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Transportation Planning to Support Economic Development: An Exploratory Study of Competitive Industry Clusters and Transportation in Minnesota

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Final Report

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Finally, we wish to thank in particular the businesses who agreed to interviews for this study, without whom this study would not have been possible. The businesses and contacts are listed in Appendix B.

Table of Contents

Chapter 1 Introduction	1
Chapter 2 Relevant Literature on Transportation and Economic Development	2
Chapter 3 Selection of industry clusters	3
Chapter 4 Cluster Analysis	5
4.1 Forest Products Cluster - Duluth.....	6
4.2 Glass Cluster - Owatonna-Faribault-Northfield.....	10
4.3 Granite Cluster – St. Cloud.....	13
4.4 Health Services Cluster – Rochester MSA	17
4.5 Heavy Machinery Cluster - Fairmont and Jackson Counties.....	21
4.6 Hospitality and Tourism Cluster - Brainerd.....	25
4.7 Medical Device Cluster – Minneapolis-St. Paul MSA	29
4.8 Processed Food Cluster - Worthington	32
4.9 Printing and Publishing Cluster - Mankato-North Mankato	35
4.10 Recreational Vehicles - Northwest Minnesota.....	39
4.11 Robotics Cluster - Minneapolis-St. Paul MSA	43
4.12 Transportation and Logistics Cluster – Minneapolis-St. Paul MSA.....	46
Chapter 5 Synthesis.....	49
5.1 <i>Statewide clusters</i> : Processed food (21), heavy machinery (19).....	49
5.2 <i>Multi-region clusters</i> : Health services (13), forest products (10), publishing and printing (10), hospitality and tourism (6), medical devices (5).....	49
5.3 <i>Single region clusters</i> : Granite, glass, recreational vehicles, footwear, mining	51
5.4 Transportation and logistics cluster	52
5.5 <i>Emerging clusters</i> : Robotics, Water Technology	53
5.6 Minnesota transportation issues and economic competitiveness	53
Chapter 6 Recommendations	56
6.1 Statewide Freight Planning	56
6.2 Regional Transportation Strategies	56
6.3 Transportation Investments to Promote Economic Competitiveness	56
6.4 Intermodal Connections and Investments	57
6.5 Public-private partnerships and collaboration.....	57

Chapter 7 Conclusion.....	58
References.....	60
Appendix A: Cluster Selection Matrix	
Appendix B: Interviews by Cluster, Location, Company and Contact	
Appendix C: Project Description and Interview Guide	
Appendix D: Cluster Definitions	
Appendix E: Graduate Student Team Cluster Projects	

List of Tables

Table 5.1 Summary of Transportation Characteristics of Firms in Competitive Clusters	50
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List of Figures

Figure 3.1 Selected Industry Clusters	4
Figure 4.1 Forestry and Primary Wood Processing	6
Figure 4.2 NewPage Duluth Mill Produces Supercalendered Paper for Magazines and Advertising	7
Figure 4.3 Lake States Lumber State-of-the-Art Duluth Treating Facility	8
Figure 4.4 Franklin Delano Roosevelt Memorial a Cold Spring Granite Project	14
Figure 4.5 Laser Etching on Black Granite.....	15
Figure 4.6 Cold Spring Granite Corporate Headquarters, Sales, Manufacturing, and Quarries	16
Figure 4.7 Mayo Medical Labs U.S. Client Base	18
Figure 4.8 FedEx “Red Box” for Mayo Medical Lab Test Samples.....	18
Figure 4.9 Mayo Clinic, Rochester, Minnesota	19
Figure 4.10 AGCO Agricultural Applicator Equipment.....	21
Figure 4.11 Grand View Lodge on Gull Lake, Nisswa, Minnesota.....	26
Figure 4.12 Dock Installed by Northwood Dock and Service	27
Figure 4.13 The Scout “Throwable” Robot	43
Figure 4.14 Examples of Omnetics Connectors.....	44
Figure 4.15 NPC Robotics Designed Turret Drive Systems for U.S. Army.....	45
Figure 5.1 Minnesota’s GDP Share Specialization by Transportation Mode, 1997 to 2011	54

Executive Summary

Firms within certain industries have a tendency to cluster geographically within urban areas. Doing so confers on them various advantages, such as access to pools of specialized labor, proximity to key suppliers or customers, and knowledge spillovers within industries. The nature of the process by which industry clusters emerge within urban areas has, in recent years, become a major topic of study in fields such as urban economics and economic development policy. The latter has focused on developing frameworks for understanding the formation of “competitive” industry clusters, that is, clusters of firms in industries which have particular competitive advantages and which export a large share of their output. These clusters are believed to form the foundation of most urban economies.

In one of the more popular texts in the economic development literature, Michael Porter’s *The Competitive Advantage of Nations*, Porter offered a framework for explaining the emergence of competitive industries in particular locations. The framework centers on four sets of factors (factor conditions, demand conditions, related and supporting industries, and firm strategy, structure and rivalry) which can create advantages for clusters of firms in a given industry. The framework makes reference to infrastructure as one of several influential factor conditions, but offers little detail as to how infrastructure, and particularly transportation infrastructure, might affect the formation and growth of competitive clusters. This study fills some of these gaps in knowledge by probing the role of transportation networks and services in the operation of firms within competitive industry clusters in Minnesota.

The study focuses on competitive industry clusters in Minnesota’s metropolitan and some of its micropolitan regions. Competitive industry clusters are identified in each region using employment data to calculate location quotients, a measure of local industry concentration that examines local employment totals relative to those for the same industry at a higher level of aggregation (in this case, the national level). Industries with higher location quotients are assumed to be more competitive, representing “traded” clusters that sell a larger share of their output outside the immediate region. 12 industry clusters are identified in regions around the state, reflecting a desire for greater geographic coverage rather than focusing in depth on a smaller number of clusters. Within each cluster, one or more firms were selected and invited to participate in face-to-face interviews, where they were asked a number of questions about their company’s history and operations, its customer base and suppliers, its use of transportation services, its plans for expansion in the near future and whether transportation networks will be an important consideration in those decisions. In all, 28 firms were interviewed within the 12 industry clusters.

Among the industry clusters examined, it was found that they tended to fall along a spectrum of geographical coverage within the state, ranging from statewide clusters that could be classified as competitive in the majority of the regions examined (for example, processed food is found to be competitive throughout most of Minnesota’s metropolitan and micropolitan regions due to its proximity to agricultural production, which is a large part of the rural economy throughout Minnesota) down to highly specialized single-region clusters. The broadness or locality in the scope of a competitive industry cluster accordingly has implications for how widely the

information collected from the interviews can be applied in informing state transportation policy. Some issues may be highly location-specific, such as issues related to air access and navigation systems for the Local Health Services industry cluster in the Rochester metropolitan area, while others may apply to common issues within statewide clusters or represent issues that apply to several different industry clusters, such as the response to construction or weather-related delays.

One of the more important common themes to emerge from the interviews was the importance of the reliability of shipments. This issue becomes more complex in an age where many freight movements have an origin or a destination not only outside the immediate region, but outside the state and nation as well. While some sources of delay emerge at other locations within a firm's supply chain, many can be addressed and managed locally, such as recurrent delays due to construction projects, inclement weather, and traffic congestion. Many of the respondents cited the state's 511.org information system as an important source of information to identify and respond to potential delays. For many of the firms interviewed, the issue of shipment reliability underlies reorganized logistics and supply chain systems that allow for faster turnaround of product orders and just-in-time production.

Many other issues that emerged from the interviews tended to apply to certain subsets of the clusters under study. Certain industries were more heavily reliant on air transportation for the movement of customers, products, or both. For example, the Mayo Clinic in Rochester relies heavily on regional air services to deliver patients from around the country in addition to large shipments of laboratory test specimens at its test facilities. Likewise, the Medical Devices industry cluster in the Twin Cities region relies heavily on express air freight shipments to deliver its products in a timely fashion to national and international customers. In both cases, the reliability of air service as well as ground-side access is critical, as delays to either are considered costly.

Another issue cited by firms in multiple clusters is the desire for improved intermodal freight facilities. Firms in the Construction Materials (mostly granite) and Forest Products clusters, both of which require shipments of heavy, bulky materials, noted examples of shifting shipments to other modes (mostly trucking) in order to adapt to a lack of availability of freight rail facilities nearby. Some of these issues also correspond to freight rail capacity issues developing due to an increase in shipments of oil supplies from North Dakota and Montana.

Infrastructure condition is a third issue arising from several different clusters. The smoothness of pavements was cited by several firms whose products were either breakable or perishable. The former include firms in the Glass cluster who move much of their products on flatbed trucks, along with medical device firms who are highly sensitive to the integrity of their product during shipment and choose freight carriers with this criterion in mind. The latter include the Processed Food cluster, which features a number of firms who must ship and receive large amounts of livestock on a daily basis, and the laboratory testing activities in the Local Health Services cluster, whose products are both breakable and perishable, and so must be especially carefully handled and shipped.

The findings from the firm interviews suggest several possible applications for the industry cluster approach that could be of use to MnDOT in its planning and operations activities. One of

its foremost uses may be to inform statewide freight planning by giving an indication of the types of freight issues encountered by firms in competitive clusters around the state. This analysis can also be focused on a regional level, where it can be used to identify specific bottlenecks or operational issues common to firms within industries that form the economic base of a particular region. Given MnDOT's decentralized, district-based administrative structure, this may be a desirable way to set policy priorities for a given district. Likewise, industry cluster studies may help to form the basis for collaboration between public and private entities in promoting economic development. Other previous studies commissioned by MnDOT have focused on specific districts or industries and have been successful both in gathering useful information about operational issues and in improving the organization's efforts to reach out to key stakeholders. Lastly, the cluster approach may provide some guidance in setting priorities for programs explicitly aimed at promoting economic development through transportation investment. Some of these programs are either corridor-specific or site-specific, while others, such as the federal TIGER grant program, offer greater flexibility in the use of funds. Using the industry cluster approach to both highlight competitive industries and identify their needs through a process similar to the interviews used in this study can offer a potentially useful criterion for screening and prioritizing candidate projects.

Chapter 1

Introduction

Traditional policies oriented toward the use of transportation infrastructure to promote economic development have focused on infrastructure as a magnet for firm location, often with little regard for the characteristics of specific industries. This project has sought to advance the state of knowledge of the relationship between transportation and economic development by investigating how firms in specific industry clusters use transportation networks and what role those networks play in the formation and growth of industry clusters. The approach combines quantitative and qualitative techniques to geographically identify competitive industry clusters in Minnesota's metropolitan and micropolitan regions, and to further investigate the role of transportation in these industry clusters through in-depth interviews and site visits with representatives of firms in specific industry clusters. These methods can yield valuable insights into how transportation functions as an input within industry clusters, and how it can inform economic development strategies tailored to certain locations and industries.

This study helps to understand both the complexity of the Minnesota economy and the role that transportation plays in the state's economic competitiveness. The competitive clusters examined provide a snapshot of how Minnesota companies in various metropolitan and micropolitan regions of the state are handling transportation costs, managing their supply chains and meeting the expectations of their customers. In addition, the study provides some insights into how the transportation system affects workforce recruitment and accessibility for some very competitive industry clusters such as health care in Rochester, MN (the Mayo Clinic) and recreational vehicles in northwest Minnesota (Polaris, Arctic Cat).

Chapter 2

Relevant Literature on Transportation and Economic Development

One of the critical ways in which transportation infrastructure may foster economic development is through its ability to foster agglomerations, that is, clusters of firms in related industries. Especially within urban areas, transportation infrastructure may represent a shared input that can be used by large numbers of firms in their respective production process. This same infrastructure may increase access to skilled labor, thus increasing the returns to firms in a given location. While there has been a large amount of empirical research conducted on the relationship between public infrastructure (including transportation) and economic growth (1,2), much of this research has been conducted using data aggregated to large spatial units, such as counties, metropolitan areas, or even entire states, and thus can offer only limited insights into how transportation is actually used by firms in various industries. Indeed, in the field of urban economics the nature and sources of agglomeration economies, including low transportation costs, are a major focus of ongoing research [3,4,5,6,7].

The parallel concept to agglomeration in urban economics is the concept of industry clusters in the fields of economic development and public policy. There remains much to be learned about how comparative advantage across locations, along with complementary factors, translates into the formation of successful, competitive industry clusters. Textbook-length treatments of the subject, including the work of Michael Porter [8,9], have sought to frame the topic in terms of core aspects of competitiveness in private industry, industrial location, and solutions to societal problems as a source of competitiveness. Porter's work on industry clusters proposes a framework for describing the elements of competitive advantage by grouping them into four sets of factors: demand conditions, related and supporting industries, context for firm strategy and rivalry, and factor (input) conditions. While the framework makes reference to a 'common innovation infrastructure' [10], there is no explicit reference to the role of transportation infrastructure and hence little guidance as to how transportation policy might support cluster development.

The nature of the literature on industry clusters has tended toward a more qualitative approach, emphasizing a more in-depth understanding of industry linkages and the behavior of individual firms within competitive industry clusters. Thus it seems reasonable to investigate the role of transportation networks and transportation policy in supporting the growth of clusters in the same fashion. Similar qualitative approaches have also been applied to other types of industry-specific studies, such as those investigating the transportation needs of high-technology industrial development [11,12,13,14]. Focusing on specific representative firms may be necessary, as it is often difficult to find data on firm or industry-level interactions at anything other than an aggregate level (as is the case with regional input-output tables), but also because it allows for a deeper level of response to questions about firms' behavior and greater context than is available through remote survey methods.

