

Developing a Market Artery System To Identify Priority Commercial Truck Routes

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In northern states, spring freeze and thaw conditions make many roads susceptible to damage from heavy trucks. To minimize this damage, some states, including Minnesota, impose spring weight restrictions to reduce truck loads. In 1986 legislation authorized the Minnesota Department of Transportation to establish a market artery system to eliminate spring weight restrictions on those state highways most important to economic and shipping activities. Criteria for population, retail and wholesale sales, and manufacturing employment were used to identify significant centers. Nearly 4,800 mi of state trunk highway market artery routes was identified to connect centers that represent at least two-thirds of the state's population and economic activities. These routes carry more than 80 percent of the state's five-axle truck travel. In addition, about 2,800 mi of commercial access routes was identified to connect other important commercial centers to the market artery system. The market artery and commercial access systems will be used to determine future road-strengthening priorities. Study results are also applicable to other activities, such as the designation of routes for the national truck network and highway system. In addition, Minnesota's market artery methodology may be useful to others in addressing trucking and shipping needs in their areas.

Trucks have become predominant players in the nation's efforts to increase productivity and compete more effectively in the global marketplace. In recent years, there has been a phenomenal growth in travel by larger and heavier tractor-semitrailer combinations. The use of heavier trucks has resulted in larger payloads, reduced trips for shippers, and cost savings for producers and consumers. However, heavier trucks have also created added stress on highway pavements. This stress has the potential to accelerate pavement deterioration and increase roadway repair costs. These effects are particularly important for many of the nation's older highways, which were not designed to carry the heavier loads of today's vehicles.

Moisture in subgrade soils from thawing frost and spring rains leaves roadbeds in their weakest condition. This weakness in the soils reduces stability and strength in highway pavements. Heavy trucks traveling over these pavements increase the possibility for accelerated deterioration and pavement breakups.

To reduce the possibility of damage caused by heavier trucks, the Minnesota Department of Transportation (Mn/DOT) imposes spring weight restrictions on structurally weak highways under its jurisdiction. These weight restrictions are generally in effect from March 15 to May 15 of each year. Spring weight restrictions can cause difficulties for shippers and producers. Using smaller trucks or shipping less-than-full loads to comply with posted spring weight restrictions results in

higher operating costs for shippers. These restrictions also could diminish the state's attraction for new business development.

In Minnesota, the maximum gross vehicle weight permitted for five-axle, tractor-semitrailer truck combinations on state trunk highways (those highways under the jurisdiction of Mn/DOT) is 10 tons per single axle or 80,000 lb per truck. In 1984 only about 18 percent (2,160 mi) of Minnesota's 12,100-mi state trunk highway system was open year-round to maximum five-axle truck gross vehicle loads of 80,000 lb. Table 1 presents state trunk highway mileage distribution among the various weight restriction categories in the spring of 1984.

Mn/DOT began reassessing its weight management policies in 1984. A number of actions were implemented to support state economic development objectives and improve shipping productivity. For example, the number of weight restriction categories was reduced. More important, a risk management philosophy was implemented to decrease spring weight restrictions and expand the number of miles open all year to gross vehicle loads of 10 tons per single axle or 80,000 lb. Under this philosophy, spring weight restriction signs were removed from many highway segments in response to public and shipper comments. These actions were taken despite pavement strength testing data that showed many of these routes to have inadequate structural capacity to carry heavier loads. Mn/DOT reserved the right to impose weight restrictions again, if necessary, to prevent significant deterioration.

Removing weight restriction signs without strengthening highways to allow them to carry additional weight is not an acceptable long-term solution. Many of these roads are not structurally designed to accommodate heavier trucks. Therefore, they will experience accelerated deterioration and possible roadway failures. On the other hand, the cost of upgrading all 12,100 mi of the state's trunk highway system to carry

TABLE 1 MN/DOT TRUNK HIGHWAY SYSTEM MILEAGE BY SPRING WEIGHT RESTRICTION CATEGORIES: 1984

Weight per Single Axle (tons)	Miles
5	1,310
6	720
7	1,830
8	90
9	5,980
10	2,160
Total	12,090

80,000-lb truck loads is prohibitive. In 1985 an Mn/DOT report estimated that the short- and long-term costs of establishing a statewide trunk highway system capable of carrying 80,000-lb loads would be over \$32 million per year just for road strengthening (1). To put this into context, Mn/DOT spent about \$35 million in 1988 to address total reconstruction needs on the 12,100-mi state trunk highway system. Road strengthening needs of this magnitude would require diverting funding resources away from other high-priority highway and bridge improvement needs.

