.

CHAPTER 2 LITERATURE SEARCH

The following literature review is divided into four sections. The first section provides an overview of the Federal work done in corridor designation. The second section discusses the work by several states in identifying freight and trade corridors. The methodology and approach used by each state is discussed. The third section provides an overview of the work done in academia. The last section discusses the work done by other agencies.

2.1 FEDERALLY DESIGNATED CORRIDORS

2.1.1 National Highway System

In the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), Congress called on the Department of Transportation to submit a proposal identifying routes to be included in the National Highway System (NHS). The proposed NHS would consist of the most important roads in the U.S that carries a large share of the traffic volume (Fig. 2.1). The NHS was created to encourage states to focus resources on a limited number of high-priority routes and to concentrate on improving them with federal dollars.

On February 19, 1991, the Federal Highway Administration (FHWA) submitted a map of the proposed NHS to the House Committee on Environment and Public Works. This map consisted of 155,000 miles of roadways to be used as a starting point to identify the NHS. The roadways included in the NHS consisted of the Interstate System, high-priority corridors identified by ISTEA, the Strategic Highway Network and its connectors identified by the Department of Defense, and selected principal arterials.

The Interstate component consists of almost 45,000 miles, which accounts for almost 30 percent of NHS. The second component includes the 21 congressionally designated high-priority corridors as identified in ISTEA. These corridors total 4,5000 miles. The third component is the non-Interstate portion of the Strategic Highway Corridor Network (STRAHNET), identified by the Department of Defense in cooperation with DOT. It totals about 15,700 miles and along with the Interstate System, is considered the most critical link in the U.S. transportation system. These links are critical to move troops and equipment via highways to airports, ports, rail terminals, and other bases for rapid deployment. The fourth component is major Strategic Highway Corridor Network connectors. They consist of more than 1,900 miles of roads linking major military installations and other defense-related facilities to the STRAHNET corridors.

Collectively, these four components account for about 67,500 miles or roughly 43 percent of the system. The fifth component, about 91,000 miles of important arterial highways serve Interstate and interregional travel and provide connections to major ports, airports, public transportation facilities, and other intermodal facilities.

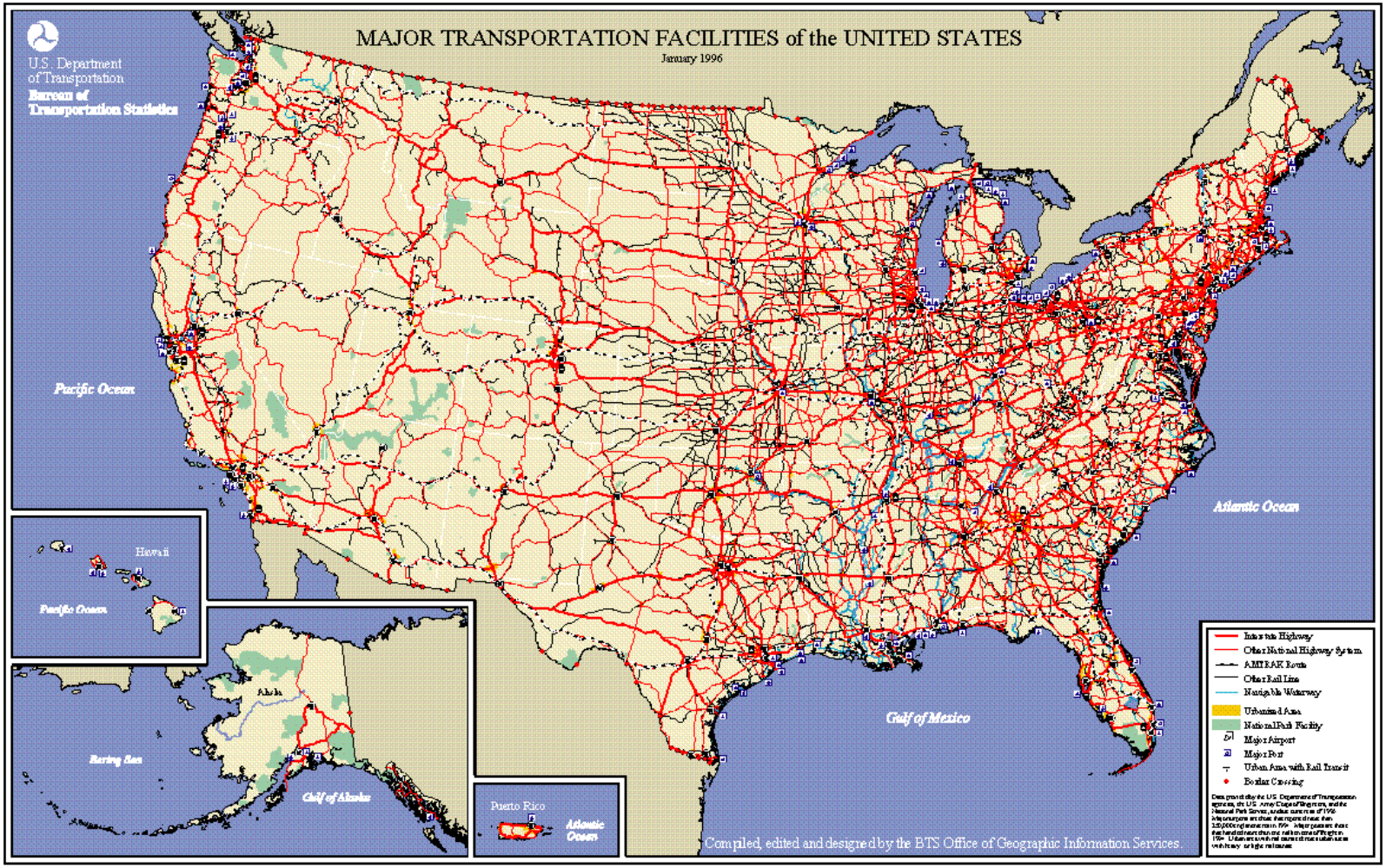

Figure 2.1 Strategic Freight Corridor Network (STRAHNET)

The NHS will promote safe efficient operations on the included network as well as numerous economic benefits. According to Secretary of transportation Rodney Slater (Ref. 19):

- The National Highway System will provide what U.S retail, industrial and other employers need- namely a predictable, consistent and reliable delivery system.
- It will provide low-cost, reliable, and flexible transportation to minimize costs, serve plants geared to just-in-time delivery, and make U.S companies more competitive in the global marketplace

In essence, the NHS promises to reduce congestion on the NHS highways and reduce the amount of time Americans waste sitting in their automobiles by targeting current and projected bottlenecks on the most important U.S highways

2.1.2 High-Priority Highways

The completion of the Interstate system concluded an era in which significant economic growth in the United States resulted in the increased mobility of the nation and the ability to rapidly move people and goods to the major population centers through out the Nation. Today, many regions of the U.S are not adequately served by the Interstate System or comparable highways and require further highway development in order to serve the travel and economic development needs of the region. The ISTEA designation act required the development of transportation corridors to efficiently and to effectively connect regions and improve efficiency and safety of commerce and travel and further promoting economic development. With help from the states, Congress established 21 high-priority highway corridors as part of a long range plan to allow states to give increase funding to the highway segments that make up these corridors.

2.1.3 Strategic Highway Corridor Network

The Strategic Highway Corridor Network is a network designated by the Department of Defense (DOD) in 1991 (Fig. 2.2). The network was developed to include the highways most critical to the rapid movement and deployment of troops to defend the United States in times of warfare and heightened security. This network provides critical links between military bases through out the country and major airports and marine ports used to deploy equipment and troops to other areas of the country and to foreign nations. Four hundred military installation and ports were identified for the analysis.

The Military Traffic Monitor Control (MTMC) team of the DOD identified four types of movements that needed to be accounted for when defining STRAHNET these were: peacetime movements, war time movements, oversize/overweight movements, and strategic interest movements.

Figure 2.2 STRAHNET Map

MTMT identified highways used the most during peacetime by evaluating the origins and destination of Govern Bills of Lading (GBL) shipments. The highways used to transport these shipments were included as part of STRAHNET.

The wartime movements were assigned to highways based on the war operation plan. The routes that troops and equipment would take to reach ports and airports were identified. Highways were prioritized according to the number of troop movements. Highways with the most troop and equipment movements were included in STRAHNET.

The oversize/overweight movement category was basically a repeat of the wartime movements. These were routes that would carry oversized equipment. The strategic interest movement category included highways that were critical to the movement of troops over a geographic area such as a mountain range. These highways were considered vital links in the system.

Once the highways for each category were identified, the final network was selected by eliminating redundant highways.

2.2 STATE DESIGNATED CORRIDORS

Numerous states have identified strategic corridors within their respective state. Most of these states have not identified, these corridors based on the movement of freight, but instead the movement of people. Two states, Wisconsin and Ohio, have identified strategic freight corridors within their state. Both states identified the corridors to promote continued economic growth within their state. The Department of Transportation in each state felt that an efficient transportation system promotes economic growth. A number of western states formed a consortium to develop economic growth within the region. Each state identified trade corridors within their state to develop a preliminary network. The work done by Wisconsin, Ohio, and the western states consortium is presented below.

2.2.1 Wisconsin

The Wisconsin Departments of Transportation (WisDOT) identified freight corridors in their Corridor 2020 plan. This plan is a statewide network of high quality highways interconnecting all regions and the major economic centers in the state and tying them to the national highway system (Fig. 2.3). The system is composed of two elements, a backbone system and a connector system. The backbone system consists of 1550 miles of multilane divided freeways, and the connector system consists of 2100 miles of two and four lane highways. Together the system links all regions and the national Interstate system. This report looks at the backbone system and the methodology used to identify it as a means of identifying strategic corridors.

WisDOT recognized that economic development is closely linked to the transportation infrastructure. A link-node approach was adopted to identify the freight corridors in the state. WisDOT identified nodes based on economic data measuring different aspects of the state economy. The links were identified as highways that interconnected the nodes and the National Highway System. In all, five

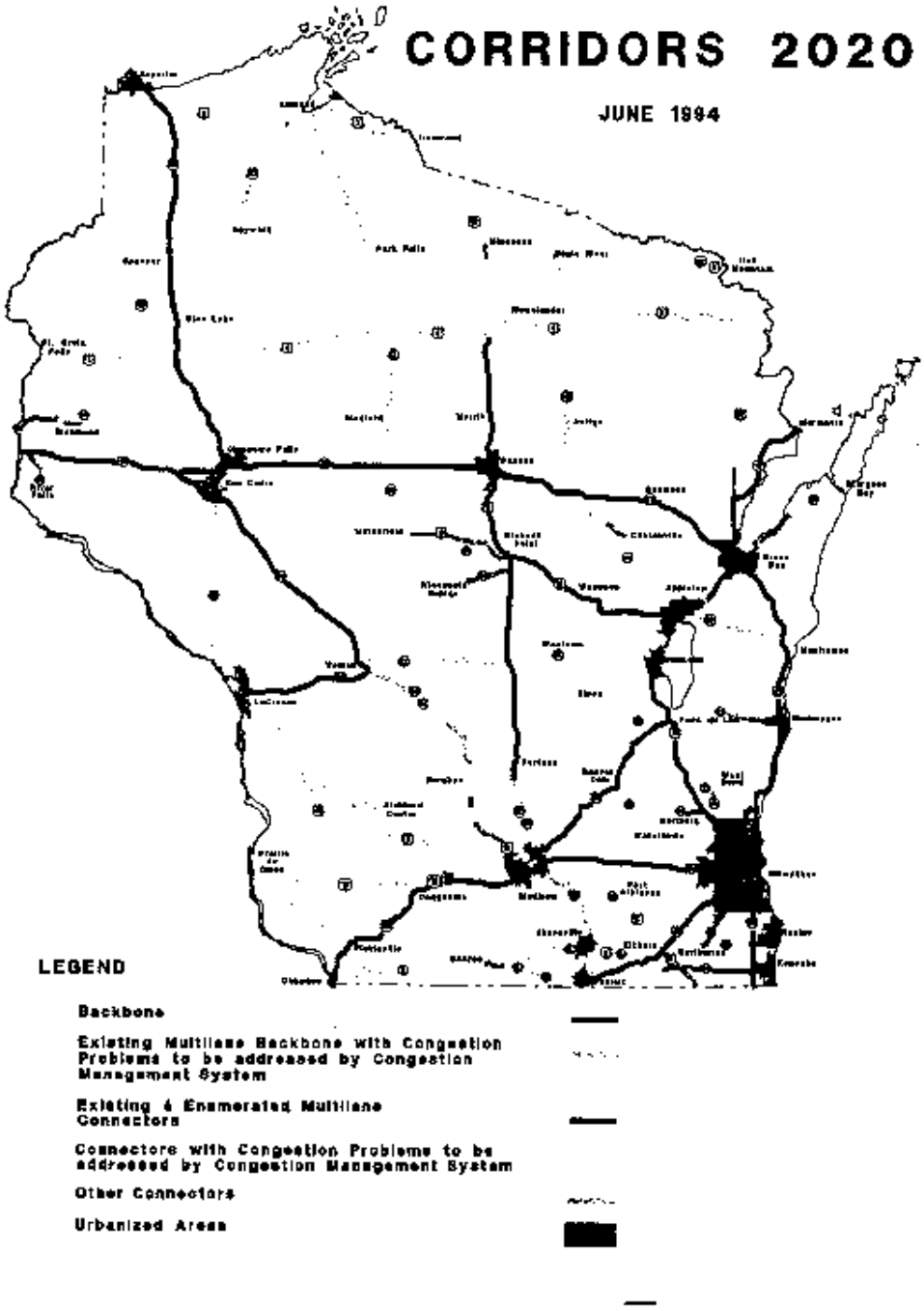

Figure 2.3 Wisconsin Corridor 2020 Plan

criteria were used to identify the nodes on the backbone system (Ref. 7):

- Service to Trade Centers
- Service to Manufacturing Centers
- Service to Agricultural Centers
- Service to Forestry Centers
- Service to Recreational/ Tourism Centers

The process WisDOT used to identify the backbone system included identifying all the major centers for the above categories in the state and selecting highways that interconnected these major centers. To identify the major centers in the state, WisDOT needed to define each type of center according to some measurable parameter.

WisDOT used the Wisconsin Place Classification for Transportation Planning (WPCTP) to identify the major trade centers. The WPCTP establishes a ranking system for population, employment, service receipts, retail trade, and wholesale trade. The ten primary activity centers were identified by aggregating the WPCTP data. These ten centers were identified as nodes for the backbone system. WisDOT proceeded to use the other data sources to rank counties according to the above criteria. The top ten centers in each category were identified as nodes for inclusion on the backbone system.

WisDOT established a sixth criterion for the selection of highways as freight corridors. In addition to selecting highways based on whether they interconnected nodes, WisDOT also identified corridors based on the average daily truck traffic. WisDOT included highways with a daily truck volume in excess of 1,250 in 1994 or 2,100 in 2020 as candidates for the backbone system. These highways serve regional needs regardless of whether they interconnect the defined nodes.

WisDOT used the same procedure to determine candidates for inclusion on their connector system. The connector system was developed to tie in the smaller economic centers with the backbone system and consequently the rest of the state and nation. Together the backbone and connector systems form an efficient transportation network that will allow the state of Wisconsin to compete in the ever-growing international trade market (Ref. 8).

2.2.2 Ohio

The Ohio Department of Transportation (ODOT) identified Transportation Hubs, Clusters, and Corridors in a Paper title *Access Ohio*. ODOT undertook the process of identifying “macro-level” corridors to establish the physical framework for the intermodal transportation system for the state (Ref. 9).

ODOT used a link-node model approach to systematize the selection and identification of the corridors and hubs. The links consisted of highways that connected the nodes, which consist of point locations that ranged in size from airports and water ports to counties. A series of criteria were identified to use in the corridor selection process. Each criterion was defined by some measurable parameter.

Because each criterion was not of equal importance, a relative weighting scheme was developed. Each parameter was ranked and scored from 1 to 5.

This scheme of ranking and weighting of criteria to identify significant hubs and corridors hinged on the ability to score and spatially analyze the input variables. The major advantage of this approach was its flexibility. By changing the weighting scheme, the criteria used as input, or the ranking system, this scheme could be used to observe different outcome based on future projections or a shifting economy.

ODOT evaluated numerous criteria for use in the identification process. Most of the potential criteria were eliminated because of data availability or redundancy. The criteria selected for the identification of the corridors included economic indicators, indirect economic indicators, traffic volumes, and the presence of intermodal facilities. Table 2.1 lists the criteria selected and the weighting factors for each.

ODOT next ranked the data within each criterion group. Logical breakpoints were then applied to the data to create five bins. Each county within a given bin received the same number of points. Table 2.2 shows the structure ODOT used for their ranking system.

TABLE 2.1 CRITERIA WEIGHTING

Corridor: Identification Criteria			
Criterion	Criteria/Sub-criteria		Weight
1	Average Daily/Yearly Traffic		25%
	A	Commercial Truck Traffic	20%
	B	Class I/II Rail (Yearly)	5%
2	Population		20%
3	Economic Activity		30%
	A	Number of manufacturing Establishments	10%
	B	Manufacturing Employment Density	10%
	C	Number of Manufacturing Employees	10%
4	Trade/Intermodal Centers		15%
5	Natural Resources/Agriculture		10%
	A	Natural Resource Centers	5%
	B	Agribusiness Centers	5%

Source: ODOT: Access Ohio: Ohio Multimodal State Transportation Plan To The Year 2000: Macro-Corridors (Ref. 9)

After developing the ranking parameters for each criterion, ODOT assigned these points to each county. ODOT then aggregated all the ranking data by applying the weights to the ranking values and summing them. This gave them their overall values used in the selection of hubs. ODOT selected a cut off point to determine whether a county should be included as a node. The counties that exceeded the cut off value were mapped. The Ohio highway and rail networks were overlayed onto the county ranking map (Fig. 2.4). By observing the relationship between final county rankings and the highway system, highways that interconnect the counties were selected as macro-level corridors.

TABLE 2.2 EXAMPLE CRITERIA RANKING

Criterion: Population	
Points	Population (persons)
5	County > 100,000 with city > 100,000
4	County > 100,000 with city > 50,000
3	County > 50,000 with city > 10,000
2	City > 10,000 (not in above category)
1	City > 5,000 (not in above category)

Source: ODOT: Access Ohio: Ohio Multimodal State Transportation Plan To The Year 2000: Macro-Corridors (Ref. 9)

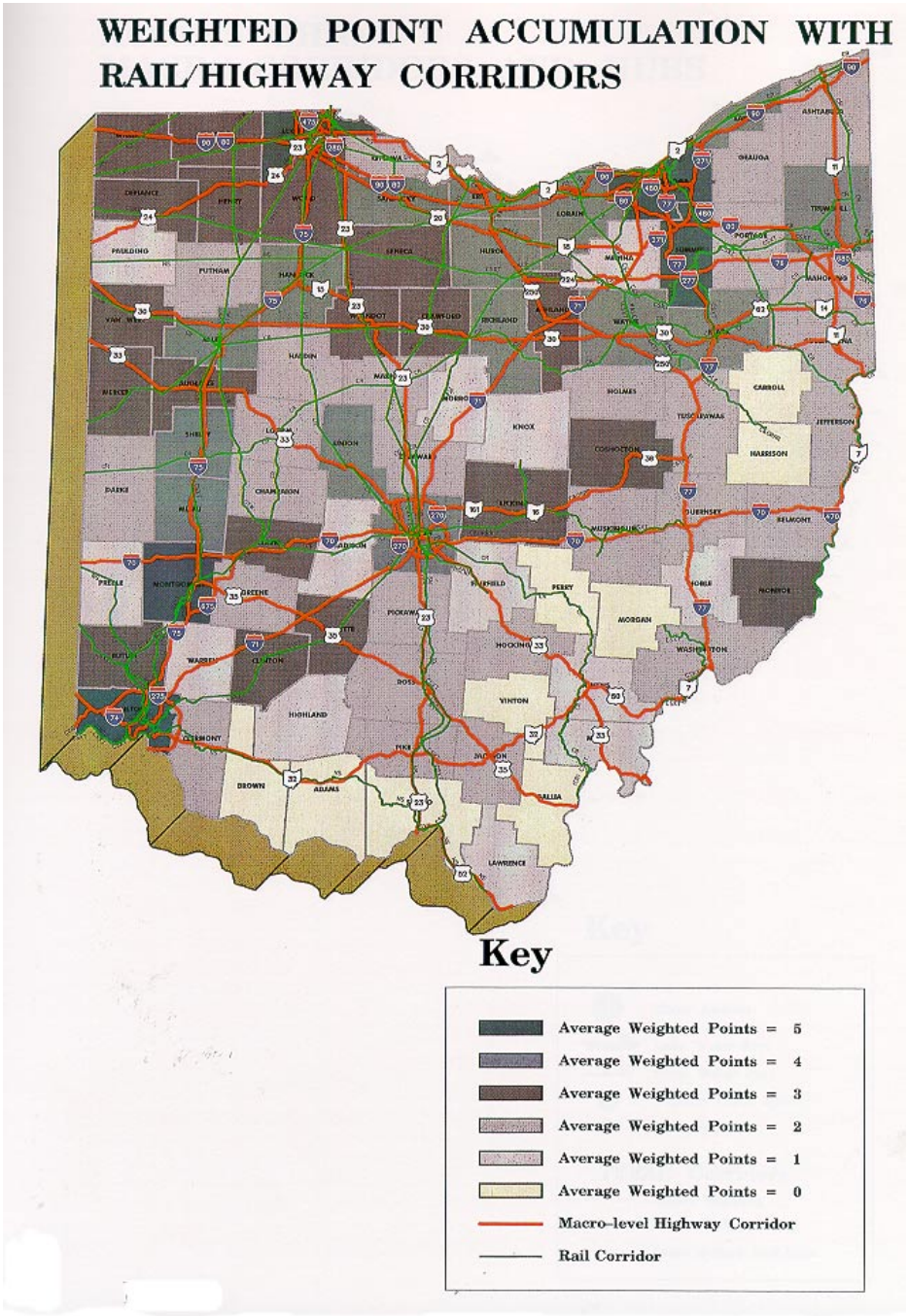

Figure 2.4 Ohio Weighted Point Map

2.2.3 WESTERN TRANSPORTATION TRADE NETWORK (WTTN)

The Policy committee of the Western Association of State Highway and Transportation Official (WASHTO) established a consortium of 17 western states to promote economic growth and to maximize regional trade opportunities. One of the main objectives of the consortium was to develop a multi-modal transportation trade network in the western United State. The consulting firm Wilbur Smith Associates was hired to oversee the development of the network.

Each of the 17 states was asked to identify the trade corridors in their respective state. A number of different methods were used by the states to select freight corridors. The four identified methods to identify the corridors were:

- Truck Volume
- Desire line of trade
- NHS system
- Freight Volume (Tonnage)

Two states used truck volumes to identify trade corridors. These two states, New Mexico and Texas defined primary and secondary corridors. In both New Mexico and Texas, primary corridors were highways that carried large volumes of trucks. In New Mexico, the secondary corridors were highways that interconnected many of the primary corridors. The secondary corridors in Texas were highways that carried a significant number of trucks, but not of the same magnitude as the primary corridors.

Seven states used the distribution of trade to determine the trade corridors within their state. Each state evaluated the trade patterns between their state and the other 49 states. The highways that appeared to serve the movement of trade were identified as trade corridors. The states that their used desire line of trade to identify corridors were: Idaho, Nebraska, North Dakota, South Dakota, Utah, Washington, Wyoming.

The state of Montana selected all the highways in the state that were part of the National Highway System (NHS) as primary trade corridors. Additional highways that provided access to these highways were identified as secondary trade corridors.

The state of Oregon used freight tonnage as the criteria for trade corridor selection. The highways with the largest tons/year were selected as trade corridor. The state of California based their trade network on their “ICES.” network. This network connects the major intermodal facilities in the state. The identification method of Arizona, Colorado and Nevada could not be determined from the WTTN Report.

The trade network identified in the western region was developed based on the highways submitted by each individual state (Fig. 2.5). Instead of including every state-submitted highway, a more compact system was developed. The final system is a network that serves the needs of the region and not merely the needs of the individual states.

WTTN Trade Network

Figure 2.5 WTTN Trade Network Map

2.3 ACADEMIC WORK

In the mid-1980's work at The University of Texas at Austin examined the concept and feasibility of an Intercity Truck Route (ITR) Network. The work at The University of Texas was driven by the trend of larger trucks on America's road and the effect that these trucks had on highway capacity, safety, and pavement conditions.

A dissertation by Chien-pei Yu studied the concepts and feasibility of a nationwide truck network connecting all the major intercity freight distribution centers and markets. The dissertation defines the concept of an ITR network, sets up the ITR network, and examines the impacts of various long combination vehicles (LCVs) on a network.

A dissertation by How-Ming Shieh explored the development of a minimum highway network for the operation of LCVs. The minimum network connected major commodity production and distribution centers, agriculture centers, and major cities in the Bureau of Economic Analysis Regions (BEAs). Regression analysis and gravity models were used to calculate shipments between major cities. These shipments were assigned to highways based on minimum cost paths.

2.3.1 Yu

The methodology developed by Yu to select the ITR route is examined here. The proposed ITR network is a continuous network of highways where LCVs are allowed to operate freely. The network representation is a series of link and nodes. The nodes are major production and distribution centers while the links are highways that interconnect these nodes and satisfy certain criteria. Using the link-node network approach allows one to use many of the developed network algorithms to determine shortest and quickest paths between all pairs of nodes.

To select the highways that comprise the ITR network, two steps were necessary. The first step consisted of selecting the nodes of the network. As mentioned the ITR network should connect all the major production and distribution centers in the U.S. Numerous sources were used to identify the major production and distribution centers. The sources used for the identification of nodes included the "Commodity Transportation Survey" (CTS), "Commodity Flow Survey," Bureau of Economic Analysis Regions (BEAs), and the "Fresh Fruit and Vegetables Unload Totals for 41 Cities." All four data sources were analyzed to eliminate redundant cities. After all the overlapping cities were discarded, 144 cities were selected as nodes for the ITR network.

The second step in identifying the ITR network was the selection of suitable highway routes to link the nodes. These routes needed to be of sufficient design standards to accommodate LCVs for large quantities of commodities.

A few constraints were identified in the selection process (Ref. 10).

- The highway should be access-controlled. Safety was a major concern in the selection of highways for the ITR. Studies have shown that accidents and fatalities rates for fully controlled access highways have been consistently about one-third to one-half those for highways with no control of access. Additionally, the capacity of a highway with full access control is greater than one with out access-control.
- The highway should be multi-lane. Multilane facilities reduce the chance of accidents in vehicle overtaking.
- The highway should be of sufficient design to meet the higher geometric requirements of LCVs. The standards set forth for the Interstate system are ideally suited for the ITR network.
- The total mileage of the network should not be excessive. The intent is to find an optimal network from an economic point.

The ITR network was selected based on the above highway constraints and the nodes previously selected for the network (Figure 2.6). A more detailed map of the ITR network in the State of Texas is shown in Figure 2.7.

2.3.1 Shieh

The objective of Shieh's research was to develop a minimum highway network for the safe and efficient operation of LCVs. The minimum network consisted of high standard highways that connected all the major production and distribution centers with very little circuity.

A link-node approach was developed to identify the minimum network. The nodes in the system were the major production and distribution centers in the U.S. These centers were identified through various sources including: the "Commodity Transportation Survey" (CTS), "Commodity Flow Survey," Bureau of Economic Analysis Regions (BEAs), and the "Fresh Fruit and Vegetables Unload Totals (FFVUT) for 41 Cities." A total of 144 cities were identified as nodes for the system.

National ITR Network

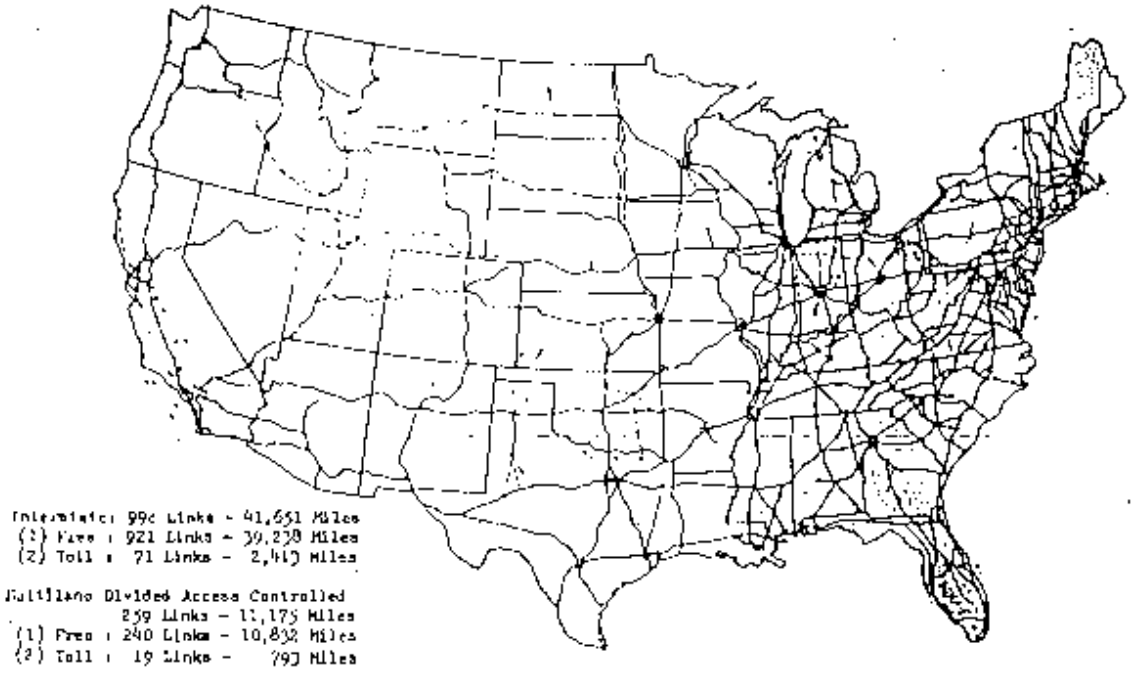

Figure 2.6 National ITR Network Map

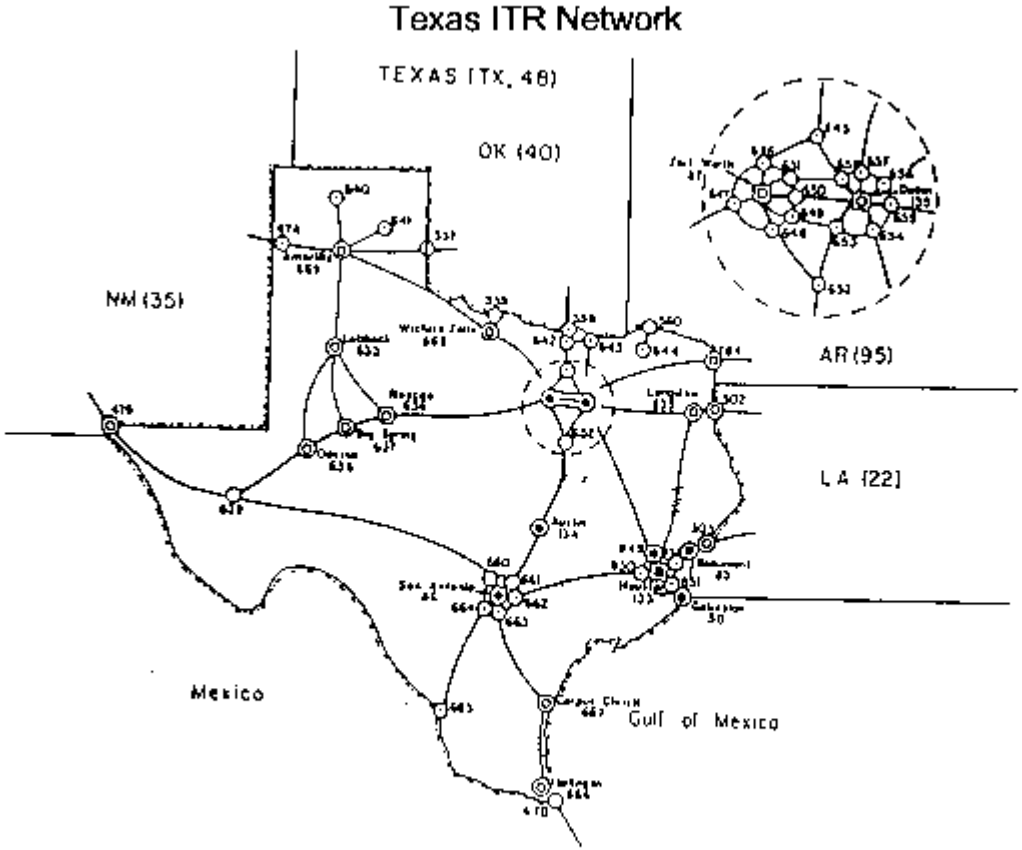

Figure 2.7 Texas ITS Network Map

The links in the minimum network system were derived from the explored system. The explored system comprised all the major highways in the U.S. Highways were selected for the minimum network based on the following criteria. (Ref. 20)

- There exists at least one two-way highway link connecting the explored network and any of the major production and distribution centers.
- All the Interstate highways will stay in the explored subnetwork except where there exists a parallel turnpike with similar design standards.
- All the links on highway loops around the large cities or the links of toll roads will stay in the explored subnetwork
- The highways, which are not on the Interstate highways and show less than 10 intercity trucks per day, will be removed if they are not the only highway connecting a major production or distributions centers.
- If a non-Interstate highway link shows less than 30 intercity trucks per day and it is not the only highway connecting major commodity production and distribution centers, it will be removed if the removal does not cause much circuitous routing and no significant increase of traffic congestion occurred in the remaining highway links of the explored subnetwork.