Chapter 3

Selection of industry clusters

For this analysis, the University of Minnesota team produced a matrix showing cluster employment location quotients for the 8 metropolitan and 17 micropolitan regions located within or partially within Minnesota. The cluster matrix included 66 traded and local clusters using 2011 U.S. Cluster Mapping data developed by the Harvard Business School for the Economic Development Administration. Cluster definitions from the U.S. Cluster Mapping tool are included in Appendix D.

A location quotient measures the share of an industry cluster's employment in a region as a ratio of the share of the cluster's employment in the U.S. as a whole. This generates an indicator of industry concentration or specialization within a region. A higher location quotient significantly exceeding 1 can indicate that an industry cluster is exporting its products or services outside of the region and is referred to as a traded cluster. Local industry clusters that serve a regional market such as restaurants or retail stores tend to have location quotients close to 1. A high location quotient may also be an indicator of the competitiveness of a regional industry cluster, and a rising or declining location quotient may indicate that a regional cluster is becoming more or less competitive within the U.S. economy. However, more information is required about productivity and innovation within the cluster to confirm the competitiveness of a regional cluster.

The matrix with 25 regions and 66 clusters resulted in a total of 1,650 cells, each indicating a regional/cluster pair (Appendix A). A location quotient threshold of 1.3 was used as an indicator of whether a cluster is competitive within its region. Based on this approach, the study team identified 401 regional clusters that met this criteria. In smaller micropolitan regions, location quotients could be quite high even though the employment was low if a cluster share was significantly higher than the national cluster share. However, the 1.3 location quotient threshold seemed to be a good proxy for competitiveness and identifying clusters throughout the state for further analysis.

The technical advisory panel (TAP) made up of Minnesota Department of Transportation (MnDOT) and Minnesota Department of Employment and Economic Development (DEED) staff identified 12 regional cluster pairs for interviews and further analysis. The TAP chose to select twelve different clusters throughout the state, rather than selecting the same cluster for multiple regions or many clusters for the same region. In addition three additional clusters were studied by students as team projects for a Humphrey School course on Economic Competitiveness during the 2013 fall semester. The selected clusters and locations are shown on the map in Figure 1.1.

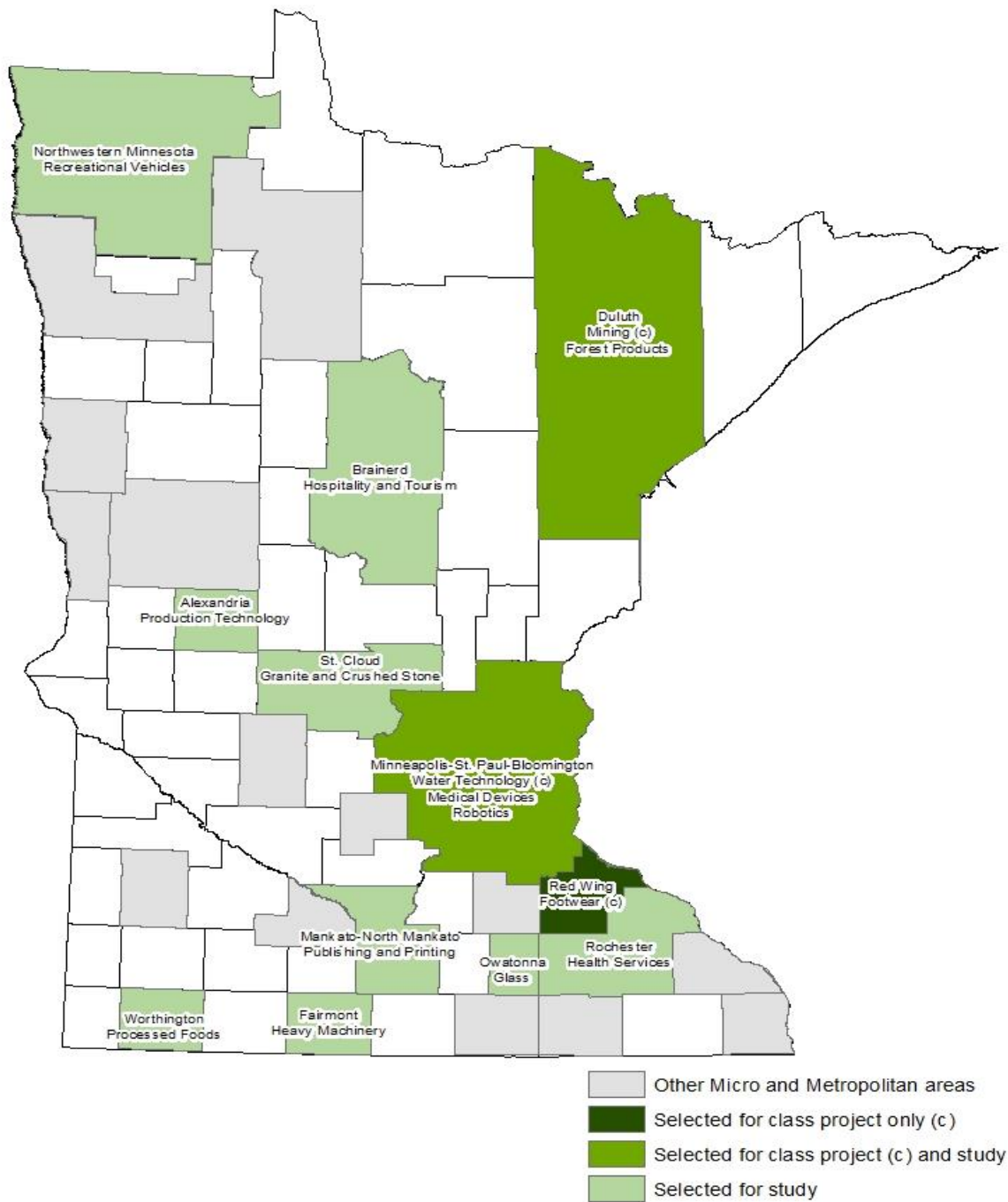


Figure 3.1 Selected Industry Clusters

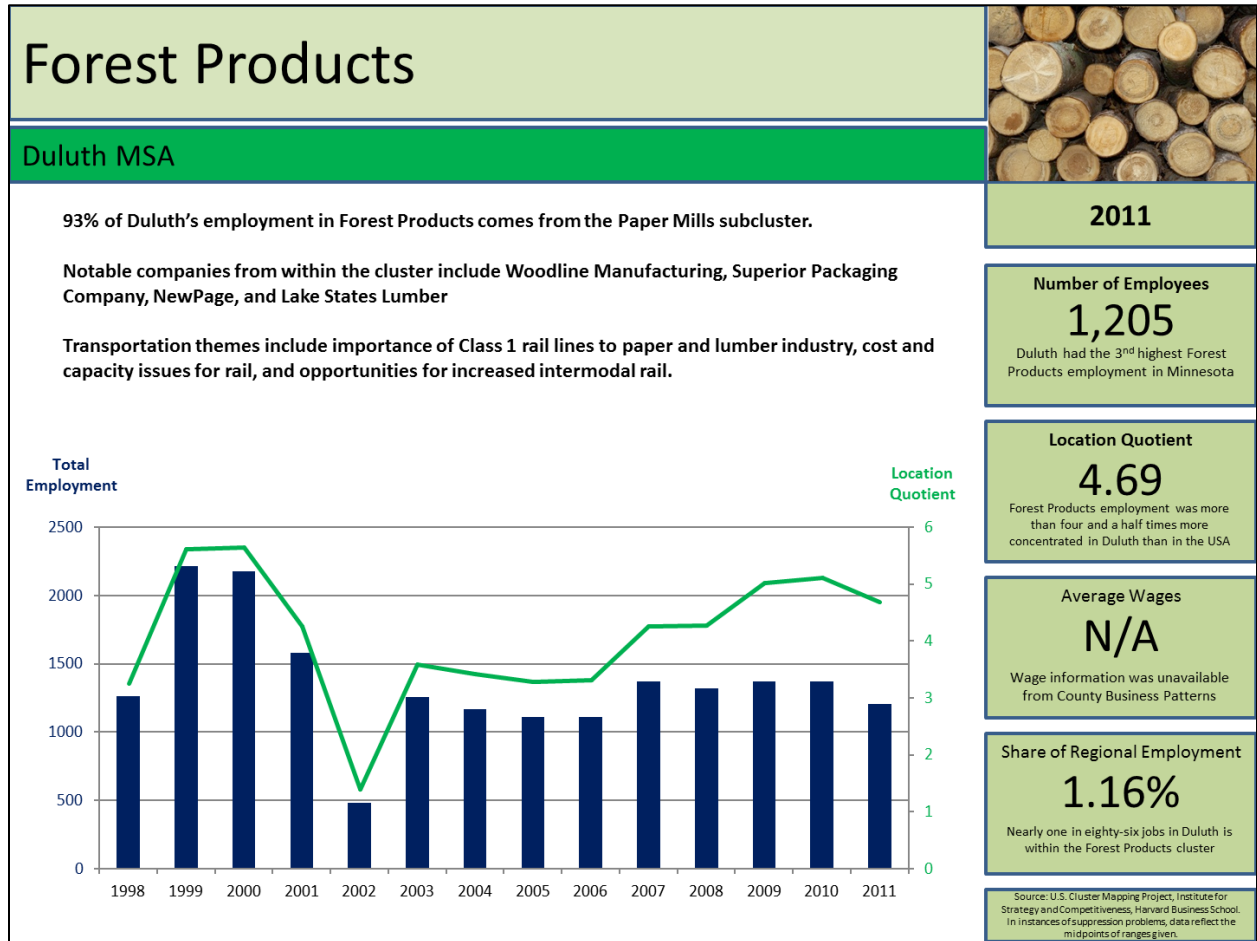
Chapter 4

Cluster Analysis

This chapter presents a summary and analysis of findings from the company interviews for each of the twelve clusters. Each cluster summary includes

- Cluster dashboard
- Cluster overview - key companies, history
- Customers – where are they, transportation modes
- Suppliers – where are they, transportation modes
- Technology impacts
- Transportation issues
- Competitiveness issues

4.1 Forest Products Cluster - Duluth



Forest products are an important industry for Duluth and northeastern Minnesota. The concentration of employment in the forest products cluster for the Duluth MSA is nearly five times the national average, with a location quotient of 4.69 in 2011. The region's forest products industry employs 1,205 people with 93 percent of those jobs in the paper mills subcluster. These include companies such as Woodline Manufacturing, Superior Packaging Company, and NewPage, and Lake States Lumber.

NewPage, a paper manufacturing corporation headquartered in Miamisburg, Ohio, began operations in Duluth in 1987. Its single paper machine produces several grades of supercalendered paper used for catalogs, magazines, advertising inserts, flyers, and other commercial printing. Supercalendered paper is highly filled, uncoated groundwood paper—calendered for

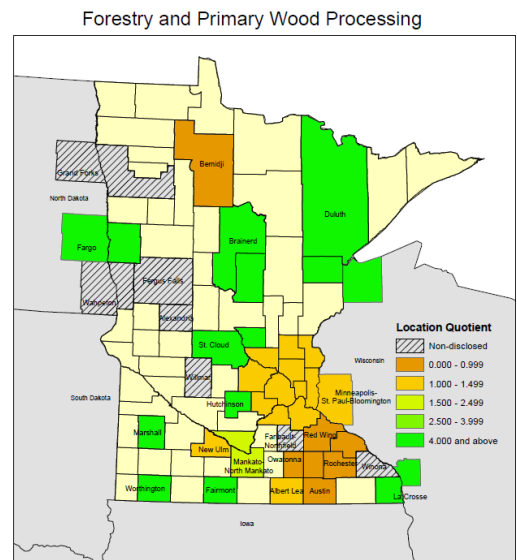


Figure 4.1 Forestry and Primary Wood Processing

smoothness and glossiness, for web offset and gravure printing.

The Duluth mill is the top producer of supercalendered paper in the United States with annual capacity of approximately 270,000 tons. The Duluth recycled pulp mill started as a greenfield operation in 1993, producing high-quality recycled pulp. The facility recycles nearly one million pounds of recovered paper each day.



Figure 4.2 NewPage Duluth Mill Produces Supercalendered Paper for Magazines and Advertising

Lake State Lumber is a wholesale lumber distributor. The company, which is headquartered in Sparta, Wisconsin, provides treated products in Duluth, wood paneling and pre-finish shop in Aiken, and some other specialty products for paneling, siding, planks, and timber management programs.

Customers

The markets for NewPage's supercalendered paper are mostly in the U.S., with some Canadian customers. Their customers are publishers and commercial printers. NewPage, a Six Sigma company, prides itself on meeting emergency orders that they can complete in one or two days. Much of their competition is in Europe that can't make those deadlines.

Lake State Lumber's customers are in the Midwest and Ontario. The company would like to branch out to other markets with its custom products. The lumber business is affected by the housing market and weather. There's a certain amount of speculation in the lumber business, trying to buy for the right amount of construction, which is dependent on the season. Lake State uses warehouses to buffer for speculation.

Suppliers

New Page's suppliers are located in British Columbia, Brazil, Iowa, Washington, St. Paul, Tennessee, Missouri, Arkansas, and Wisconsin. Most supplies are delivered by truck with some by rail and some by water.