MARKET ARTERY LEGISLATION

Discussion of truck weight management activities and the desirability of opening more roads to year-round 80,000-lb gross vehicle loads was a frequent topic in the state legislature in the 1980s. In 1986 the legislature determined that insufficient resources were available to eliminate spring weight restrictions on all highways in the state. The result was the passage of legislation authorizing Mn/DOT to establish a market artery system (Minnesota Statutes, Chap. 169.832, Subdivision 13, 1986).

The market artery legislation provided more focus and direction to the management of spring truck axle weight restrictions. For example, the legislation was applied only to highways under the jurisdiction of Mn/DOT; county, city, and township roads were excluded. In addition, the legislation included specific language to help Mn/DOT identify market artery routes most important to trucking and shipping activities.

In the legislation, market arteries were identified as state trunk highways that

- Connect significant centers of population or commerce,
- Connect highways that connect significant centers of population or commerce,
- Provide access to transportation terminals, and
- Provide temporary emergency service to particular shipping or receiving points on market arteries.

Mn/DOT was required to notify the legislature of any spring weight restrictions on designated market artery routes. The law further specified that notices must include plans showing how improvements would be made within 3 years so that the restrictions would no longer be necessary on these routes.

The passage of the market artery legislation triggered an extensive study identifying state trunk highway routes most important to population and commercial activity centers. It also initiated a process to enhance the sensitivity of Mn/DOT's trunk highway project programming process to road strengthening needs throughout the state. The market artery study represented the department's first comprehensive attempt to base statewide truck weight management decisions on economic activities rather than on pavement conditions or strength testing data.

IDENTIFYING MARKET ARTERIES—STUDY APPROACH AND METHODOLOGY

The steps taken to define the levels of population and commercial activities that warrant year-round unrestricted truck

service are defined and how market artery routes were identified to connect significant centers in Minnesota, surrounding states, and Canadian provinces is explained. In addition, information is included outlining Mn/DOT's philosophy for managing spring weight restrictions on market arteries, other important commercial access routes, and low-volume local and regional access routes. The information obtained from the study will be used to identify future roadway-strengthening priorities for highways under the jurisdiction of Mn/DOT. Study findings and results will also be applicable to other Mn/DOT highway planning activities.

Step 1—Reviewing Available Data and Information

The 1986 legislation specified that the market artery system be made up of routes that connect significant centers of population and commerce. To determine appropriate market artery route connections, criteria had to be identified for defining which cities fit this specification. Two key studies provided background information on the evolution and growth of important trade centers in Minnesota. These studies also provided valuable information on accepted guidelines for measuring the relative importance of metropolitan areas and regional centers. The first study (2), conducted in 1963 by John Borchert at the University of Minnesota, identified a hierarchy of trade centers in the Upper Midwest. The classification system developed by Borchert was based on the theory that urban places are arranged in a hierarchical order according to the size and diversity of wholesale and retail functions. Borchert measured diversity specialization by the number of wholesale and retail establishments and the dollar value of annual wholesale and retail sales.

In the second study (3), conducted in 1970, Borchert noted that settlement patterns in the Upper Midwest were evolving into urban clusters. He suggested that in future years most of the population in the Upper Midwest would be concentrated in the Minneapolis–St. Paul metropolitan area and other low-density urban clusters located throughout Minnesota. The number and diversity in retail and wholesale activities were used to establish a relative ranking of urban clusters.

The activities of other state transportation departments were also consulted as a part of Mn/DOT's study. For example, a priority commercial network (PCN) has been identified in Michigan to help establish highway project priorities. A production and attraction gravity model uses data on wholesale sales, manufacturing, tourism, and forestry to identify priority commercial routes, which carry products to the most likely attraction, user, or processor sites (4).

In Iowa, a commercial and industrial highway network has been identified as part of the Iowa Transportation 2000 investment package. The 2,000-mi network provides a high standard of service to all regional growth centers with 20,000 or more people located in the center of 30-min to 1-hr commuter sheds. According to the Iowa Department of Transportation, routes included in the commercial and industrial network generally carry approximately 3,000 average vehicles and 250 tractor-semitrailers each day.