Intercity truck trips were calculated by forecasting commodity shipments from each production area for the year 2000. The base year flows of commodities were obtained from the CTS and FFVUT and forecast for the year 2000 using growth factors from the National Truck Size and Weight Survey.

A gravity model was used to calculate the number of shipments between each production and distribution center. The expected truck model composition for the year 2000 was assumed and used to calculate the number of truck trips to and from each production and distribution center. Each truck was assigned a route between centers based on the quickest travel time. The number of truck trips per highway segment was part of the above criteria to select the minimum network. The minimum network for the state of Texas is shown in Figure 2.8.

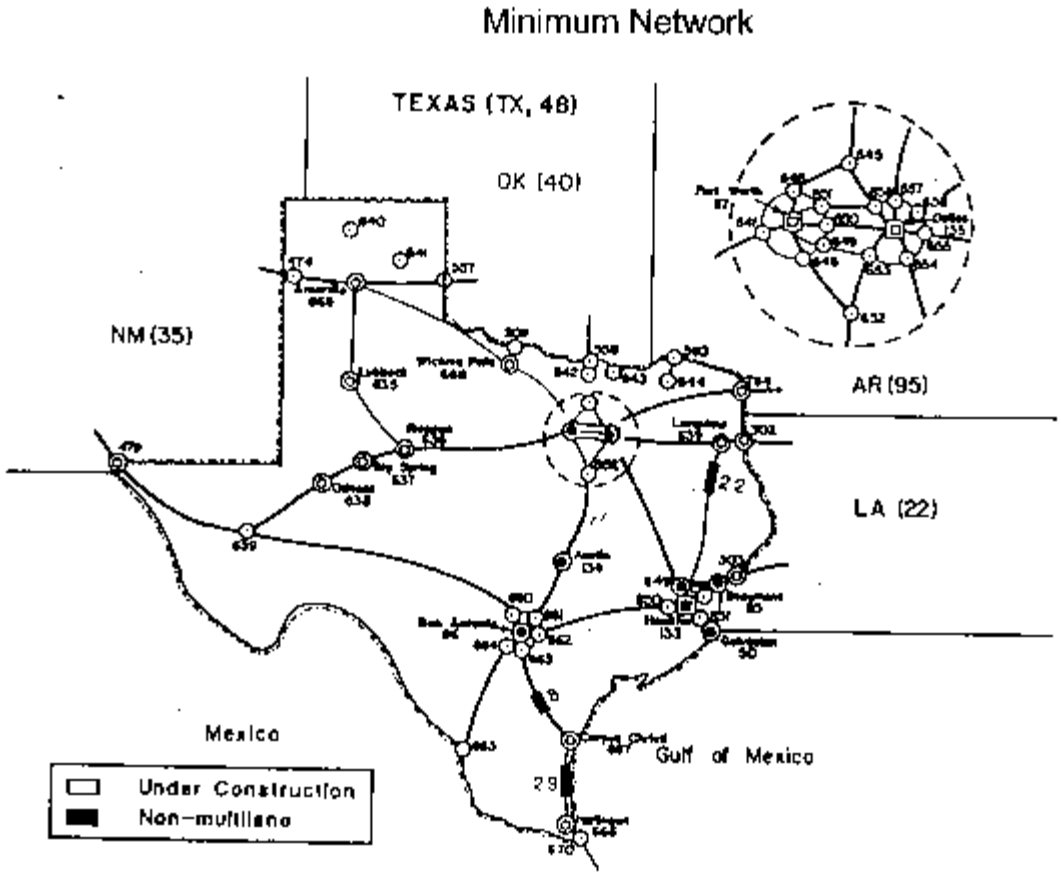

Figure 2.8 Minimum Highway Network Map

2.4 OTHER

2.4.1 Port Authority of New York

The New York City-northern New Jersey region is losing the competitive advantage once provided by its freight transportation system (Ref. 18) This region once offered low-cost access to world markets and efficient local distribution needed to sustain the area's population. The freight transportation system, particularly the truck freight system has become increasingly costly, inefficient and unreliable. The Port Authority of New York and New Jersey commissioned Cambridge Systematic Inc. to investigate how the area freight transportation system might be improved so that the region could regain the competitive advantage it has lost.

Over the past twenty five years, the economy of the New York City-Northern New Jersey region has shifted from a manufacturing based economy to a service based economy. This change in the area's economy has had a dramatic impact on the transportation needs of local businesses. The demand for smaller, lighter, higher value goods such as clothing, computer equipment, electronics, etc. has increased while the demand for the movement of bulky low-value goods such as industrial machines, bulk farm goods, unfinished products, etc. has diminished as the manufacturing sector has shrunk.

Just as the types of goods have changed with the shifting economy, so has the mode used to transport these goods. The increase in the value of goods has cause many businesses to reduce inventory in an attempt to reduce overhead. To offset smaller inventories, many businesses have adopted just-in-time (JIT) delivery. The theory behind JIT is to deliver goods to business as they are needed. For instance, instead of maintaining a large warehouse, a local electronic store might only stock a few of each type of video cassette recorder (VCR) and place restocking orders whenever a VCR or two are sold. Though this strategy relieves local businesses of warehousing costs, it places a strain on the local transportation system. JIT requires rapid reliable transport of goods. The two modes primarily used for the rapid movement of goods are air and truck. Both modes offer fairly reliable service, but are subjected to the effects of road congestion. Nearly all airfreight is carried to and from airports in trucks and is therefore subjected to the same delays that affected automobiles and trucks. Consequently, JIT service is highly dependent on the ability for trucks to move rapidly through out the transportation network.

The roadways of the New York City-Northern New Jersey area have become saturated with automobiles. Trucks must use the same roadway as automobiles and are therefore subjected to the same congestion. As a result, the movement of freight by truck has become increasing less reliable, more costly, and more inefficient. The study by Cambridge Systematic, "Regional Truck Network Strategic Planning," defined a truck freight network for the region. This network includes highway corridors and intermodal facilities that are critically important to the region.

The study identified four criteria for the designation of strategic freightways. These four criteria were based on traffic volumes and providing critical links for the movement of freight (Ref. 11).

- The highway carries a large volume of truck traffic - For the purpose of this study, a AADT of 2,500 truck was defined as a large volume.
- The highway serves a facility with a high capital cost - For the purpose of this study a high capital cost was defined as $500 million dollars. This dollar amount limited facilities to major airports, intermodal rail facilities, and marine ports. These facilities should be included on the network regardless of truck volumes.
- The highway provides a critical link for the reliable and efficient movement of freight - A highway is considered strategic if it provides the most direct, lowest cost, or safest route for the transport of freight. Six specific criteria are used to assess critical links. First, the route provides the most direct route; Second, the route provides the most reliable route to a destination; recurring congestion, traffic incidents or constructions makes alternative routes inefficient for freight movement. Third, the route accommodates large trucks. Fourth, the route id designated for special truck operations, such as hazardous materials. Fifth, the route links two other major truck routes. Sixth, the route provides an alternative to tolled roads
- The highway is vital to serving key economic activities - a highway is considered strategically important if it serves economic activities that are critically important to the region's economy. Also considered under this criterion are routes that provide the only truck access to "one of a kind " activities, such as certain manufacturing plants, utility plants, terminals, and other similar facilities.

Cambridge Systematic identified the areas of economic interest: marine ports, airports, warehouse districts, intermodal facilities, etc. Highways that linked these areas with the region were also identified and designated as strategic truck corridors.

After identifying the strategic truck corridors, guidelines were offered to improve the efficiency of the network. The region does not have a freight policy plan. The creation and adoption of a freight policy plan should be undertaken by a regional agency. This plan should recognize the importance of freight movement to the regional economy and as such strive to improve the flow of goods through the region.

Cambridge Systematic offered specific strategies to improving various facilities on the freight network. These strategies can be generalized as operational and geometric improvements and the implementation of ITS technologies.

The highways in the region have numerous geometric deficiencies that prohibit larger trucks from moving freely through the network. Many roads in the city do pass under bridges that do not have sufficient clearance for many of the larger trailers in use today. To reach some parts of New York City, goods must be removed from trailers and placed on smaller trucks. This increase in shipping times and costs and decreased efficiency and reliability. Many of the suggested geometric improvements are aimed at reducing this problem (Ref. 11).

Bridge renovation - In some instances the bridges may be retrofitted to accommodate larger trucks.

- New bridge construction - In many instances, bridge clearances can not be increased. Instead new bridges must be built.
- General road rehabilitation - Many highways in the region are in poor condition. Improving the condition of these highways should improve overall safety, reduce accidents and reduce delay.

A number of operation improvements were suggested to improve the efficiency of the system (Ref. 11).

- Convert existing lanes to HOV - The conversion of existing lanes to HOV lanes should reduce the congestion on certain highways.
- Designate Truck priority lanes - These lanes would be used exclusively by commercial vehicles. This lane would reduce congestion for freight carrying vehicles and reduce travel times.
- Congestion pricing - Congestion pricing would discourage motorists from using highways during peak times. This would result in less vehicles on the roadway at peak periods and less delay for trucks.

The implementation of ITS technologies was suggested to improve safety, reduce congestion and increase system reliability (Ref. 11).

- Traffic management system (TMS) - Incident detection systems would reduce delay associated with accidents. Variable message signs would warn drivers of traffic conditions and offer alternative routes.
- Electronic Tolls Collection - Electronic tolls collection allows drivers to proceed through toll booths without stopping thus increasing the handling capacity of the plaza and reducing delay.

A cost/benefit study was not conducted for each recommendation made by Cambridge Systematic, but the benefit to the region in terms of reduced freight shipping costs, delay, and improved reliability will help it regain the distinction of being an efficient gateway to the world markets.

2.4.2 Federal Highways Administration (FHWA)

The FHWA was contacted to determine the level of freight corridor planning activity at the state level. The results from this telephone conversation suggested that states are taking varied approaches to defining freight corridors. Some states such as Ohio and Wisconsin have adopted a criteria scheme to identify strategic corridors. Others have used a panel discussion approach to identify corridors. In this case a group of experts discuss which highways should be labeled strategic. Using this approach, states identify strategic corridors but have no specific methodology for future use. Most states, however, have not designated specific highways as “strategic” freight corridors. The term strategic frightens many states. A large number of states are weary of designating highways as strategic because they feel the term

“strategic” carries a monetary value. By designating a highway “strategic,” most DOTs feel there is an obligation to correct deficiencies on that highway. Correcting deficiencies costs money. Money that most DOTs do not have. (Ref. 12)

CHAPTER 3 METHODOLOGY AND PROCEDURE

The economy of a state or region is highly dependent on its transportation system. Historically, transportation has been a vital component of almost every aspect of economic development. Transportation has made possible the extraction of resources, the specialization of industry, the commercialization of agriculture, and the rise of trade centers (Ref. 13). Conversely, the lack of efficient transportation hinders and retards economic development. Economic development has long been recognized as a rationale for transportation investment, but the nature of the relationship remains unclear (Ref. 13). Though many studies have examined the relationship between economic development and transportation, the results of these studies are inconclusive. The traditional view in the literature, however, has been that the improvement of the transportation structure is a necessary predecessor to economic development in a region (Ref. 13). This can be expanded to state that an efficient transportation system is necessary to continued economic growth. An improvement in the transportation system will not result in economic development if it does not also result in a reduction in transportation cost.

This chapter presents the methodology used to identify the strategic freight corridors. A model that captures the economic significance of counties was developed. The counties deemed economically significant play an important role in the economic success of the Texas economy, and as such should be served by an efficient transportation system to ensure economic growth for each county and for Texas.

3.1 CRITERIA

The State of Texas, the largest in the contiguous 48, consists of 254 counties ranging in population from 107 to 2,828,199 persons (Appendix A1*)*. Due to the vastness of the state, many diverse climatic and geological regions exist. Each region possesses natural resources, and these resources directly and indirectly affect the economic capacity of that region. As mentioned above, the quality of a transportation system within a given region is related to the economic activity in that region.

This study developed a link-node model to identify the strategic freight corridors in the state of Texas. Links consisted of high quality freeways that interconnected the nodes in the system. The nodes were point locations representing the defined regions in Texas. A set of criteria by which strategic freight corridors were identified was developed. These criteria contained economic and non-economic data (Table 3.1) using previous freight corridor work, specifically that by the Ohio Department of Transportation (ODOT). The economic criteria received 75 percent of the overall weighting, while the non-economic criteria received the remaining 25 percent. Economic data are readily available on a county basis, therefore the county was used as the analysis region for this study. The basic assumption made by this study is that the demand to move goods efficiently over the transportation network is proportional to the economic activity in a region. As such, measuring certain outputs of the economy would reflect a county's demand to transport goods.

TABLE 3.1 CRITERIA WEIGHTING

Corridor Selection Criteria	
Economic Activity	75.00%
Manufacturing	27.00%
Farm	10.00%
Mining	11.00%
Retail	16.00%
Wholesale	11.00%
Intermodal Facilities	15.00%
Port	5.00%
Airport	5.00%
Truck/Rail	5.00%
Border Crossing	10.00%

To identify the nodes in the system, a model was developed that accounted for both economic and non-economic factors. The economic factors were county income data downloaded from the Regional Economic Information System (REIS). REIS contains various economic data such as income data, employment data, transfer payments, etc. for every county in the U.S. Income data from the most significant industries in Texas were downloaded. The Texas Gross State Product (GSP) was analyzed to determine the most significant industries in the state (Table 3.2). The income data for these industries were identified as criteria. A review of the selected industries revealed that not all industries do require the same type of goods movement. For instance, a small manufacturing firm with an annual income of $200,000 requires the movement of more goods than a computer consulting firm in the service sector earning the same income. The most significant industries based on the Texas GSP that required a high demand for the movement of goods were included as economic criteria in the model. The five industries identified as criteria for the analysis were manufacturing, farming, mining, wholesale, and retail.

Economic factors alone could not capture a county's demand for transportation. Other factors contribute to the demand to move goods. Other indicators such as intermodal facility locations and border crossing locations were included in the analysis to account for these non-economic factors that contribute to the demand to move goods. Neither type of facility has a direct measurable impact on the economy of a county, yet each facility increases a county's demand for an efficient transportation system. Three types of intermodal facilities were included in the analysis: marine ports, airports, and rail/truck transfer facilities. The operational characteristics of each facility, the number of truck and rail cars using each facility, size of facility, etc. were ignored. For this analysis, merely the presence of these facilities affected a county's score. Evaluating the performance of an intermodal facility is beyond the scope of this study, so only the presence of an intermodal facility was included in the model.

TABLE 3.2 TEXAS GROSS STATE PRODUCT (GSP)

Industry	$(1X10^6)	
Farms	4837	1.19%
Agriculture, Forestry, Fisheries	1932	0.47%
Mining	24296	5.96%
Construction	13661	3.35%
Manufacturing	55698	13.67%
Durable	27941	6.86%
NonDurable	27575	6.77%
Transportation	43335	10.63%
Wholesale trade	24812	6.09%
Retail trade	34664	8.51%
Finance	52783	12.95%
Services	58883	14.45%
Federal/Civ Government	6729	1.65%
Federal Military	4151	1.02%
State and local Gov.	26209	6.43%
Total GSP	407506	

3.2 ECONOMIC CRITERIA

The income data for each criterion were ranked and scored from 1 to 10. A score of 10 was assigned to a county whose income was in the top 10 percent. A score of 9 was assigned to counties whose income was in the next 10 percent. Each county was assigned a score based on the bin that their income was located. Scoring from 1 to 10 and using 10 percent bin ranges were chosen for this analysis for their ease of use. Using bin sizes larger than 10 percentiles, aggregated the data too much and produced meaningless results. In essence, a scoring system with bins greater than 10 percentiles inflated the final county score of counties whose income for the various criteria typically fell in the 20 to 30 percentile range.

3.2.1 Manufacturing

Manufacturing income serves as an indicator for the movement of raw and improved goods (Table 3.3). Manufacturing, by its very nature, is closely tied to the surrounding transportation infrastructure. The manufacturing process requires importing raw or unfinished products and exporting improved or finished products. Both movements utilize the surrounding transportation network. As such, it is expected that counties with high manufacturing incomes will be located along established corridors.

TABLE 3.3 MANUFACTURING INCOME CRITERIA RANKING

Criterion: Economic Activity (Manufacturing Income)		
Points		$ (Thousands)
10	County >	281134
9	County >	97641
8	County >	47172
7	County >	26393
6	County >	12647
5	County >	6727
4	County >	3094
3	County >	1571
2	County >	180
1	County >	0

3.2.2 Farming

Farming income serves as an indicator of a county's farm production (Table 3.4). Farming in Texas is an important industry at both the state and national level as Texas ranks among the leaders in the production of many crops and livestock. In this weighting scheme, farming receives a greater relative weighting than it deserves based on the Texas GSP. The importance of farming in Texas extends beyond the monetary value of the crops, and the higher weighting reflects this.

TABLE 3.4 FARMING INCOME CRITERIA RANKING

Criterion: Economic Activity (Farming Income)		
Points		$ (Thousands)
10	County >	41935
9	County >	21623
8	County >	12512
7	County >	9376
6	County >	7175
5	County >	5188
4	County >	3874
3	County >	2244
2	County >	1026
1	County >	-6253

3.2.3 Mining

Mining is an important segment of the Texas economy. Aside from petroleum, Texas possesses an abundance of coal and commercial minerals. Texas ranks sixth nationally in coal production. The domestic coal production is essential to Texas as much of the coal is used to power utility companies in the state. Other significant mining products in the state are gravel, crushed stone, sand, and lime. Table 3.5 shows the scoring for county mining income.

TABLE 3.5 MINING INCOME CRITERIA RANKING

Criterion: Economic Activity (Mining Income)		
Points		$ (Thousands)
10	County >	44943
9	County >	19994
8	County >	10498
7	County >	5921
6	County >	3217
5	County >	1851
4	County >	781
3	County >	284
2	County >	56
1	County >	0

3.2.4 Retail

Retail income serves as an indicator for the demand of finished goods (Table 3.6). A county's demand for clothing, electronics, furniture, etc. is reflected in the retail income of that county. For a given quality of life, a county's retail income rises with population. A county's retail income is generally proportional to its population.

TABLE 3.6 RETAIL INCOME CRITERIA

Criterion: Economic Activity (Retail Income)		
Points		$ (Thousands)
10	County >	181069
9	County >	59217
8	County >	33926
7	County >	20656
6	County >	13934
5	County >	9352
4	County >	6018
3	County >	3816
2	County >	1997
1	County >	0

3.2.5 Wholesale

Wholesale income reflects the location of warehouses and distribution centers. These centers are located in areas with easy access to the marketplace. This can be within a city, outside of a city, or in rural areas with easy highway access to many marketplaces.

TABLE 3.7 WHOLESALE CRITERIA RANKING

Criterion: Economic Activity (Wholesale Income)		
Points		$ (Thousands)
10	County >	71849
9	County >	17869
8	County >	10470
7	County >	7100
6	County >	5004
5	County >	3629
4	County >	1905
3	County >	974
2	County >	392
1	County >	0

3.3 INDIRECT ECONOMIC CRITERIA

Each county was assigned a score of 0 to 10 based on the presence of intermodal facilities and border crossings. Depending on the type of facility a score of 0 was assigned to counties with out that facility and a score of 10 was assigned to counties with a facility. For certain types of facilities, a score of five was assigned to small facilities and a score of 10 was assigned to large facilities.

3.3.1 Marine Port

Counties with ports along the Gulf serve as the point of connection between intermodal goods using truck/rail and water. Most of the goods flowing through Texas' marine ports have international origins or destination. As the global trade market increases, the importance of highway and rail access to marine ports will increase. Providing reliable efficient access to Texas' marine ports will solidify Texas' role in the international market place. In this study, deep water and shallow water ports were separated and given different point values to reflect their effect on a county's demand for transportation (Table 3.8). The *Texas SeaPort and Inland Waterway System* was consulted to identify the counties with deep and shallow water ports.

TABLE 3.8 MARINE PORT CRITERIA RANKING

Criterion: Intermodal Facility: (Marine Port)	
Points	Description
10	County With a Deep Water Port
5	County With A Shallow Water Port
0	County Without a Port

3.3.2 Airport

The location of airports indicate air/truck intermodal facility locations. Although all commercial airports may serve as an intermodal facility, major and minor airports needed to be differentiated based on the cargo activity at the airport. For this study the Federal Aviation Administration's (FAA) list of major cargo airports and the FAA's list of enplanements was used to designate the major and minor airports in the state. The FAA publishes a list of the top 108 airports by tonnage of cargo, and this list was used to identify the major cargo airports in Texas. The counties where these airports were located received a score of 10 points (Table 3.9). Though the major airports in Texas carry the bulk of air cargo into and out of the state, numerous smaller airports through out the state serve the air freight needs of the region. To account for these smaller airports, a numerical value of five was assigned to the counties where these airports were located. The minor airports in the state were identified using a FAA list of enplanements. Commercial Airports not on the FAA's air cargo list but had significant enplanements were included as minor cargo airports.

Table 3.9 Airport Criteria Ranking

Criterion: Intermodal Facility: (Airport)	
Points	Description
10	County With A Major Airport
5	County With An Airport
0	County Without An Airport

3.3.3 Rail/Truck

The rail/truck facilities criterion indicates the location of counties with an intermodal facility that handles truck to rail transfers (Table 3.10). The *Texas Transportation Plan* and *U.S – Mexico Trade And Transportation: Corridors, Logistics Practices And Multimodal Partners* were used to identify the location of rail/truck transfer facilities. The presence of an intermodal facility will have a small impact on a county's income data. Because of the importance of an intermodal facility, however, and the fact that the intermodal facility creates a significant demand for transportation, the presence of an intermodal facility should be included in the model.

TABLE 3.10 RAIL/TRUCK TRANSFER CRITERIA RANKING

Criterion: Intermodal Facility: (Rail/ Truck Facility)	
Points	Description
10	County With Truck/ Rail Transfer
0	County Without Truck/ Rail Transfer

3.3.4 Border Crossing

The last criteria, border crossing location (Table 3.11), indicates the location of international commercial border crossings between the United States and Mexico. With the introduction of NAFTA and the resulting increase in U.S.-Mexico trade, these counties will continue to grow in importance to the Texas economy as a larger proportion of goods in Texas will flow through these counties. For the future growth of the Texas economy, many of these border crossing should be included along a SFC to ensure the growth of the transportation infrastructure in the border region and improve the flow of goods between the two nations.

TABLE 3.11 BORDER CROSSING CRITERIA RANKING

Criterion: Border Crossing	
Points	Description
10	County With A Boarding Crossing
0	Country With Out a Border Crossing

3.4 AGGREGATION

The methodology used to identify criteria, establish the weights associated with each criterion, and score the data associated with each criterion were reviewed in the previous sections. To identify the most economically significant counties in Texas, the criteria weights were applied to the scores assigned to each county. This yielded a final county ranking score that is used to evaluate the selection of the strategic freight corridor network. An example aggregation for Harris County is shown Table 3.12.

TABLE 3.12 EXAMPLE DATA AGGREGATION FOR HARRIS COUNTY

Criteria	Weighting	Ranking Score	Weighted Score
Manufacturing	.27	10	2.7
Farm	.1	9	.9
Mining	.11	10	1.1
Retail	.16	10	1.6
Wholesale	.11	10	1.1
Port	.05	10	.5
Airport	.05	10	.5
Truck/Rail	.05	10	.5
Border Crossing	.1	0	0
		Final	8.9

Note: Final = (.27*Manufacturing) + (.1*Farm) + (.11*Mining) + (.16*Retail) + (.11*Wholesale) + (.05*Port) + (.05*Airport) + (.05*Truck) + (.1*Border)

3.5 SUMMARY

As previously described, a scoring system was developed to rank counties by income data and intermodal/border crossing facility location. For each criterion, a county was assigned a point value based on which percentile its income was located. For example, a county whose manufacturing income was in the top 10 percent received a score of 10, a county whose manufacturing income was in the second 10 percent received a score of 9, and so on. The scores for each criterion were aggregated using the model developed to predict the economic significance of a county. The counties identified as economically

significant would become nodes for the SFC network. The results of the model are examined in the next chapter.

CHAPTER 4 RESULTS

The previous chapter explained the methodology used to develop the model, weighting scheme, and the ranking system. This chapter examines the results of that model. The strategic freight corridor network is identified based on the results of the model.

A Geographic Information System (GIS) was used to analyze the results of the model. A GIS is a computer-based tool for mapping and analyzing things that exist and events that happen on earth (Ref. 14). For this analysis, GIS was used to analyze geographic data to look for patterns and trends. Querying, overlaying, and simple visualization were used to identify economically significant counties and their relationship with the highway system in the state.

The previous explained the criteria used in the model to identify the economically significant counties in the state. Nine criteria were included in this model. Five of these criteria were economic data obtained form the Regional Economic Information System (REIS), and four were the presence of intermodal facilities or border crossings (Table 4.1).

TABLE 4.1 CORRIDOR SELECTION CRITERIA

Economic Activity:

- Manufacturing Income
- Farm Income
- Mining Income
- Retail Income
- Wholesale Income

Intermodal Facility

- Marine Port
- Airport
- Truck/Rail Facility

Border Crossing

Each county received criterion scores between 0 and 10 based on the procedure described in the previous chapter. The first nine sections of this chapter examine the geographic distribution of the county score for each criterion. Section 4.10 examines the final aggregated county score. Counties of economic significance are based on these final scores. Section 4.11 shows the major highways in the state. Section 4.12 overlays the major highways in Texas and the final county ranking map to identify the strategic freight corridors.

4.1 MANUFACTURING INCOME

As shown in Figure 4.1, the distribution of manufacturing income is concentrated in the eastern third of the state. In the eastern half of the state, the counties with the highest manufacturing income are those that contain or are in the surrounding area of Dallas/Fort Worth, Houston, San Antonio, Austin,

Brownsville, Corpus Christi, Victoria, Beaumont, Wichita Falls, and Texarkana. These counties typically scored between 8 and 10 points. Only a few counties in west Texas scored in the 8 to 10 point range. The counties that did were El Paso, Lubbock, Amarillo, Tom green, and Abilene. In addition, most counties in east Texas scored between 6 and 8, whereas in west Texas, only a few counties scored in the 6 to 8 range.

The disparity between the manufacturing incomes of counties in east and west Texas can be partially explained by the difference in natural resources and the extent of the transportation system between the two regions. The region of east Texas typically has more natural resources than west Texas. Additionally the higher population density has led to a more thorough transportation system in the east.

4.2 FARMING INCOME

As shown in Figure 4.2, the farming income within the state is concentrated in the panhandle region. This region accounts for approximately one third of the farming income in the state. Outside of this region the farming income is scattered through out the state. The east Texas region contains a number of counties in the top 20 percent in farm production. These counties are scattered around the Houston, Corpus, Brownsville, and Longview areas.

4.3 MINING INCOME

Mining income is distributed among four distinct regions in the state (Figure 4.3). The counties with the highest mining incomes are those traditionally considered oil counties. The first region is located in west Texas roughly along a line extending from Pecos to Hockley County. The North central and north east area extending from Dallas area to Longview also has a large cluster of counties with high mining incomes. The other major region with high mining income is a region beginning in the Laredo area and extending to the Corpus Christi area and up the Texas coast. A small region in the north panhandle along the Oklahoma border also exists.

4.4 RETAIL INCOME

Retail income serves as an indicator of consumer demand for finished products. Traditionally the distribution of retail income mirrors that of the distribution of population. As Figure 4.4 shows, this holds true in the state of Texas as the counties encompassing the major cities in Texas and the surrounding suburban cities of Austin, Dallas, Houston, San Antonio, etc. received the highest scores. In general the regions of east and central Texas received higher scores than the western part of the state as the population density in the eastern part of the state is generally higher than that in the western part of the state. Also of note is the fact that counties along a major highway, in this case an Interstate, generally have higher retail incomes than those not along a major highway.

4.5 WHOLESALE INCOME

The distribution of wholesale income (Figure 4.5) is very similar to the distribution of retail income. The distribution however is less reflective of the state's population distribution. A number of counties in rural areas near major highways received high wholesale income scores. Most likely, these counties contain distribution centers that utilize the local transportation system to provide quick inexpensive transportation.

4.6 MARINE PORT

As shown in Figure 4.6A, the marine port criterion reflects the specific location of counties with deep water and shallow water ports along the Gulf Coast. In 1993, the Texas seaport and inland waterway system handled over 390 million tons. As international trade increases, the importance of accessibility to the marine ports will also increase. As Table 4.2 shows, the major mode used to transport international goods is sea. Two types of ports exist along the Texas coast, deep water and shallow water ports. The shallow water ports serve domestic trade almost exclusively. Ocean going vessels transporting international trade require deep-water ports to dock. Appendix B.1 lists the deep and shallow water ports in the state. If Texas wishes to participate in the increasingly global economic market, marine ports must be accessible by truck.