Lake State Lumber's suppliers are in British Columbia, fir mills in the west, redwood in California, Southern yellow pine in Arkansas and Mississippi. Most of the wood products move by rail, with truck accounting for about 30 percent.

Transportation Issues

The NewPage plant in Duluth has direct access to the BNSF Class 1 rail line as well as the Lake Superior Warehouse that has access to 4 Class I rail lines. The company has always been a strong rail shipper but due to current challenges including increased transit times, equipment shortages, decrease in quality equipment to load and rail delays, their percent of rail shipments are down considerably from previous years. The BNSF has also compounded the challenges by taking on additional volume, especially in their northern corridor, that has grown faster than anticipated. All indications are that the type of boxcars that the company needs for shipping large paper rolls – watertight 50-foot plug door cars, are no longer being replenished. New railcar types, such as 60' foot boxcars with 16' doors, creates demand for the AAR (American Association of Railroads) to approve new loading patterns which can be a lengthy process.

NewPage ships about 750 tons per day. The company was set up as a rail facility – they only have six truck docks but have eight rail car spots. Rail lead times have doubled to certain lanes in the last 25 years. NewPage is seeking intermodal connections that can provide some cost and time savings over purely truck. NewPage ships some products via intermodal, which tends to be more expensive than shipping in 50-foot plug door rail cars but less expensive than shipping by truck to certain lanes. NewPage would be interested in having an intermodal ramp in the Duluth area.

Lake States Lumber ships 70 percent of its products by rail. Duluth's Port has four Class 1 railroads (Canadian Pacific, CN, BNSF, UP), which is unique to the Midwest. This means Lake States can buy wood from anywhere in the world because they aren't restricted to one rail line.



Source: Lake States Lumber brochure

Figure 4.3 Lake States Lumber State-of-the-Art Duluth Treating Facility

Supply chain management has led Lake States Lumber to increase the size of its truck fleet. Lake States uses its own truck fleet first, then relies on common carriers, which account for 90 percent of its shipments.

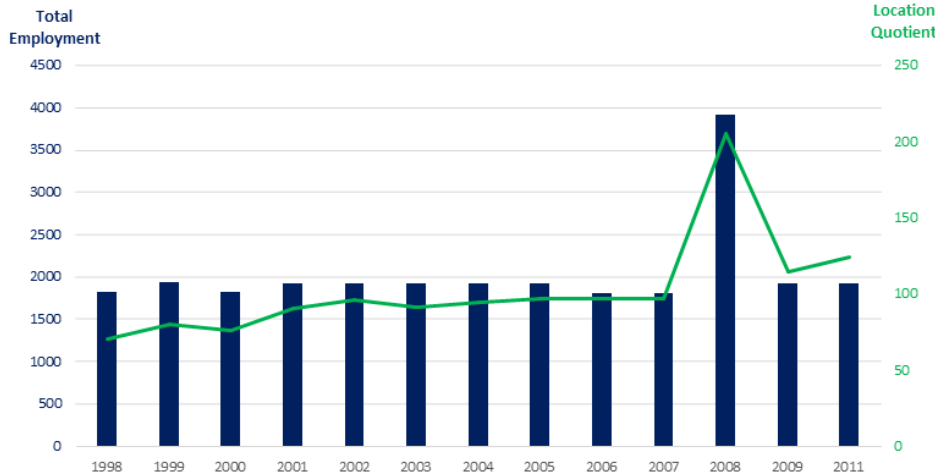
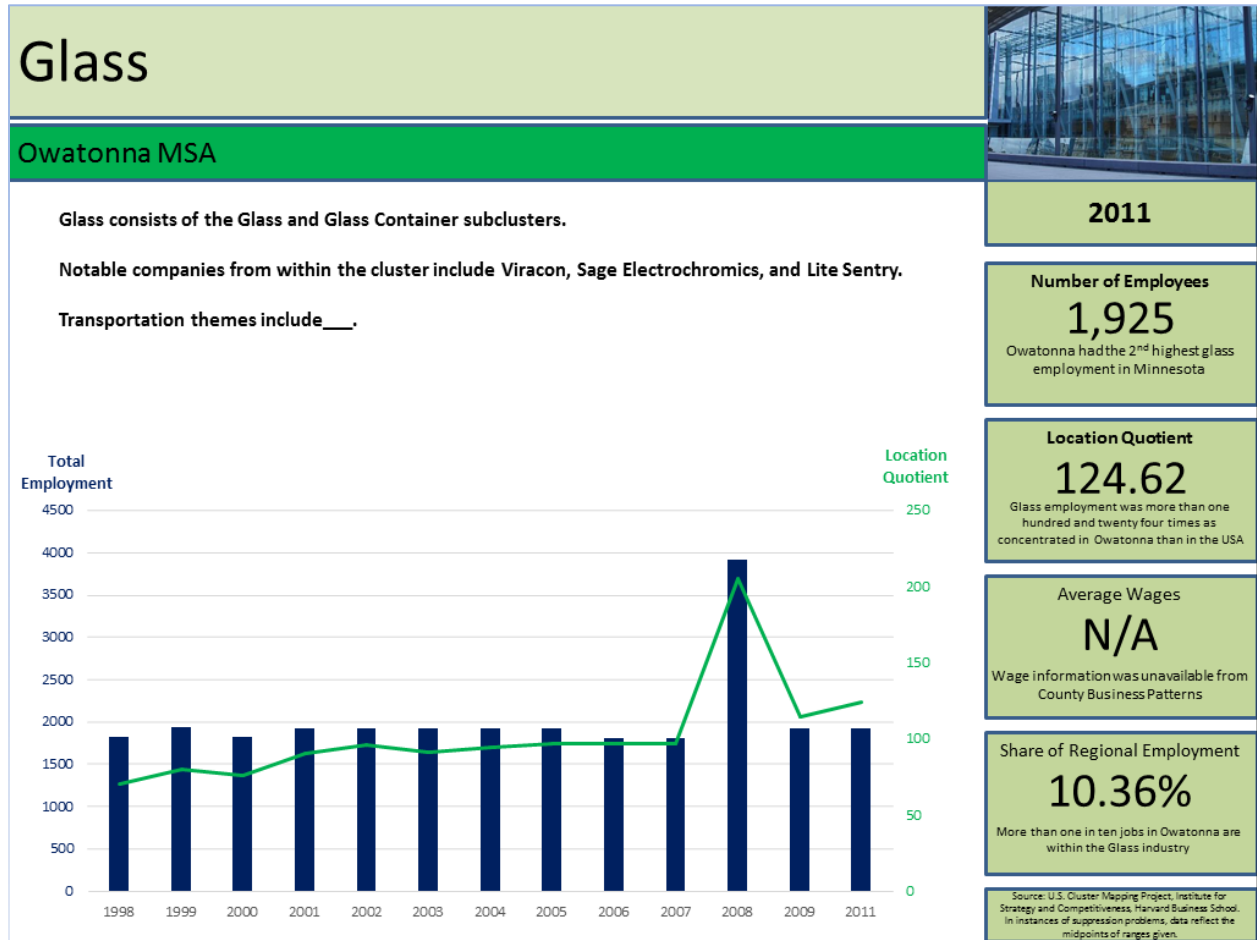
Transportation is a key aspect of Lake States' business. If all companies are trying to go to certain markets at the same time, having lower transportation costs across the supply chain can make the difference. The company follows railroad trends – railcar shortage impacts how and when product will show up. The company has key rail relationships, and it makes an effort to ensure its voice is heard when the rail lines have problems.

Competitiveness Issues

Rail transportation availability and costs are critical to the competitiveness of the forest products industry in the Duluth region. The availability of four Class 1 rail lines in Duluth is a competitive advantage for this cluster.

From a systems perspective, new technology has been the biggest driver for the paper industry. These technologies include web-based data, smart phones for constant communication, cameras for documentation of shipments, electronic document storage, portals for end users' orders, shipment tracking, and tendering programs for shipment assignment. However, new technology has also decreased paper use.

4.2 Glass Cluster - Owatonna-Faribault-Northfield



Owatonna, Minnesota, a city of just over 25,000 located in Steele County, lies at the center of a competitive industry cluster focused on the glass industry. This cluster consists of subclusters focusing on the glass and glass container industries. Though centered in Steele County, which is coextensive with the Owatonna Micropolitan Statistical Area (μ SA), the industry cluster geographically spills over into neighboring Rice County to the north, with several firms located in the larger cities of the Faribault-Northfield Micropolitan Area.

While glass manufacturing activities are no longer concentrated in the region, several firms have emerged to provide a variety of high-value glass treatments that are marketed primarily to commercial clients around the U.S. and overseas. These operations account for a significant share of regional employment in the U.S., with the industry directly employing over 1,900 workers, or over 10 percent of the region’s total employees. The largest single company in the glass cluster is Viracon, an Owatonna-based architectural glass fabricator, which is the city’s second-largest employer with 1,446 local employees. The high level of concentration of the glass industry in the region is reflected in the industry’s exceptionally high location quotient of nearly 125 (relative to the national industry) for the Owatonna μ SA. Other companies within this industry who were interviewed include Sage Electrochromics, a developer of specialized, electrochromic window glass that employs 160 workers in its Faribault plant, and Lite Sentry, a

Dundas-based company that develops and manufactures inspection tools for glass and other surfaces such as solar panels and sheet plastic in order to reduce distortion and defects.

Customers

Viracon's customer base is comprised mostly of commercial clients, though the company also provides its products to public and non-profit organizations, such as schools and hospitals. Viracon frequently partners with architects and skilled glaziers on specific development projects. Its customers are spread out across the U.S., as well as parts of Canada, Mexico, and several Pacific Rim countries. For domestic shipments, the vast majority of its products move by highway on flatbed trailers. Until recently, truck shipments were handled in-house. It is only within the past year that this service has been outsourced to a commercial freight transportation provider. Shipments to international customers generally move by water, with a small percentage by international air freight in case of time-sensitive orders.

Sage Electrochromics also maintains a worldwide customer base, with many of its customers requesting the retrofitting of existing buildings with electrochromic glass treatments. The company is seeing significant demand from Europe, though it has not been able to fully meet this demand due to prohibitively high costs in this market. Shipments to domestic customers generally move by truck, while international shipments go by ocean and air, with ocean being the preferred mode. Ocean freight shipments typically take about a month to arrive and encounter more delays due to international customs enforcement, while air freight shipments can arrive in a fraction of the time – often around three days – but are usually avoided due to much higher costs.

Suppliers

Viracon's major suppliers are located throughout the U.S. It receives 4,500 to 5,000 truckloads of glass per year from the Carolinas, California, Pennsylvania and a several other states. These glass shipments are moved exclusively by flatbed truck to Owatonna, since Viracon's current facility lacks the storage space to receive rail shipments. In contrast, most of Sage Electrochromics's suppliers are local. It buys raw glass locally and applies the coatings at its facility in Faribault. Sage also relies exclusively on trucks to move this product to its plant.

Transportation Issues

Timely delivery of its finished product is a major issue for Viracon. Since many of its customers are developers of commercial properties and general contractors, it is critical that the glass panels arrive at the scheduled time. During construction projects, installation of glass is necessary before interior work can begin. Thus, delays in the delivery of its product can result in delays for construction projects as a whole and higher construction costs.

Also, transportation of glass on flatbed trucks requires special equipment. Since there are a limited number of carriers that have such equipment, it is important to ensure that at least one is available to make deliveries at a given time.

Viracon has also encountered some issues with getting employees to and from work. It draws on an area within a roughly 50-mile radius, including Rochester and parts of the southern Twin Cities metropolitan region, for its labor pool. Traffic congestion and safety issues on U.S. Highway 14, the main east-west highway through Owatonna, have made commuting more

difficult. Viracon hires a large number of low-skilled workers at its plant, and more recently it has turned to hiring a larger number of first-time workers and recent immigrants in order to meet its staffing needs. Since these tend to be lower-wage positions, it is difficult to find workers with ideal skill sets who are also willing to commute longer distances. The company has tried to encourage carpooling at its facility, but the options are limited. Since Owatonna is a smaller city, there are also few fixed-route public transit services available.