Pennsylvania has established a 12,000-mi PCN made up of the state's most important commercial routes for the movement of materials and manufactured products. An agricultural access network has also been identified to provide service for

lumber, milk and poultry products, feed mills, and fertilizer plants. These networks will guide future Pennsylvania road-way improvement decisions (5).

The Michigan, Iowa, and Pennsylvania studies were particularly useful in helping Mn/DOT identify the specific types of economic activities and population levels believed to be most important to trucking and shipping activities. To obtain information on existing economic conditions and emerging shipping trends in Minnesota, Mn/DOT personnel met with geographers, regional planners, and representatives from the Minnesota Department of Trade and Economic Development. These discussions were useful in deciding how study results from other states could be applied to conditions in Minnesota.

With information from studies and interviews, Mn/DOT staff began a comprehensive review of the census data available for cities regarding population, business, and economic development activities. These efforts revealed four significant trends.

First, the data reaffirmed the dominance of the Minneapolis-St. Paul metropolitan area in overall state population and business activities. About 50 percent of the state's 4.2 million people live in the seven counties that make up the Twin Cities metropolitan area.

Second, the data showed ongoing growth, prosperity, and concentration of economic activities in the state's other major urbanized areas. Urbanized areas with populations of over 50,000, such as the cities of Duluth, Rochester, St. Cloud, and Mankato, are expanding their service areas and becoming major regional centers for retail, service, and educational activities.

The third trend was the predictable decline of many small town retail and service functions. Population losses have occurred in more than half of the 616 cities in Minnesota's nonmetropolitan counties during the 1980s, and many main street retail trade centers in small towns are fading away (6).

The fourth and most surprising trend revealed by the data was the large number of significant small-town manufacturing and wholesaling establishments scattered throughout the state. This trend was recently discussed in an article (7) by John Fraser Hart of the University of Minnesota. Hart noted that much of the population increases in midwestern small towns since World War II are the result of expanded manufacturing employment in nonmetropolitan areas. He suggests that the future of small towns depends on their ability to adapt from agricultural service functions to manufacturing. Further evidence of this trend was reported in a recent newspaper article, which stated that employment in manufacturing was growing twice as fast in areas outside the Twin Cities metropolitan area as inside the area (8).

The evidence of the large number of dispersed small-town manufacturing and wholesale establishments caused Mn/DOT to reassess its thinking about population and business centers. Population alone was not a reliable indicator of the need for year-round heavy-truck service. The following examples reflect the trucking and shipping needs of several selected small-town businesses in Minnesota:

- The city of Warroad (population 1,200), located in far northwestern Minnesota, is the home of Marvin Windows, a national producer of window and specialty glass products, which employs over 3,000.

- In southwestern Minnesota, the town of Round Lake (population 480) is the home of Sathers, Inc., a major nationwide wholesale producer and distributor of cookies, candies, and bakery products, with estimated annual revenues in excess of \$102 million (9, p. 347).

- The unincorporated city of Bongards, west of the Twin Cities metropolitan area, is the location of one of the largest dairy operations in the world.

- In western Minnesota, the town of Frazee (population 1,284) has nearly 2,200 persons employed in poultry processing.

The presence of businesses scattered throughout the state made it clear that a flexible definition of significant centers of population and commerce was needed to address their important trucking and shipping needs.

Step 2—Involving the Public in the Market Artery Study

The market artery study elicited considerable interest among shippers, producers, and county and local government officials concerned with the effects of state weight management activities.

A public involvement process was established early in the study to explain study goals and objectives and solicit comments and opinions from the public and the county and local governments. Minnesota's active Regional Development Commissions (RDCs) provided a logical forum for coordinating these activities. With the help of the RDCs, 12 public meetings were held throughout the state. Attendees included nearly 270 highway users and representatives of manufacturing, retail trade, shipping, agriculture, and county and local government. The comments and opinions helped refine Mn/DOT criteria for defining significant centers of population and commerce. In addition, the input helped department staff recognize important trucking and shipping needs missed by traditionally reported census and manufacturing directories. Public comments also identified the need for comprehensive truck weight management strategies that addressed the total state highway system in addition to market artery connections between significant centers.