TABLE 4.2 MODE SHARE OF U.S - WORLD TRADE

Mode	Import	Export
Sea	49%	51%
Air	6%	<1%
Truck	45%	49%

Source The Texas SeaPort and Inland Waterway System (Ref. 15)

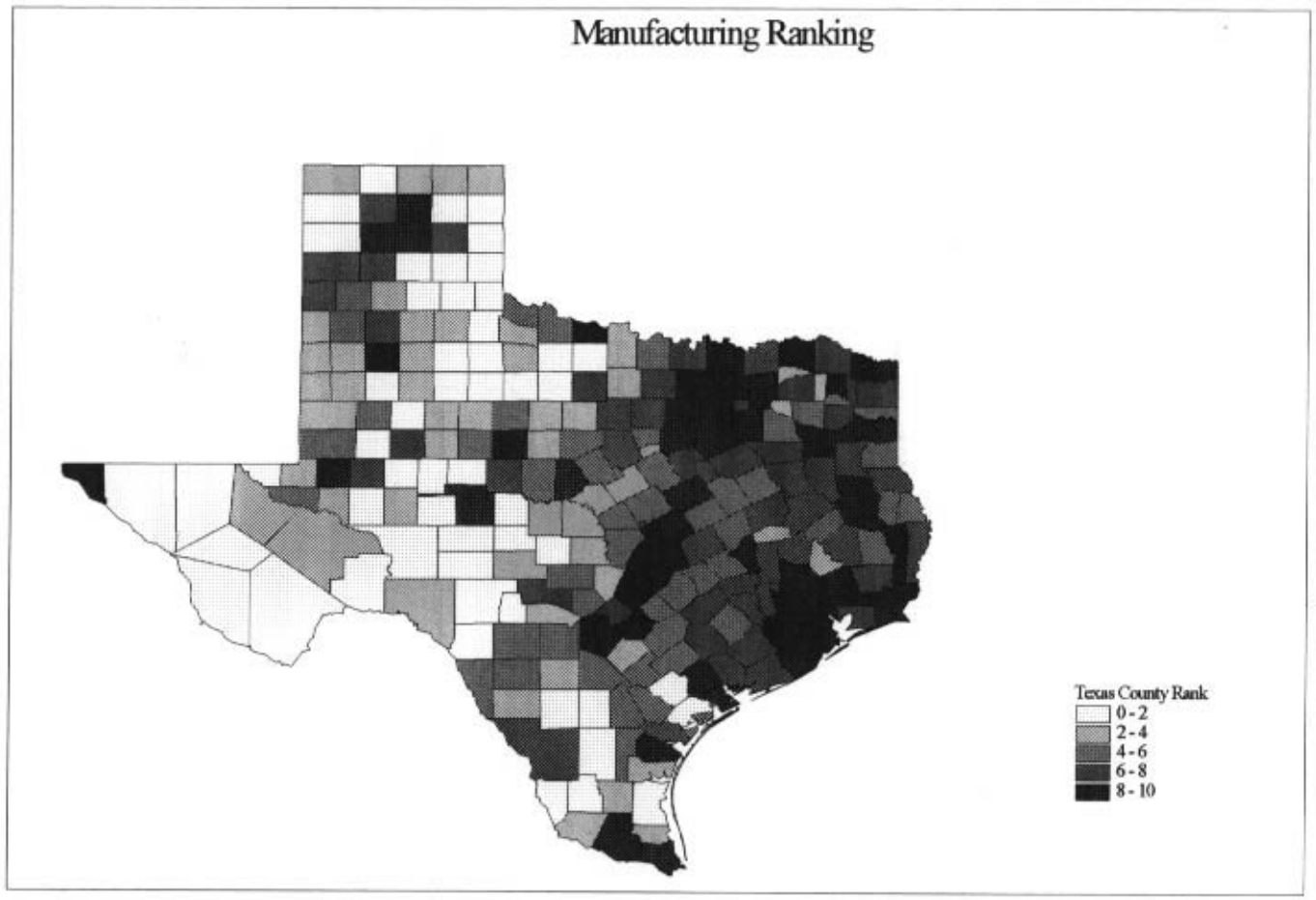

Figure 4.1 Manufacturing County Ranking

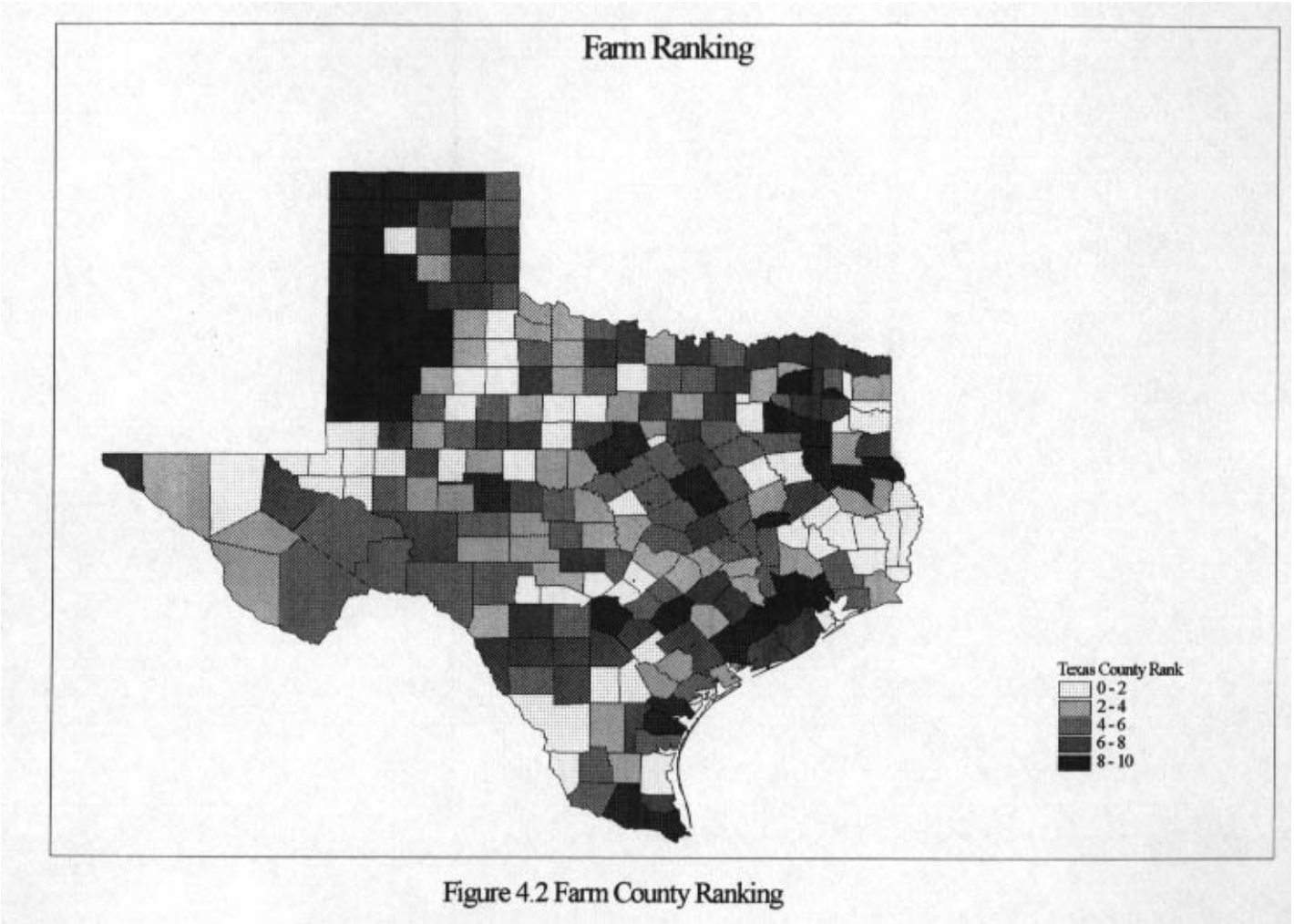

Figure 4.2 Farm County Ranking

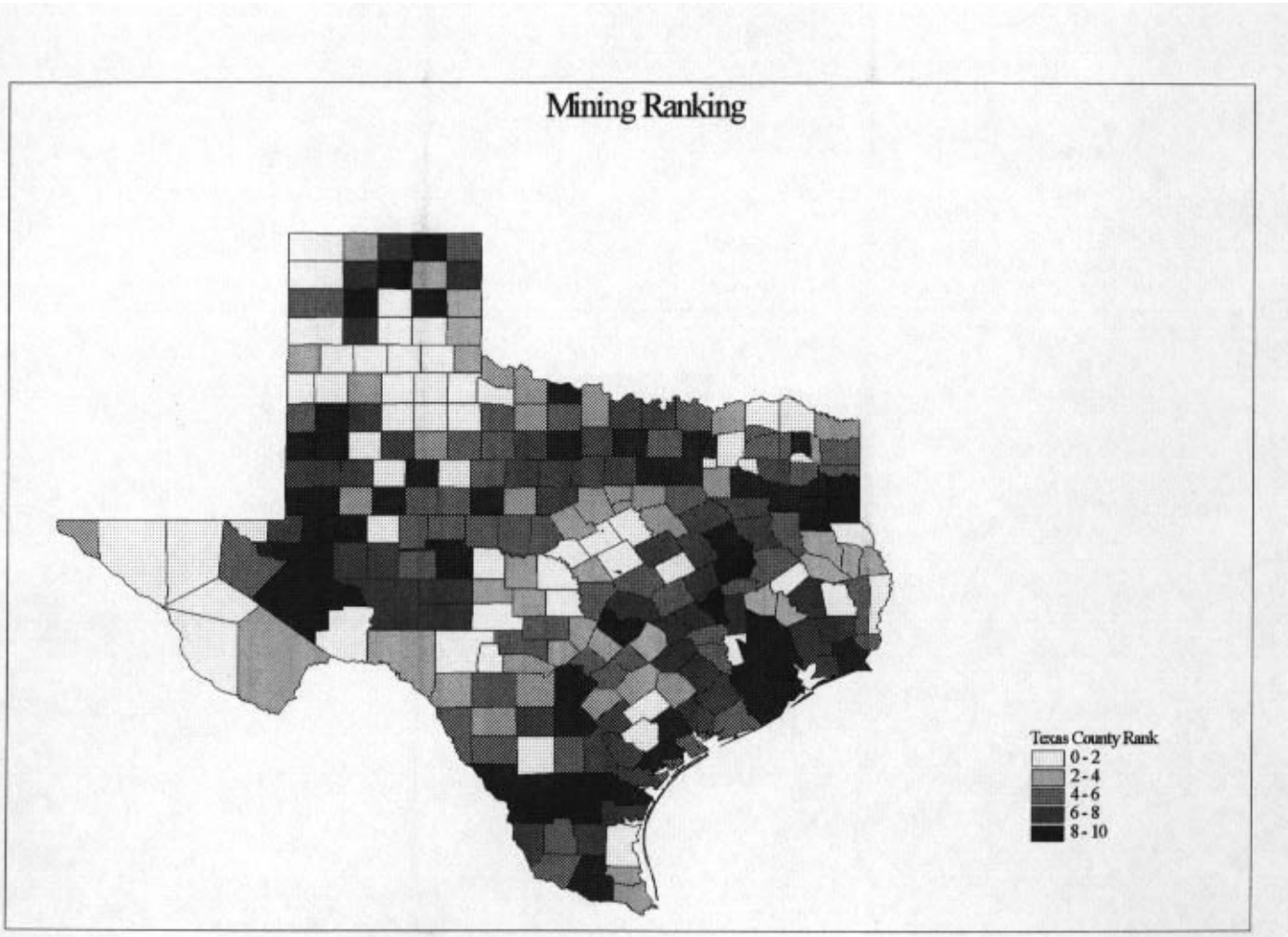

Figure 4.3 Mining County Ranking

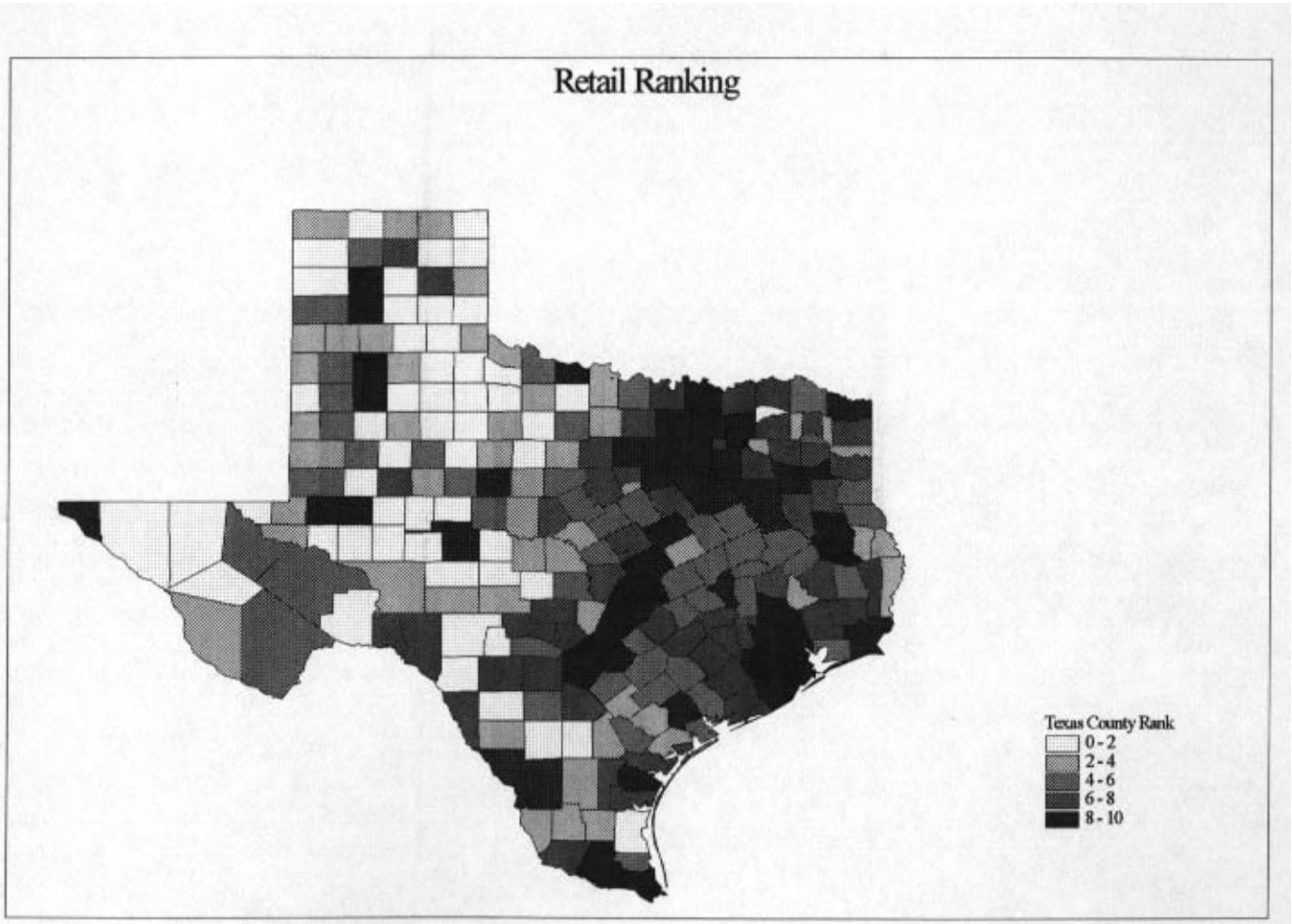

Figure 4.4 Retail County Ranking

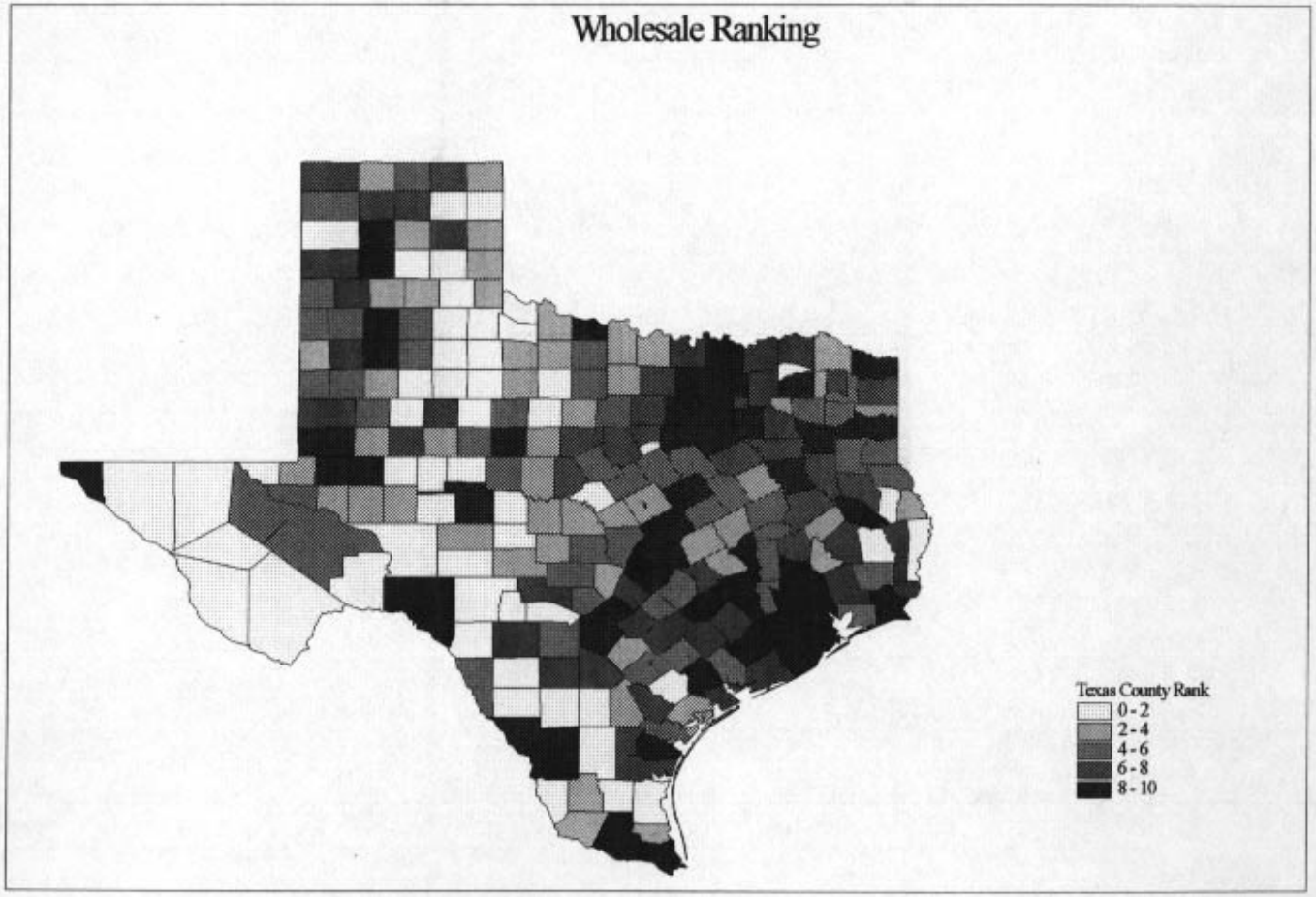

Figure 4.5 Wholesale County Ranking

4.7 AIRPORT

As shown in Figure 4.6b, the location of airports is distributed through out the state. Airport locations correspond to the location of the urbanized areas in Texas. Major and minor airports were identified based on cargo activity and enplanements. The major airports were identified on the basis of freight activity (Appendix B.2). These airports are located in the largest cities: Austin, Brownsville, Dallas, El Paso, Houston, Laredo, and San Antonio. The minor airports in the state were identified based on FAA enplanement totals (Appendix B.3).

Air freight activity continues to increase at a rate higher than other modes. As the economy shifts to a service economy, the demand for the movement of high value goods will continues to increase. Access to airports will become more critical as the demand to rapidly move goods increases.

4.8 BORDER CROSSING

Counties receiving a border crossing score of 10 indicates the presence of border crossing facilities that allow freight movement (Figure 4.7B). These counties provide an essential service to both the Texas economy and the U.S economy as over $67 billion in goods cross the Texas-Mexico border annually. Efficient access across the border is essential to the growth of the U.S. and Mexican economy.

4.9 RAIL/TRUCK

As shown in Figure 4.7B, the Rail/truck transfer facilities are scattered through out the state. For the most part these intermodal facilities are located near large urban areas and the intersection of more than one Interstate highway and a class I rail line. Additionally, a few rail/truck facilities are located at the intersection of Class I railways and major highways at major border crossings.

4.10 AGGREGATED CRITERIA

The final ranking for a county is the aggregated score of the individual criterion. Figure 4.8 shows the final scores of all the counties. Seven counties received scores in the 8 to 10 point range (tier 1). These counties were Dallas, Tarrant, Harris, Bexar, Nueces, Hidalgo, Cameroon, and El Paso. Three of these counties Cameroon, Hidalgo, and El Paso greatly benefited from having a border crossing and an intermodal facility. Dallas, Tarrant and Bexar County each possessed a major airport and rail/truck transfer facility. Additionally these counties ranked in the top 10 percent of most income criteria. Cameroon and Harris County received the two highest overall scores. Each possessed the three types of intermodal facilities. Cameroon edged out Harris County for the overall score as it contained a border crossing and Harris County did not.

Figure 4.6A Marine Port Ranking

Figure 4.6B Airport Ranking

Figure 4.7A Border CrossingRanking

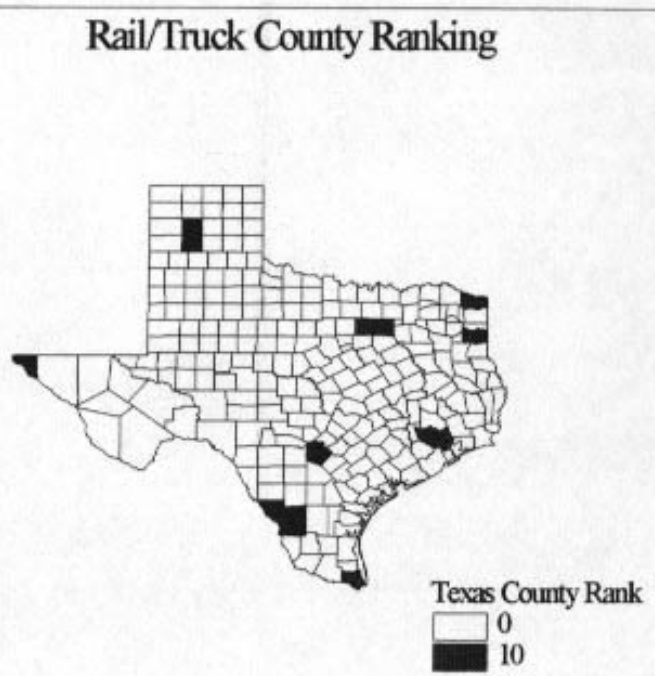

Figure 4.7B Rail/Truck Ranking

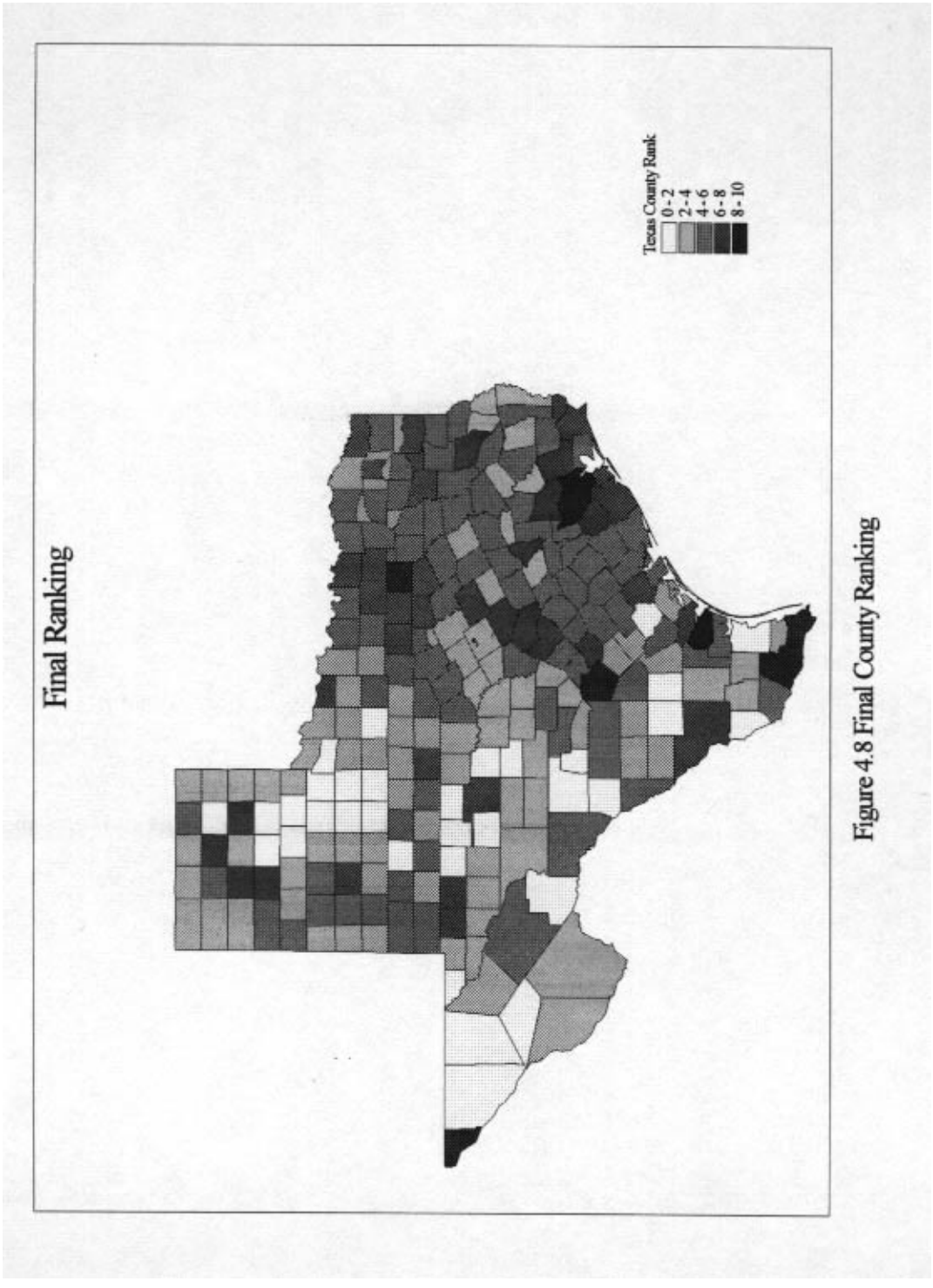

Figure 4.8 Final County Ranking

Thirty eight other counties received a score between 6 and 8 points (tier 2). This represents approximately 15 percent of the counties in the state. The final ranking score of six was selected as the minimum score for an economically significant county as this value provided a logical break point in the data. The 46 counties in the 6-10 point range represents approximately 80 percent of the state's population and 90 percent of the income from the five industries included in the model. The 38 tier 2 counties can be classified into three categories: those next to tier 1 counties, those that contain midsize major cities, an those counties next to other tier 2 counties.

Fifteen of the 38 counties in the 6 to 8 point range were located in the immediate vicinity of one of the tier 1 counties. Seven of these were located in the Houston area, another six of these counties were in the Dallas-Fort Worth area. Two of these counties were located next to San Antonio and Corpus Christi respectively.

Thirteen tier 2 counties were counties that generally possessed smaller cities tier 1 counties. The counties under this category were Hutchinson, Midland, Ector, Tom Green, Taylor, Travis, Brazos, Wichita, Victoria, Longview, Texarkana, Potter, Lubbock. The remaining 10 counties were scattered around other tier 2 counties.

4.11 HIGHWAY NETWORK

Figure 4.9 shows the major highways in the state. The highways shown in the figure are U.S Primary highways (U.S), State Roads, and Interstate highways. The highways have been color coded to indicate the number of lanes in both directions. Highways for the SFC network should meet certain geometric standards. Unless a highway is the only non-circuitous route connecting economically significant counties, the following constraints should be placed on highways in the SFC network:

1. The highway should be multi-lane
2. The highway should be access-controlled.
3. The highway should be of sufficient design to meet the higher geometric requirements of trailers e.g. Bridge clearance, turning radius, etc.

As Figure 4.9 suggests, a large number of U.S Highways and State Roads are eliminated from inclusion in the SFC network based on the above constraints. A note should be made, however, that if small segments of a highway that other wise would be designated a SFC fails to meet an above constraint it will not prevent the highway from being designated a strategic freight corridor. It would however be the recommendation of this paper to upgrade the inadequate highway segment

4.12 OVERLAY OF HIGHWAY AND AGGREGATED

The Interstate Highways, U.S roads and State roads in Texas were overlayed onto the final selected county ranking map (Fig. 4.10). This overlay was the basis for the selection of the SFC network.

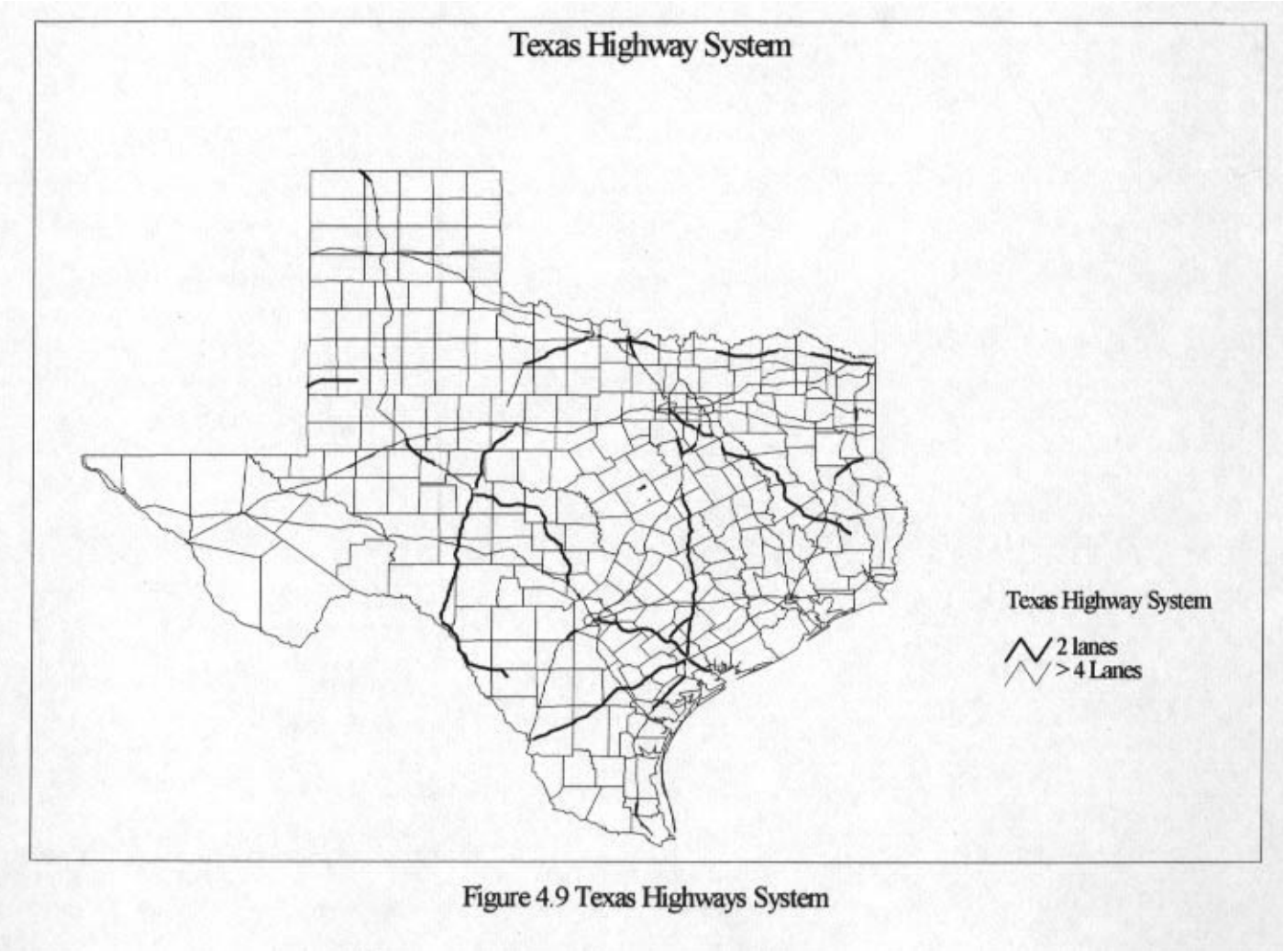

Figure 4.9 Texas Highways System

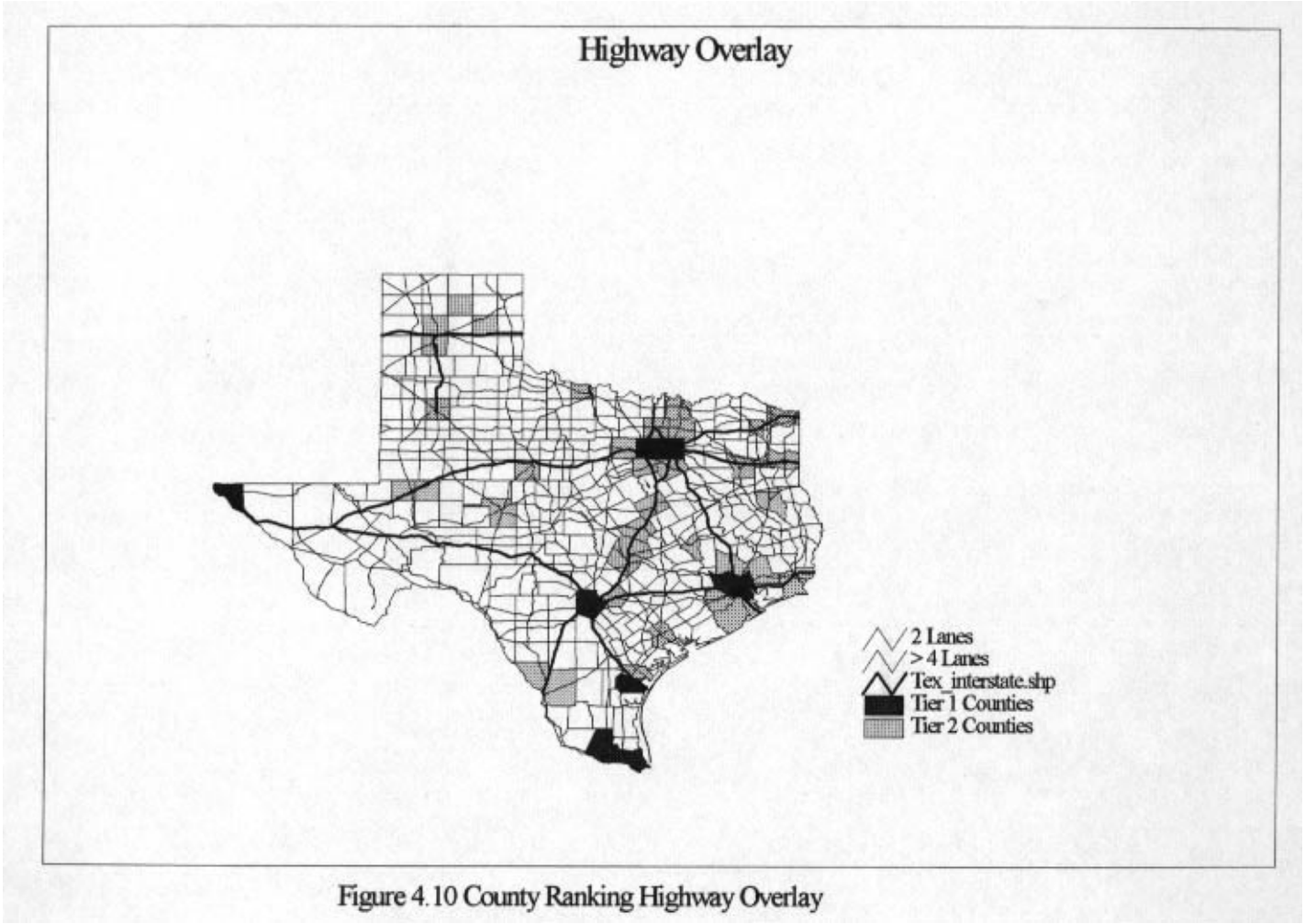

Figure 4.10 County Ranking Highway Overlay

The first task was to interconnect the seven most significant counties: Dallas, Tarrant, El Paso, Bexar, Harris, Nueces, Cameroon, and Hidalgo. All of the Interstate highways in the state were chosen to be included in SFC network. One of the primary goals of the Interstate System was to interconnect all population centers greater than 50,000 people. As such, the Interstate system should interconnect most of the economically significant counties in the state. Five of the seven tier 1 counties (final ranking 8-10) were interconnected by the Interstate system (Fig. 4.11). The counties of Hidalgo and Cameroon were the two not connected to the Interstate System. To provide access to these counties, U.S 77 was included in the SFC network (Fig. 4.12).