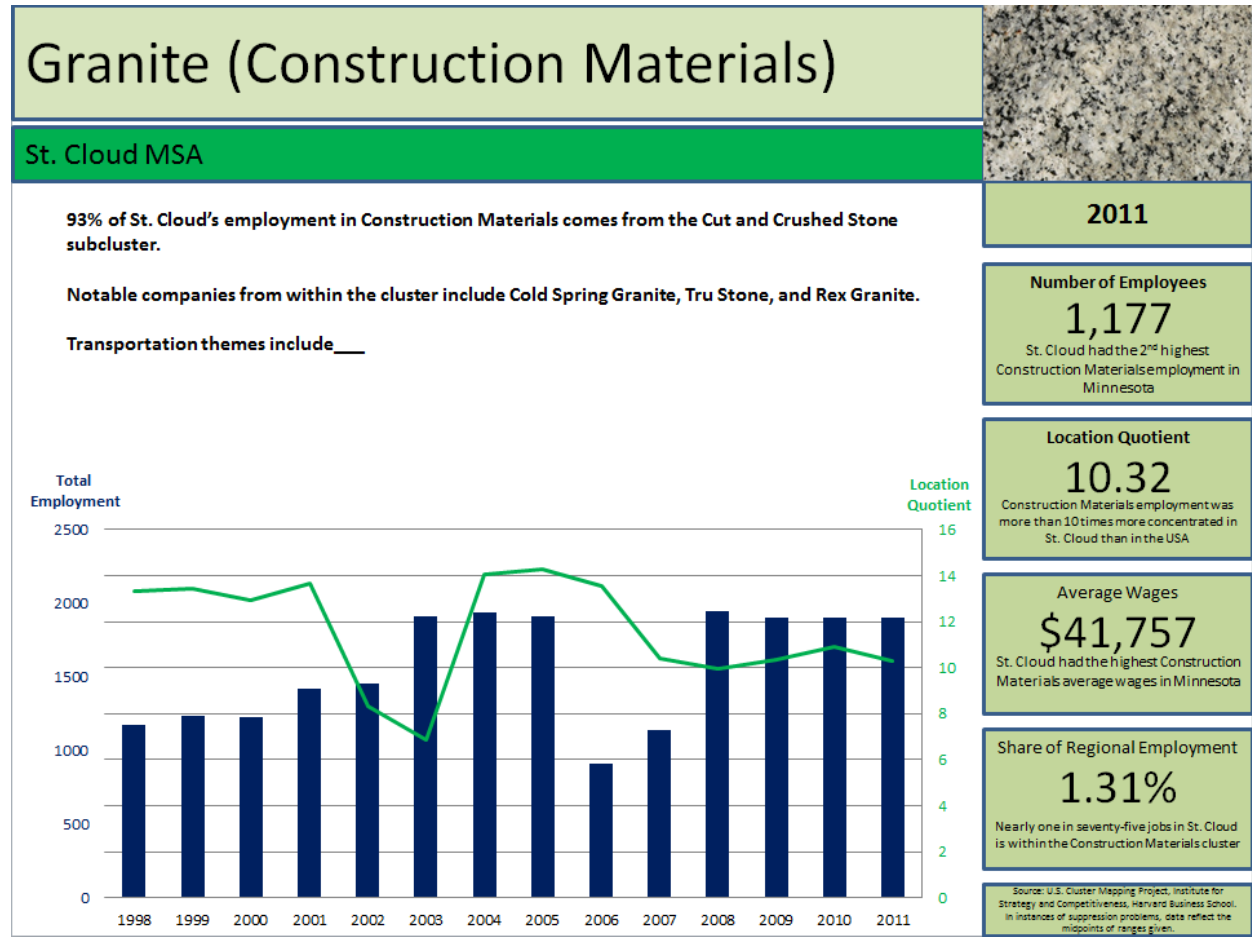
Lite Sentry identified weather-related delays, especially during winter, as a major transportation issue. For certain time-sensitive deliveries, big delays can be extremely costly. Where possible, these types of situations are dealt with by switching modes from truck to air freight. As a smaller company, Life Sentry's employee transportation issues are limited. Most employees are drawn from the local area (Northfield, Faribault) and have relatively short commutes.

Competitiveness Issues

Two of the three companies interviewed (Viracon and Sage) cited locational advantages relative to transportation networks as a factor in their overall competitiveness. Both cited good freeway access as a strength of their current locations, along with proximity to the Minneapolis-St. Paul International Airport. On the other hand Lite Sentry, which is located several miles off of I-35 in Dundas, suggested that its current location is not necessarily a strength, at least in terms of meeting its transportation needs. While there are a large number of trucks coming into the region, there are not as many moving outbound, and thus Life Sentry is limited to the use of less-than-truckload (LTL) carriers.

Companies in the glass industry have also been able to leverage technological improvements to improve their competitiveness. For example, Viracon is acquiring new equipment to automate the glass coating process, thus reducing its vulnerability to high turnover rates among some of its lower-skilled positions. The company is also making greater use of teleconferencing to reduce the need for travel to plants in other parts of the U.S., as well as Brazil. Lite Sentry also reported that it is making greater use of communications technologies to both stay in touch in with customers and to conduct certain tasks remotely. The company is able to link up with customers' computer systems remotely to conduct training, do design work, or run diagnostics. These new capabilities allow Life Sentry to overcome its relative geographic isolation and remain competitive in its industry.

4.3 Granite Cluster – St. Cloud



St. Cloud, Minnesota, is known as the “Granite City.” The growth of Minnesota’s granite industry was sparked in 1866 with the arrival of the Northern Pacific Railroad. Previous efforts to open granite quarries had failed because it was economically impossible to transport granite without the railroad. Mathias Breen and his colleagues opened the first successful quarry in 1868 in east St. Cloud. By 1913, the St. Cloud granite industry exceeded 25 firms with more than 2,400 employees, the largest industry in St. Cloud.¹ Granite remains a major industry cluster for the St. Cloud region and relies on a multimodal transportation system to serve regional and nationwide customers and to move granite to St. Cloud from U.S. and international quarries.

Granite, which is used in buildings and public monuments as well as headstones, is part of the construction materials cluster. The cut and crushed stone subcluster represents 93 percent of the employment in St. Cloud’s construction materials cluster. St. Cloud’s employment location quotient for construction materials was 10.32 in 2011, indicating that St. Cloud has an employment concentration in this cluster that is 10 times the national share for this cluster. St. Cloud employed 1,177 people with an average wage of \$41,757, representing 1.31 percent of the

¹ *A Century of Enduring Beauty: Cold Spring Granite Company*. Published by Cold Spring Granite Company, Cold Spring, Minnesota, 2002, p. 5.

St. Cloud region's employment. St. Cloud region companies in this cluster include Cold Spring Granite, Tru Stone, Rex Granite and Sunburst Memorials.

Customers

Cold Spring Granite, employs 600 people in Cold Spring, Minnesota, and 850 people company-wide. Cold Spring markets its products nationally, with most of its customers located along the east coast. In addition to granite fabrication, Cold Spring Granite also has a bronze foundry to produce memorial plaques. For large buildings and mausoleums, customers may request Cold Spring Granite to assemble or fabricate. They will then install with their own setting crews or subcontractors.

Cold Spring Granite has done many memorials including the World Trade Center building in New York City and the Martin Luther King Jr. Memorial, the Franklin Delano Roosevelt Memorial, and the Korean War Memorial in Washington, DC. Additionally, Cold Spring Granite will provide the limestone for the new Vikings stadium in downtown Minneapolis.

Cold Spring Granite has over 200 colors of slabs and stock monuments they keep in stock based on customer demand. A competitive advantage for Cold Spring is that the company owns quarries throughout the U.S, giving them additional colors beyond the pink-colored St. Cloud granite that other granite companies do not have.

Sunburst Memorials, employs 29 people at their St. Cloud location and 54 people company-wide. Sunburst sells granite products regionally in the Midwest. About 95 percent of Sunburst's business is monumental sales (headstones). Sunburst's other sales are granite for kitchen and bath and custom limestone sales.

Granite products are moved primarily by flat-bed truck. Cold Spring Granite selects carriers based on their reliability in delivering granite without chips or cracks. If a carrier exceeds one percent in damage claims, they are dropped.

Suppliers

Cold Spring Granite's major suppliers are located all over the world. A lot of the granite used by Cold Spring comes by truck from Millbank, South Dakota; Babbitt, Minnesota; and Rockville, Minnesota. Additionally, Cold Spring uses granite from its other U.S. quarries and



Figure 4.4 Franklin Delano Roosevelt Memorial a Cold Spring Granite Project

imports granite from India, China, and Brazil. Sunburst Memorials suppliers of stone are in Minnesota, Georgia, Vermont, Indiana, Kansas, Wisconsin, Canada, and India.

Most granite headstones are engraved using an etching and sandblasting process. However, a more recent process involves laser etching that allows much finer detail and transferring photos to the monuments. Solid color black stone is preferred for this laser etching, since the detail shows up much better than on speckled or veined granite.



Source: Sunburst Memorials, St. Cloud, MN. Photo by Lee Munnich

Figure 4.5 Laser Etching on Black Granite

The black granite, which is only available in China and India, is shipped in twenty-foot containers by boat to the port in Tacoma, Washington; by rail to Minneapolis; and then by flat-bed truck to the St. Cloud area. Cold Spring Granite receives an average of 500 of these containers per year and also supplies other St. Cloud companies with black granite.

Transportation issues

Fuel costs and reliable shipping are critical for Cold Spring Granite. Flatbed trucks provide more security in terms of product safety. If products shipped are not full truckloads, they may be moved multiple times before final delivery with possible damage to the granite. I-94 is the primary route for moving granite to Cold Spring for production and finished product to customers. Cold Spring Granite averages one million pounds of granite shipped per week during the busy months. That's about 26 truckloads per week, plus additional customer pickups.

Cold Spring is concerned with changing DOT truck shipping regulations for hours of service, dimensions, and weights. Moving product across state lines is difficult because the regulations are different in each state. Some states have limitations on truck traffic for hours, permitted days of travel, etc. Cold Spring Granite tries to keep the trucks at 45 to 48 thousand pounds.

Cold Spring Granite's other locations in the U.S. are situated near quarries. If the quarry facility can process the order they do. If not, they use rail to get materials from Raymond, California, and truck from all other facilities to the Cold Spring facility for processing.

Pre-9-11, Sunburst Memorial's shipments of black granite from India took around 70 days. Post 9-11, shipments have been 80 to 85 days. The government has slowed product delivery with more scrutiny. The granite shipments are now spending 30 days on the ship in transit. If a container is selected for inspection, it delays product on average one week, but Sunburst has experienced up to six weeks delay in international shipments. With the oil boom in North Dakota, rail bottlenecks in Williston, have also delayed their shipments a minimum of two days.

These delays can be critical to Sunburst in meeting customer expectations for headstones by Memorial Day. Memorial Day is an important day for headstones to be installed for many customers. Sunburst offers a money-back guarantee if the headstone isn't satisfactorily installed on time.

Competitiveness issues

In 2007 Cold Spring Granite consolidated its headquarters and operations into one campus in their current location in Cold Spring along Minnesota Highway 23. The Cold Spring location has little congestion, which makes it easy to move trucks, plus there is easy access to I-94. Before they consolidated operations, there were duplicated trips between the

offices and the processing plants. The move came with improvements to the highway to accommodate the new truck traffic. Cold Spring Granite has automated many of its processes in recent years reducing the number of employees required in production.

Transportation costs can be a big challenge for Cold Spring Granite. Lack of proximity to their major customers means costs are passed through to the customers. Sometimes transportation costs can make them not competitive on bids. Cold Spring Granite is doing some expansion in North Dakota to take advantage of the economic boom there. The company will be doing more slab sales and landscaping in the state. In this case the proximity of Cold Spring to North Dakota is a transportation and logistics advantage.

Cold Spring Granite Corporate Headquarters, Sales, Manufacturing, and Quarries



Source: *A Century of Enduring Beauty: Cold Spring Granite Company*. Cold Spring Granite Company, Cold Spring, MN. 2002. p. 96. Used with permission of Cold Spring Granite

Figure 4.6 Cold Spring Granite Corporate Headquarters, Sales, Manufacturing, and Quarries

and the Rochester region in general, are thus more reliant on effective, high-quality intercity transportation than most of their peers.

Customers

Mayo Clinic treats approximately 500,000 unique patients per year, with over 1.5 million visits. These patients come from all 50 states and 150 different countries. Mayo estimates that around half of these visitors come from within a 150 to 200 mile radius of Rochester. Many of these patients drive due to the shorter distance, but some also arrive by bus from the Twin Cities and other parts of Minnesota and neighboring states. There are also customers, including some from North Dakota, who take Amtrak’s passenger rail service to Winona, the nearest station, then board a shuttle bus to Rochester to complete their journey. Most longer-distance visitors arrive by air, either through commercial airline service or by private corporate jet. Rochester’s airport serves a small number (around 10) of commercial flights per day from larger hubs in Chicago and the Twin Cities through Delta Airlines and regional carrier American Eagle Airlines, a subsidiary of American Airlines. Direct service to Atlanta and Detroit have recently been added.

Suppliers

Mayo Clinic’s activities among its different operating divisions require a large amount of supplies to be brought into the region from locations around the country. For example, Mayo Medical Laboratories (MML) is one of the largest air cargo customers at Rochester International Airport. MML receives an average of 30,000 test samples per day for diagnostic and therapeutic evaluations. These samples arrive from locations all over the U.S. (see map at right), as well as parts of Central and South America, Europe, the Middle East, Asia and Australia. MML counts over 6,600 clients worldwide, with approximately 5,000 of them in the U.S. alone.

The test samples arrive by multiple modes, usually a combination of air service and couriers to handle local pickup and delivery. In addition to routing many of these shipments through the Rochester airport, MML also uses two airports in the Twin Cities (MSP International and Anoka County Airport), with these shipments transferred to ground modes to complete their trip to Rochester. This service provides a contingency option when weather conditions preclude direct air service to Rochester International

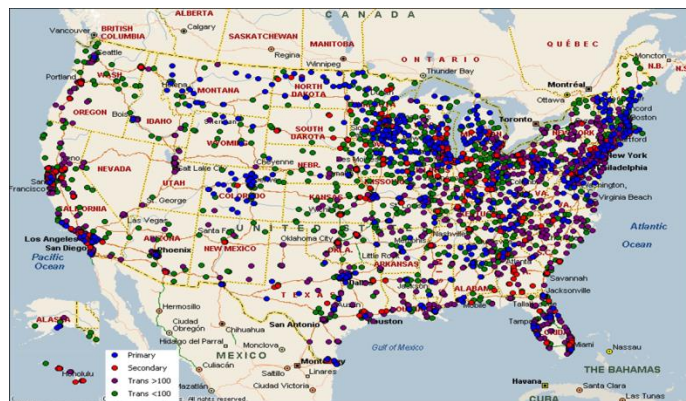


Figure 4.7 Mayo Medical Labs U.S. Client Base

Airport. MML uses several airlines to handle its shipments, including Delta, United, American, and Federal Express, along with truck freight transport through FedEx and ICS Transportation.