Step 3—Choosing Criteria To Define Significant Centers

On the basis of the analysis undertaken and the comments received, significant centers of population and commerce were defined as

- Cities in Minnesota that meet any one or more of the following criteria:

- Population of 5,000 or more,
- \$50 million or more in annual retail sales,
- 450 or more manufacturing employees, or
- \$50 million or more in annual wholesale sales.

- Cities in surrounding states or Canadian provinces that have populations of 50,000 or more.

The numerical values were based on logical breaks in the distribution of data for each of the criteria. It was also deter-

mined that numerical values should be selected on the basis of their ability to encompass roughly two-thirds of the state's total population and commercial activities.

The definition of significant centers of population and commerce permits cities to be identified as significant centers if they meet any one of the criteria for population, retail sales, manufacturing employment, and wholesale sales. This liberal definition was adopted for two reasons. First, it became apparent that there was considerable legislative, public, and business support for a definition that would ensure access to a market artery route and year-round unrestricted service for an optimum number of economic activity centers. Second, economic trends supported the development of a flexible definition that relied on more than one measure of a city's economic activity.

This liberal definition permitted Mn/DOT to address the shipping needs of many smaller towns with significant manufacturing and wholesale activities. As a result, when the data for all the cities in Minnesota meeting the criteria were added together, approximately 64 percent of the state's population, 82 percent of annual retail sales, 78 percent of manufacturing employment, and 88 percent of annual wholesale sales were represented.

The population and economic censuses prepared by the U.S. Department of Commerce, Bureau of the Census, were used as the primary sources of data to determine whether cities met the criteria. These sources were chosen because they provide the most readily available and consistently reported data on city population and commercial trends. The censuses, however, had several major shortcomings.

First, much of the data were old—population information dated back to 1980 and data on economic activities were last reported in 1982. Another drawback was the lack of information available on cities with fewer than 2,500 persons. Data privacy provisions also resulted in the withholding of information on specific business activity levels in cities with a single major employer. These shortcomings were overcome by using supplementary directories of business activities and by contacting the RDCs, company representatives, chambers of commerce, and local units of government. The following paragraphs summarize the reasons for selecting the criteria used to define significant centers of population and commerce.

Population

Population was used as a criterion because it was identified in the legislation. In addition, population is generally considered a reliable measure of the importance and relative economic strength of cities. The numerical value for populations was set at 5,000 or more persons. This value was selected because it has historically been used for other transportation programs in Minnesota. For example, current state law requires that 9 percent of the net revenues of the Minnesota Highway User Tax Distribution Fund be paid to the municipal state aid street fund. Municipal state aid street fund revenues, in turn, may only be spent on state aid streets in cities with more than 5,000 persons (Minnesota Statutes, Section 12.09, 1986). The population value of 5,000 or more is also used to define urban areas in federal highway regulations (*Code of Federal Regulations*, Part 470.103, Subdivision (b)(1), p. 99, rev. April 1, 1988).

Retail Sales

The retail sales criterion came from the legislation, which defined significant centers of population and commerce as all cities that had total retail sales of at least \$50 million as reported in the 1982 Census of Retail Trade of the U.S. Department of Commerce.

Manufacturing and Wholesaling

Criteria for manufacturing and wholesaling were added to the definition of significant centers because these activities are good indicators of the need for heavy-truck service. For example, manufacturing includes the state's food and kindred products, lumber and wood products, paper printing and publishing, chemicals, primary metals, fabricated metals, machinery, electric and electronic equipment, and transportation equipment industries. Wholesaling includes all establishments that sell goods, such as groceries, furniture and home furnishings, lumber and construction materials, and farm product raw materials to industrial, commercial, institutional, or professional users; to government; or to farmers for farm use.

The number of manufacturing employees was selected as a reasonable measure of the need for heavy-truck service. This assumption is based on the traditional view of manufacturing as a labor-intensive activity with a strong positive correlation between the volume of goods produced and the number of production workers employed. The numerical value of 450 manufacturing employees was chosen because it is the smallest unit reported in the Census of Manufactures. The dollar value of annual wholesale sales was selected as an appropriate indicator for measuring business size and associated shipping levels.

Other indicators of a city's economic diversity, such as service industries or tourism, were not used to define significant centers because there was no strong evidence of a relationship between these activities and the need for year-round service by large heavy trucks.

Using the four selected criteria, 67 cities in the Minneapolis–St. Paul metropolitan area and 82 cities located outside of the metropolitan area were identified as significant centers of population and commerce.