The second task involved connecting the tier 2 counties with each other and to the tier 1 counties. Figure 4.13 shows the tier 2 counties located along the Interstates and U.S 77. All but eight of the tier 2 counties were located along a SFC. Though most of the counties were interconnected by just the Interstate system and U.S 77, the most direct route between many of the counties were circuitous.

Additional highways were needed to complete the system and to reduce travel time between counties. U.S 287, a four lane highway connecting the Amarillo area to the Dallas/Forth Worth area, offers a direct path between the two regions. In addition, it also connects Wichita Falls with the Dallas area and the panhandle region.

The current SFC network does not contain a highway link that connects the panhandle region, Amarillo and Lubbock, with the rest of the state. U.S 84 is included in the SFC to do just this. U.S 84 connects Lubbock, the end of IH27, with IH20.This however still does not offer a direct route to points south of IH20. The U.S 87 and U.S 277 corridor from Tom Green County to IH 10 was included as a SFC to offer a direct route between the panhandle an IH 10. Including U.S 87 from Lubbock County to Tom Green County and U.S 277 from Tom Green County to IH10 offers a fairly direct route to all regions of the state from the panhandle region. Parts of U.S 87 and U.S 277 are two lane undivided highways that fail to meet the constraints identified. Because this route is the only direct connection between the two regions it shall be included as a SFC

The Brownsville-Hidalgo region does not have a continuous non-circuitous route to the Houston and North coastal region of the state. The current SFC network requires a truck in Brownsville to travel along U.S 77 and turn northwest onto IH37 and proceed to San Antonio where it turns east on IH10. An alternative more direct route would be U.S 59 from Nueces County to Texarkana. The U.S 77/U.S59 route links the Brownsville-Hidalgo area to the Houston area in a direct manner. Aside from a short segment between Nueces and Victoria Counties and a segment south of Texarkana, the entire length of U.S 59 is at least four lane highway. This route would also connect four economically significant counties that were not on the SFC network (Fig. 4.14).

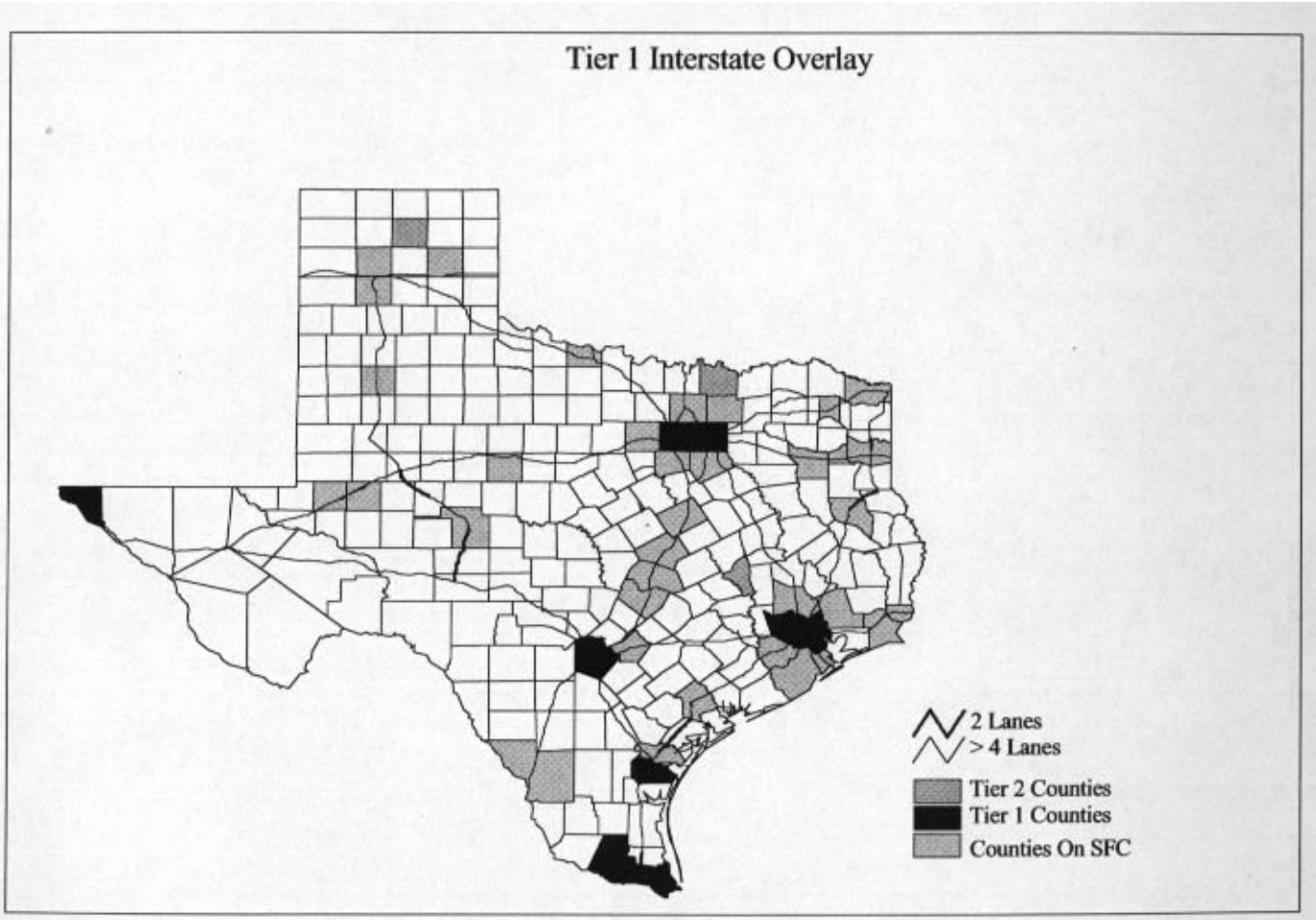

Figure 4.11 Tier 1 Interstate Overlay

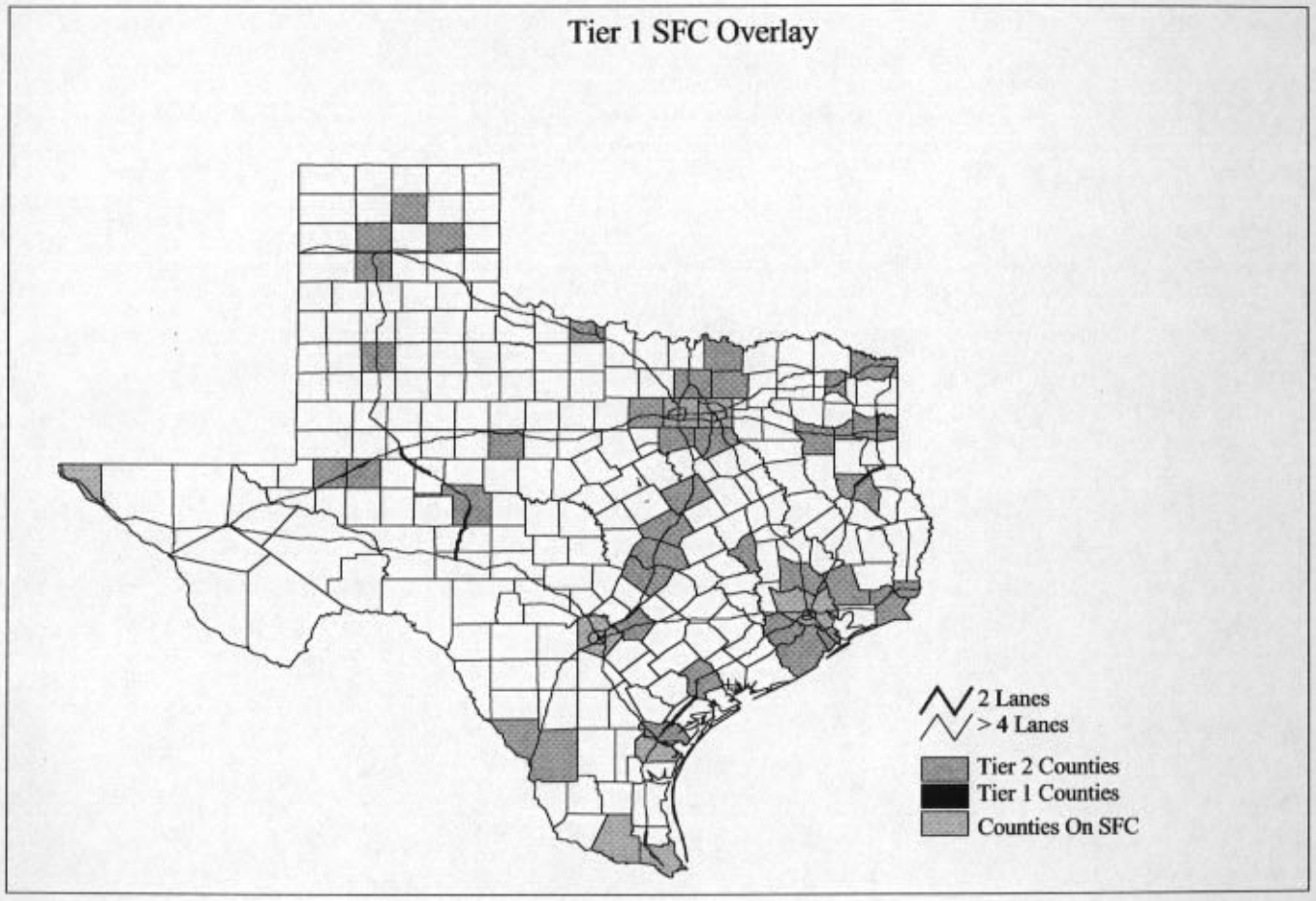

Figure 4.12 Tier 1 SFC Overlay

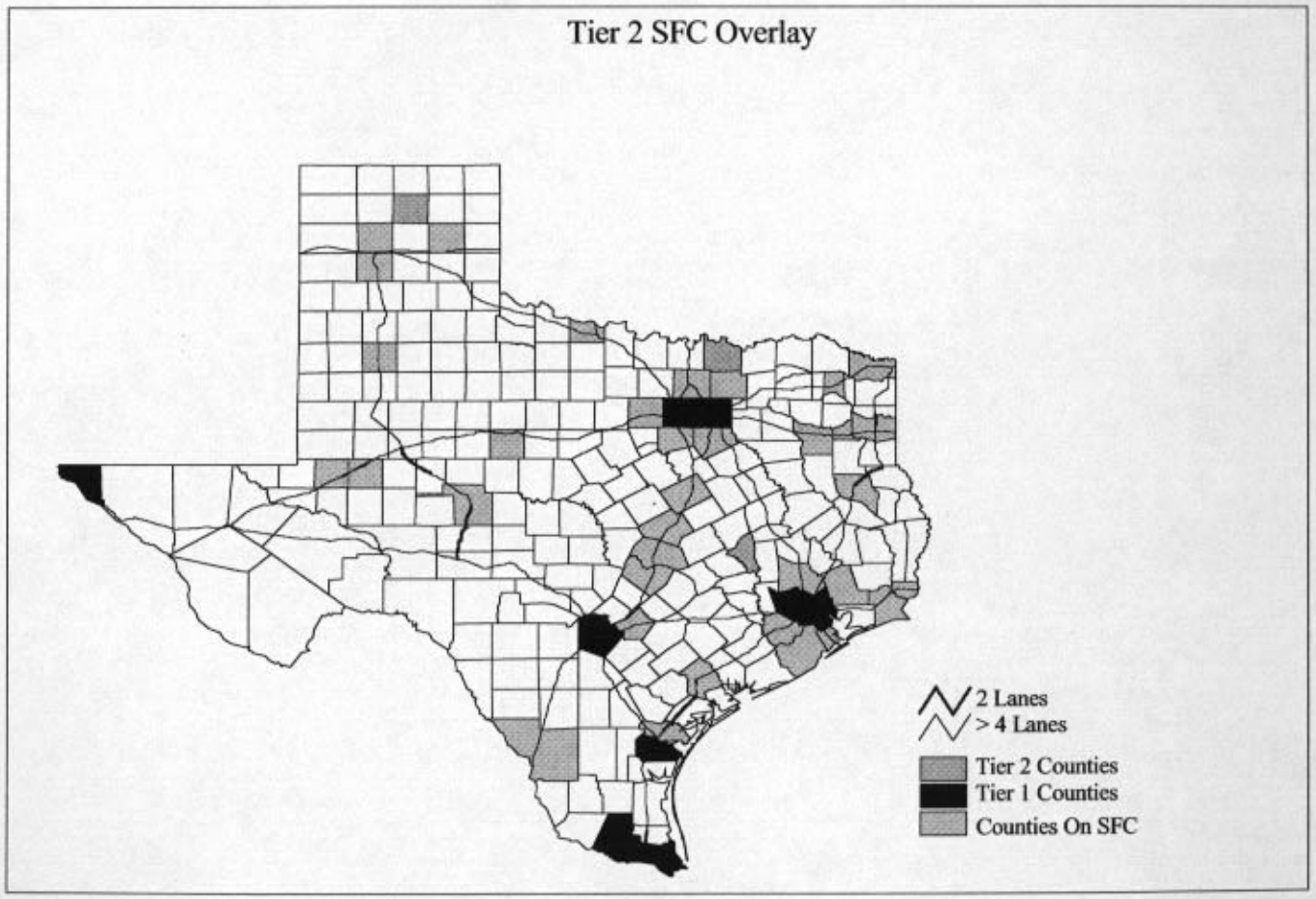

Figure 4.13 Tier 2 SFC Overlay

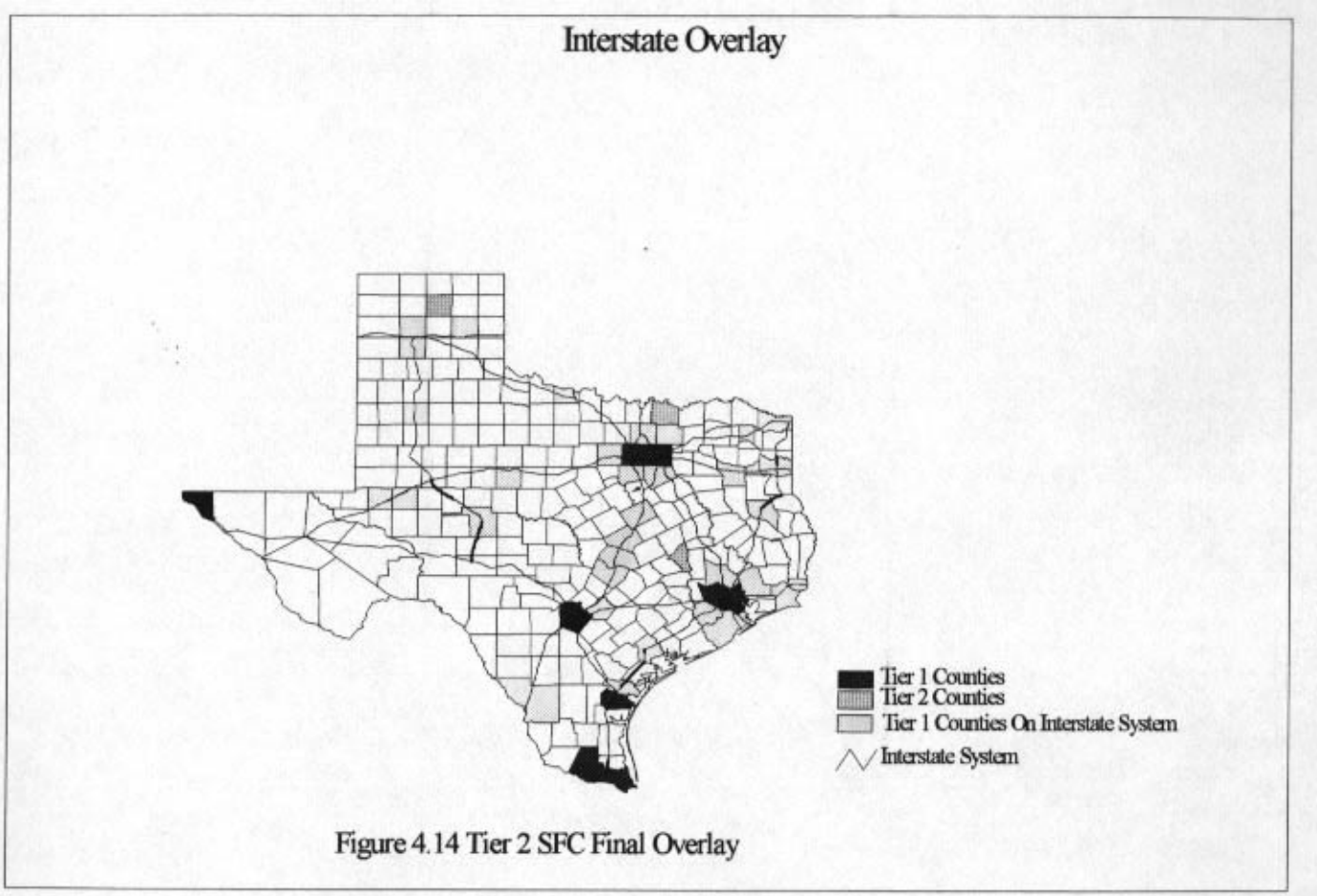

Figure 4.14 Tier 2 SFC Final Overlay

4.13 SUMMARY

The model to identify the economically significant counties in the state has been discussed through out this chapter. The scores for each criterion were aggregated to calculate a final county score. This final county score was used as the basis to select the strategic freight corridor network. The SFC network was identified by interconnecting all but a few economically significant counties (Fig. 4.15). This network interconnects all but three of the economically significant counties. This network provides most of the counties within the state with good access to the rest of the state. One hundred ninety of 254 counties are located within 10 miles of a SFC, representing 92 percent of the state population.

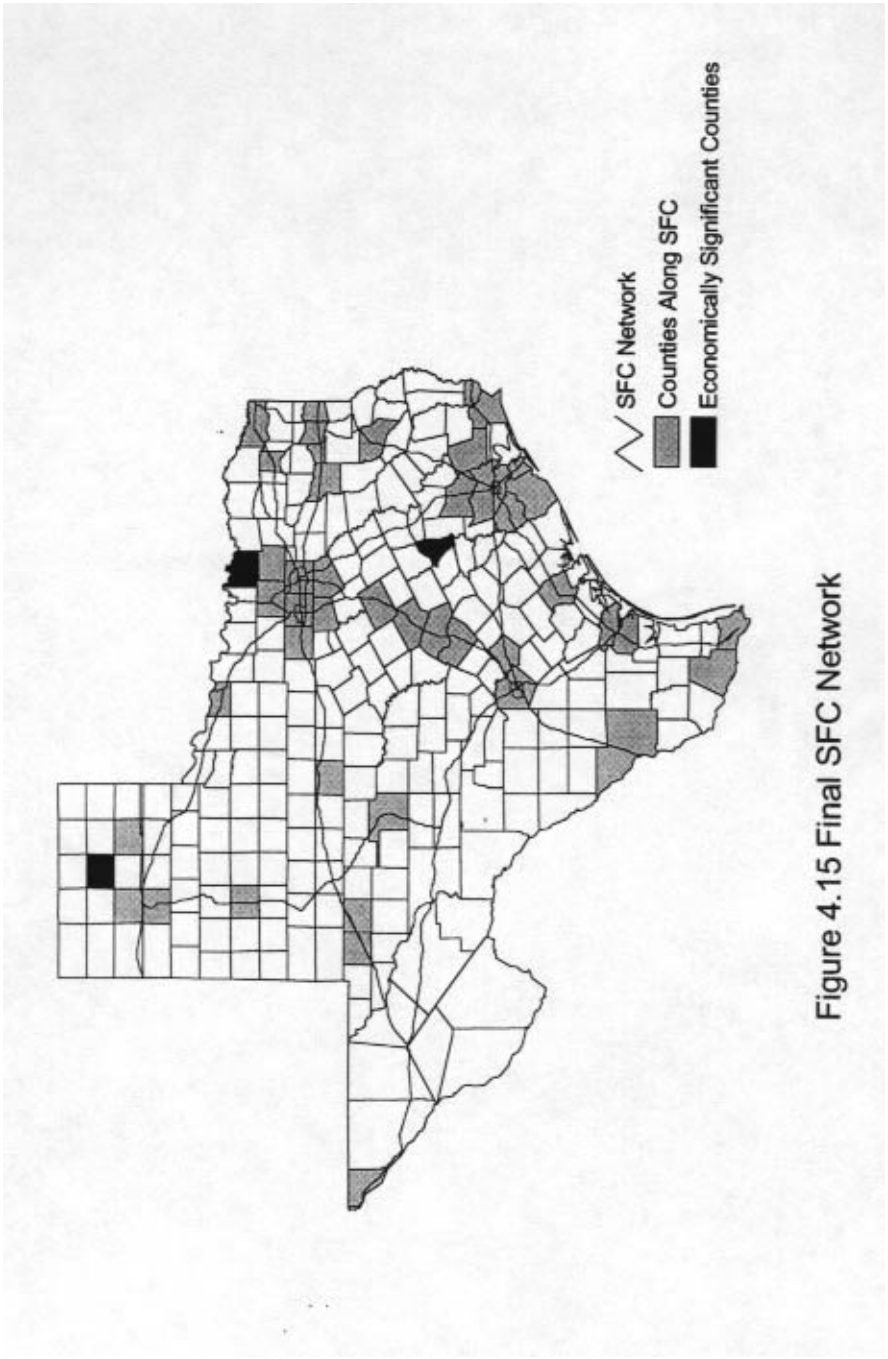

Figure 4.15 Final SFC Network

CHAPTER 5 VALIDATION

The model developed to identify the strategic freight corridors in Texas is based on certain economic and non-economic criteria. The success of the model hinges on the weights assigned to each criterion. The weighting assigned each criterion was based on a methodological process that evaluated the significance of each economic criteria relative to the Texas economy. Though the results of this model can not be tested and compared to empirical data to validate the results, the model can be tested to determine its sensitivity to the weighting values assigned to each criterion. Though the model does not directly select the strategic freight corridors, the selection of economically significant counties directly affects the selection of highways to be designated as strategic freight corridors. It is therefore possible to determine how the criteria weighting affects the selection of SFCs by observing the changes in the selection of economically significant counties.

5.1 VALIDATION METHODOLOGY

The objectives of the validation tests were to determine how the weighting scheme affected the final rankings of the counties and if these effects were significant. Nineteen scenarios were created to test the sensitivity of the model and to detect any anomalies in the results. The results of the original model were used as a base case to compare with the results of the other scenarios. The 18 other scenarios were obtained by varying the weighting criteria for each of the nine criteria by +/- 50% (Table 5.1). For example, the weighting value used for farming income in the original model was .1. The two farming income scenarios used to test the model's sensitivity were .05 and .15. The final rankings for the base case, increased weighting case, and the decreased weighting case were recorded and compared to detect any differences in the results. This procedure was repeated for each criterion.

5.2 VALIDATION RESULTS

The objective of the sensitivity test was to determine if the numerical weighting values affect the inclusion or exclusion of counties as economically significant counties. As discussed in the previous chapter, the final ranking score of 6.0 was used as the cutoff point to label a county as economically significant. Using the original weighting values, 46 counties were deemed economically significant (Figure 5.1). Of these 46 counties, 31 counties were always economically significant regardless of the weighting scheme. The other 15 counties were not economically significant under at least one scenario. An additional 22 counties were labeled as economically significant under at least one of the scenarios.

Table 5.1 Weighting Scheme Effects

Industry	Manufacturing		Wholesale		Retail		Farming		Mining	
	+50%	-50%	+50%	-50%	+50%	-50%	+50%	-50%	+50%	-50%
Manufacturing	0.405	0.135	0.253	0.287	0.244	0.296	0.255	0.285	0.253	0.287
Wholesale	0.090	0.130	0.165	0.055	0.100	0.120	0.104	0.116	0.103	0.117
Retail	0.130	0.190	0.150	0.170	0.240	0.080	0.151	0.169	0.150	0.170
Farming	0.082	0.118	0.094	0.106	0.090	0.110	0.150	0.050	0.094	0.106
Mining	0.090	0.130	0.103	0.117	0.100	0.120	0.104	0.116	0.165	0.055
Border Crossing	0.082	0.118	0.094	0.106	0.090	0.110	0.094	0.106	0.094	0.106
Marine	0.041	0.059	0.047	0.053	0.045	0.055	0.047	0.053	0.047	0.053
Rail/Truck	0.041	0.059	0.047	0.053	0.045	0.055	0.047	0.053	0.047	0.053
Airport	0.041	0.059	0.047	0.053	0.045	0.055	0.047	0.053	0.047	0.053

Industry	Border Crossing		Marine		Rail/Truck		Airport	
	+50%	-50%	+50%	-50%	+50%	-50%	+50%	-50%
Manufacturing	0.255	0.285	0.263	0.277	0.263	0.277	0.263	0.277
Wholesale	0.104	0.116	0.107	0.113	0.107	0.113	0.107	0.113
Retail	0.151	0.169	0.156	0.164	0.156	0.164	0.156	0.164
Farming	0.094	0.106	0.097	0.103	0.097	0.103	0.097	0.103
Mining	0.104	0.116	0.107	0.113	0.107	0.113	0.107	0.113
Border Crossing	0.150	0.050	0.097	0.103	0.097	0.103	0.097	0.103
Marine	0.047	0.053	0.075	0.025	0.049	0.051	0.049	0.051
Rail/Truck	0.047	0.053	0.049	0.051	0.075	0.025	0.049	0.051
Airport	0.047	0.053	0.049	0.051	0.049	0.051	0.075	0.025

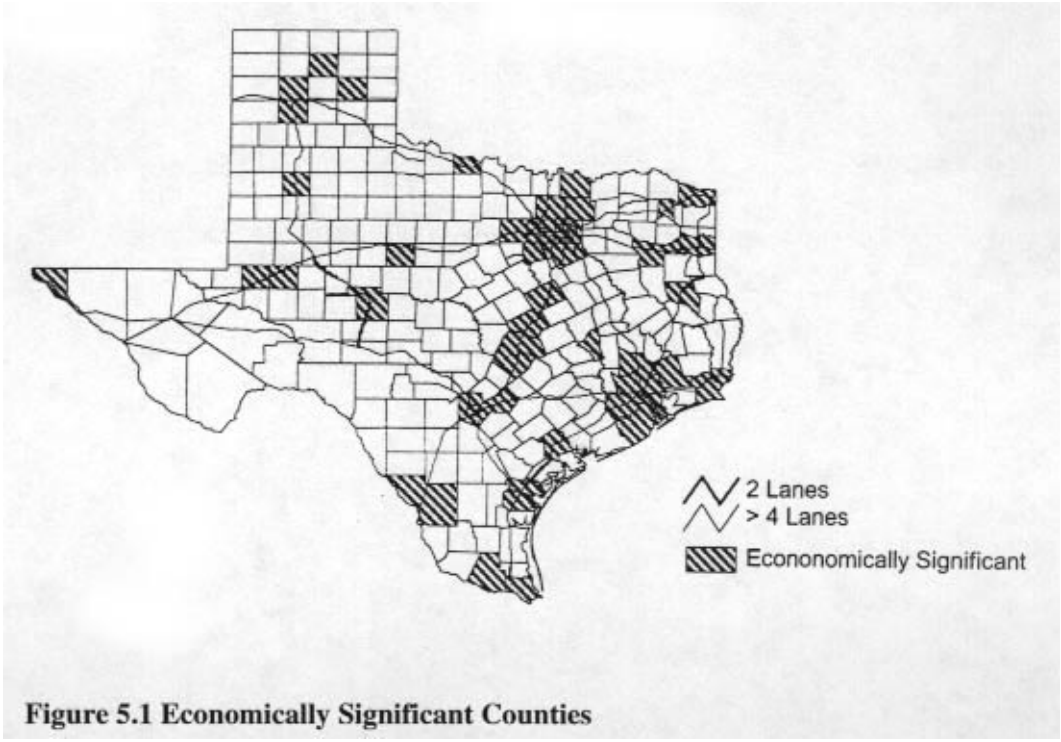

Figure 5.1 Economically Significant Counties

5.2.1 Manufacturing

The weight assigned to the manufacturing criteria affected the largest number of counties in terms of inclusion or exclusion on the SFC. By increasing the manufacturing weight to 41%, an additional 19 counties were labeled as economically significant (Figure 5.2). Fourteen of these counties were located within 10 miles of the SFC network, and all but 1 of the additional counties were located within twenty miles of a SFC.