Transportation Issues

Due to the large number of non-local visitors, the Clinic relies on high-quality commercial air service



Figure 4.8 FedEx “Red Box” for Mayo Medical Lab Test Samples

to bring passengers to Rochester. The level of air service is not the only issue, however. Perhaps more important is the reliability of service from other major markets. Connecting flights from the east, many of which pass through Chicago, can encounter delays due to high volumes of traffic at airports like O'Hare International or even due to severe weather. This can cause connecting flights to be missed or delayed for some of Mayo's visitors. Delays in travel for visitors may jeopardize previously scheduled appointment times, and rescheduling these appointments can be difficult and/or costly.

Shipments to and from Mayo Medical Labs also present a number of challenges. Most importantly, the product being transported is often refrigerated and highly perishable. Many of the samples may have a shelf life of no more than a single day. Turnaround time for the test samples is critically important, since most customers will make a decision about whether or not use MML based on how quickly a physician can get test results in order to adjust care. The perishability of the product also implies that reliability and on-time performance are critical to getting the samples to the lab quickly. Lab samples are scheduled to arrive daily by 7:00 A.M. in order to provide adequate time for testing during the work day. Delays can be extremely costly and MML organizes their transportation and logistics activities with their suppliers in order to avoid delays to the greatest extent possible.

Other challenges that MML faces in the transportation of its lab samples include Delta Airlines' prioritization of other types of cargo, FedEx's limited capacity for refrigerated shipments (the packing of the lab samples typically requires the use of dry ice), and the older navigation system (Category I) in place at Rochester International Airport. This latter issue affects the ability of flights to be cleared for landing at the airport during conditions of low visibility. As a consequence, some flights need to be diverted to the Twin Cities and have their cargo transferred to ground modes in order to reach Rochester. This process can potentially delay shipments by several hours or more.

Weather conditions affect not only freight shipments to Rochester, but also the transport of patients in situations requiring emergency medical services. Access is critical to hospitals, since distance to the nearest trauma center can affect patient mortality rates during emergency medical events. Weather conditions at nearby air facilities affect the ability of dispatchers to assign patients to faster modes of transport (e.g. helicopter, air transport), since patient safety is of paramount concern. Adoption of instrument flight rules (IFR) could allow more flights to operate under conditions of fog, rain, or snow, or other low visibility conditions; however, such operations require better information feedback on conditions at airport facilities, along with better instrumentation. Additionally, the Federal Aviation Administration (FAA) needs to provide certification for IFR.

Competitiveness Issues

Mayo Clinic is one of only a handful of medical centers nationally that provides a combination of tertiary health care services, medical research, and education. As such, they are in intense competition to provide these services. Their main competitors in the U.S.

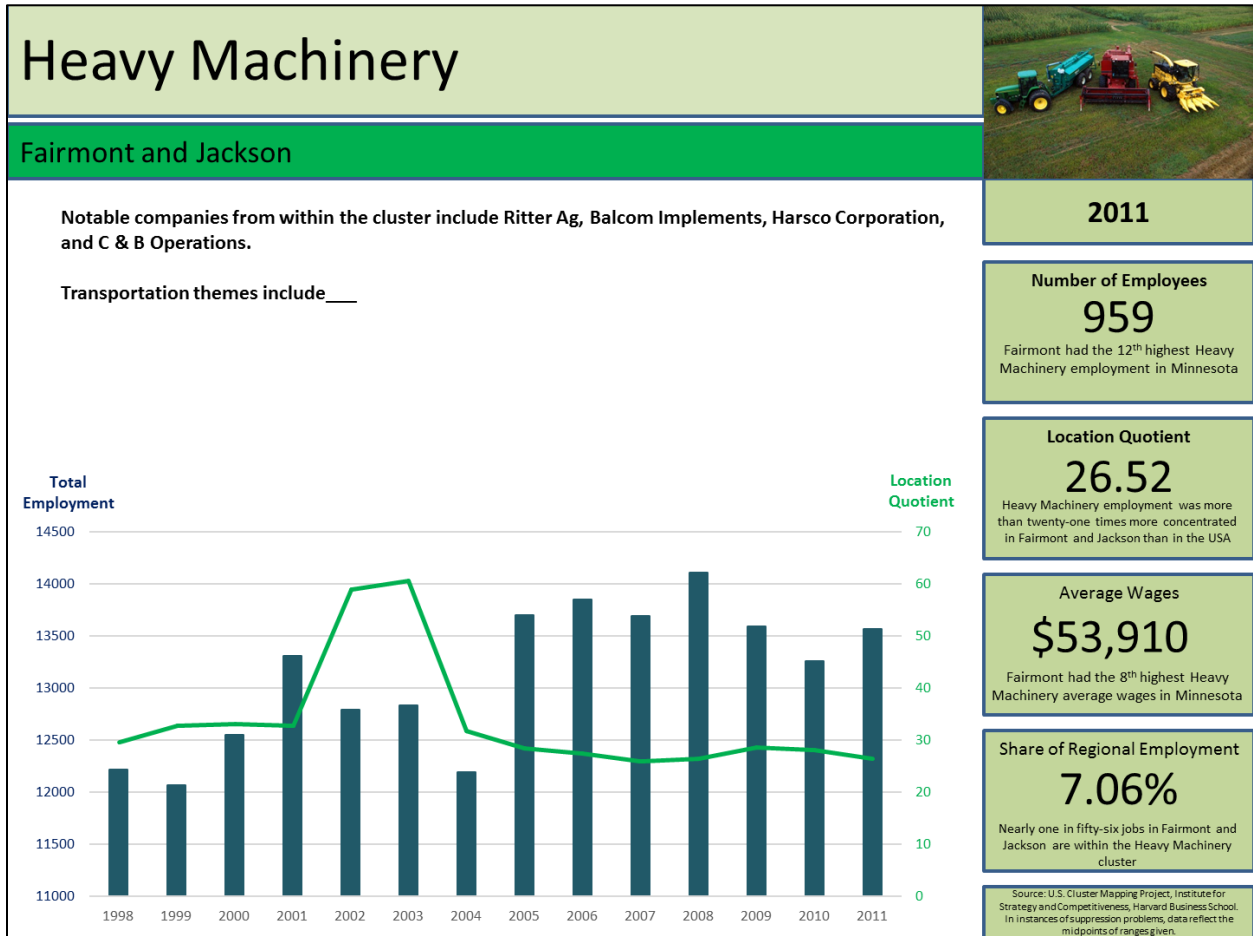


Figure 4.9 Mayo Clinic, Rochester, Minnesota

include Cleveland Clinic, Johns Hopkins in Baltimore, and M.D. Anderson Cancer Center in Houston. Since each of these competitors is located in a large metropolitan area, Mayo Clinic is at an inherent disadvantage in terms of location. Being located in a smaller metropolitan area means that prospective visitors will have less direct commercial air service, thus Mayo relies heavily on high-quality intercity passenger and freight transportation to remain competitive and attractive to visitors.

In addition to transportation issues, Mayo is also at a disadvantage in terms of visibility and attractiveness as a destination for visitors. Many of its patients and their friends or family members may be visiting Rochester for several days or longer. Given Rochester's smaller size, it has fewer cultural and recreational opportunities for visitors relative to its peers in larger urban areas. Overcoming this limitation and planning for Mayo's anticipated future expansion in Rochester are the impetus for the Destination Medical Center (DMC) project, which is a public-private partnership between the Clinic and state and local units of government. The project is designed with several key development areas in mind, including Transportation, Arts and Culture/Civic/Entertainment, Sports, Recreation and Nature, Livable City/Retail/Dining, and Hospitality/Convention. It is hoped that enhancements to each of these aspects of the region's identity will place it on par with its peers in larger urban areas.

4.5 Heavy Machinery Cluster - Fairmont and Jackson Counties



Jackson and Fairmont counties in southwest Minnesota have a significant concentration of employment in the heavy machinery cluster, over 26 times the national average.

AGCO is an American agricultural equipment manufacturer based in Duluth, Georgia. As a leading global manufacturer of agricultural equipment, AGCO offers a full line of tractors, combines, hay tools, sprayers, forage and tillage equipment, which are distributed through more than 3,100 independent dealers and distributors in more than 140 countries worldwide.² AGCO's plant in Jackson, Minnesota, near I-90 assembles farm equipment--tractors, sprayers and spreaders.

AGCO acquired the former Ag-Chem Equipment plant in Jackson in 2001 and expanded its applicator business. AGCO currently employs 1,350 to 1,400 employees in Jackson, a substantial increase over its 900 employees in 2011. Other AGCO manufacturing locations in the U.S. include Hesston, KS, Beloit, KS,



Photo by Lee Munnich

Figure 4.10 AGCO Agricultural Applicator Equipment

² Wikipedia <http://en.wikipedia.org/wiki/AGCO#History>

Independence, MO, and Batavia, IL. Headquarters are in Duluth, GA. AGCO also has several other facilities in Europe, South America and Asia.

Hen-Way Manufacturing in Fairmont, Minnesota, produces a variety of steel products, including feeders and other equipment for hogs and livestock. Other products include steel trim and corner guards for restaurants. 22 people with skills in welding, assembly, and general labor work at the Fairmont facility.

Easy Automation has a small shop in Welcome, Minnesota, near Fairmont that builds equipment for feed mills – augers, microsystems (hoppers where you input small ingredients and then they drop into a main auger that mixes ingredients into a feed, with multiple bins and multiple speeds). Easy Automation builds all of that equipment in custom orders, depending on what the customer wants. Another part of the company writes programs for electrical control programs that run the equipment that they make. This keeps track of inclusion rates and other vitals in the feed process. The company's software workers also write programs to keep track of ingredients and warehousing so customers know when to reorder, and can track the intake of their animals. There is also software that goes specifically to hog producers so they can keep track of their hogs, their food, and their performance.

Customers

Access to customers is probably the most important reason for AGCO locating in Jackson. The facility serves a large number of customers in the Upper Midwest. However, AGCO's customers are located all over the U.S., and some are also located overseas. Shipments are by truck and water transport, with some rail.

About 25 percent of Hen-Way's customers are in the Fairmont area, about 50 percent in other parts of southern Minnesota, about 20 percent in other parts of the Midwest, and five percent or less overseas or other parts of the U.S. Trucks are used for most shipments, estimated at around 90 percent. Many shipments are 400-pound pallets loaded onto trucks. Water and air account for about five percent each. Water is used for international shipments, air for high-priority/time-sensitive orders.

New Automation distributes its products all over the United States and Canada. In particular, New Automation's products are popular in Alberta. The company does some other international distribution as well, but not a lot. New Automation has a Dooley Truck and a fifth-wheel trailer that are used to deliver the systems right to the customer. Service technicians install the equipment. Overall, the company doesn't use a whole lot of transportation.

Suppliers

AGCO's suppliers are distributed worldwide, but 50-60% of the product coming into the facility originates in Europe. Truck is the primary mode used by AGCO for domestic shipments. Water transport is required for overseas shipments. Use of air transport is rare, occasionally for specialized parts.

Nearby equipment manufacturers such as HitchDoc, a contract manufacturing company that can provide customized/specialized equipment, provide a variety of services for AGCO, as do other manufacturers such as Ziegler CAT and Ziegler AG. Also, there are major trucking firms such as Bradley Trucking nearby which can provide freight services.

Supply chain management for AGCO primarily deals with the management of parts and materials coming into the facility, as well as tracking of products being shipped to customers. Hen-Way's suppliers are about 40 percent in state, about 50 percent from Chicago and Cleveland (major stainless steel markets), and about ten percent international (specialized steel inputs). Most domestic shipments are received by container trucks. International shipments, such as steel from China, moves from coastal ports to St. Paul via rail, then by truck to Fairmont.

Easy Automation's suppliers are located all over the United States. Incoming goods arrive mainly through UPS trucks, which are dispatched from nearby St. James, Minnesota.

Transportation Issues

AGCO is currently in the middle of an expansion to its Jackson production facility. This is being done in parallel with a reorganization and modernization of its production line. The biggest challenge will be modifying the facility to allow larger products to move in and out. Over-the-road truckers will also need to be able to load these products and get them quickly and safely onto the nearby highways (I-90/US 71).

Transportation plays a critical role in ensuring the timely delivery of AGCO products. Approximately 60 truck loads are shipped into and out of the Jackson site per day. Disruptions to highway service are particularly costly. This can include delays incurred in the Twin Cities and other major destinations or shipping hubs. Winter conditions can occasionally make travel difficult for AGCO and introduce uncertainty to the shipping process.

AGCO mostly uses a third party service to arrange shipments with private carriers for domestic customers. All shipping to overseas customers is arranged through a third party.

Condition of roads (smoothness) is a major concern for Hen-Way. Efficient routes are important; weight restrictions can create circuitous routes. Weather conditions can be a minor issue, delay shipments. One other issue is that it is difficult to get some carriers to come to an out-of-town location, since Hen-Way is five miles from Fairmont. Only some LTL carriers will make single-stop trips to serve Hen-Way, while most will look to find other customers closer to Fairmont along the way. Previously, many of Hen-Way's customers picked up their products on site and had them installed.