Step 4—Identifying Market Artery Connections Between Centers

The next step in the study process involved identifying market artery connections between the significant centers. The methodology for connecting centers was based on the assumption that shipments from lower-order centers are most naturally attracted to higher-order centers.

To determine attraction patterns, significant centers were ranked from high to low for each of the four criteria. The four relative ranks for each significant center were then summed and a relative ranking was established of all the cities identified as significant centers. The result was a composite ranking that listed places with the largest populations and highest levels of economic activity at the top and those with the smallest populations and least economic diversity at the bottom.

Starting at the top of the list, the Minneapolis–St. Paul metropolitan area was connected to other major urbanized

areas in surrounding states and Canada. Using the ranking, all other significant centers in Minnesota were connected to higher-order centers. Connections were made following state trunk highways that showed the strongest patterns of interaction and attraction, primarily on the basis of five-axle truck traffic counts. If centers showed relatively equal attractions in multiple directions, more than one route was chosen. Further minor adjustments were made to provide logical interconnections within the network once a skeletal system was identified. Using this methodology, approximately 4,800 mi of state trunk highway market artery routes was identified for connecting the significant centers throughout the state.

ADDRESSING OTHER IMPORTANT COMMERCIAL ACCESS NEEDS

As the effort to identify a market artery system progressed, it was apparent that the system would only resolve weight management issues on a limited number of state trunk highways. Public comments and business concerns suggested that shipping requirements on additional state trunk highways needed to be addressed. As a result, three categories were identified to define route functions and describe the appropriate weight management philosophies applicable to all roadways under the jurisdiction of Mn/DOT. Definitions and management philosophies adopted for each of these categories follow.

Category 1—Market Artery System

The market artery system will provide guaranteed, year-round, unrestricted service between significant centers of population and commerce on nearly 40 percent of Minnesota's state trunk highway system. These highways carry over 80 percent of the five-axle heavy commercial travel in Minnesota. Market artery routes have been identified as priority routes for the elimination of truck axle weight restrictions in the spring. Mn/DOT's highway improvement programming process is currently being adjusted so that the routes with load-carrying capacity deficiencies are given special consideration in future investment decisions.

Category 2—Commercial Access Routes

Commercial access routes make up the second category of Mn/DOT's weight management approach. These routes connect important commercial places to the market artery system. Commercial places do not have the economic diversity or strength of significant centers. Nonetheless, they represent important activity areas for the state's economy.

For this study, commercial places were defined as cities in Minnesota with one or more of the following economic activities:

- Manufacturing (more than 100 employees);
- Major dairies with multiple processing operations (cheese, milk, and butter);
- Large grain elevators with permanent storage capacity of more than 670,000 bushels; and
- Major log and timber processors.

Commercial places identified in Minnesota that were not already served by market artery routes totaled 160. Connections between commercial places and the market artery system were based on an assessment of truck traffic patterns and an evaluation of where Mn/DOT was most willing to risk access for the anticipated heavier-truck traffic. Commercial access routes were also designated to serve as supplemental linkages between significant centers of population and commerce. Alternative connections between significant centers were designated as commercial access routes if they carried at least one-half of the five-axle commercial traffic on the designated market artery route. Approximately 2,800 mi of state trunk highway commercial access routes were designated.

To minimize or eliminate weight restrictions, Mn/DOT's management philosophy for commercial access routes authorizes district offices to take risks beyond those suggested by strength-testing data. The Mn/DOT highway programming process will be modified to incorporate commercial access routes in overall project ranking decisions.

Category 3—Local and Regional Access Routes

Local and regional access routes make up the third category in Mn/DOT's weight management approach. These highways primarily serve individual land holdings, such as farms, residences, and pulp-cutting sites. They provide for the first haul of agricultural, forest, or other products to local processing plants or storage facilities. They are also used for the last haul of fertilizer, feed, seed, and other products from distribution sites to farm or home use. These routes have low traffic volumes. Local and regional access routes are managed to preserve the life of the roadway by minimizing damage from heavy vehicles. This means that spring weight restrictions will continue to be imposed if pavement strength testing data warrant their use. Because of limited financial resources, local and regional access routes do not compete well for improvement dollars against more heavily traveled routes with higher-priority needs.