Decreasing the manufacturing weight to 13.5 % resulted in 15 counties not being included on the network. All but two of these counties were located within 10 miles of a SFC. With a criteria weight of 41 percent, 64 counties were defined as economically significant. Of these 64 counties, 56 were located within 10 miles and 59 within 20 miles. The weight of 13.5 % yielded 30 economically significant counties. Twenty nine of these were located within 10 miles of a SFC.

Altering the manufacturing weighting criteria does not affect the selection of the strategic freight corridors. Most of the affected counties are located along an existing SFC and do not require additional highways to be designated as a SFC.

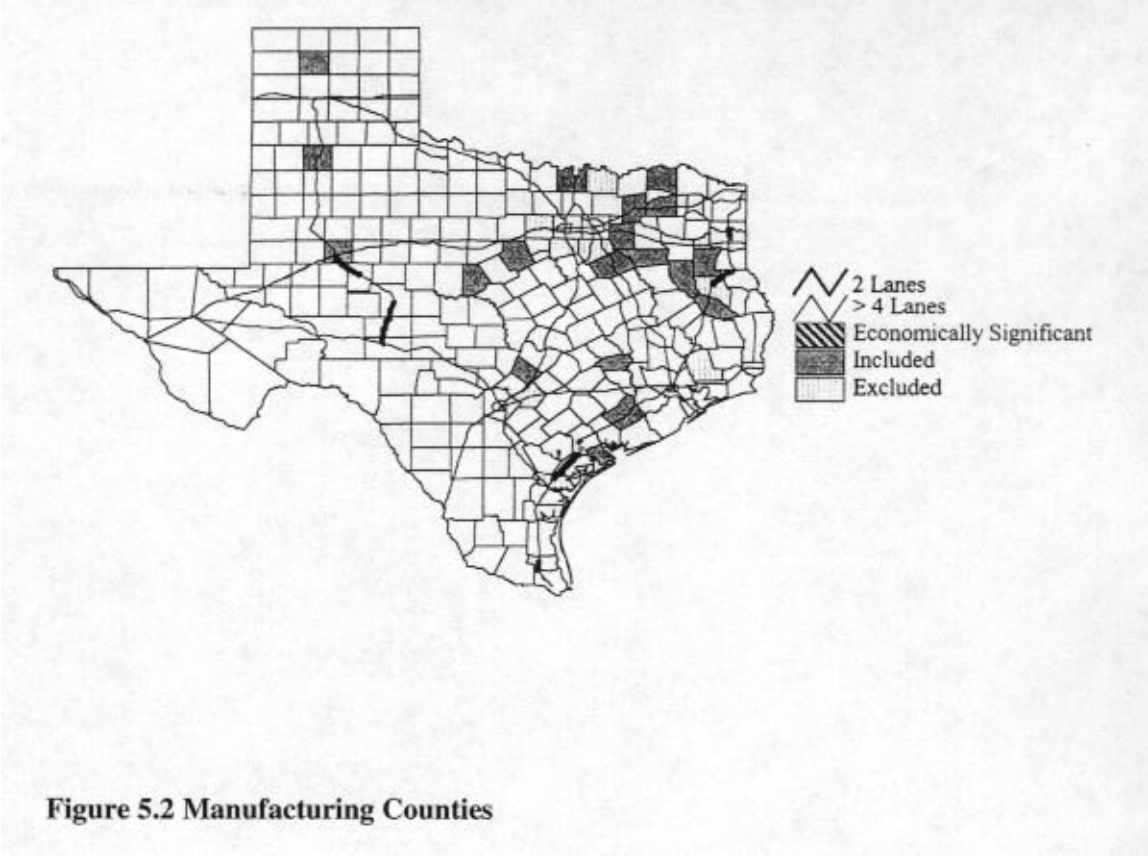

Figure 5.2 Manufacturing Counties

5.2.2 Wholesale

The weighting of the wholesale criteria had a minimal effect on the counties labeled economically significant. Increasing the wholesale weight by 50 percent resulted in an additional four counties being included as significant economic counties (Figure 5.3). Three of these counties are located along an existing SFC. The fourth county is located within 10 miles of a SFC. Decreasing the wholesale criteria weight by 50 percent prevented five counties from being labeled economically significant. These five counties were all located within 10 miles of a SFC.

Altering the wholesale criteria weighting marginally changes the list of economically significant counties. It does not however, affect the selection of freeways to comprise the SFC. All the additional counties that would be included have good access to the network.

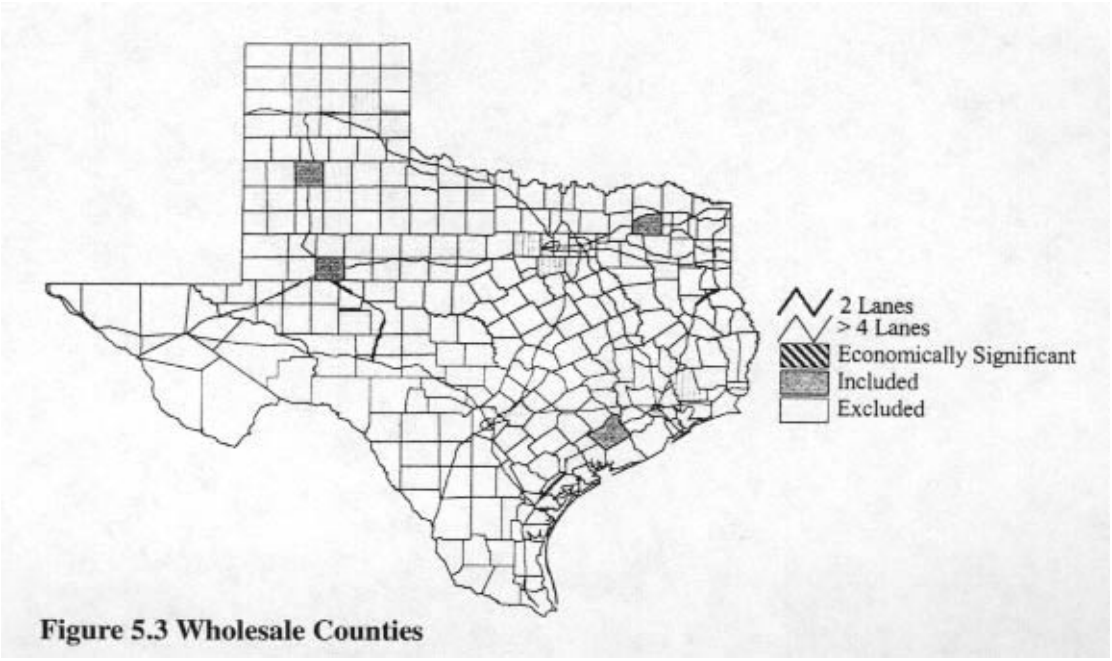

Figure 5.3 Wholesale Counties

5.2.3 Retail

The retail criteria-weighting scheme had a large impact on the selection of economically significant counties, though not nearly as large as that of the manufacturing criteria. Changing the retail weighting affected 18 counties. Increasing the weighting resulted in 10 counties being classified as economically significant (Figure 5.4). Seven of these counties are locate on an SFC, and two others are located within 10 miles of a SFC. Reducing the retail criteria weighting resulted in eight counties being excluded as economically significant counties. Of these eight, seven are located on a SFC.

Altering the retail weighting does not affect the selection of SFCs. Though the weighting does affect the number of counties considered economically significant, the location of these counties along the SFCs does not result in additional freeways being included as a SFC

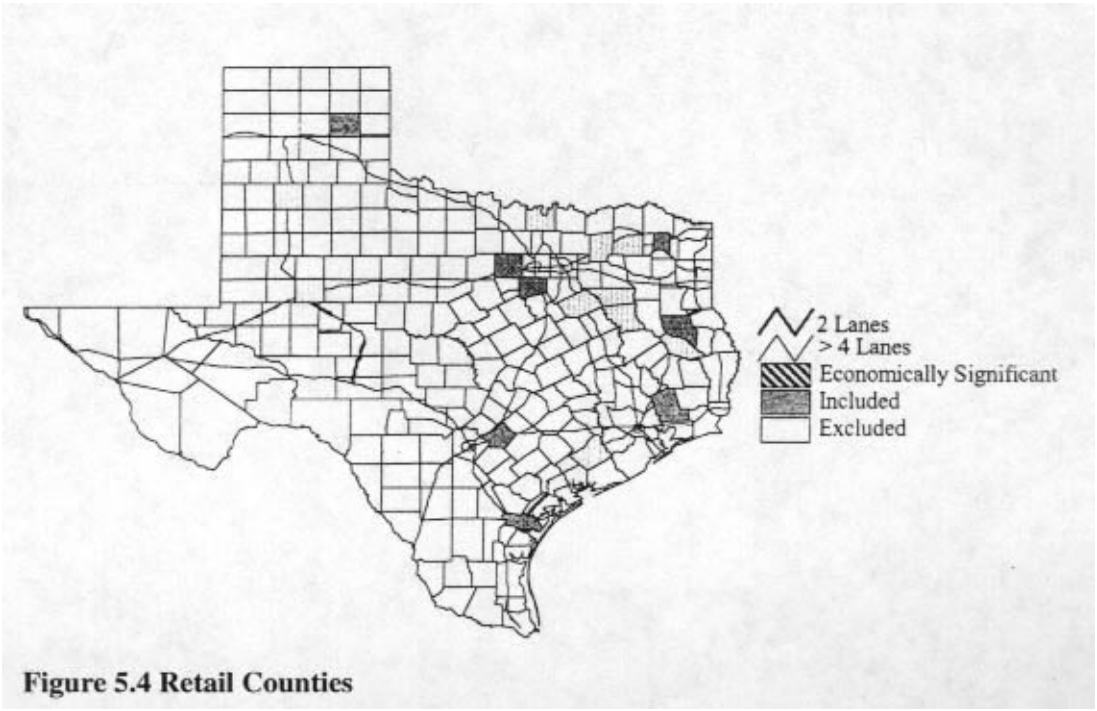

Figure 5.4 Retail Counties

5.2.4 Farming

The farming criteria weighting had the smallest effect of all the criteria. Only eight counties were affected by altering the farm weighting. Increasing the weight by 50 percent resulted in three counties being included as economically significant counties (Figure 5.5). All three of these counties are located along a SFC. Reducing the farm weight resulted in five counties being excluded as economically significant. All but 1 of these counties are located on an SFC.

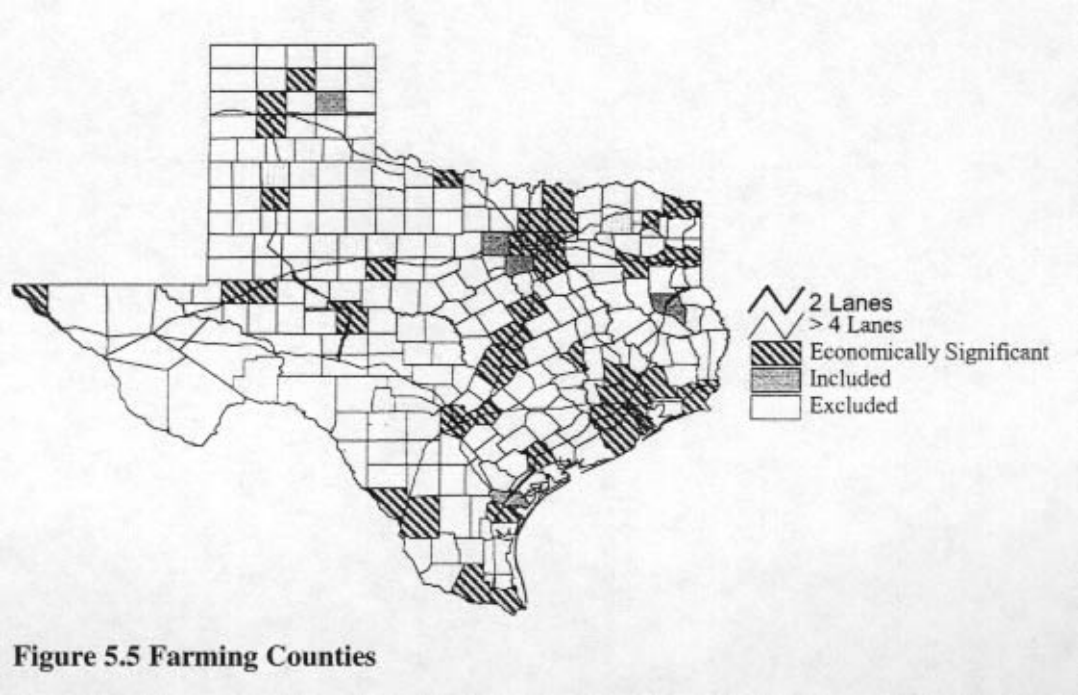

Figure 5.5 Farming Counties

5.2.5 Mining

Unlike the other criteria, altering the weighting of the mining criteria had mixed effects on the county rankings. Increasing the mining weight by 50 percent resulted in a net of three counties being excluded from the list of economically significant counties. The weighting increase caused two counties to be included and 1 to be excluded as significant counties (Figure 5.6). Decreasing the mining weighting criteria resulted in a net of 1 county being excluded from the system. One county was excluded as economically significant and two were included. Using the increased weighting scheme, 43 counties were labeled as economically significant. The decreased weighting scheme resulted in a system with 47 counties.

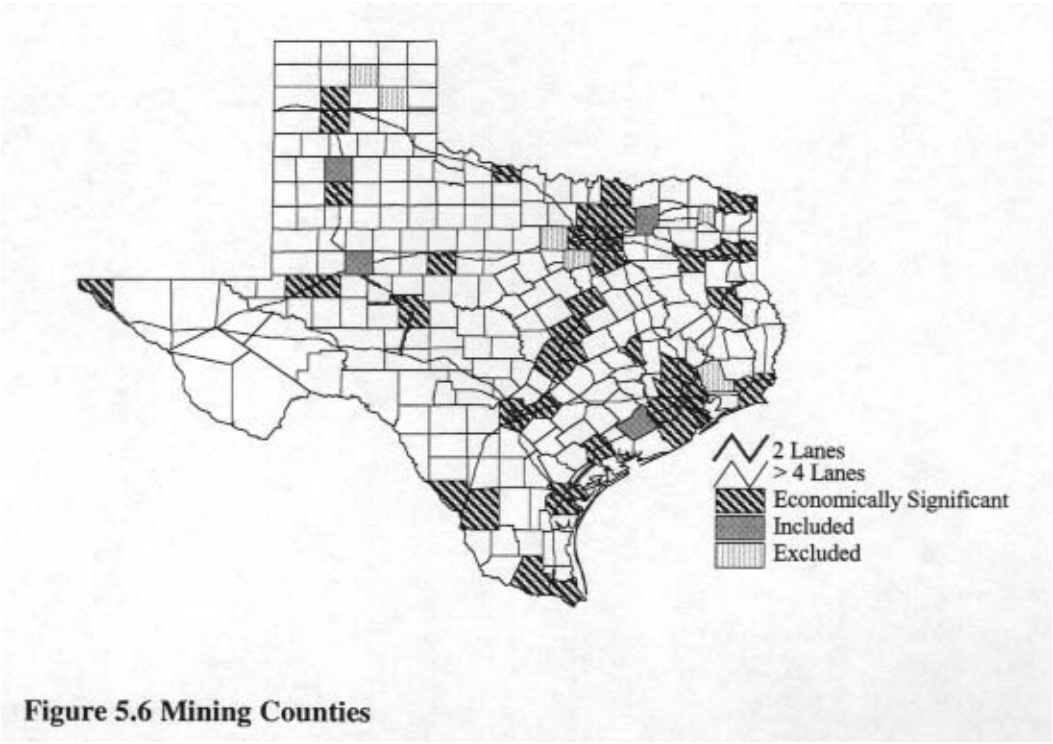

Figure 5.6 Mining Counties

5.2.6 Border Crossing

The border crossing criteria weighting had the second largest impact of the criteria. Altering the weighting affected 24 counties. Increasing the weighting resulted in 16 counties not being classified as economically significant while decreasing the border crossing weighting results in nine counties being labeled as economically significant (Figure 5.7). Seven of these additional counties are located on a SFC, and another is located within 10 miles.

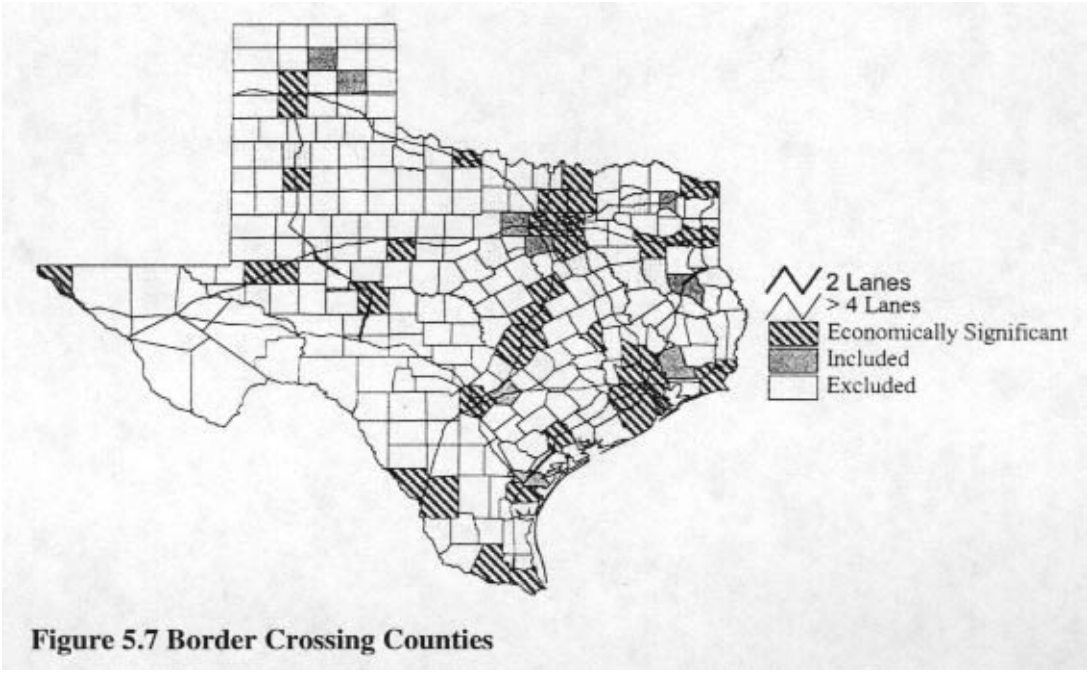

Figure 5.7 Border Crossing Counties

5.2.7 Intermodal Facilities

Altering the weighting for marine ports, airports, and rail/truck transfer facilities all affected the same nine counties. The effect of each criterion will be addressed together. Increasing an intermodal criteria's weighting resulted in five counties not being labeled economically significant (Figure 5.8). All five of these counties are located on an SFC. Decreasing the intermodal criteria's weighting resulted in three counties being labeled economically significant. These three counties were all located on a SFC. The intermodal facility criteria does not affect SFC selection.

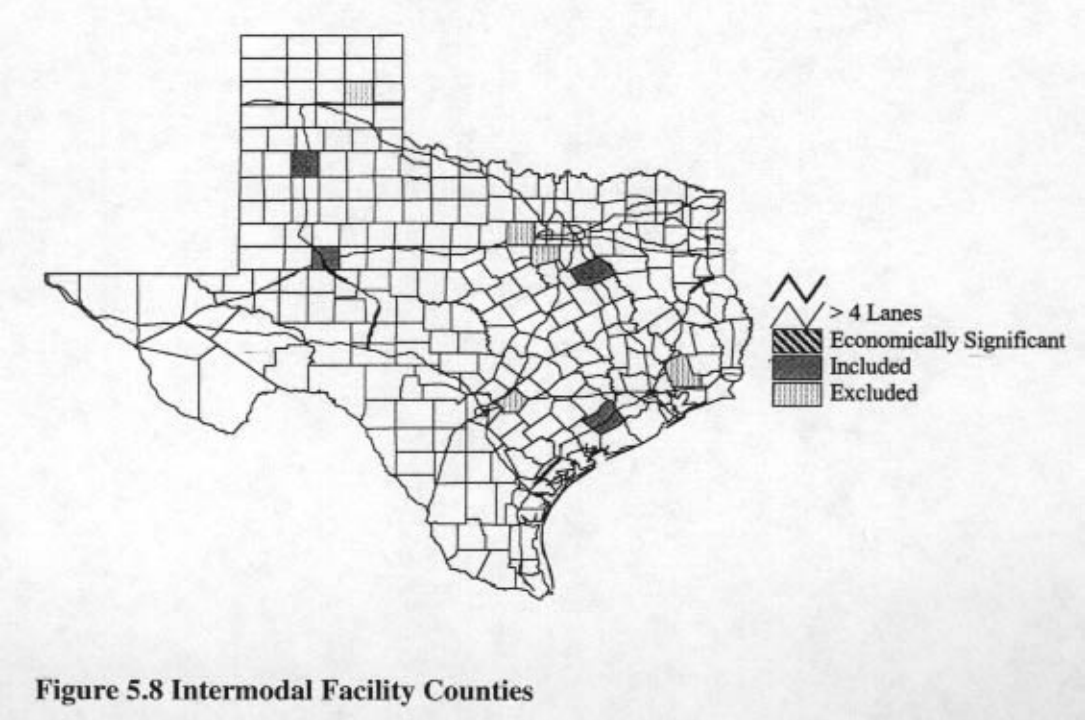

Figure 5.8 Intermodal Facility Counties

5.3 SUMMARY

This chapter analyzed the effects that the weighting of each criterion had on the final ranking of the counties. Though each scenario changed the final ranking of every county, only a few of the counties' final scores were increased or decreased enough to be included or excluded as economically significant. Table 5.2 shows the number of counties affected by the weighting change to each criterion. In all, 37 counties were affected by the weighting scheme. That is to say 37 counties were included or excluded in the list of economically significant counties based on the weighting scheme applied to the criteria. Figures 5.9 shows the counties that are economically significant under the original weighting scheme. Additionally, the counties that are economically significant under all weighting schemes are identified. All but three of the economically significant counties (base case) are located within 10 miles of a SFC. Only two of the counties that are always significant are located further than 10 miles from a SFC. Figure 510 shows the base case economically significant counties as well as the counties that are significant under at least one of the weighting schemes. The large majority of additional counties are within 10 miles of a SFC. In fact, 15 out of 22 counties are located along a SFC.

TABLE 5.2 CRITERIA WEIGHTING AFFECT ON ECONOMICALLY SIGNIFICANT COUNTIES

Criteria	+ 50 %	- 50 %
Manufacturing	15	(19)
Wholesale	5	(4)
Retail	8	(10)
Farming	5	(3)
Mining	2(5)	2(1)
Border Crossing	(16)	9
Marine	4	(5)
Rail/ Truck	4	(5)
Airport	4	(5)

Note: Positive numbers indicate additional counties included as economically significant. Numbers in parenthesis indicate counties removed as economically significant.

The results of the sensitivity test show that the selection of strategic freight corridors is not dependent on the weighting system used. The sensitivity test analyzed the effects of varying the weighting of each criterion by plus and minus 50 percent. The increased or decreased weighting assigned to each criterion did not affect the selection of the highways for the strategic freight corridor network.

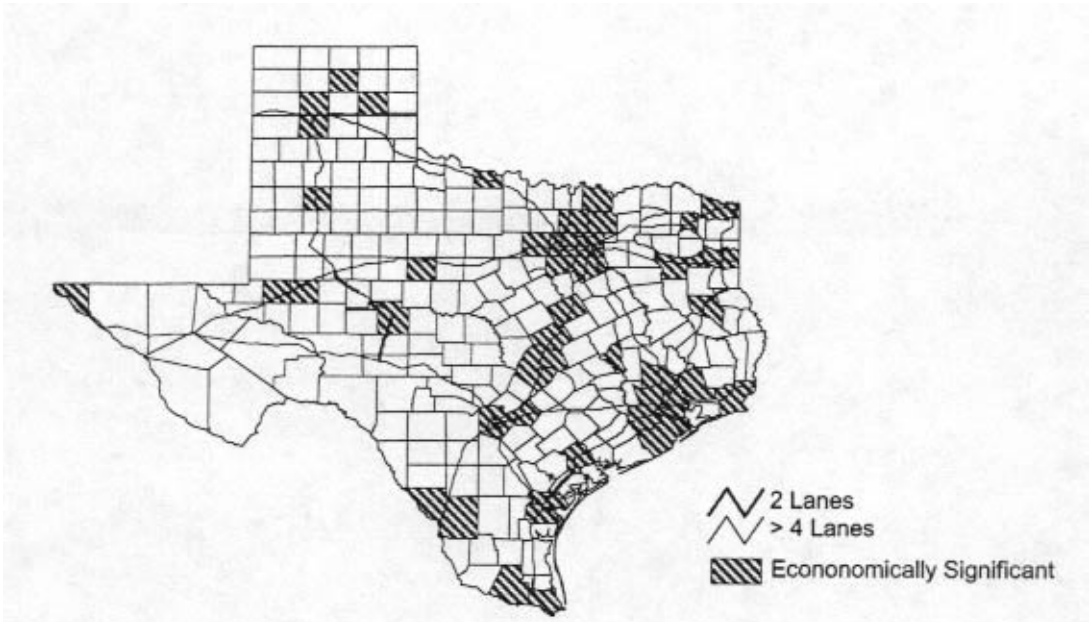

Figure 5.9 Economically Significant Counties (Base Case)

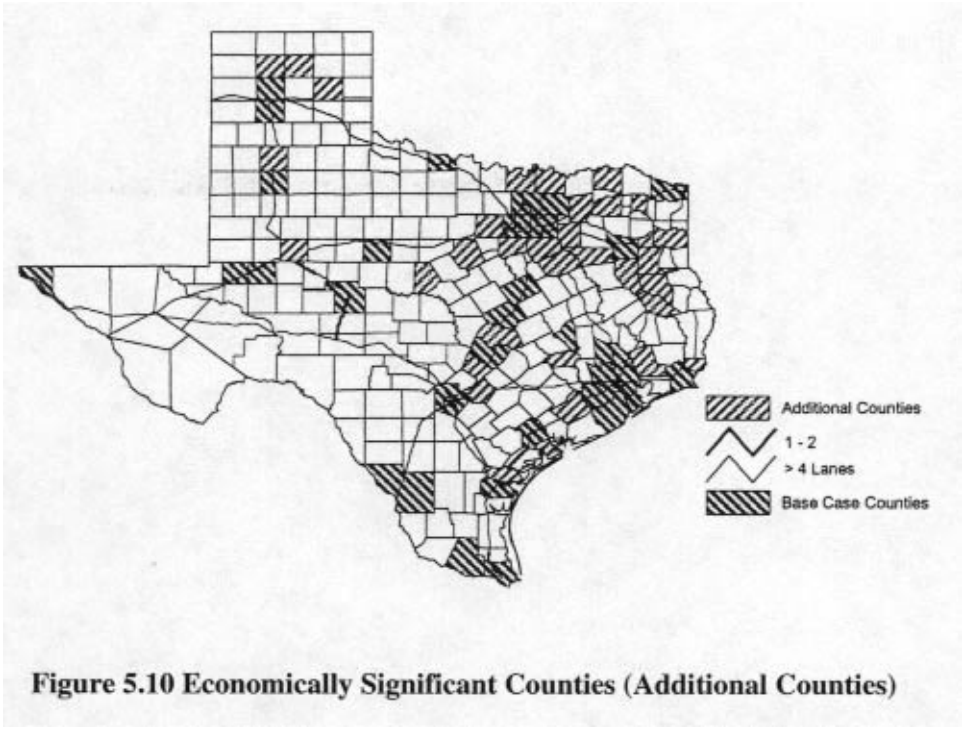

Figure 5.10 Economically Significant Counties (Additional Counties)

CHAPTER 6 NORTH AMERICAN FREE TRADE AGREEMENT

6.1 BACKGROUND

The January 1, 1994 signing of the North American Free Trade Agreement (NAFTA) between Canada, Mexico, and the United States lowered initial tariffs and established the phase in time by commodity for zero tariffs. The lower tariffs are expected to increase the flow of goods across the national border, reduce shipping costs, and reduce consumer costs. NAFTA should decrease the cost of products in each nation as economic competition increases.

Texas has a substantial economic interest in the increased trade resulting from NAFTA. With its 2,000 kilometer long border with Mexico, Texas will, however, sustain a disproportionate share of negative effects such as traffic hazards, pavement consumption, and excessive capacity on its highways and at its border crossings (Ref. 16).

In 1996, over $67 billion worth of import and export truck trade crossed the U.S.-Mexico border via Texas highways (Ref. 17). Approximately $35 billion was destined for Texas, while the remaining $32 billion had origins or destination scattered through out the United States. Currently, Interstate Highway 35 (IH35) is the major highway for the flow of goods between the U.S. and Mexico (Ref. 18). Many segments of IH35 are heavily populated with a number of major cities along the corridor. These cities, Laredo, San Antonio, Austin, Waco, Dallas, and Fort Worth all have the congestion associated with urban areas, and as a result, trucks carrying freight along this corridor must contend with peak hour congestion within these urban boundaries. The importance of IH35 in U.S. - Mexico trade has led to the suggestion that IH35 should be designated as a NAFTA superhighway, and that federal funds should be set aside to fund maintenance and improvement projects to increase capacity along on the most congested segments of the highway.

An alternative to relieve truck congestion on IH35 would be improving United States Primary Highway 59 (U.S 59) to interstate standards. Currently, portions of U.S 59 are in the planned to be upgraded to Interstate Highway Status. U.S 59 connects the Mexican border at Laredo, to Texarkana at the Arkansas border. U.S 59 offers the most direct route to Houston, to many of the ports along the Gulf, and to the eastern third of the country. U.S 59 would be an ideal alternative to IH35 if consistent geometric standards existed through out U.S 59. Unfortunately, the highway varies greatly both in access control and in number of lanes. U.S 59 varies in width from two lanes between Laredo county and Victoria county to 15 lanes in the Houston metro area (Figure 6.1). Approximately 220 miles of the 600-mile highway are two lanes wide.

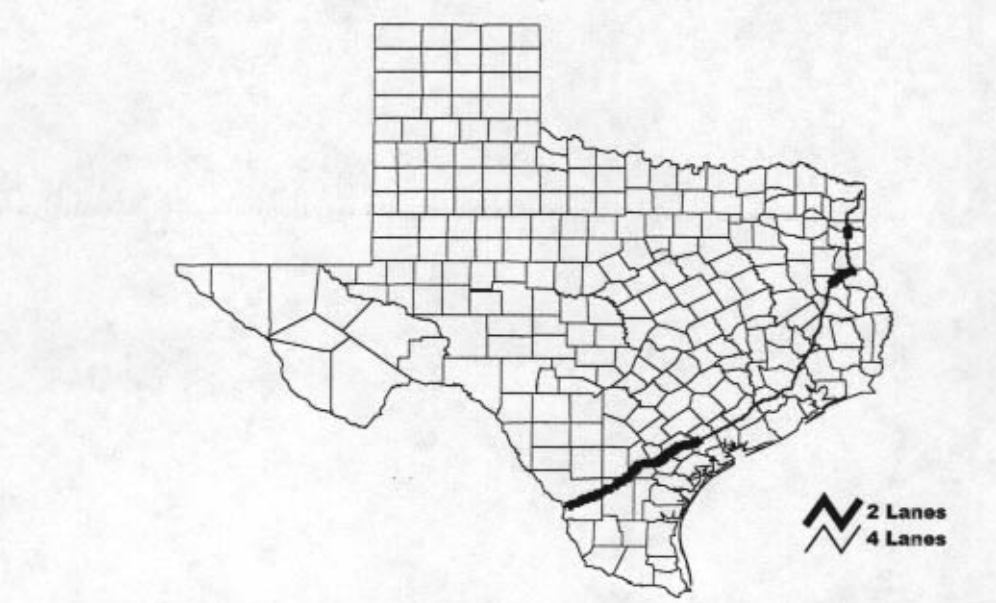

Figure 6.1 U.S 59 Lane Widths

As mentioned, U.S. 59 connects Laredo, the busiest U.S - Mexico border crossing in the nation with the city of Houston, IH10, I20, and IH30. U.S 59 if improved to interstate standards provides a gateway to the South East and Mid Atlantic regions that offers a substantial time savings over IH35. The current trade patterns between the U.S. and Mexico (Table 6.1) suggest that a significant portion of U.S - Mexico trade would benefit by upgrading U.S 59. These benefits would include reductions in shipping times and improved reliability. The flow of goods through Texas and particularly Laredo will be evaluated to identify the origins and destination of goods in the U.S. This evaluation will indicate the percentage of trade that could benefit from improvements to U.S 59.