Cost and reliability are important tradeoffs in evaluating carriers for Hen-Way. Reliability in this case can also refer to the availability of trucks. For example, it is difficult to find trucks that can make a return trip after hauling a shipment of raw materials in from Nebraska.

For New Automation truck is the most important transportation mode. The company transports its products in-house, but there are instances where it uses private commercial providers. UPS

uses freight rail in some instances out of its St. James office. A company representative feels they may use air more frequently than they probably should (2-3 times per week), but this is really dependent on the customer wanting the product immediately and being willing to pay for it. Water is used internationally, some 6-7 times per year. For pickups that are less than a truckload, New Automation uses a trucking company which is only in the area two or three days a week. In these instances, the customer may have to wait.

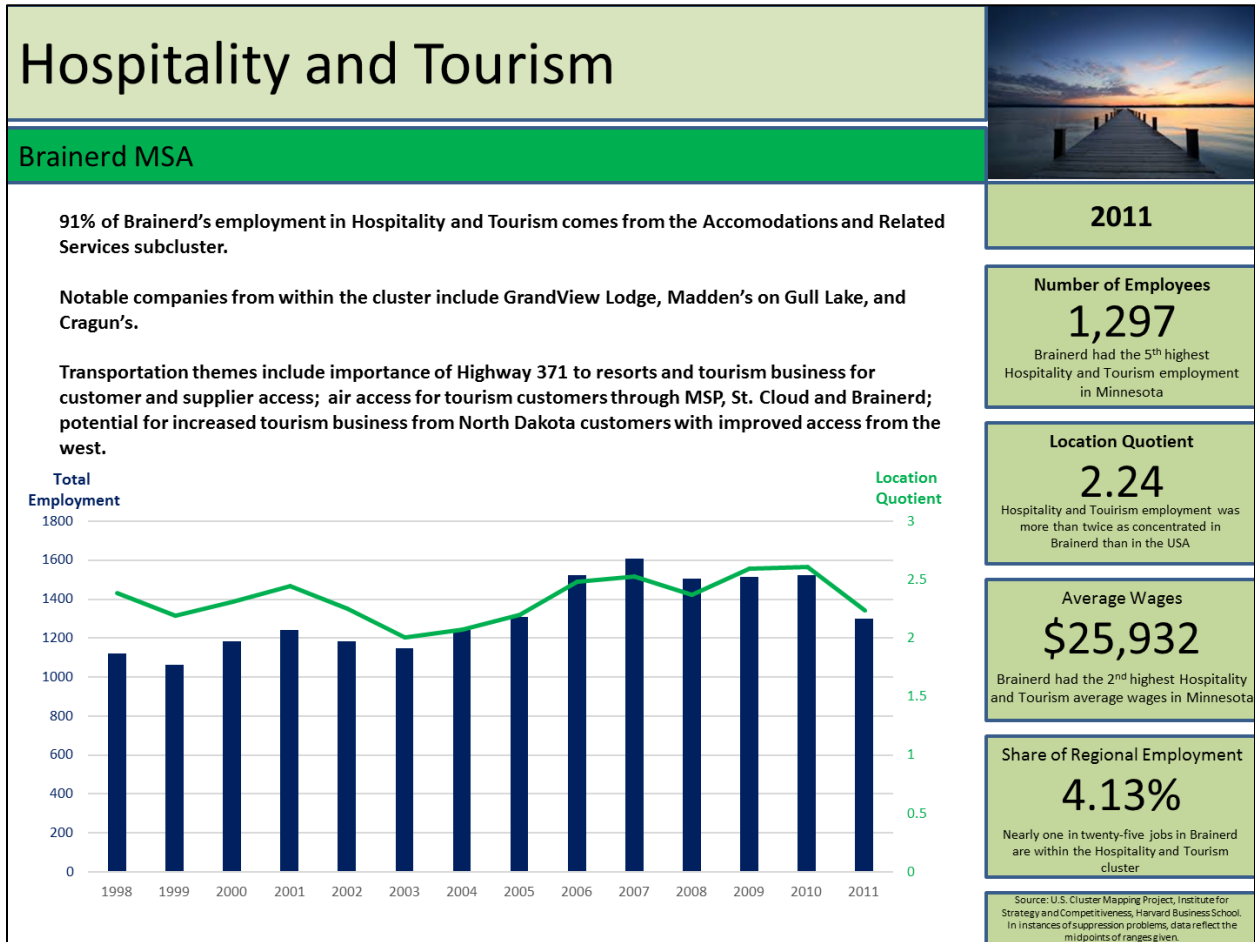
Competitiveness Issues

AGCO uses a variety of skills to match the variety of tasks performed at its facility in Jackson. Skills range from engineering to assembly to specialized manufacturing skills such as welding. Welding, in particular, is a skill that is in high demand but short supply. The AGCO Jackson plant provides some on-site training in this area. While some of the welding is being automated, the plant still needs a large number of welders to perform a wide-range of welding tasks in assembling the equipment. The plant uses a temp service to meet some short-term labor needs for certain jobs. Generally speaking, all employees have a minimum of a high school education.

The company is working to implement various aspects of robotics in its assembly processes. It is testing methods for using robotic equipment to perform tasks such as painting and welding. Another application of technology is the use of electronic testing during the assembly process. Electronic diagnostics for tractors and other products during assembly is replacing manual testing.

Finding housing for AGCO employees has been a challenge as the company has expanded. The plant draws not only on the city of Jackson for its workforce, but also on nearby cities such as Fairmont, Worthington, and Spirit Lake, Iowa. New Automation does not consider transportation to be a big factor in its ability to compete. The company's competitive advantage comes largely from its technological expertise and customer relationships.

4.6 Hospitality and Tourism Cluster - Brainerd



The Brainerd lake region in central Minnesota has long been a popular summer tourist destination. The employment in the hospitality and tourism cluster is 1,297, with a location quotient of 2.24. About 91 percent of Brainerd's hospitality and tourism jobs are in the accommodations and related services subcluster. While the summer months are the busy season for Brainerd's major lodges and resorts – Grand View, Madden's and Cragun's - these resorts attract guests year round for vacations and conferences.

Grand View Lodge in Nisswa has been located on Gull Lake since 1916. Grand View offers lodging, food and beverage, spas, golf courses, marina, and conferences at its Gull Lake facility. Grandview has 140 year round employees and 300 seasonal employees with skills in culinary, service, sales, catering, golf course operations and maintenance, landscaping, building maintenance, and housekeeping.

There are numerous smaller companies that support the hospitality and tourism industry in Brainerd as well. One such example is Northwoods Dock and Service in Hackensack, Minnesota. Northwoods two owners have nine employees who assemble, install and service docks and boatlifts.

Customers

About 70 percent of the guests at Grand View Lodge are there for social reasons, such as vacations. Another 20 percent of the guests are there for conferences, and 10 percent are there for other reasons. The largest portion of Grand View's guests come from Minneapolis-St. Paul. Greater Minnesota is the second largest source of guests. Chicago, Des Moines, Fargo, Omaha, Kansas City, and Oklahoma City are also major origins for Grand View guests. 95 percent of Grand View's customers drive to the lodge; five percent fly to Brainerd, St. Cloud, or MSP and drive from there.

There are 120 lakes within ten miles of Northwood's Hackensack location, providing a sizable and reliable base of customers for the company's dock and boatlift business.



Figure 4.11 Grand View Lodge on Gull Lake, Nisswa, Minnesota

All of Northwood's customers are very local and regionally based in the Brainerd lakes area. Northwood's customer range about 40 miles west, 40 miles north, 30 miles east, and 10-15 miles south.

Suppliers

Food is the main supply coming into Grand View Lodge on a daily basis, amounting to millions of pounds of food per year. During peak seasons Grandview receives two food deliveries per day. Other supplies include boats and other aquatic accessories and furniture, such as couches or beds. Supplies come from Fargo (Sysco Food), St. Cloud, Minneapolis, and Brainerd (daily produce).

A lot of consumption happens at the resort, as you would expect with 500-1000 guests staying there at a time. Because of this scale, you can't go to grocery stores and must bring all of these supplies in. Supply chain management is very important for Grand View. During the summer the resort never has more than 1 or 1.5 days' worth of food at the same time. In the winter Grand View still has 80 percent occupancy on weekends and about 500 guests at a weekend breakfast.

Everything comes to Grandview by truck. There is a shipping bay at the resort. Docks and boatlifts are brought in and assembled on location at the Northwoods facility in Hackensack. Northwoods typically receives one big order of docks and boatlifts per year. Additional supplies come in the summer from a distributor in Brainerd.

Transportation Issues

As Grand View Lodge's name recognition and reputation has grown, transportation has become increasingly important. St. Cloud now has air service daily coming from Chicago, making it easier for customers from other regions to get to the lodge. Highway 371 near Grand View's location is a critical route for their customers and suppliers. Turning 371 north to Nisswa into a four-lane highway has also helped Grand View's business a lot. In 2000 the highway was expanded to four lanes north as far as Nisswa, and now there is a noticeable difference from towns further north on 371 like Hackensack or Walker. This makes it easier and faster to get to Grand View even though some of their competitors are located closer to the cities.

Coming from the west, it is inconvenient to get to the resort. The resort is in a bit of a no-man's land for highway access. Ideally Grand View would like to get some of the vacationers who have been making money from the oil boom in North Dakota to come to the resort. Overall, the resort is very well connected to the south and MSP.

Private vehicles are the most important transportation mode to the lodge and resort business. Truck and air are also important. Air has become increasingly important, as more and more guests are flying into Fargo and then driving. Trucks bring goods in. Guests typically come by car, but sometimes by air.

Being located on Highway 371 is a huge advantage for Northwoods Dock and Service, as the company is better connected to their main client base in the region than some of their competitors.



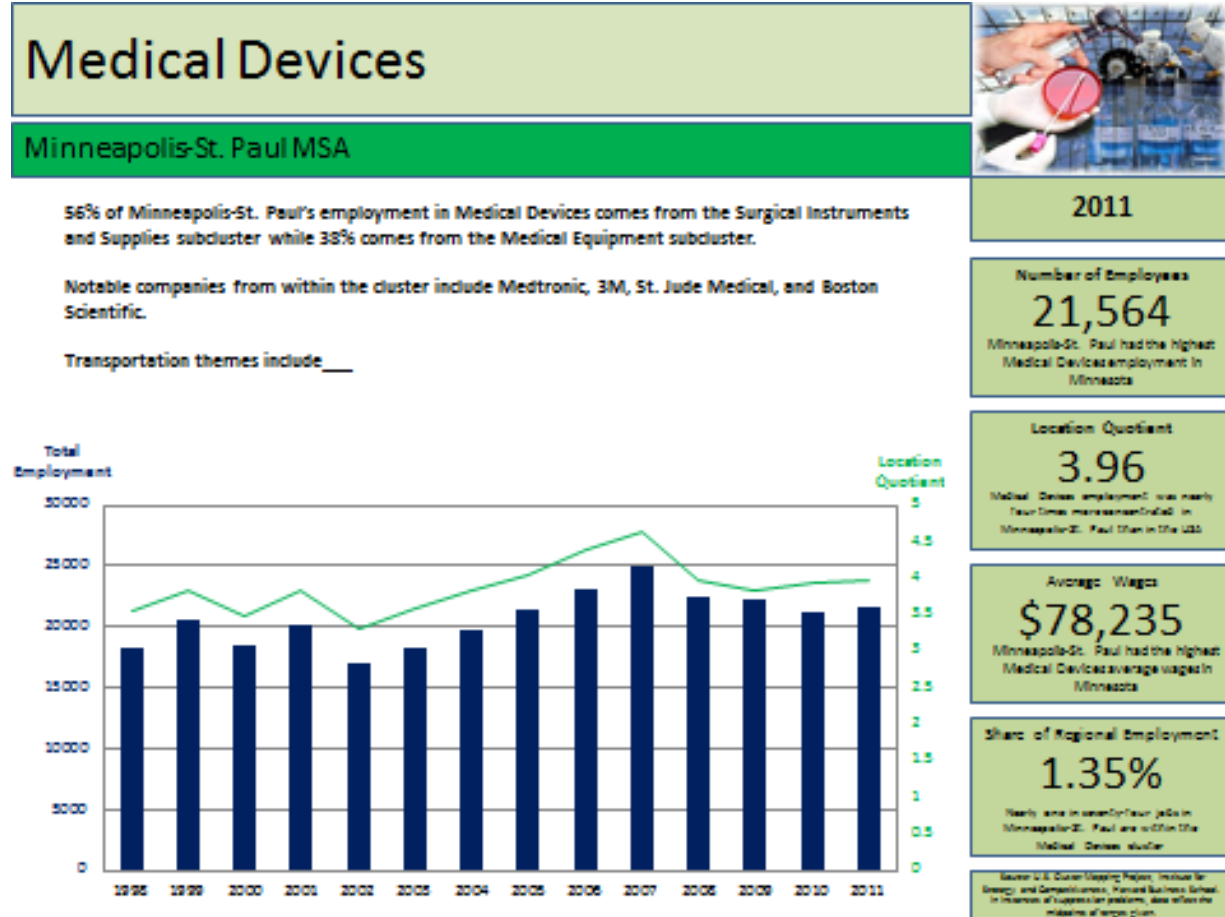
Figure 4.12 Dock Installed by Northwood Dock and Service

Competitiveness Issues

Grand View Lodge has a goal of being able to accommodate around 1,500 guests, which is an expansion of about 50-60 percent. An effective and reliable road system as well as regular air service are critical in bringing these guests to Grand View, and the road system is similarly important in bringing food and supplies to Grand View for these guests.