On local and regional routes, shippers are responsible for deciding how to manage loads during spring weight restriction periods. They may ship in advance of or after the weight restriction periods, or they may haul products during unrestricted periods and stockpile commodities at sites next to market artery or commercial access routes. Shippers may also ship in smaller, more divisible loads that comply with posted weight restrictions.

CONCLUSION

The Mn/DOT market artery study represented the department's first comprehensive attempt to base state truck weight management decisions on economic activities rather than on pavement conditions or strength-testing data. This paper describes the extensive data analysis and public involvement process that was used to identify economic activity areas and route connections important to trucking and shipping in Minnesota.

The road and weight management philosophies that resulted from the market artery study were implemented in 1989. Significant progress has already been made to improve shipping

TABLE 2 COMPARISON OF MN/DOT TRUNK HIGHWAY MILEAGE WITH SPRING WEIGHT RESTRICTIONS: 1984 AND 1989

Weight per Single Axle (tons)	Miles	
	1984	1989
5	1,310	540
6	720	0
7	1,830	2,320
8	90	0
9	5,980	0
Total restricted mileage	9,930	2,860
10	2,160	9,210
Total mileage	12,090	12,070

productivity on state trunk highway market artery and commercial access routes. Table 2 shows the progress that has been made since 1984 to reduce spring weight restrictions and increase the number of miles of trunk highway open year-round to 10-ton-per-axle or 80,000-lb gross vehicle loads.

The Mn/DOT market artery study will primarily be used to determine future state trunk highway road strengthening priorities. However, the study process produced a wealth of information on state economic activities that will be useful in a variety of other transportation planning studies and programs, including

- Managing requests for additions to Minnesota's National Truck Network,
- Identifying candidate routes for the proposed Highway System of National Significance,
- Evaluating the need for expanded four-lane highway connections to economic centers,
- Determining appropriate detour routes for scheduled highway construction projects, and
- Continuing communication with highway users, business interests, and local government officials.

The market artery study will be updated every 2 years. Hence, future changes in economic activities and shipping patterns can be incorporated into Mn/DOT weight management decisions.

Market artery study results, together with the significant reductions in spring weight restrictions, have met with con-

siderable legislative, business, and community support. Concerns continue to be expressed regarding trucking needs on local and regional routes under the jurisdiction of Mn/DOT and on other roads in the state that are under the jurisdiction of counties and local units of government. Mn/DOT is working with state legislators and others to reassess transportation needs and develop a consensus on adequate, stable, and predictable highway funding to address these and other important transportation needs in Minnesota.

Transportation is the lifeline that links farms and cities and connects products with markets. The strength of a state's transportation system can determine its competitive advantage in the national and global marketplace. The market artery study reaffirmed the important role of state transportation agencies in enhancing economic development opportunities. Designated market artery and commercial access routes will permit Mn/DOT to target resources to highways that are most important to Minnesota businesses while maximizing the state's ability to address overall transportation needs.

The market artery study process described in this paper may be of use or interest to other state highway and transportation departments that are involved in identifying trucking, shipping, or economic networks.

REFERENCES

1. *Truck Weight Action Group Report*. Minnesota Department of Transportation, St. Paul, Jan. 1985.
2. J. R. Borchert. *The Urbanization of the Upper Midwest: 1930-1960*. Urban Report No. 2, Upper Midwest Economic Study. Geography Department, University of Minnesota, 1963.
3. J. R. Borchert and D. D. Carroll. *Minnesota Settlement and Land Use*. Minnesota State Planning Agency, St. Paul, 1970.
4. *Methodology for Determining Michigan's Priority Commercial Network*. Michigan Department of Transportation, Lansing, May 1985.
5. *Pennsylvania Agri-Access Network Statewide Report*. Pennsylvania Department of Transportation, Harrisburg, April 1985.
6. B. Von Sternberg and R. Meador, eds. *Fading Away*. *Star Tribune*, Section A, Part II, Oct. 30, 1988, pp. 29A-34A.
7. J. F. Hart. Small Town Manufacturing. *The Geographical Review*, Vol. 78, No. 3, July 1988, pp. 272-287.
8. C. Strouse. Rural Manufacturing Jobs Up Sharply. *Minneapolis/St. Paul City Business*, Oct. 31, 1988, pp. 1 and 22.
9. Engler-Budd & Company Inc. *Corporate Fact Book, 1988 Edition*. MCP Inc. Publishers, Dec. 1987.

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