6.2 DATA SCOPE AND SOURCES

U.S.-Mexico trade data was obtained from the U.S. Department of Transportation Bureau of Transportation Statistics (BTS). In 1993, BTS began publishing summaries of shipper' export declarations and some import documentation. These files consist of surface value data taken from U.S. customs documents crossing the U.S.-Canada border and the U.S.-Mexico Border. The data files are organized in two ways - those with a commodity emphasis and those with a geographic emphasis.

TABLE 6.1 U.S. - MEXICO TRUCK TRADE THROUGH TEXAS

Region	*$ (billions)*	*Percent*
New England	1.03	1.5%
Pacific	2.74	4.1%
MidAtlantic	3.64	5.4%
S Atlantic	7.53	11.2%
E N Central	12.29	18.4%
E S Central	3.32	5.0%
Mtn	0.41	0.6%
W N Central	1.67	2.5%
W S Central	34.34	51.3%
Total	66.97	100.0%

The BTS import and export files for January 1996 to December 1996 were used in this analysis. Each month from 1996 was analyzed separately, and later aggregated to determine freight flows for the year. The data contents for the import and export files are shown in Tables 6.2 and 6.4.

6.2.1 Import Data

The import data needed for this analysis were the variables MODE, DESTATE, DEPE, and VALUE. All other data were not needed for this study and thus discarded. A series of macros were developed in Microsoft Excel to aggregate the monthly data (Appendix C). The aggregated data were input into Arc View so that they could be visually inspected and analyzed.

TABLE 6.2 CONTENT OF IMPORT FILES WITH GEOGRAPHIC DETAIL (JAN. - DEC. 1996)

Variable Name	Type	Definition	Description
MODE	Character	Mode of Transportation	4' =mail; '5'=truck; '6'=rail; '7'= pipeline; '8'=other
CONTCODE	Character	whether the merchandise is containerized	"1" = containerized shipment. (Only applicable for truck and rail shipments)
DESTATE	Character	U.S. state of destination	
DEPE	Character	District and Port of Entry	Four-digit classification of U.S. districts and ports Customs(see Appendix 6)
VALUE	Numeric	Commodity value in U.S. dollars	
DATE	Character	Month and Year	Example: 0593
COUNT	Numeric	Record Count of the sorted and summarized raw data fields	

Adapted from *Analysis of U.S.-Mexico Traffic Within Texas* (Ref. 16)

The import file contained data aggregated from customs record showing value transported by truck, rail, and mail. Because this study was concerned only with the movement of freight by truck, the non-truck value data were discarded. The data were sorted by port of entry and then by destination state. Each port of entry contained multiple records for each destination state, because the record for each destination state had the location of the originating Mexican state. This study did not differentiate between the Mexican state's origin, so the records for the destination state were summed to produce one record that contained the freight value destined for that state through the respective port of entry. The flow through each port of entry was also calculated by summing the freight flow between Mexico and each state by port of entry (Appendix D1). In addition to calculating the flow of goods to each state, the flow of goods to different regions of the country were also calculated. The geographic regions defined in Arc View were chosen as the analysis regions. These regions and the states compromising each region are shown in Table 6.3. The data for each month were summed to calculate the imported freight flow for the year.

TABLE 6.3 GEOGRAPHIC REGIONS

Region	States								
New England	CT	MA	ME	NH	RI	VT			
Pacific	CA	OR	WA						
Mid Atlantic	NJ	NY	PA						
South Atlantic	DC	DE	FL	GA	MD	NC	SC	VA	WV
E N Central	IL	IN	MI	OH	WI				
E S Central	AL	KY	MS	TN					
Mountain	AZ	CO	ID	MT	NM	NV	UT	WY	
W N Central	IA	KS	MN	MO	ND	NE	SD		
W S Central	AR	LA	OK	TX					

6.2.2 Export Data

The export data needed for this analysis were the variables MODE, ORSTATE, DEPE, and VALUE. All other data were not needed for this study and thus discarded. The export file contained value data transported by truck, rail, and mail. Only the truck freight data were retained for this analysis. The freight data for the other modes were discarded. Similar to the procedure used to aggregate the import data files, the export data were sorted by port of entry and by originating U.S state. Each port of entry contained multiple records for each originating U.S state. This study did not differentiate between the Mexican states, so the records for the originating U.S states were summed to produce one record that contained the freight value from each U.S state through the each port of entry. The freight flow through each port of entry was calculated by summing the freight flow between Mexico and each U.S state by port

of entry. The flow to each geographic region defined in the previous section were calculated (Appendix D2) The data for each month were summed to calculate the imported freight flow for the year.

TABLE 6.4 CONTENT OF EXPORT FILES WITH GEOGRAPHIC DETAIL (JAN. - DEC. 1996)

Variable Name	Type	Definition	Description
MODE	Character	Mode of Transportation	4' =mail; '5'=truck; '6'=rail; '7'= pipeline; '8'=other
DF	Numeric	Where the merchandise was produced	"1" = domestically produced "2" = foreign produced
ORSTATE	Character	U.S. state of origin	
MEXSTATE	Character	Mexican state of consignee	
DEPE	Character	District and Port of Entry	Four-digit classification of U.S. districts and ports Customs(see Appendix 6)
VALUE	Numeric	Commodity value in U.S. dollars	
DATE	Character	Month and Year	Example: 0593
COUNT	Numeric	Record Count of the sorted and summarized raw data fields	

Adapted from *Analysis of U.S.-Mexico Traffic Within Texas* (Ref. 16)

6.3 FLOW OF GOODS THROUGH TEXAS

The previous section described the procedure to aggregate the monthly data files. The aggregation produced import and export value flow data for the year. These flow data were summed to calculate the total freight flow through Texas. Table 6.5 shows the total (bi-directional) flow of freight through each port of entry as well as the flow of freight to each geographic region. Over 40 percent of the U.S.-Mexico trade through Texas passed through the Laredo border crossing. The next section will

Table 6.5 U.S. - Mexico Truck Trade Through Texas

Region	*$ (billions)*	*Percent*
New England	1.03	1.5%
Pacific	2.74	4.1%
MidAtlantic	3.64	5.4%
S Atlantic	7.53	11.2%
E N Central	12.29	18.4%
E S Central	3.32	5.0%
Mtn	0.41	0.6%
W N Central	1.67	2.5%
W S Central	34.34	51.3%
Total	66.97	100.0%

identify the U.S origins and destinations of the freight flowing through Laredo. Section 6.5 will calculate and compare the travel time for freight traveling from the border crossing at Laredo to cities in each geographic region via IH35 and U.S 59.

6.4 FLOW OF GOODS THROUGH LAREDO

As mentioned, Laredo is the busiest port of entry on the U.S Mexico border, and as such, the IH35 corridor, which terminates in Laredo, carries a large share of NAFTA trucks. In fact, the sections along IH35 between Laredo and San Antonio and between San Antonio and Dallas are the two most densely traveled truck corridors in the U.S. (Ref. 18). Congestion in San Antonio, Austin, Dallas and other urban areas along IH35 severely hinders the flow of goods form Mexico to the rest of the U.S. A current proposal is to designate the IH35 corridors as a NAFTA superhighway and apportion federal funds to upgrade and maintain the highway. Though the additional capacity along sections of IH35 would greatly reduce congestion on the highway and improve the flow of goods through the region, an alternative proposal to upgrade U.S 59 to Interstate standards should be examined. The crux of this plan is to divert some of the commercial vehicles from IH35 to U.S. 59.

The flow of goods through Laredo (Table 6.6) was calculated to determine the origin and destination of goods flowing through this port. The travel time between Laredo and major cities within each geographic region will be calculated. The major cities within each geographic area were used solely as an identification point. The cities did not represent the origins or destination of commodities. These travel times will be calculated for trucks using IH35 and for trucks using an upgraded U.S. 59. The travel times will be compares to determine the travel time savings of U.S 59.

TABLE 6.6 U.S. - MEXICO TRUCK TRADE THROUGH LAREDO, TEXAS

Region	*$ (billions)*	*Percent*
New England	0.81	2.8%
Pacific	2.04	7.2%
MidAtlantic	2.93	10.3%
S Atlantic	4.92	17.3%
E N Central	7.46	26.2%
E S Central	1.58	5.5%
Mtn	0.26	0.9%
W N Central	1.03	3.6%
W S Central	7.40	26.0%
Total	28.43	100.0%

6.5 TRAVEL TIME CALCULATIONS

Travel times between Laredo and various cities in the eastern half of the country were calculated for travel along both IH35 and U.S 59. Travel times were calculated by using AutoMap by Microsoft.

AutoMap is a travel itinerary program that can plan trips and calculates travel times for quickest, shortest, and preferred routes. Preferred routes are calculated using users specified options such as vehicle speeds and preferences for different classes of roadways.

To reflect current commercial vehicle operations (CVO) practices, the user options were set to giver Interstates an extremely high preference. This however, led to the problem of U.S 59 not being selected as a route. Unfortunately, a specific road can not be specified when planning a trip. To work around this problem, the trips that used the U.S 59 route needed to be chained.

The travel times from Laredo to Houston and from Houston to Texarkana were calculated using the quickest route option. The route selected were U.S 59. The travel time from Laredo to Houston was recorded, and the travel time form Houston to Texarkana was added to the Laredo to Houston travel time. Any trip using U.S 59 will travel either the Laredo to Houston segment or the Laredo to Texarkana segment. The U.S 59 connects with IH10 in Houston and IH30 in Texarkana. Travel times between Laredo and other cities were calculated by taking the minimum travel time between Laredo to Houston and Houston to that city and Laredo to Texarkana and Texarkana to that city.

The travel time of trucks using IH35 was calculated by setting the starting point of the journey at Laredo. Additionally, the selected route was forced to pass through San Antonio. This essentially guaranteed that at least a portion of the route would be along IH35. Once again, Interstates were given a strong preference to ensure realistic routes. The travel times via IH35 and via U.S. 59 were compared to calculate travel time savings.

6.6 TRAVEL TIME COMPARISON

The travel time from Laredo to major cities in each geographic region east of IH35 were calculated (Table 6.7). The difference in travel times was also computed. The time savings for using U.S 59 are shown as positive numbers in the time savings column. Negative numbers indicate that the travel time using IH35 was less than the travel time using U.S 59. The table shows that freight originating or terminating in the west south central, south Atlantic, mid Atlantic or new England region would benefit from improvements to U.S 59. These time savings ranged from 18 to 50 minutes.

Freight traveling to or from the east south central or the east north central region would not reduce their traveling time by using U.S 59. The time savings for freight using IH35 ranged from two minutes to 24 minutes. Though the magnitude of these time savings are approximately the same as the time savings for the other regions using U.S 59, they are not as substantial when the fact that the freight traveling along these routes must travel through more urban areas is factored in. The last two columns in Table 6.7 show the major cities that freight must pass through using each route. In every case, freight traveling along IH35 passed through more urban areas than freight traveling on U.S. 59. As mentioned, the two primary east-west highways that carry NAFTA trade from IH35 are IH10 and IH30. Freight destined for the Midwest and North East would travel along IH35 to IH30. Using this route, freight passed through the major cities of San Antonio, Austin and Dallas. Using the U.S 59 route freight passes through

only the major city of Houston before connecting to IH30. IH35 bound freight destined for the South Atlantic or Mid Atlantic region use IH35 to San Antonio then connect to IH10. Under this scenario, freight must pass through both San Antonio and Houston. Freight using U.S 59 only passes through Houston.

Though many of the routes using IH35 had smaller travel times, the variability of those travel times are greater than those along U.S 59 routes. Automap does not account for congestion and time of day when calculating travel times. Both of these variables will significantly affect travel time through a city.

An improved U.S. 59 offers a substantial travel time savings to many regions of the country. In other regions, the travel time using the U.S 59 route is marginally longer than the IH35 route. The reliability of travel on the U.S 59 route, however, is significantly greater. Upgrading U.S. 59 to Interstate standards will offer a viable alternative route to IH35 that will reduce travel times to many areas of the country and reduce congestion on IH35.

6.7 SUMMARY

In addition to improving freight shipping efficiency and reducing congestion along IH35, the improvement of U.S 59 will offer a significant economic boost to the counties along the U.S 59 corridor. In chapter 4, the entire U.S 59 corridor was not identified as a strategic freight corridor because of the geometric deficiencies along the southern portions of the highway. This chapter examined the movement of goods over the Texas-Mexico border and evaluated some of the effects upgrading U.S 59 to Interstate standards would have on NAFTA trucks. The results of the analysis indicate that U.S-Mexico trade trucks using Laredo would benefit from an alternate route to I 35. As such the entire U.S 59 corridor is being included as a SFC.

Table 6.7 I35 Vs. U.S. 59 Travel Time

Origin	Destination	Trip Tine		Time Savings	Major Cities Along Route	
		I 35	US 59	(minutes)	I35	US59
Laredo	Houston	6.68	6.17	31	San Antonio	
Laredo	Texarkana	11.63	11.92	-17	San Antonio, Dallas	Houston
Laredo	New Orleans	13.35	12.78	34	San Antonio, Houston	Houston
Laredo	Jackson	15.05	14.53	31	San Antonio, Houston	Houston
Laredo	Atlanta	21.68	21.15	32	San Antonio, Houston	Houston
Laredo	Memphis	16.77	17.12	-21	San Antonio, Dallas	Houston
Laredo	St. Louis	21.57	22.03	-28	San Antonio, Dallas	Houston, Memphis
Laredo	Nashville	20.82	21.00	-11	San Antonio, Dallas, Texarkana, Memphis	Houston, Texarkana, LittleRock
Laredo	Louisville	23.85	24.03	-11	San Antonio, Dallas, Texarkana, LittleRock, Memphis	Houston, Texarkana, Little Rock, Memphis
Laredo	Columbus	28.62	28.65	-2	San Antonio, Dallas, Texarkana, LittleRock, Memphis, Indianapolis	Houston, Texarkana, Little Rock, Memphis, Indianapolis
Laredo	Chicago	27.07	27.47	-24	San Antonio, Dallas, Texarkana, LittleRock, Memphis	Houston, Texarkana, Little Rock, Memphis
Laredo	Detroit	31.25	31.28	-2	San Antonio, Dallas, Texarkana, LittleRock, Memphis, Indianapolis, Toledo	Houston, Texarkana, Little Rock, Memphis, Indianapolis, Toledo
Laredo	Cleaveland	31.25	31.28	-2	San Antonio, Dallas, Texarkana, LittleRock, Memphis, Indianapolis, Columbus	Houston, Texarkana, Little Rock, Memphis, Indianapolis, Columbus
Laredo	Norfolk	33.82	32.98	50	San Antonio, Houston, Atlanta	Houston, Atlanta
Laredo	Washingotn, DC	32.82	32.52	18	San Antonio, Dallas, Texarkana, LittleRock, Memphis	Houston
Laredo	New York	36.73	36.32	18	San Antonio, Dallas, Texarkana, LittleRock, Memphis, New York	Houston, New York
Laredo	Boston	41.42	41.12	18	San Antonio, Dallas, Texarkana, LittleRock, Memphis	Houston

CHAPTER 7 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the efforts undertaken to identify a strategic freight corridor network in the state of Texas. It gives an overview of the procedure used to identify the network, and provides recommendations for further study.

7.1 SUMMARY

The tasks undertaken for this report included (1) gathering information from state, federal and other agencies concerning the designation of corridors, (2) identifying and gathering data necessary to SFC identification, (3) identifying economically significant counties, (4) identifying the SFC network, (5) evaluating NAFTA trade data to determine its impact on the SFC selection, (6) selecting final SFC network.

The first step involved a survey of the literature. The literature was search to find previous work on strategic freight corridors and corridor designation in general. Very little information was found concerning the methodological procedures used to define corridors. Numerous State DOTs were contacted to determine the work that had been done within their states to define corridors. It appears that only a few states have defined corridors based on methodological procedures. The two procedures used by the two states that defined strategic freight corridors, Ohio and Wisconsin, were evaluated.

A model was developed to identify the economically significant counties in the state. This model included economic and non-economic data to capture the demand to move goods within a county. The economic data consisted of the county income data for the five largest industries in the state that required a significant demand to transport goods. The non-economic income data consisted of dummy variables that modeled the presence or absence of intermodal and border crossing facilities. Each economic and non-economic criterion was assigned a weight according to their relative importance. Additionally, the data for each criterion were ranked from 0 to 10. A final score for each county was computed by assigning the weighting factor to the scores for each criterion and summing up each criterion score. A cutoff value was calculated to determine the economic significance of a county.

Forty six counties were determined to be economically significant. These 46 counties along with the final SFC network may be found in Figure 7.1. The SFC network was selected by identifying the economically significant counties and then interconnecting these counties with a minimal network that was not too circuitous.

A sensitivity test was performed to determine how the model's weighting scheme affected the selection of highways for the SFC network. This sensitivity test revealed that the weighting scheme had no effect on the selection of highways for the SFC network.

7.2 CONCLUSION

The main objective of this study was to interconnect the most important counties in the state and provide for the rapid and efficient movement of goods to and from these counties. The final SFC network

(Fig. 7.1) meets this objective by interconnecting all but three of the most economically significant counties in the state. For the most part, the SFC network provides non-circuitous routes between all the economically significant counties. Approximately two thirds of the 254 counties in the state are located along a SFC. This represents approximately 90 percent of the income for the five industries included in the study. Over 80 percent of the counties and 98 percent of the state income are located within 20 miles of a SFC.

7.3 RECOMMENDATIONS

The main objective of the Strategic Freight Corridor Network was to identify highways critical to the efficient movement of goods within the state. The highways included in the network were high-quality roadways that interconnected the most economically important counties in the state. The most economically important counties tend to be those in urban areas and as a result the highways serving these counties suffer congestion problems in and around these counties. Identifying the strategic corridors will not in itself improve the flow of goods. Necessary steps must be taken to reduce congestion along these highways. The current and projected bottlenecks of each SFC must be identified and corrected.

The implementation of ITS technologies promises to improve traffic flow and reduce congestion. An additional study should be preformed to located bottlenecks along the strategic freight corridors. Additionally, the most suitable ITS technology for each identified bottleneck should be identified. A cost-benefit analysis of implementing these ITS technologies should be conducted for each bottleneck. This cost benefit ratio should be ranked and used as the basis for ITS implementation to reduce bottlenecks along the SFC network.

This study, due to its scope, did not evaluate the movement of freight via modes other than truck. An additional study evaluating the movement of goods via other modes, particularly rail should be conducted.

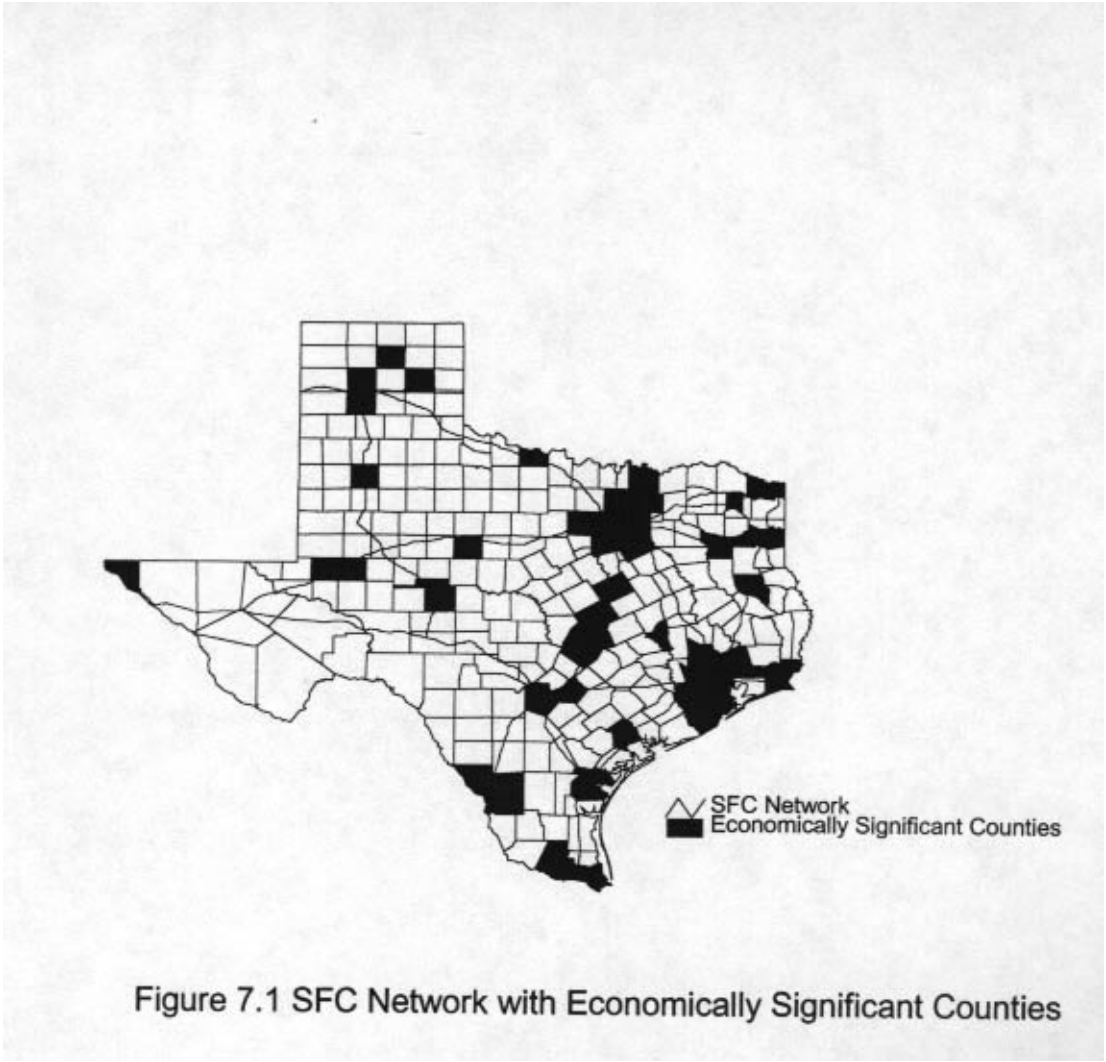

Figure 7.1 SFC Network with Economically Significant Counties

APPENDIX A: COUNTY INCOME AND WEIGHTING INFORMATION

Table A-1 County Population and Income Data

County Name	Population	Manufacturing Income	Wholesale Income	Retail Income	Farming Income	Mining Income
Anderson	49000	27267	20130	73339	1952	15610
Andrews	14500	10340	21636	9962	-2473	48721
Angelina	73900	281134	36949	109269	4144	546
Aransas	20800	9948	2659	23501	-224	4864
Archer	7900	67	4996	3019	20827	4423
Armstrong	2100	0	484	1090	4918	0
Atascosa	32900	8750	13480	21229	10175	21009
Austin	21800	46490	20076	22249	3257	2522
Bailey	6700	3323	5503	5748	32288	0
Bandera	12500	3425	618	9555	1896	1197
Bastrop	42600	26259	5437	33301	3730	813
Baylor	4300	817	2317	4115	4434	566
Bee	23800	7987	7267	19797	3242	13110
Bell	215500	307944	105439	250985	9009	2932
Bexar	1280100	1246312	913726	2051091	35400	102100
Blanco	7100	2170	2980	5366	7956	431
Borden	800	0	0	391	7294	0
Bosque	16200	14129	5191	10256	7280	85
Bowie	83600	107079	48391	135932	9776	1253
Brazoria	211500	985858	77519	207752	21475	54917
Brazos	130400	119363	44495	186717	7981	22146
Brewster	8800	732	940	13622	5405	528
Briscoe	1800	1524	1383	978	9720	88
Brooks	8300	2173	741	6672	2811	6790
Brown	35300	106030	10986	44545	2666	2575
Burleson	14700	6982	3485	10526	7136	17851
Burnet	25400	26393	4619	30779	4542	2450
Caldwell	28100	10737	3815	18893	9376	5623
Calhoun	20400	220282	9324	20096	2400	4523
Callahan	12300	1988	1022	7350	2181	1690
Cameron	299600	308420	109397	317676	34747	389
Camp	10500	11631	6748	15512	38060	0
Carson	6600	142095	2698	3816	9146	0
Cass	30400	87171	8289	28400	3236	3217
Castro	8600	8462	7125	7527	85806	0
Chambers	21300	83464	5447	13298	6145	17294
Cherokee	40800	78235	8647	40618	63558	2161
Childress	6400	988	1824	9075	7127	557
Clay	10000	4876	1491	6969	11750	1701
Cochran	4200	2152	1546	2928	28107	2837
Coke	3500	455	220	3671	2258	4492
Coleman	9700	7462	1783	8800	2628	2102
Collin	326200	795841	236770	447799	13291	115927
Collingsworth	3400	931	1763	2644	10213	451
Colorado	18600	25791	8087	21842	18656	6019
Comal	60800	88958	21963	108161	-2004	4056
Comanche	13500	6783	5435	12887	29336	600
Concho	3100	1500	377	1690	11157	73
Cooke	31300	60452	12180	39142	9667	9825
Coryell	71700	13693	1756	30471	5672	0
Cottle	2100	52	642	1424	1355	0

County Name	Population	Manufacturing Income	Wholesale Income	Retail Income	Farming Income	Mining Income
Crane	4600	2049	1197	3404	651	29564
Crockett	4200	321	554	5009	10665	8267
Crosby	7300	1880	6898	2890	31831	0
Culberson	3300	1107	439	3799	1788	0
Dallam	5900	1906	12957	7845	44842	0
Dallas	1942300	7749412	5691115	4508540	13905	1715929
Dawson	14100	9804	5038	17096	24803	12264
De Witt	18400	20175	4736	18137	10616	248
Deaf Smith	19300	26841	15772	14097	118772	118
Delta	4800	3530	648	2432	4752	4091
Denton	320100	548774	155895	345781	7083	2245
Dickens	2400	90	166	1572	3476	101
Dimmit	10700	4540	392	6060	7775	4637
Donley	3700	574	457	3437	16220	0
Duval	12800	0	0	4558	4209	23156
Eastland	17900	21048	7149	14694	12512	10498
Ector	123100	163050	121500	168718	1470	182257
Edwards	2900	0	569	2173	8185	0
El Paso	664800	1085365	391038	749817	10215	311
Ellis	91900	312637	33299	66548	7761	5124
Erath	29600	55409	11106	40201	58939	924
Falls	17800	8894	4213	9324	22272	137
Fannin	25100	40860	8441	22818	10292	670
Fayette	20900	31242	19251	25439	14277	12036
Fisher	4400	3954	808	2291	7615	0
Floyd	8200	4831	3695	5232	58476	71
Foard	1600	3094	473	665	2853	60
Fort Bend	280000	396902	111278	222691	57662	108215
Franklin	8700	3852	1653	5070	13046	1906
Freestone	15800	6894	1230	18303	1249	26173
Frio	15400	2401	8765	10165	12445	6668
Gaines	14500	2576	8752	9202	57095	19850
Galveston	234700	527294	69478	270644	120	30856
Garza	4800	1825	925	4273	4980	7795
Gillespie	18800	21357	6245	29299	14164	2055
Glasscock	1400	0	90	370	12374	127
Goliad	6100	1571	310	4371	3641	202
Gonzales	17300	25980	7994	13994	56688	1554
Gray	23400	64061	12086	30959	24720	34520
Grayson	97300	402227	34065	138355	6268	5624
Gregg	109800	303640	117576	226283	-164	110121
Grimes	20600	50587	3985	12213	7139	13973
Guadalupe	70600	187425	17053	59979	7931	3732
Hale	35700	64320	25820	76323	75958	529
Hall	3800	1257	872	3030	11728	136
Hamilton	7600	6196	3650	10423	8135	0
Hansford	5400	2968	4736	4357	74761	9711
Hardeman	4900	9331	974	3947	4009	569
Hardin	45600	36094	6975	46358	-1420	9237
Harris	3045200	8848960	5122609	4987706	31998	5380315
Harrison	58100	287936	20565	52226	-2950	35491
Hartley	3700	0	3835	1997	65339	0
Haskell	6500	727	2589	7533	11355	2068

County Name	Population	Manufacturing Income	Wholesale Income	Retail Income	Farming Income	Mining Income
Hays	74200	100522	14707	104408	2085	285
Hemphill	3500	665	608	3152	7916	12678
Henderson	62100	32446	10478	61246	7207	10757
Hidalgo	461000	292538	177731	508950	45053	38646
Hill	28200	27327	4248	33926	11261	847
Hockley	24500	5039	13123	17900	32114	65578
Hood	31500	6867	11922	36605	4323	892
Hopkins	29400	40277	37353	43970	63710	4353
Houston	21700	44714	9950	20296	12278	3884
Howard	32100	47264	12419	39175	4041	26515
Hudspeth	2900	0	154	1347	3125	95
Hunt	66000	300647	16050	72384	4045	56
Hutchinson	24900	128771	8514	24269	11320	48853
Jack	6900	1913	1045	4653	1553	13360
Jackson	13600	33057	4328	12535	21657	8607
Jasper	32300	112438	9026	37201	0	3072
Jeff Davis	2100	0	132	1872	2973	83
Jefferson	242900	938754	175825	376183	3020	24946
Jim Hogg	5100	75	1093	4173	5900	2523
Jim Wells	39400	7381	14516	38586	11627	62393
Johnson	104300	168490	41507	96368	13569	1447
Jones	16000	12510	3943	9140	5188	5013
Karnes	12400	11163	4271	9321	1936	7037
Kaufman	58300	97932	18201	64130	-914	1225
Kendall	18500	8815	4618	24598	1035	1737
Kenedy	400	0	0	0	2244	0
Kent	1000	0	0	641	893	576
Kerr	39600	27381	7316	52649	2933	2340
Kimble	4100	6470	1605	8229	3381	281
King	300	0	0	0	1573	0
Kinney	3200	419	0	886	3874	628
Kleberg	30800	6666	7370	32488	8963	18723
Knox	4600	1733	2519	3271	7306	3480
La Salle	5400	0	782	2839	13163	178
Lamar	45000	189435	16668	59217	12319	106
Lamb	14800	16245	6772	11821	65031	152
Lampasas	15300	11691	2787	12139	1167	457
Lavaca	18600	38457	8016	20598	4043	1762
Lee	13600	12647	10243	12589	4141	18041
Leon	13600	37123	6292	13934	3275	25957
Liberty	58000	100183	15718	48712	4345	15874
Limestone	20900	14768	6966	19927	6290	6492
Lipscomb	3000	2224	3612	2003	7201	2189
Live Oak	10200	17655	1363	9352	1349	12605
Llano	12500	2785	5713	12494	4719	210
Loving	100	0	0	0	599	0
Lubbock	230500	278362	270622	479682	75654	19994
Lynn	6600	858	2274	2360	23508	0
Madison	11400	2600	5725	10350	43156	3763
Marion	10100	20361	1666	6018	1776	3216
Martin	4900	1393	1204	3764	15284	390
Mason	3500	874	1851	3534	7175	1576
Matagorda	38700	42429	13908	40230	21005	1912