Northwood's location in the midst of its lake-area customer with good transportation access on Highway 371 are competitive advantages for the firm in its dock and boatlift business.

4.7 Medical Device Cluster – Minneapolis-St. Paul MSA



The Minneapolis-St. Paul Metropolitan Statistical Area (MSA) is home to one of the largest clusters of medical device firms in the United States. This cluster is one of the more important to the Twin Cities economy, due to the presence of several industry-leading companies and to the high-skill, high-wage jobs they provide. The average wage in this industry exceeded \$78,000 (as of 2011), one of the highest in the entire state. Some of the more notable companies in this cluster include Medtronic, 3M, St. Jude Medical, and Boston Scientific. Medtronic and Boston Scientific were the two companies interviewed as part of this study.

Medtronic is the world's largest medical technology company, developing a variety of devices and therapies designed to treat cardiac and vascular diseases, diabetes, and neurological and musculoskeletal conditions. A global company with over 46,000 employees worldwide, Medtronic's operations are separated into three business units: a cardiac and vascular group, a diabetes group, and a restorative therapies group which specializes in neuromodulation, surgical technologies, and spinal therapies³. Medtronic has a large presence in the Twin Cities region, with around 5,000 employees distributed across nine locations, mostly in the northern suburbs. This includes its world headquarters in Fridley, which employs about 1,100 workers.

³ Source: www.medtronic.com/about-us/company-profile/medical-technology.htm

Boston Scientific is a global medical device manufacturer whose products and technologies are used to diagnose or treat a wide range of health conditions, including coronary artery disease, cardiovascular disorders, irregular heart rhythms, heart failure, sudden cardiac arrest, diseases of the digestive system, airway and lungs, chronic neuropathic pain and neurological diseases, heart rhythm disorders, gynecological disorders and vascular system blockages.⁴ Headquartered in Marlborough, Massachusetts, the company has approximately 23,000 employees worldwide, and nearly 5,000 are concentrated in the company's Arden Hills and Maple Grove locations of the Twin Cities region. The Arden Hills facility specializes in devices for cardiac rhythm management, such as pacemakers and defibrillators, while Maple Grove produces vascular stents and catheters.

Customers

Medtronic's major customers tend to be doctors, hospitals, and clinics, and so are distributed across a broad geographic area. Their customers are located all over the U.S. and in 140 countries worldwide. Air freight is the primary mode used for shipments to and from major distribution facilities, with trucks handling most local collection and distribution functions near distribution facilities. Rail is used less frequently, and Medtronic partners with a freight forwarding company (FMI) for most rail shipments.

Boston Scientific devices serve a broad and diverse set of medical professionals, including interventional cardiologists, electrophysiologists, gastroenterologists, oncologists, gynecologists and pain specialists. The company's major customers are doctors, hospitals and clinics.

Approximately 50 percent of Boston Scientific's sales are made outside the U.S. The company has direct marketing and sales operations in 40 countries and representation in more than 100 countries. The primary transportation mode used to move shipments to and from major distribution facilities is air freight.

Suppliers

Like their customers, Medtronic's suppliers are distributed worldwide though most of their manufacturing is done in North America. The company has one manufacturing facility in Tijuana, Mexico that interacts frequently with a separate facility in Santa Ana, CA that specializes in heart valves. Shipments from suppliers typically move by air to and from distribution facilities, then are moved by truck to their final destination. Ocean shipping is sometimes necessary for international shipments involving heavy equipment such as large microscopes.

Similar to its customers, Boston Scientific's suppliers are dispersed in locations throughout the U.S. and around the world. The company operates manufacturing facilities in the U.S., Ireland and Costa Rica, 12 total sites. In the U.S., airfreight and ground transport are the delivery modes most often used by the company's suppliers, with ocean transport used for inbound international shipments.

⁴ Source: www.bostonscientific.com/en-US/about-us/core-businesses.html

Transportation Issues

One of the major concerns faced by Medtronic in the shipping of its products is ensuring timely delivery in the face of interruptions. Delays can be weather-related or due to a variety of other causes, and can occur at essentially random locations. Timeliness of shipments is very important to Medtronic's customers due to the nature of its products, as is the quality and integrity of the products when they reach their destination. Certain types of shipments are especially time-sensitive, such as human tissue samples and other perishable items. Minimizing delays for these types of shipments is critical.

Timely delivery is very important to Boston Scientific customers. It is also essential that customers receive undamaged shipments, as many of the company's devices are used on or implanted in patients during surgery. Transportation interruptions caused by weather, *acts of god*, and various manmade disturbances and errors occasionally happen. To minimize the frequency and duration of those delays, Boston Scientific coordinates with its shipping carriers several times daily.

Competitiveness Issues

With many of its competitors in the industry located in the same region, Medtronic views time-responsive shipment of its products, something its customers value, as a way to gain a competitive advantage. It views the strengths of its present Twin Cities locations from a transportation and logistics standpoint as including being located near a major freight hub and having access to several major freight carriers, such as FedEx, UPS, and Ceva, a shipping company that provides cross-docking and shipment consolidation services. These locational strengths allow the company to ship cheaply to major distribution centers around the country. In addition, the company has adopted transportation management system (TMS) practices to optimize the distribution of its products.

In addition to reliable, on-time delivery, Boston Scientific values the favorable shipping rates offered by its preferred carriers. Lower rates on incoming shipments from suppliers help the company maintain lower production costs. The company has partnerships with several regional, national and international carriers, locking in low shipping rates for all distances and modes of transport. Proximity to the Minneapolis-St. Paul International Airport is cited as one of the greatest strengths of its current Twin Cities locations, in terms of meeting its transportation needs. This is an important consideration, since many of the company's products are shipped to customers along the coasts and overseas. Boston Scientific has facilities in several large U.S. markets, many of which handle warehousing and distribution services in addition to supporting manufacturing activities.

operating several feed mills. In June 2013 they opened a new feed mill near the town of Magnolia which processes finished feed for dairy cattle, beef cattle, hogs and poultry. The new Magnolia mill is intended meet demand currently served by New Vision's Worthington facility, which is already operating at capacity. The feed is comprised of dried distillers grains, corn, soybean meal, and microadditives, and is sold to farmers within a 150-mile radius of the mill.

Customers

The customer base of JBS is spread over a wide geographic area both nationally and internationally. JBS ships to all 50 states, with many retail products going to the coasts, and 35 different countries. In addition, some parts are sent to other locations for further processing. Trucks are typically used to ship fresh products, since it is a faster mode. JBS also uses rail to ship some frozen products, as well as lard, grease, and dried blood (which is used in some fertilizers). Ocean shipping is used for most international orders, with air shipping used in rare cases where a shipment is shorted or faster delivery is needed.

The customers, primarily farms, served by New Vision's Magnolia mill are estimated to be located within a 150-mile radius of the mill itself, an area which encompasses parts of southwestern Minnesota, southeastern South Dakota, and northwestern Iowa. Trucks are used to deliver feed to them from the mill and truck transportation is provided in-house by New Vision's drivers.

Suppliers

Many of hogs from which JBS processes its products are sourced regionally, within about a 150-mile radius of the Worthington plant. Some of the cardboard and plastic materials used for packaging come from Chicago, as well as other Midwestern locations like Kansas City and Albert Lea (MN). The bulk of the company's inputs are drawn from various parts of the Midwest, although JBS does receive certain types of specialized equipment from Canada and Germany. Truck is the primary mode for most of these shipments with the exception of international shipments, which are more likely to arrive by water.

New Vision's suppliers are mainly producers of the crops that are feed ingredients. The company estimates that most of its suppliers are located within a 100-mile radius of the mill. Soybeans come largely from Sheldon (Iowa), Brewster, or Fairmont. Distillers grains come from Heron Lake, Lamberton, and Chancellor. The microadditives are added to the feed come in from all over the world. Trucks are the primary mode used to deliver each of the supplies.

Transportation Issues

One of the main transportation issues JBS encounters is finding enough carriers to cover their loads, especially during the busier months. The company uses 20 to 25 contract carriers and also works with some brokers to meet its needs. Its shipments are typically truckload shipments, though some of them are multi-stop loads. Timing is essential since JBS is dealing with a perishable product. The product must be processed, packed, and shipped so that it reaches the final consumer within a five-day window in order to ensure food safety. As mentioned previously, JBS uses rail (Union Pacific) for some shipments, but this is limited by the reliability of rail service. UP only runs one train per day past this location and JBS is not considered a priority customer of the railroad. That has meant that JBS has had to occasionally pull rail shipments and put them on trucks when the railroad does not pick up its loads, which then puts additional strain on the truck carriers the company uses.

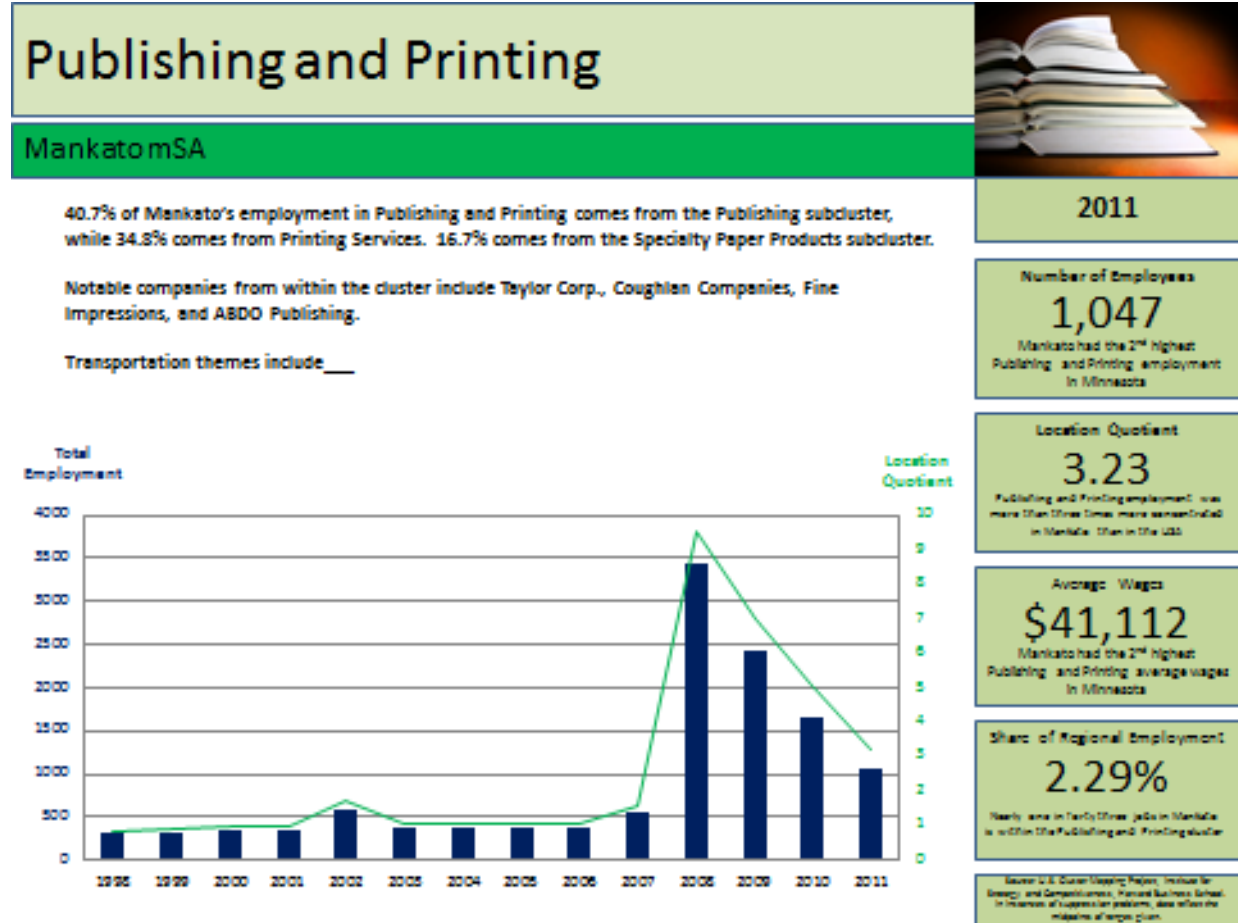
One of the main transportation issues faced by New Vision is inconsistency in vehicle weight restrictions between neighboring counties (within Minnesota) and neighboring states. Most county roads have 10-ton weight limits, while a number of bridges are restricted to 7-ton loads. This often leads to difficult or circuitous routing for vehicles trying to comply with these restrictions. Also, a company representative notes that Minnesota's permitting process is more complicated and less standardized than neighboring states. Permits often specify that vehicles can only travel on state highways, county highways, or some subset of them. Compliance is complicated since New Vision's market includes parts of Iowa and South Dakota, each of which may impose different sets of restrictions.

Competitiveness Issues

While JBS has seen its processing operations grow more or less constantly since the plant opened, it face two obstacles to further growth at its current location. One is that its shipping dock is currently operating at capacity and will need to be expanded to handle additional shipments. The other limiting factor is water availability. Pork processing is a relatively water-intensive industry, using 108 to 110 gallons of water per head of livestock during production. A water shortage in the region has limited the plant's ability to handle additional hogs, though the recent approval of state-level funding for the Lewis and Clark Regional Water System, which will deliver additional water supply from the Missouri River, should help to meet rising demand.