County Name	Population	Manufacturing Income	Wholesale Income	Retail Income	Farming Income	Mining Income
Maverick	44200	20055	5636	36745	17562	2980
McCulloch	8500	6092	3408	9145	5325	827
McLennan	197200	527576	138210	272186	47883	9128
McMullen	800	0	0	426	1905	2482
Medina	30400	14868	6700	26356	6022	1341
Menard	2300	0	0	2011	4523	459
Midland	114200	81047	99618	148938	1216	581594
Milam	23500	97193	3079	19655	17280	1993
Mills	4700	3774	825	7433	5901	0
Mitchell	7700	6090	2272	8353	5744	2639
Montague	17700	17124	3575	19362	3712	6040
Montgomery	222200	236273	120809	214771	2617	85271
Moore	18900	89186	9716	19134	50192	8960
Morris	13200	96816	5472	6955	760	1763
Motley	1400	2385	170	1350	3062	0
Nacogdoches	56200	119769	16177	76695	47351	1274
Navarro	40300	96376	15525	66292	5404	7988
Newton	13900	26728	955	6095	806	0
Nolan	16400	25794	4208	18420	14843	4293
Nueces	310900	667204	193693	453568	27239	156768
Ochiltree	8700	2913	7432	9074	22222	28416
Oldham	2200	0	685	2538	24066	2121
Orange	84300	366831	13636	74163	837	5921
Palo Pinto	25100	36466	6570	31785	2429	8554
Panola	22600	22915	4353	15101	13516	22806
Parker	71300	76690	17713	67012	14025	6873
Parmer	10200	48055	6056	5124	115522	533
Pecos	14400	4275	5004	14776	7890	24062
Polk	37300	62789	7777	34365	-259	7611
Potter	102900	206840	129625	234142	-5360	150411
Presidio	7400	1544	310	3834	4388	0
Rains	7400	5449	1599	4798	6571	85
Randall	94100	59690	69727	79859	55014	7044
Reagan	4500	1874	1109	1975	2583	14347
Real	2400	336	91	1637	2132	59
Red River	14000	26466	1173	10755	10248	0
Reeves	15400	6089	4035	13001	21623	3293
Refugio	7800	924	2845	7877	9371	22577
Roberts	1000	0	113	572	5330	781
Robertson	15400	20753	1905	10604	8195	6110
Rockwall	31400	37608	17869	33366	-1143	221
Runnels	11200	28024	4498	10199	316	5898
Rusk	44200	54051	6155	33656	3870	79391
Sabine	10100	18666	2274	7080	510	1140
San Augustine	7900	7920	505	5858	3898	404
San Jacinto	18600	6596	1046	4773	475	461
San Patricio	64800	97641	6886	40515	26863	12006
San Saba	5800	1787	3629	4980	4709	0
Schleicher	3000	0	1089	1054	6201	6233
Scurry	18200	6335	12122	15656	1382	59400
Shackelford	3300	1727	446	2036	-2436	13032
Shelby	22300	66162	4837	20656	33398	0
Sherman	2900	0	3093	2395	74244	477

County Name	Population	Manufacturing Income	Wholesale Income	Retail Income	Farming Income	Mining Income
Smith	159000	469010	107738	293689	37332	110251
Somervell	5700	3785	500	3991	-104	1124
Starr	49500	1580	2692	39311	8300	3748
Stephens	8900	5774	2371	9228	1616	11511
Sterling	1500	0	0	1311	1495	4531
Stonewall	2000	417	382	1531	2069	2924
Sutton	4300	486	907	4601	4479	13816
Swisher	8300	3462	3432	5692	85239	171
Tarrant	1257200	4145058	1454279	2338319	4585	422319
Taylor	121900	113069	71849	181069	19944	56135
Terrell	1300	0	0	1115	5977	74
Terry	12900	2249	7100	11818	41935	27837
Throckmorton	1800	180	374	1081	4663	7246
Titus	24500	109759	10470	34623	8320	40696
Tom Green	101200	167066	44743	135080	22859	25706
Travis	646400	2443315	588783	1227264	4151	44943
Trinity	12200	15224	3556	9559	1370	284
Tyler	18300	25473	872	13572	-920	0
Upshur	33500	33196	4438	29295	10721	3222
Upton	4100	1180	2113	2108	5639	17422
Uvalde	25000	13053	13315	26240	9804	5106
Val Verde	42700	6727	26680	42204	6203	492
Van Zandt	40700	9514	7385	27966	26180	20012
Victoria	79400	133142	56320	130093	9603	58419
Walker	53500	47996	8255	52210	2164	1031
Ward	12300	8706	4474	8988	1292	28294
Washington	27600	72787	32664	36080	3860	4407
Webb	163100	33769	85377	249696	662	110508
Wharton	40000	47172	23009	42225	36597	19903
Wheeler	5500	753	1952	6441	13996	1851
Wichita	124100	272428	66818	172376	5505	80046
Wilbarger	14600	21410	2904	17061	4524	1573
Willacy	19000	3435	1894	10512	17891	1783
Williamson	172700	222838	53131	153140	8398	11363
Wilson	25800	5159	3050	15587	16252	722
Winkler	8100	1608	1608	5566	-295	14885
Wise	37300	41080	10352	38570	6926	34299
Wood	31900	25641	5576	31250	13740	7702
Yoakum	8500	2563	3713	5777	30105	36978
Young	17600	41580	4633	17634	6482	31523
Zapata	10700	485	107	5309	1026	8028
Zavala	12300	9612	868	3708	14216	1161

Table A-2 County Weighting Data

County	Manufac. Weight	Wholesale Weight	Retail Weight	Farming Weight	Mining Weight	Border Crossing Weight	Marine Port Weight	Rail / Truck Weight	Airport Weight
Anderson	7	9	9	5	8	0	0	0	0
Andrews	5	9	5	1	10	0	0	0	0
Angelina	9	9	9	6	3	0	0	0	0
Aransas	5	4	7	1	6	0	5	0	0
Archer	1	5	2	9	6	0	0	0	0
Armstrong	1	2	1	6	1	0	0	0	0
Atascosa	5	8	7	7	9	0	0	0	0
Austin	7	9	7	6	5	0	0	0	0
Bailey	4	6	3	9	1	0	0	0	0
Bandera	4	2	5	5	4	0	0	0	0
Bastrop	6	6	7	6	4	0	0	0	0
Baylor	2	4	3	6	3	0	0	0	0
Bee	5	7	6	6	8	0	0	0	0
Bell	10	10	10	7	5	0	0	0	0
Bexar	10	10	10	9	10	0	0	10	10
Blanco	3	4	3	7	3	0	0	0	0
Borden	1	1	1	7	1	0	0	0	0
Bosque	6	6	5	7	2	0	0	0	0
Bowie	9	9	9	7	4	0	0	10	0
Brazoria	10	10	10	9	10	0	10	0	0
Brazos	9	9	10	7	9	0	0	0	5
Brewster	2	2	5	6	3	0	0	0	0
Briscoe	2	3	1	7	2	0	0	0	0
Brooks	3	2	4	5	7	0	0	0	0
Brown	9	8	8	5	5	0	0	0	0
Burleson	5	4	5	7	8	0	0	0	0
Burnet	6	5	7	6	5	0	0	0	0
Caldwell	5	5	6	7	6	0	0	0	0
Calhoun	9	7	6	5	6	0	10	0	0
Callahan	3	3	4	5	4	0	0	0	0
Cameron	10	10	10	9	3	10	10	10	10
Camp	5	6	6	9	1	0	0	0	0
Carson	9	4	2	7	1	0	0	0	0
Cass	8	7	7	6	5	0	0	0	0
Castro	5	7	4	10	1	0	0	0	0
Chambers	8	6	5	7	8	0	5	0	0
Cherokee	8	7	8	10	5	0	0	0	0
Childress	2	3	4	7	3	0	0	0	0
Clay	4	3	4	8	4	0	0	0	0
Cochran	3	3	2	9	5	0	0	0	0
Coke	2	1	2	5	6	0	0	0	0
Coleman	5	3	4	5	5	0	0	0	0
Collin	10	10	10	8	10	0	0	0	0
Collingsworth	2	3	2	7	3	0	0	0	0
Colorado	6	7	7	8	7	0	0	0	0
Comal	8	9	9	1	6	0	0	0	0
Comanche	5	6	5	9	3	0	0	0	0
Concho	2	1	1	8	2	0	0	0	0
Cooke	8	8	8	7	7	0	0	0	0
Coryell	6	3	7	6	1	0	0	0	0
Cottle	1	2	1	4	1	0	0	0	0
Crane	3	3	2	3	9	0	0	0	0
Crockett	2	2	3	8	7	0	0	0	0
Crosby	3	6	2	9	1	0	0	0	0
Culberson	2	2	2	4	1	0	0	0	0
Dallam	3	8	4	9	1	0	0	0	0
Dallas	10	10	10	8	10	0	0	10	10
Dawson	5	6	6	9	8	0	0	0	0
De Witt	6	5	6	8	2	0	0	0	0
Deaf Smith	7	8	6	10	2	0	0	0	0
Delta	4	2	2	6	6	0	0	0	0
Denton	10	10	10	7	5	0	0	0	0
Dickens	1	1	1	6	2	0	0	0	0
Dimmit	4	1	4	7	6	0	0	0	0
Donley	2	2	2	8	1	0	0	0	0

County	Manufac. Weight	Wholesale Weight	Retail Weight	Farming Weight	Mining Weight	Border Crossing Weight	Marine Port Weight	Rail / Truck Weight	Airport Weight
Duval	1	1	3	6	9	0	0	0	0
Eastland	6	7	6	8	7	0	0	0	0
Ector	9	10	9	4	10	0	0	0	0
Edwards	1	2	2	7	1	0	0	0	0
El Paso	10	10	10	7	3	10	0	10	10
Ellis	10	9	9	7	6	0	0	0	0
Erath	8	8	8	10	4	0	0	0	0
Falls	5	5	4	9	2	0	0	0	0
Fannin	7	7	7	7	3	0	0	0	0
Fayette	7	9	7	8	8	0	0	0	0
Fisher	4	2	2	7	1	0	0	0	0
Floyd	4	5	3	10	2	0	0	0	0
Foard	3	2	1	5	2	0	0	0	0
Fort Bend	10	10	10	10	10	0	0	0	0
Franklin	4	3	3	8	5	0	0	0	0
Freestone	5	3	6	4	9	0	0	0	0
Frio	3	7	5	8	7	0	0	0	0
Gaines	3	7	4	10	8	0	0	0	0
Galveston	10	9	10	2	9	0	10	0	0
Garza	3	2	3	6	7	0	0	0	0
Gillespie	6	6	7	8	5	0	0	0	0
Glasscock	1	1	1	8	2	0	0	0	0
Goliad	2	1	3	6	2	0	0	0	0
Gonzales	6	7	6	10	4	0	0	0	0
Gray	8	8	7	9	9	0	0	0	0
Grayson	10	9	9	7	6	0	0	0	0
Gregg	10	10	10	1	10	0	0	0	0
Grimes	8	5	5	7	8	0	0	0	0
Guadalupe	9	8	9	7	6	0	0	0	0
Hale	8	9	9	10	3	0	0	0	0
Hall	2	2	2	8	2	0	0	0	0
Hamilton	4	5	5	7	1	0	0	0	0
Hansford	3	5	3	10	7	0	0	0	0
Hardeman	5	2	3	6	3	0	0	0	0
Hardin	7	6	8	1	7	0	0	0	0
Harris	10	10	10	9	10	0	10	10	10
Harrison	10	9	8	1	9	0	0	10	0
Hartley	1	5	1	10	1	0	0	0	0
Haskell	2	4	4	8	5	0	0	0	0
Hays	9	8	9	5	3	0	0	0	0
Hemphill	2	2	2	7	8	0	0	0	0
Henderson	7	8	9	7	8	0	0	0	0
Hidalgo	10	10	10	10	9	10	0	0	5
Hill	7	5	7	8	4	0	0	0	0
Hockley	4	8	6	9	10	0	0	0	0
Hood	5	8	8	6	4	0	0	0	0
Hopkins	7	9	8	10	6	0	0	0	0
Houston	7	7	6	8	6	0	0	0	0
Howard	8	8	8	6	9	0	0	0	0
Hudspeth	1	1	1	5	2	0	0	0	0
Hunt	10	8	9	6	1	0	0	0	0
Hutchinson	9	7	7	8	10	0	0	0	0
Irion	1	1	1	6	5	0	0	0	0
Jack	3	3	3	4	8	0	0	0	0
Jackson	7	5	5	9	7	0	0	0	0
Jasper	9	7	8	1	5	0	0	0	0
Jeff Davis	1	1	1	5	2	0	0	0	0
Jefferson	10	10	10	5	9	0	10	0	5
Jim Hogg	1	3	3	6	5	0	0	0	0
Jim Wells	5	8	8	8	10	0	0	0	0
Johnson	9	9	9	8	4	0	0	0	0
Jones	5	5	4	6	6	0	0	0	0
Karnes	5	5	4	5	7	0	0	0	0
Kaufman	9	9	9	1	4	0	0	0	0
Kendall	5	5	7	4	4	0	0	0	0
Kenedy	1	1	1	5	1	0	0	0	0
Kent	1	1	1	4	3	0	0	0	0

County	Manufac. Weight	Wholesale Weight	Retail Weight	Farming Weight	Mining Weight	Border Crossing Weight	Marine Port Weight	Rail / Truck Weight	Airport Weight
Kerr	7	7	8	5	5	0	0	0	0
Kimble	4	3	4	6	2	0	0	0	0
King	1	1	1	4	1	0	0	0	0
Kinney	2	1	1	6	3	0	0	0	0
Kleberg	4	7	7	7	8	0	0	0	0
Knox	3	4	2	7	6	0	0	0	0
La Salle	1	2	2	8	2	0	0	0	0
Lamar	9	8	8	8	2	0	0	0	0
Lamb	6	6	5	10	2	0	0	0	0
Lampasas	5	4	5	4	3	0	0	0	0
Lavaca	7	7	6	6	4	0	0	0	0
Lee	5	7	5	6	8	0	0	0	0
Leon	7	6	5	6	9	0	0	0	0
Liberty	9	8	8	6	8	0	0	0	0
Limestone	6	6	6	7	7	0	0	0	0
Lipscomb	3	4	2	7	5	0	0	0	0
Live Oak	6	3	4	4	8	0	0	0	0
Llano	3	6	5	6	2	0	0	0	0
Loving	1	1	1	3	1	0	0	0	0
Lubbock	9	10	10	10	8	0	0	0	5
Lynn	2	4	2	9	1	0	0	0	0
Madison	3	6	5	9	6	0	0	0	0
Marion	6	3	3	4	5	0	0	0	0
Martin	2	3	2	8	3	0	0	0	0
Mason	2	3	2	7	4	0	0	0	0
Matagorda	7	8	8	9	5	0	5	0	0
Maverick	6	6	8	8	5	0	0	0	0
McCulloch	4	4	4	6	4	0	0	0	0
McLennan	10	10	10	10	7	0	0	0	0
McMullen	1	1	1	5	5	0	0	0	0
Medina	6	6	7	7	4	0	0	0	0
Menard	1	1	2	6	3	0	0	0	0
Midland	8	10	9	4	10	0	0	0	5
Milam	8	4	6	8	5	0	0	0	0
Mills	4	2	4	6	1	0	0	0	0
Mitchell	4	4	4	6	5	0	0	0	0
Montague	6	4	6	6	7	0	0	0	0
Montgomery	9	10	10	5	10	0	0	0	0
Moore	8	7	6	10	7	0	0	0	0
Morris	8	6	4	3	4	0	0	0	0
Motley	3	1	1	5	1	0	0	0	0
Nacogdoches	9	8	9	10	4	0	0	0	0
Navarro	8	8	9	6	7	0	0	0	0
Newton	7	2	4	4	1	0	0	0	0
Nolan	6	5	6	8	6	0	0	0	0
Nueces	10	10	10	9	10	0	10	0	5
Ochiltree	3	7	4	9	9	0	0	0	0
Oldham	1	2	2	9	5	0	0	0	0
Orange	10	8	9	4	6	0	10	0	0
Palo Pinto	7	6	7	5	7	0	0	0	0
Panola	6	5	6	8	9	0	0	0	0
Parker	8	8	9	8	7	0	0	0	0
Parmer	8	6	3	10	3	0	0	0	0
Pecos	4	5	6	7	9	0	0	0	0
Polk	8	7	8	1	7	0	0	0	0
Potter	9	10	10	1	10	0	0	10	5
Presidio	2	1	3	6	1	10	0	0	0
Rains	4	3	3	7	2	0	0	0	0
Randall	8	9	9	10	7	0	0	10	5
Reagan	3	3	1	5	8	0	0	0	0
Real	2	1	1	5	2	0	0	0	0
Red River	7	3	5	7	1	0	0	0	0
Reeves	4	5	5	9	6	0	0	0	0
Refugio	2	4	4	7	9	0	0	0	0
Roberts	1	1	1	6	3	0	0	0	0
Robertson	6	3	5	7	7	0	0	0	0
Rockwall	7	8	7	1	2	0	0	0	0

County	Manufac. Weight	Wholesale Weight	Retail Weight	Farming Weight	Mining Weight	Border Crossing Weight	Marine Port Weight	Rail / Truck Weight	Airport Weight
Runnels	7	5	5	3	6	0	0	0	0
Rusk	8	6	7	6	10	0	0	0	0
Sabine	6	4	4	3	4	0	0	0	0
San Augustine	5	2	3	6	3	0	0	0	0
San Jacinto	4	3	3	3	3	0	0	0	0
San Patricio	8	6	8	9	8	0	5	0	0
San Saba	3	4	3	6	1	0	0	0	0
Schleicher	1	3	1	7	7	0	0	0	0
Scurry	4	8	6	4	10	0	0	0	0
Shackelford	3	2	2	1	8	0	0	0	0
Shelby	8	5	6	9	1	0	0	0	0
Sherman	1	4	2	10	3	0	0	0	0
Smith	10	10	10	9	10	0	0	0	0
Somervell	4	2	3	1	4	0	0	0	0
Starr	3	4	8	7	6	10	0	0	0
Stephens	4	4	4	4	8	0	0	0	0
Sterling	1	1	1	4	6	0	0	0	0
Stonewall	2	1	1	5	5	0	0	0	0
Sutton	2	2	3	6	8	0	0	0	0
Swisher	4	4	3	10	2	0	0	0	0
Tarrant	10	10	10	6	10	0	0	10	10
Taylor	9	9	9	8	10	0	0	0	5
Terrell	1	1	1	7	2	0	0	0	0
Terry	3	6	5	9	9	0	0	0	0
Throckmorton	1	1	1	6	7	0	0	0	0
Titus	9	7	8	7	9	0	0	0	0
Tom Green	9	9	9	9	9	0	0	0	5
Travis	10	10	10	6	9	0	0	0	10
Trinity	6	4	5	4	2	0	0	0	0
Tyler	6	2	5	1	1	0	0	0	0
Upshur	7	5	7	8	6	0	0	0	0
Upton	2	4	2	6	8	0	0	0	0
Uvalde	6	8	7	7	6	0	0	0	0
Val Verde	4	9	8	7	3	10	0	0	0
Van Zandt	5	7	7	9	9	0	0	0	0
Victoria	9	9	9	7	10	0	5	0	5
Walker	8	7	8	5	4	0	0	0	0
Waller	8	6	7	7	1	0	0	0	0
Ward	5	5	4	4	9	0	0	0	0
Washington	8	9	8	6	6	0	0	0	0
Webb	7	10	10	3	10	10	0	10	10
Wharton	7	9	8	9	8	0	0	0	0
Wheeler	2	4	4	8	4	0	0	0	0
Wichita	9	9	9	6	10	0	0	0	5
Wilbarger	6	4	6	6	4	0	0	0	0
Willacy	4	3	5	8	4	0	10	0	0
Williamson	9	9	9	7	8	0	0	0	0
Wilson	4	4	6	8	3	0	0	0	0
Winkler	3	3	3	1	8	0	0	0	0
Wise	7	7	8	7	9	0	0	0	0
Wood	6	6	7	8	7	0	0	0	0
Yoakum	3	5	3	9	9	0	0	0	0
Young	7	5	6	7	9	0	0	0	0
Zapata	2	1	3	4	7	0	0	0	0
Zavala	5	2	2	8	4	0	0	0	0

APPENDIX B INTERMODAL FACILITY LOCATIONS

Table B-1 Rail/Truck Intermodal Facilities

Location	Rail Road
"Alliance Airport/Haslet, TX"	ATSF
Amarillo	ATSF
""""	BN
Dallas	KCS
""""	SP
Dallas-Mesquite	UP
El Paso	STSF
""""	SP
Harlingen	UP
Houston	STSF
""""	SP
""""	UP
Laredo	ATSF
""""	UP
""""	TM
Prosser	ANR
Marshall	UP
Texarkana	KCS
San Antonio	SP
""""	UP

"Source: Telephone communication by C. Toews, "
"TXDOT, with Texas Rail Carriers, Oct. 27, 1994"

Table B-2 Marine Ports in Texas

Deep Water
Port of Beaumont
Port of Brownsville Navigation District
Port of Corpus Christi Authority
Port of Freeport
Port of Galveston
Port of Houston Authority
Matagorda Ship Canal (Port of Port Lavaca-Point Comfort)
Port of Orange County Navigation and Port District
Port of Port Arthur Navigation District
Port of Port Isabel
Sabine Pass
Port of Texas City Terminal Railway Company

Shallow Water
Port of Anahuac
Port of Port Aransas
Port of Aransas Pass
Port of Bay City
Port of Fulton
Port of Harlingen
Port of Ingleside
Port of Liberty
Port of Palacious
Port of Port Mansfield
Port of Port O'Connor
Port of Rockport
Port of Seadrift
Port of Sweeney
Port of Victoria

Table B -3 Air Cargo at U.S Airports

#	LOCID	AIRPORT (CITY,ST)	CY1995	CY1994
1	ANC	ANCHORAGE INTL(ANCHORAGE,AK)	10,467,721,237	9,473,495,017
2	MEM	MEMPHIS INTL(MEMPHIS,TN)	8,439,908,588	8,098,231,886
3	ORD	CHICAGO O'HARE INTL(CHICAGO,IL)	6,921,818,960	6,893,610,004
4	SDF	LOUISVILLE INTL(LOUISVILLE,KY)	6,890,901,500	6,944,578,000
5	MIA	MIAMI INTL(MIAMI,FL)	4,824,302,590	4,536,135,965
6	HNL	HONOLULU INTL(HONOLULU,HI)	4,628,561,000	4,295,690,500
7	LAX	LOS ANGELES INTL(LOS ANGELE,CA)	4,249,532,890	3,350,997,620
8	DAY	JAMES M COX DAYTON I(DAYTON,OH)	3,233,239,725	3,160,919,210
9	IND	INDIANAPOLIS INT(INDIANAPOL,IN)	2,979,501,885	2,772,665,690
10	OAK	METROPOLITAN OAKLAN(OAKLAND,CA)	2,911,682,180	2,598,214,771
11	DFW	DALLAS/FORT WORT(DALLAS-FOR,TX)	2,643,742,408	2,480,495,367
12	PHL	PHILADELPHIA INT(PHILADELPH,PA)	2,624,469,870	2,217,975,850
13	ONT	ONTARIO INTL(ONTARIO,CA)	2,131,339,570	1,821,654,540
14	ATL	THE WILLIAM B HARTS(ATLANTA,GA)	1,916,358,207	2,183,761,494
15	SFO	SAN FRANCISCO IN(SAN FRANCI,CA)	1,841,857,860	1,682,791,000
16	TOL	TOLEDO EXPRESS(TOLEDO,OH	1,707,054,455	1,668,339,200
17	OGG	KAHULUI(KAHULUI,HI)	1,692,942,200	1,636,897,800
18	DEN	DENVER INTL(DENVER,CO)	1,407,826,770	1,349,973,840
19	SEA	SEATTLE-TACOMA INTL(SEATTLE,WA)	1,371,917,865	1,447,097,095
20	PHX	PHOENIX SKY HARBOR(PHOENIX,AZ)	1,280,772,600	1,186,973,570
21	PDX	PORTLAND INTL(PORTLAND,OR)	1,251,555,236	1,106,594,596
22	BOS	GENERAL EDWARD LAWRE(BOSTON,MA)	1,184,000,600	1,156,414,220
23	CVG	CINCINNATI/NORTH(COVINGTON/,KY)	1,159,828,128	960,161,920
24	MSP	MINNEAPOLIS-ST P(MINNEAPOLI,MN)	1,100,552,600	993,533,700
25	LIH	LIHUE(LIHUE,HI)	1,039,664,400	964,645,300
26	FAI	FAIRBANKS INTL(FAIRBANKS,AK)	986,105,250	759,198,011
27	KOA	KEAHOLE-KONA INT(KAILUA/KON,HI)	964,433,700	935,559,100
28	SLC	SALT LAKE CITY I(SALT LAKE,UT)	963,044,840	946,289,420
29	MCO	ORLANDO INTL(ORLANDO,FL)	917,752,340	818,496,910
30	IAH	HOUSTON INTERCONTIN(HOUSTON,TX)	899,247,689	776,274,507
31	BDL	BRADLEY INTL(WINDSOR LOCKS,CT)	879,659,830	873,813,695
32	DSM	DES MOINES INTL(DES MOINES,IA)	801,148,220	697,440,470
33	ITO	HILO INTERNATIONAL(HILO,HI)	798,845,800	786,715,600
34	CLT	CHARLOTTE/DOUGLAS(CHARLOTTE,NC)	760,667,770	807,141,436
35	SJU	LUIS MUNOZ MARIN I(SAN JUAN,PR)	734,467,950	734,138,790
36	MCI	KANSAS CITY INTL(KANSAS CIT,MO)	706,217,460	736,928,510
37	DTW	DETROIT METROPOLITA(DETROIT,MI)	705,802,950	700,023,600
38	STL	LAMBERT-ST LOUIS I(ST LOUIS,MO)	671,581,430	543,173,860
39	HUF	HULMAN REGIONAL(TERRE HAUTE,IN)	659,756,200	254,731,410
40	FLL	FORT LAUDERDALE/(FORT LAUDE,FL)	640,384,660	578,605,130
41	YIP	WILLOW RUN(DETROIT,MI)	625,936,960	783,795,410
42	RFD	GREATER ROCKFORD(ROCKFORD,IL)	611,693,820	183,455,125
43	BFI	BOEING FIELD/KING C(SEATTLE,WA)	582,128,480	345,648,020
44	MKE	GENERAL MITCHELL(MILWAUKEE,WI)	574,890,490	590,363,420
45	CAE	COLUMBIA METROPOLI(COLUMBIA,SC)	562,980,245	265,760,455
46	RDU	RALEIGH-DURHAM I(RALEIGH/DU,NC)	560,438,404	498,736,000
47	LCK	RICKENBACKER INTER(COLUMBUS,OH)	554,317,900	466,887,370
48	BWI	BALTIMORE-WASHING(BALTIMORE,MD)	553,528,210	493,819,410
49	ABQ	ALBUQUERQUE INTL(ALBUQUERQU,NM)	533,417,040	480,418,210
50	IAD	WASHINGTON DULLES IN(LOUDON,VA)	532,010,050	464,701,100
53	SAN	SAN DIEGO INTL-LI(SAN DIEGO,CA)	469,621,007	415,079,500
54	SJC	SAN JOSE INTERNATI(SAN JOSE,CA)	430,083,850	358,941,700
55	MSY	NEW ORLEANS INTL(NEW ORLEAN,LA)	426,772,740	260,660,400
56	SYR	SYRACUSE HANCOCK I(SYRACUSE,NY)	420,012,586	416,534,565
57	SAT	SAN ANTONIO INTL(SAN ANTONI,TX)	415,477,240	438,571,520
58	AUS	ROBERT MUELLER MUNI(AUSTIN,TX)	405,220,057	369,134,225
59	PIT	PITTSBURGH INTER(PITTSBURGH,PA)	397,796,120	462,086,160
60	GSO	PIEDMONT TRIAD I(GREENSBORO,NC)	393,128,650	400,004,240
61	BUF	GREATER BUFFALO INT(BUFFALO,NY)	386,702,400	390,642,800
62	CID	CEDAR RAPIDS MUN(CEDAR RAPI,IA)	370,832,890	339,582,585
63	OMA	EPPLEY AIRFIELD(OMAHA,NE)	367,912,440	398,502,200
64	TPA	TAMPA INTL(TAMPA,FL)	355,519,084	306,721,080
65	ELP	EL PASO INTL(EL PASO,TX)	343,745,370	327,052,980

#	LOCID	AIRPORT (CITY,ST)	CY1995	CY1994
66	OKC	WILL ROGERS WORL(OKLAHOMA C,OK)	338,161,050	340,737,120
67	ROC	GREATER ROCHESTER(ROCHESTER,NY)	322,711,020	409,681,000
68	MHT	MANCHESTER(MANCHESTER,NH)	316,614,700	307,698,270
69	ICT	WICHITA MID-CONTINE(WICHITA,KS)	312,895,200	348,558,200
70	TUL	TULSA INTL(TULSA,OK)	312,183,475	293,752,893
71	BQN	RAFAEL HERNANDEZ(AGUADILLA,PR)	300,684,350	307,530,400
72	GEG	SPOKANE INTL(SPOKANE,WA)	281,708,760	254,952,460
73	ROA	ROANOKE REGIONAL/WO(ROANOKE,VA)	281,495,840	191,918,880
74	JAX	JACKSONVILLE INT(JACKSONVIL,FL)	273,628,500	261,382,110
75	LRD	LAREDO INTL(LAREDO,TX)	265,591,101	334,751,040
76	PIA	GREATER PEORIA REGIO(PEORIA,IL)	265,055,040	236,852,230
77	BHM	BIRMINGHAM INTL(BIRMINGHAM,AL)	261,612,860	217,214,548
78	EFD	ELLINGTON FIELD(HOUSTON,TX)	258,693,628	232,100,930
79	BNA	NASHVILLE INTERNA(NASHVILLE,TN)	252,399,150	320,907,020
80	FSD	JOE FOSS FIELD(SIOUX FALLS,SD)	245,512,770	0
81	SHV	SHREVEPORT REGIO(SHREVEPORT,LA)	233,029,207	159,723,390
82	TUS	TUCSON INTL(TUCSON,AZ)	230,831,000	170,081,400
83	MDT	HARRISBURG INTER(HARRISBURG,PA)	219,020,150	229,192,710
84	SWF	STEWART INT'L(NEWBURGH,NY)	207,383,800	227,218,450
85	GRR	KENT COUNTY INTL(GRAND RAPI,MI)	206,009,800	235,951,500
86	TYS	MC GHEE TYSON(KNOXVILLE,TN)	201,316,168	235,358,279
87	HSV	HUNTSVILLE INTL-(HUNTSVILLE,AL)	193,412,145	237,606,032
88	JAN	JACKSON INTERNATION(JACKSON,MS)	188,040,280	219,764,900
89	ABY	SOUTHWEST GEORGIA RE(ALBANY,GA)	83,890,920	144,851,420
90	LAN	CAPITAL CITY(LANSING,MI)	171,945,960	169,087,201
91	ORF	NORFOLK INTL(NORFOLK,VA)	165,333,355	183,136,925
92	BRO	BROWNSVILLE/SOUT(BROWNSVILL,TX)	165,240,600	145,663,900
93	FNT	BISHOP INTERNATIONAL(FLINT,MI)	160,234,900	182,280,160
94	RNO	RENO/TAHOE INTERNATION(RENO,NV)	155,690,500	116,324,590
95	ALB	ALBANY COUNTY(ALBANY,NY)	151,157,900	144,865,000
96	LAS	MC CARRAN INTL(LAS VEGAS,NV)	150,959,720	153,577,600
97	SGF	SPRINGFIELD REGI(SPRINGFIEL,MO)	141,423,332	113,030,400
98	MOB	MOBILE REGIONAL(MOBILE,AL)	128,000,020	120,186,500
99	FWA	FORT WAYNE INTER(FORT WAYNE,IN)	109,278,055	143,755,970
100	GSP	GREENVILLE-SPARTANBUR(GREER,SC)	107,685,280	0
101	RSW	SOUTHWEST FLORID(FORT MYERS,FL)	100,468,000	99,367,820
102	PVD	THEODORE FRANCIS(PROVIDENCE,RI)	100,205,700	0
103	CHS	CHARLESTON AFB/I(CHARLESTON,SC)	77,300,100	53,542,300
104	PSM	PEASE INTERNATIO(PORTSMOUTH,NH)	39,184,000	11,964,500
105	CMH	PORT COLUMBUS INTL(COLUMBUS,OH)	33,126,000	112,703,838
106	LNY	LANAI(LANAI CITY,HI)	9,838,000	6,978,800
107	MKK	MOLOKAI(KAUNAKAKAI,HI)	8,749,600	7,301,400
108	IAG	NIAGARA FALLS IN(NIAGARA FA,NY)	4,955,872	4,864,272

Table B -4 Enplanement Totals at Texas Airports

State	Associated City	Airport Name	LOCID	Enplanements
TX	DALLAS-FORT WORTH	DALLAS/FORT WORTH INTERNATIONAL	DFW	26,962,940
TX	HOUSTON	HOUSTON INTERCONTINENTAL	IAH	11,350,898
TX	HOUSTON	WILLIAM P HOBBY	HOU	3,905,727
TX	DALLAS	DALLAS LOVE FIELD	DAL	3,418,604
TX	SAN ANTONIO	SAN ANTONIO INTL	SAT	3,028,246
TX	AUSTIN	ROBERT MUELLER MUNI	AUS	2,670,454
TX	EL PASO	EL PASO INTL	ELP	1,826,460
TX	LUBBOCK	LUBBOCK INTL	LBB	595,885
TX	MIDLAND	MIDLAND INTERNATIONAL	MAF	559,437
TX	CORPUS CHRISTI	CORPUS CHRISTI INTL	CRP	499,793
TX	HARLINGEN	RIO GRANDE VALLEY INTL	HRL	488,824
TX	AMARILLO	AMARILLO INTL	AMA	459,317
TX	MC ALLEN	MC ALLEN MILLER INTL	MFE	323,281
TX	BEAUMONT/PORT ARTHUR	JEFFERSON COUNTY	BPT	108,862
TX	COLLEGE STATION	EASTERWOOD FIELD	CLL	85,252
TX	TYLER	TYLER POUNDS FIELD	TYR	74,183
TX	BROWNSVILLE	BROWNSVILLE/SOUTH PADRE ISLAND	BRO	71,301
TX	ABILENE	ABILENE REGIONAL	ABI	67,900
TX	WICHITA FALLS	SHEPPARD AFB/WICHITA FALLS MUN	SPS	62,645
TX	LAREDO	LAREDO INTL	LRD	59,899
TX	KILLEEN	KILLEEN MUNI	ILE	59,498
TX	WACO	WACO REGIONAL	ACT	58,854
TX	SAN ANGELO	MATHIS FIELD	SJT	53,095
TX	HOUSTON	ELLINGTON FIELD	EFD	43,821
TX	LONGVIEW	GREGG COUNTY	GGG	34,480
TX	VICTORIA	VICTORIA REGIONAL	VCT	19,327
TX	TEMPLE	DRAUGHON-MILLER MUNI	TPL	15,848
TX	FORT HOOD/KILLEEN	ROBERT GRAY AAF	GRK	11,796
TX	FORT BLISS/EL PASO/	BIGGS AAF	BIF	5,428
TX	DEL RIO	DEL RIO INTL	DRT	2,224
TX	HOUSTON	SUGAR LAND MUNI/HULL FIELD	SGR	2,074
TX	BROWNWOOD	BROWNWOOD RGNL	BWD	2,035
TX	ORANGE	ORANGE COUNTY	ORG	545
TX	SAN ANTONIO	KELLY AFB	SKF	541
TX	LUBBOCK	REESE AFB	REE	468
TX	ALPINE	ALPINE-CASPARIS MUNICIPAL	E38	430
TX	ABILENE	DYESS AFB	DYS	333
TX	AUSTIN	BERGSTROM ARS	BSM	224
TX	GALVESTON	SCHOLES FIELD	GLS	200
TX	FORT WORTH	FORT WORTH ALLIANCE	AFW	191
TX	DEL RIO	LAUGHLIN AFB	DLF	140
TX	CORPUS CHRISTI	CORPUS CHRISTI NAS/TRUAX FIELD	NGP	123
TX	GREENVILLE	MAJORS	GVT	99
TX	DALLAS	ADDISON	ADS	69
TX	HEBBRONVILLE	JIM HOGG COUNTY	03XS	67
TX	FALFURRIAS	BROOKS COUNTY	T18	65
TX	JUNCTION	KIMBLE COUNTY	JCT	62
TX	ENCINAL	A P RANCH	TX27	55
TX	FORT WORTH	FORT WORTH MEACHAM	FTW	47
TX	HOUSTON	DAVID WAYNE HOOKS MEMORIAL	DWH	40
TX	NACOGDOCHES	A L MANGHAM JR. REGIONAL	OCH	23
TX	BAY CITY	BAY CITY MUNI	3R1	19
TX	ODESSA	BATES FIELD	71TA	19
TX	DUMAS	MOORE COUNTY	DUX	16
TX	MOUNT PLEASANT	MOUNT PLEASANT MUNI	MSA	15

State	Associated City	Airport Name	LOCID	Enplanements
TX	ARLINGTON	ARLINGTON MUNI	F54	15
TX	DENTON	DENTON MUNI	DTO	13
TX	WICHITA FALLS	KICKAPOO DOWNTOWN AIRPARK	T47	10
TX	WACO	TSTC WACO	CNW	9
TX	DALHART	DALHART MUN	DHT	9
TX	LUFKIN	ANGELINA COUNTY	LFK	9
TX	CONROE	MONTGOMERY COUNTY	CXO	8
TX	FREER	DUVAL-FREER	T19	6
TX	MC KINNEY	MC KINNEY MUNI	TKI	5
TX	LANCASTER	LANCASTER	LNC	5
TX	PARIS	COX FLD	PRX	5
TX	KERRVILLE	KERRVILLE MUNI/LOUIS SCHREINER	ERV	3
TX	DALLAS	REDBIRD	RBD	2
TX	PERRYTON	PERRYTON OCHILTREE COUNTY	PYX	2
TX	ALICE	ALICE INTL	ALI	2
TX	PALESTINE	PALESTINE MUNI	PSN	2
TX	MARSHALL	HARRISON COUNTY	ASL	2
TX	CORSICANA	C DAVID CAMPBELL FIELD-CORSICA	CRS	0
TX	HONDO	HONDO MUNI	HDO	0
TEXAS TOTAL (76 AIRPORTS) :				56,932,367

Source : FAA DOT/TSC CY1995 ACAIS Database. Report Date : 11/14/96, U.S. Airport Enplanement Activity Summary For CY1995. Listed by State and Rank Order within the State.

APPENDIX C EXCEL MACROS

```
'
' Delete Macro
' Macro recorded 6/13/97 by craigbw
'
'
Sub desmot()
Dim Count As Integer, Endcount As Integer, Sh As Integer

For Sh = 1 To 12
Call Shee(Sh)
Sheets("Sheet1").Select
Cells(1, 9).Select
Selection.EntireColumn.Delete
Cells(1, 9).Select
Selection.EntireColumn.Delete

Endcount = 3500
For Count = 1 To Endcount
   Cells(1, 14) = Count
   If (Cells(1 + Count, 1).Value = False) Then
   Count = 3500
   ElseIf (Cells(1 + Count, 1).Value <> 5) Then
   Cells(1 + Count, 1).Select
   Selection.EntireRow.Delete
   Count = Count - 1
   End If


   Next Count

Application.Run Macro:="Macrotoredux.XLS!Sort.Sort"
Application.Run Macro:="Macrotoredux.xls!Data_Redux"
Application.Run Macro:="Macrotoredux.XLS!Delete.Delete"
Application.Run Macro:="Macrotoredux.XLS!Clean.Clean"
Application.Run Macro:="Macrotoredux.XLS!State.State"
Application.Run Macro:="Macrotoredux.xls!NE.NE"

Next Sh

End Sub

Sub Shee(Sh)

   'If (Sh = 1) Then
   'Windows("D5AJAN96.xls").Activate

   'ElseIf (Sh = 2) Then
   'Windows("D5AFEB96.xls").Activate

   'ElseIf (Sh = 3) Then
   'Windows("D5AMAR96.xls").Activate

'    ElseIf (Sh = 4) Then
'    Windows("D5AAPR96.xls").Activate

 '   ElseIf (Sh = 5) Then
  '  Windows("D5AMAY96.xls").Activate

  ' ElseIf (Sh = 6) Then
   'Windows("D5AJUN96.xls").Activate

   'ElseIf (Sh = 7) Then
   'Windows("D5AJUL96.xls").Activate

'    ElseIf (Sh = 8) Then
```

```
'   Windows("D5AAUG96.xls").Activate

 '  ElseIf (Sh = 9) Then
  ' Windows("D5ASEP96.xls").Activate

   'ElseIf (Sh = 10) Then
   'Windows("D5AOCT96.xls").Activate

'    ElseIf (Sh = 11) Then
'   Windows("D5ANOV96.xls").Activate

 '  ElseIf (Sh = 12) Then
  ' Windows("D5ADEC96.xls").Activate

   If (Sh = 1) Then
   Windows("D11JAN96.xls").Activate

   ElseIf (Sh = 2) Then
   Windows("D11FEB96.xls").Activate

   ElseIf (Sh = 3) Then
   Windows("D11MAR96.xls").Activate

   ElseIf (Sh = 4) Then
   Windows("D11APR96.xls").Activate

   ElseIf (Sh = 5) Then
   Windows("D11MAY96.xls").Activate

   ElseIf (Sh = 6) Then
   Windows("D11JUN96.xls").Activate

   ElseIf (Sh = 7) Then
   Windows("D11JUL96.xls").Activate

   ElseIf (Sh = 8) Then
   Windows("D11AUG96.xls").Activate

   ElseIf (Sh = 9) Then
   Windows("D11SEP96.xls").Activate

   ElseIf (Sh = 10) Then
   Windows("D11OCT96.xls").Activate

   ElseIf (Sh = 11) Then
   Windows("D11NOV96.xls").Activate

   ElseIf (Sh = 12) Then
   Windows("D11DEC96.xls").Activate

   End If

   End Sub


Sub Sort()
   Columns("A:I").Select
   Selection.Sort Key1:=Range("D2"), Order1:=xlAscending, Key2:=Range _
      ("C2"), Order2:=xlAscending, Header:=xlGuess, OrderCustom:=1, _
      MatchCase:=False, Orientation:=xlTopToBottom
End Sub


Sub Data_Redux()
   Dim Row As Integer, Endrow As Integer, Srwo As String, Count As Integer, Endcount As Integer
   Endrow = Worksheets("Sheet1").Range("N1")
   Sheets("Sheet1").Select
   Application.ScreenUpdating = False
   For Row = 1 To Endrow
```

```
    Cells(1, 12) = Row
    If (Cells(1 + Row, 3) <> Cells(2 + Row, 3) And Cells(1 + Row, 3) <> Cells(Row, 3)) Then
       Cells(1 + Row, 9) = Cells(1 + Row, 6)
       ElseIf (Cells(1 + Row, 3) = Cells(2 + Row, 3) And Cells(1 + Row, 3) <> Cells(Row, 3)) Then
       Cells(1 + Row, 9) = Cells(1 + Row, 6)
       Else
       Cells(1 + Row, 9) = Cells(Row, 9) + Cells(1 + Row, 6)
       Cells(Row, 9) = 0

    End If

        Next Row


End Sub



Sub Delete()
Dim Count As Integer, Endcount As Integer


Sheets("Sheet1").Select
Endcount = Worksheets("Sheet1").Range("n1")
counter = 1
For Count = 1 To Endcount
    Cells(1, 12) = Count
    If (Cells(1 + Count, 1).Value = False) Then
    Count = Endcount
    ElseIf (Cells(1 + Count, 9).Value = 0) Then
    Cells(1 + Count, 9).Select
    Selection.EntireRow.Delete
    Count = Count - 1
    counter = counter + 1
    Cells(1, 13) = counter
    End If
    Next Count


Sub Clean()
    Columns("A:B").Select
    Selection.Delete Shift:=xlToLeft
    Columns("C:F").Select
    Selection.Delete Shift:=xlToLeft
    Range("C1").Select
    ActiveCell.FormulaR1C1 = "Value"
    Columns("D:E").Select
    Selection.Delete Shift:=xlToLeft
    Columns("E:F").Select
    Selection.Delete Shift:=xlToLeft
End Sub


Sub State()
    Dim Row As Integer, Endrow As Integer, Srwo As String, Count As Integer, Endcount As Integer
    Endrow = Worksheets("Sheet1").Range("D1")
    Sheets("Sheet1").Select
    Application.ScreenUpdating = False

    Worksheets("Sheet1").Range("S1") = "New England"
    Worksheets("Sheet1").Range("T1") = "Pacific"
    Worksheets("Sheet1").Range("U1") = "MidAtlantic"
    Worksheets("Sheet1").Range("V1") = "S Atlantic"
    Worksheets("Sheet1").Range("W1") = "E N Central"
    Worksheets("Sheet1").Range("X1") = "E S Central"
    Worksheets("Sheet1").Range("Y1") = "Mtn"
    Worksheets("Sheet1").Range("Z1") = "W N Central"
    Worksheets("Sheet1").Range("AA1") = "W S Central"
    Worksheets("Sheet1").Range("R2") = "2301"
```

```
    Worksheets("Sheet1").Range("R3") = "2302"
    Worksheets("Sheet1").Range("R4") = "2303"
    Worksheets("Sheet1").Range("R5") = "2304"
    Worksheets("Sheet1").Range("R6") = "2305"
    Worksheets("Sheet1").Range("R7") = "2307"
    Worksheets("Sheet1").Range("R8") = "2309"
    Worksheets("Sheet1").Range("R9") = "2310"
    Worksheets("Sheet1").Range("R10") = "2402"
    Worksheets("Sheet1").Range("R11") = "2403"
    Worksheets("Sheet1").Range("R12") = "2404"

    For Row = 1 To Endrow

    If (Cells(1 + Row, 1) = "CT") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MA") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "ME") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NH") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "RI") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "VT") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "VT") Then
        Cells(1 + Row, 6) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "CA") Then
        Cells(1 + Row, 7) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "OR") Then
        Cells(1 + Row, 7) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "WA") Then
        Cells(1 + Row, 7) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NJ") Then
        Cells(1 + Row, 8) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NY") Then
        Cells(1 + Row, 8) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "PA") Then
        Cells(1 + Row, 8) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "DU") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "DE") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "FL") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "GA") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MD") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NC") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "SC") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "VA") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "WV") Then
        Cells(1 + Row, 9) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "IL") Then
        Cells(1 + Row, 10) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "IN") Then
        Cells(1 + Row, 10) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MI") Then
        Cells(1 + Row, 10) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "OH") Then
        Cells(1 + Row, 10) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "WI") Then
        Cells(1 + Row, 10) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "AL") Then
        Cells(1 + Row, 11) = Cells(1 + Row, 3)
```

```
ElseIf (Cells(1 + Row, 1) = "KY") Then
      Cells(1 + Row, 11) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MS") Then
      Cells(1 + Row, 11) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "TN") Then
      Cells(1 + Row, 11) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "AZ") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "CO") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "ID") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MT") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NM") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NV") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "UT") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "WY") Then
      Cells(1 + Row, 12) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "IA") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "KS") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MN") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "MO") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "ND") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "NE") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "SD") Then
      Cells(1 + Row, 13) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "AR") Then
      Cells(1 + Row, 14) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "LA") Then
      Cells(1 + Row, 14) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "OK") Then
      Cells(1 + Row, 14) = Cells(1 + Row, 3)
ElseIf (Cells(1 + Row, 1) = "TX") Then
      Cells(1 + Row, 14) = Cells(1 + Row, 3)

      Else
      Cells(1, 5) = Row

   End If

      Next Row


End Sub


Sub NE()
   Endrow = 700
   For Row = 1 To Endrow
   If (Cells(1 + Row, 2) = "2301") Then
      Cells(2, 19) = Cells(2, 19) + Cells(1 + Row, 6)
   ElseIf (Cells(1 + Row, 2) = "2302") Then
      Cells(3, 19) = Cells(3, 19) + Cells(1 + Row, 6)
   ElseIf (Cells(1 + Row, 2) = "2303") Then
      Cells(4, 19) = Cells(4, 19) + Cells(1 + Row, 6)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 19) = Cells(5, 19) + Cells(1 + Row, 6)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
      Cells(6, 19) = Cells(6, 19) + Cells(1 + Row, 6)
```

```
    ElseIf (Cells(1 + Row, 2) = "2307") Then
        Cells(7, 19) = Cells(7, 19) + Cells(1 + Row, 6)
    ElseIf (Cells(1 + Row, 2) = "2309") Then
        Cells(8, 19) = Cells(8, 19) + Cells(1 + Row, 6)
    ElseIf (Cells(1 + Row, 2) = "2310") Then
        Cells(9, 19) = Cells(9, 19) + Cells(1 + Row, 6)
    ElseIf (Cells(1 + Row, 2) = "2402") Then
        Cells(10, 19) = Cells(10, 19) + Cells(1 + Row, 6)
    ElseIf (Cells(1 + Row, 2) = "2403") Then
        Cells(11, 19) = Cells(11, 19) + Cells(1 + Row, 6)
    ElseIf (Cells(1 + Row, 2) = "2404") Then
        Cells(12, 19) = Cells(12, 19) + Cells(1 + Row, 6)


    End If

    Next Row
    Application.Run Macro:="Macrotoredux.xls!Pac.Pac"
    Application.Run Macro:="Macrotoredux.xls!Mid.Mida"
    Application.Run Macro:="Macrotoredux.xls!SAtl.SAtl"
    Application.Run Macro:="Macrotoredux.xls!ENC.ENC"
    Application.Run Macro:="Macrotoredux.xls!ESC.ESC"
    Application.Run Macro:="Macrotoredux.xls!Mtn.Mtn"
    Application.Run Macro:="Macrotoredux.xls!WNC.WNC"
    Application.Run Macro:="Macrotoredux.xls!WSC.WSC"

End Sub


Sub Pac()
    Endrow = 700
    For Row = 1 To Endrow
    If (Cells(1 + Row, 2) = "2301") Then
        Cells(2, 20) = Cells(2, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2302") Then
        Cells(3, 20) = Cells(3, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2303") Then
        Cells(4, 20) = Cells(4, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2304") Then
        Cells(5, 20) = Cells(5, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2305") Then
        Cells(6, 20) = Cells(6, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2307") Then
        Cells(7, 20) = Cells(7, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2309") Then
        Cells(8, 20) = Cells(8, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2310") Then
        Cells(9, 20) = Cells(9, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2402") Then
        Cells(10, 20) = Cells(10, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2403") Then
        Cells(11, 20) = Cells(11, 20) + Cells(1 + Row, 7)
    ElseIf (Cells(1 + Row, 2) = "2404") Then
        Cells(12, 20) = Cells(12, 20) + Cells(1 + Row, 7)

    End If

    Next Row
End Sub


Sub MidA()
    Endrow = 700
    For Row = 1 To Endrow
    If (Cells(1 + Row, 2) = "2301") Then
        Cells(2, 21) = Cells(2, 21) + Cells(1 + Row, 8)
    ElseIf (Cells(1 + Row, 2) = "2302") Then
        Cells(3, 21) = Cells(3, 21) + Cells(1 + Row, 8)
    ElseIf (Cells(1 + Row, 2) = "2303") Then
```

```
      Cells(4, 21) = Cells(4, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 21) = Cells(5, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
      Cells(6, 21) = Cells(6, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2307") Then
      Cells(7, 21) = Cells(7, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2309") Then
      Cells(8, 21) = Cells(8, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2310") Then
      Cells(9, 21) = Cells(9, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2402") Then
      Cells(10, 21) = Cells(10, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2403") Then
      Cells(11, 21) = Cells(11, 21) + Cells(1 + Row, 8)
   ElseIf (Cells(1 + Row, 2) = "2404") Then
      Cells(12, 21) = Cells(12, 21) + Cells(1 + Row, 8)

   End If

   Next Row
End Sub


Sub SAtl()
   Endrow = 700
   For Row = 1 To Endrow
   If (Cells(1 + Row, 2) = "2301") Then
      Cells(2, 22) = Cells(2, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2302") Then
      Cells(3, 22) = Cells(3, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2303") Then
      Cells(4, 22) = Cells(4, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 22) = Cells(5, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
      Cells(6, 22) = Cells(6, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2307") Then
      Cells(7, 22) = Cells(7, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2309") Then
      Cells(8, 22) = Cells(8, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2310") Then
      Cells(9, 22) = Cells(9, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2402") Then
      Cells(10, 22) = Cells(10, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2403") Then
      Cells(11, 22) = Cells(11, 22) + Cells(1 + Row, 9)
   ElseIf (Cells(1 + Row, 2) = "2404") Then
      Cells(12, 22) = Cells(12, 22) + Cells(1 + Row, 9)

   End If

   Next Row
End Sub



Sub ENC()
   Endrow = 700
   For Row = 1 To Endrow
   If (Cells(1 + Row, 2) = "2301") Then
      Cells(2, 23) = Cells(2, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2302") Then
      Cells(3, 23) = Cells(3, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2303") Then
      Cells(4, 23) = Cells(4, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 23) = Cells(5, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
```

```
      Cells(6, 23) = Cells(6, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2307") Then
      Cells(7, 23) = Cells(7, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2309") Then
      Cells(8, 23) = Cells(8, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2310") Then
      Cells(9, 23) = Cells(9, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2402") Then
      Cells(10, 23) = Cells(10, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2403") Then
      Cells(11, 23) = Cells(11, 23) + Cells(1 + Row, 10)
   ElseIf (Cells(1 + Row, 2) = "2404") Then
      Cells(12, 23) = Cells(12, 23) + Cells(1 + Row, 10)

   End If

   Next Row
End Sub


Sub ESC()
   Endrow = 700
   For Row = 1 To Endrow
   If (Cells(1 + Row, 2) = "2301") Then
      Cells(2, 24) = Cells(2, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2302") Then
      Cells(3, 24) = Cells(3, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2303") Then
      Cells(4, 24) = Cells(4, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 24) = Cells(5, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
      Cells(6, 24) = Cells(6, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2307") Then
      Cells(7, 24) = Cells(7, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2309") Then
      Cells(8, 24) = Cells(8, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2310") Then
      Cells(9, 24) = Cells(9, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2402") Then
      Cells(10, 24) = Cells(10, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2403") Then
      Cells(11, 24) = Cells(11, 24) + Cells(1 + Row, 11)
   ElseIf (Cells(1 + Row, 2) = "2404") Then
      Cells(12, 24) = Cells(12, 24) + Cells(1 + Row, 11)

   End If

   Next Row
End Sub


Sub Mtn()
   Endrow = 700
   For Row = 1 To Endrow
   If (Cells(1 + Row, 2) = "2301") Then
      Cells(2, 25) = Cells(2, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2302") Then
      Cells(3, 25) = Cells(3, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2303") Then
      Cells(4, 25) = Cells(4, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2304") Then
      Cells(5, 25) = Cells(5, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2305") Then
      Cells(6, 25) = Cells(6, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2307") Then
      Cells(7, 25) = Cells(7, 25) + Cells(1 + Row, 12)
   ElseIf (Cells(1 + Row, 2) = "2309") Then
      Cells(8, 25) = Cells(8, 25) + Cells(1 + Row, 12)
```

```
    ElseIf (Cells(1 + Row, 2) = "2310") Then
        Cells(9, 25) = Cells(9, 25) + Cells(1 + Row, 12)
    ElseIf (Cells(1 + Row, 2) = "2402") Then
        Cells(10, 25) = Cells(10, 25) + Cells(1 + Row, 12)
    ElseIf (Cells(1 + Row, 2) = "2403") Then
        Cells(11, 25) = Cells(11, 25) + Cells(1 + Row, 12)
    ElseIf (Cells(1 + Row, 2) = "2404") Then
        Cells(12, 25) = Cells(12, 25) + Cells(1 + Row, 12)

    End If

    Next Row
End Sub


Sub WNC()
    Endrow = 700
    For Row = 1 To Endrow
    If (Cells(1 + Row, 2) = "2301") Then
        Cells(2, 26) = Cells(2, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2302") Then
        Cells(3, 26) = Cells(3, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2303") Then
        Cells(4, 26) = Cells(4, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2304") Then
        Cells(5, 26) = Cells(5, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2305") Then
        Cells(6, 26) = Cells(6, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2307") Then
        Cells(7, 26) = Cells(7, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2309") Then
        Cells(8, 26) = Cells(8, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2310") Then
        Cells(9, 26) = Cells(9, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2402") Then
        Cells(10, 26) = Cells(10, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2403") Then
        Cells(11, 26) = Cells(11, 26) + Cells(1 + Row, 13)
    ElseIf (Cells(1 + Row, 2) = "2404") Then
        Cells(12, 26) = Cells(12, 26) + Cells(1 + Row, 13)

    End If

    Next Row
End Sub


Sub WSC()
    Endrow = 700
    For Row = 1 To Endrow
    If (Cells(1 + Row, 2) = "2301") Then
        Cells(2, 27) = Cells(2, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2302") Then
        Cells(3, 27) = Cells(3, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2303") Then
        Cells(4, 27) = Cells(4, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2304") Then
        Cells(5, 27) = Cells(5, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2305") Then
        Cells(6, 27) = Cells(6, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2307") Then
        Cells(7, 27) = Cells(7, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2309") Then
        Cells(8, 27) = Cells(8, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2310") Then
        Cells(9, 27) = Cells(9, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2402") Then
        Cells(10, 27) = Cells(10, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2403") Then
```

```
        Cells(11, 27) = Cells(11, 27) + Cells(1 + Row, 14)
    ElseIf (Cells(1 + Row, 2) = "2404") Then
        Cells(12, 27) = Cells(12, 27) + Cells(1 + Row, 14)
    'Else
     '   Cells(1 + Row, 2).Select
      '  Selection.EntireRow.Delete
       ' Row = Row - 1

    End If

    Next Row
    Application.Run Macro:="Macrotoredux.xls!table.table"
End Sub


Sub table()

    Columns("F:Q").Select
    Selection.Delete Shift:=xlToLeft

    Columns("A:E").Select
    Selection.Delete Shift:=xlToLeft

End Sub
```

APPENDIX D U.S MEXICO TRADE DATA

TABLE D1 Imports Through Texas

	ew Englan	*Pacific*	*MidAtlantic*	*S Atlantic*	*E N Central*	*E S Central*	*Mtn*	*W N Central*	*W S Central*
2301	57713804	30614597	149526291	155522911	161336846	108082077	10576138	34664011	3257253171
2302	270717	1419704	1226527	5011520	33045146	24252345	2295313	26445	824307131
2303	898513	19299007	21147364	418451972	29907527	38294866	10867693	12590840	465433330
2304	433424966	904737136	1276366170	2748027607	4373825271	751078217	195084553	582530078	4652178058
2305	534522	40265220	6913370	26545340	62003826	15332606	1183226	5721933	2444982802
2307	433397	265401	310733	912857	458840	257619	151316	339577	82639719
2309	810243	1627314	1229325	5765258	4042585	1442581	84623	232049	117196060
2310	63018	897252	705672	1969466	2191265	266560	391959	1015092	65289847
2402	27717937	26013929	14303857	154946662	43879613	18074759	38627561	79341716	8856195787
2403	100963	1974778	171082	1046327	1608903	2155830	736747	1615449	19964249
2404	64128	1414952	0	60240	0	0	0	0	0
Total	522032208	1028529290	1471900391	3518260160	4712299822	959237460	259999129	718077190	33975775804

Table D 2 Exports Through Texas

	New England	*Pacific*	*MidAtlantic*	*S Atlantic*	*E N Central*	*E S Central*	*Mtn*	*W N Central*	*W S Central*
2301	21872662	69839122	114137192	528790182	722904263	143638474	1095612	184544610	1205651228
2302	12467	1538290	5808278	5653160	88937997	347649369	996805	1542844	499840821
2303	2572756	28559604	12232907	490546763	140413794	42953701	14664336	13028323	402287338
2304	375185085	1130484741	1656725153	2172481180	3084478532	825427659	66243502	447072065	2751221432
2305	12782005	46590047	59110215	112429091	325844079	50642632	2581889	94002822	2887692813
2307	0	497292	6759937	846675	0	47904	146506	58209	45959450
2309	15456	96094	0	121938	478982	13163700	10190	74282	42343872
2310	0	164167	122080	1278932	430509	31773	715688	5884	56366336
2402	98834472	430334846	317326240	694325365	3212441826	933708184	60719740	210951729	5642698165
2403	0	820910	4704	1393924	1263713	2772844	242503	777728	23833856
2404	0	0	0	0	0	0	0	0	0
Total	511274903	1708925113	2172226706	4007867210	7577193695	2360036240	147416771	952058496	32994894445

REFERENCES

1. United States Department of Transportation, *Transportation Annual Report 1995* (Washington D.C. 1996)
2. United States Department of Transportation, Federal Highway Administration, *Highway Statistics 1994* (Washington D.C:1995)
3. Shrank, D.S. Turner, and T. Lomax, 1993 *Estimates of Urban Roadway Congestion*, 1990, Report 1131-5. Texas Transportation Institute, College Station
4. United States Department of Transportation, Federal Highway Administration Transportation Statistics Annual Report 1996 (Washington D.C:1996)
5. Dielbold Institute for Public Policy, *Transportation Infostructures*, 1995
6. *Curbing Gridlock*, Transportation Research Board, Special Report 242
7. Wisconsin Department Of Transportation, *Corridors 2020*, 1994
8. Wisconsin Department Of Transportation, *Translink21: Mission Statement*, 1994
9. Ohio Department of Transportation, *Access Ohio*, 1996
10. Yu, Chien-pei *Modeling And Forecasting Selected Effects On Intercity Truck Route Network,* The University of Texas At Austin, December 1985
11. Cambridge Systematics, Inc., *Regional Truck Freight Network Strategic Plan*, The Port Authority of New York and New Jersey, 1997
12. Notsky, Steve, Federal highway Administration,, *Statewide Freight Corridor Planning*, July 7, 1997
13. Helaakoski, Reijo, Hani S. Mahmassani, C. Michael Walton, Mark Euritt, Robert Harrison, and S. Johann Andersen, Economic Effects of Highway Bypass on Business Activities in Small Cities, Research Project 1247-1, Center for Transportation, The University of Texas at Austin, October 1992.
14. Environmental System Research Institute Inc., h*ttp://www.esri.com/base/gis/abtgis/what_gis.html*
15. *The Texas Seaport and Inland Waterway System*, LBJ School of Public Affairs, The University of Texas, 1995
16. Weissmann, Angela Jannini, and Robert Harrison, *Analysis of U.S.-Mexico Traffic Within Texas*, Research Project 2932-2, Center for Transportation Research, The University of Texas at Austin, December 1995
17. Bureau of Transportation Statistics, Transborder Surface Freight Data, January-December 1996
18. McCray, John P. And Robert Harrison, 1996, *The River of Trade: U.S. - Mexico Trade Truck Transportation Corridors*, Transportation Research Forum, 1996
19. Slater, Rodney E., *Backbone of Our National Transportation Network* , Public roads v. 57, no. 3 (Winter 1994), Office of Research and Development, U.S. Federal Highway Administration.

20. Shieh, How-Ming *Exploring An Intercity Truck Route Network Concept for Large Combination Vehicles*, The University of Texas at Austin, May 1986