New Vision notes that suppliers in the feed industry compete intensively on price, and that farmers will often choose the cheapest feed supplier they can find. Hence, low transportation costs are critical. The company's main competitors include other cooperatives within the region such as Eastern Farmers Co-op in Luverne, Farmers Cooperative Society (FCS), which is based in Sioux Center, Iowa, Twin Cities-based Cenex Harvest States, and several other smaller feed mills located nearby. New Vision's new mill in Magnolia improves its competitiveness by expanding its market area to the west, including parts of South Dakota, and also by lowering costs to serve existing customers in the area who previously received shipments from its Worthington facility. The new mill also significantly increased the cooperative's processing capacity.

4.9 Printing and Publishing Cluster - Mankato-North Mankato



The Mankato-North Mankato Metropolitan Statistical Area (MSA) in recent years has seen the development of a competitive industry cluster focused on the Printing and Publishing industry. This industry cluster is comprised of separate subclusters devoted to activities such as printing, publishing, and specialty paper products. The cluster accounted for about 2.3 percent of regional (MSA) employment, or 1,047 employees as of 2011. While the industry has declined somewhat in the wake of the most recent recession, it still remains considerably larger than pre-recession levels and more concentrated than the national average, as its large location quotient (3.23) attests to. While there is no single, large firm dominating the industry, there are several successful small to mid-size firms located within the region. Some of the more notable companies include Taylor Corporation, Capstone Publishing, Fine Impressions, and ABDO Publishing. Companies within this cluster that were interviewed for this study were Taylor Corporation, Capstone Publishing, and The Creative Company.

Taylor Corporation is a family of companies headquartered in Mankato with over 80 subsidiaries located throughout the U.S., Canada, Mexico, and parts of Europe and Asia. While the company has expanded over time into areas such as marketing, packaging, and retail solutions, the bulk of its sales tend to be concentrated among published and printed products, including business cards, children's books, and wedding invitations.

Capstone Publishing, a subsidiary of Coughlan Companies, Incorporated, has operated in the Mankato region since it was founded in 1991. Capstone publishes books in a variety of formats, including hardcover, paperback, e-books, and interactive books. While the company serves a variety of markets, it does not participate in the textbook or encyclopedia markets. Capstone has gone through a period of rapid expansion in recent years, growing to a total of around 200 employees clustered in several locations throughout Mankato and North Mankato.

The Creative Company is a publisher of children's educational books, with most of its products targeted toward primary to middle school-aged students. Founded in Mankato in 1932, it is currently headquartered in North Mankato, where it has been for about 10 years with a workforce ranging between 30 and 38 employees.

Customers

Taylor Corporation's major customers are located in larger urban centers, both nationally and internationally. Most of its shipments to domestic customers are sent by truck, either through small parcel carriers such as UPS and FedEx, or through other less-than-truckload (LTL) carriers. Shipments to international customers are generally sent by water.

Capstone Publishing's major customers tend to be school districts, which are located throughout the U.S. A Capstone representative notes that nearly every school district in the country has a Capstone product in its system. The company also sells its products to many public libraries. Internationally, Capstone has a strong presence in Canada and is currently expanding into markets in China and Turkey. Domestic shipments tend to arrive by truck, either through small parcel or LTL carriers. Most international shipments move by water, with air shipments used rarely for time-sensitive orders.

Similar to Capstone, most of The Creative Company's major customers are schools, libraries and wholesalers within the U.S. A Capstone representative estimates that around 90 percent of its shipping is by small parcel ground transport carriers (UPS and FedEx), while the remaining 10 percent is on palletized LTL services. The company typically ships anywhere between two and 10 pallets twice per week. The company works closely with R.R. Donnelly, an Indiana-based printing company that provides a specialized logistics service for publishers.

Suppliers

The major suppliers for Taylor Corporation include suppliers of forest products. Taylor relies heavily on mills in Wisconsin to provide these products, though it has some international suppliers as well. Virtually all of the domestic shipments arrive by truck, either as full truckloads or on less-than-truckload shipments. Some Taylor plants handle as many as 40 truckloads per day.

One of Capstone Publishing's major suppliers is another Taylor subsidiary, Corporate Graphics. Corporate Graphics is a printer located adjacent to Capstone in North Mankato. Capstone notes that it prefers to use domestic printers whenever possible due to lower costs, including some located regionally in Brainerd, Minnesota and Stevens Point, Wisconsin. Capstone has one international supplier in China who specializes in the production of cardboard books. Trucks are used to handle the majority of shipments from suppliers, except for international shipments from China, which typically arrive in Minnesota via water and rail, then reach Mankato by truck.

The Creative Company also uses Corporate Graphics for some of its printing work, but also relies on some overseas suppliers for more specialized work. For certain types of books which require specialized binding and artwork the company uses suppliers in Italy and Belgium. It also work with overseas publishers in Singapore and Australia, with whom the company has developed reciprocal distribution agreements. Domestic suppliers typically ship by truck to Mankato, while inbound overseas book shipments are collected on pallets with 1,200 to 1,500 books per pallet and shipped over the ocean via less-than-container load shipments.

Transportation Issues

Taylor Corporation cited the timeliness of shipments as a critical transportation issue, since it allows them to maintain lower inventory levels. Shorter lead times made possible by this and other logistics improvements gives Taylor an advantage over its competitors.

Cost and reliability of transportation were issues cited by Capstone Publishing as important to its operations. Orders by schools and other customers typically pass through distributors who need to receive the product in a timely fashion in order to ensure on-time delivery. Weather can be a big issue with shipping, especially in Minnesota. For some international shipments, customs issues can also create delays.

The biggest concern cited by The Creative Company regarding transportation and logistics decisions is meeting publishing schedules for its products. Adhering to these schedules allows the company to keep costs down and avoid unanticipated mode shifting, which may result in higher transportation costs. Shipping delays may have some effect on this process but are less important relative to other stages of production farther up the supply chain, such as editorial work and printing.

None of the companies interviewed cited any major transportation issues associated with their employees. Many of the companies' workers live nearby, either in the Mankato area or in towns within 20-30 miles of their location, and traffic congestion is generally not a problem. The extension of fixed-route public transit services within the city also provides commuting options for residents without access to a private vehicle.

Competitiveness Issues

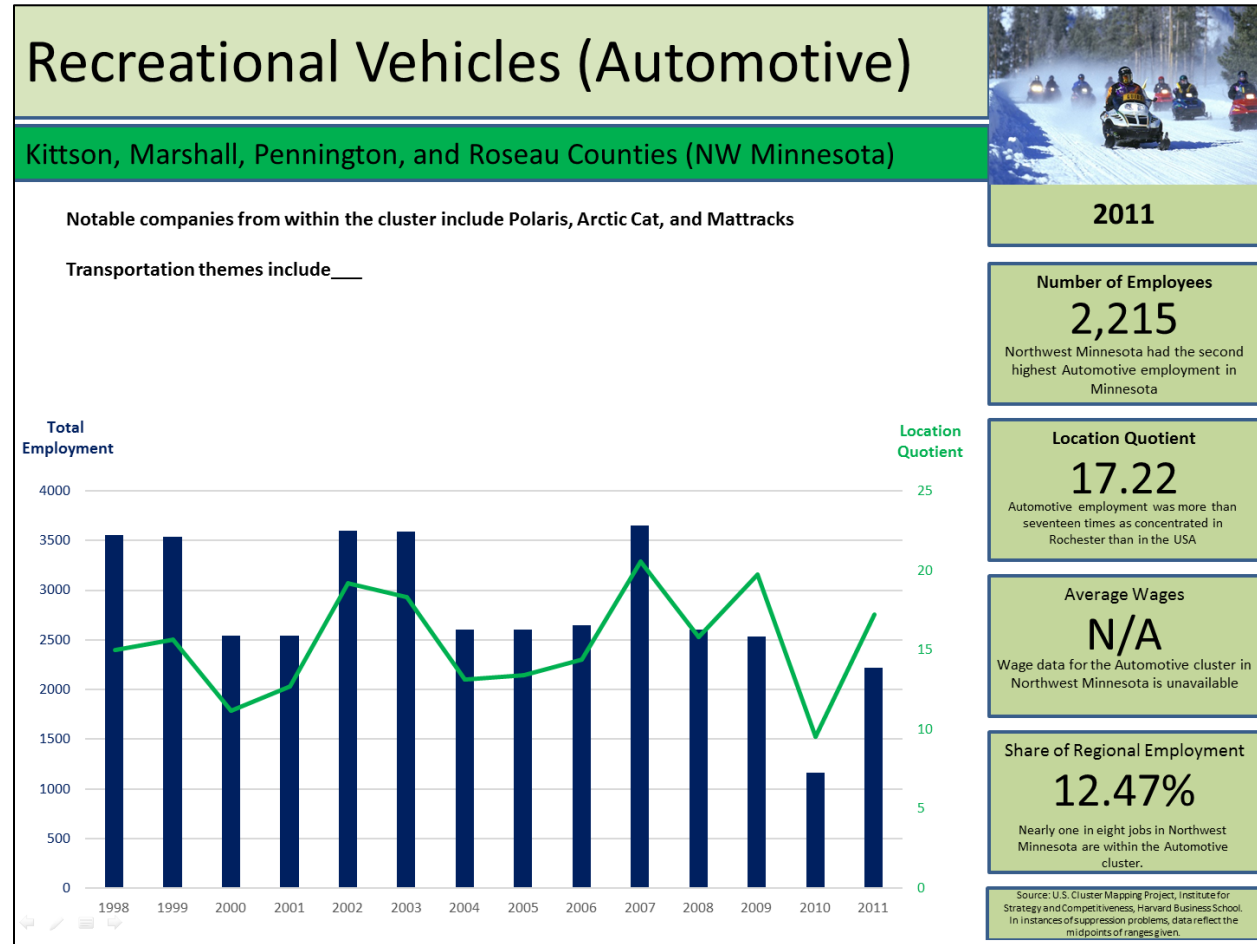
Each of companies interviewed suggested that the key to competitiveness in its industry is improving the content of its product. A major driving force in the industry, especially for publishers, is the movement towards digital media, including e-books and interactive children's books. Technology has aided this transition through the computerization of graphics and design functions.

Transportation may still play a residual role in competitiveness for some of the industry's companies, however. For example, Taylor Corporation notes that improved freight transportation allows it to reduce the turnaround time on its customers' orders, a key aspect of service quality in this industry. Taylor also cite the improved availability and lower cost of truck shipping following deregulation as a factor in their ability to reach new markets.

Transportation also plays into the companies' longer-term decisions regarding location and expansion. Taylor Corporation suggests that its efforts toward strategic expansion favor

consolidating operations into fewer brick-and-mortar facilities in more highly accessible locations. Capstone Publishing also notes that its current location might not be a strength in terms of minimizing transportation costs since it is not located near a major freight transportation hub, and that it has previously considered centralizing its operations in another location. However, these considerations must be traded off against other advantageous aspects of its current location, such as affordable land, lower wage rates, and connection to the region.

4.10 Recreational Vehicles - Northwest Minnesota



The recreational vehicle industry in northwest Minnesota has been a very competitive industry with a location quotient of 17.22. The snowmobile industry led by Polaris and Arctic Cat has moved into other recreational vehicles and has experienced rapid growth in recent years. The sparsely-populated area of the state relies on a high-quality workforce and a strong transportation and logistics system to respond to customer demand in a global market.

Polaris employs 1,780 people in Roseau, Minnesota. The company makes recreational vehicles including snowmobiles and motorcycles (made in North America) but has additional products for international markets including small vehicles. Polaris makes all-terrain vehicles (ATVs), side-by-sides, and snowmobiles in Roseau. The company also has a parts, garments, and accessories division. Polaris employs skilled workers in engineering, operations, and welders. These skilled workers are at a premium in Roseau.

Arctic Cat employs about 1,400 people in Minnesota, with most of these working in the company's Thief River Falls plant. Arctic Cat's annual sales are about \$750 million. The company makes recreational vehicles – snowmobiles, ATVs, side-by-sides for utility and support. The company also has a parts, garments, and accessories department that accounts for about \$115 million worth of sales. Arctic Cat has been on an upward trend. Four years ago the company's sales were about \$430 million. The growth can be attributed mostly to the side-by-

side market. Welding is a big skill for Arctic Cat, and the company gets a lot of talent from junior colleges. The company also has a lot of people working on DC Controls and about 200 design engineers.

Mattracks employs 30 people in Karlstad, Minnesota. The company makes rubber tracks for 4-wheel drive vehicles and ATVs plus a motorized snowboard. Mattracks employs production and administration workers but also welding, machinists, and laser jet.

Customers

Polaris has global customers. This includes Australia for ATVs and Scandinavia for snowmobiles. Trucks are used to ship to customers along with intermodal and water for international customers. Air is used only to “fix the other modes’ mistakes.

Arctic Cat’s international customers for snowmobiles include Scandinavia and Russia. Austria is the main distribution point for ATVs to Europe. Arctic Cat has a very strong presence in Canada but weaker in the south. Arctic Cat uses supply chain management to determine where and what product it needs and to be the most cost efficient. The company is working on continuous cost improvement. Approximately 6 percent of its cost is outbound logistics. Arctic Cat has moved to high tech, highly educated supply chain managers now.

Mattracks customers are all over – oil fields, recreational and snowmobile clubs, Yellowstone and other governmental departments, industrial, agriculture (cranberry bogs), movies, military. The company provides rubber tracks for many uses, both recreational and commercial.

Suppliers

Polaris’ suppliers are global. Most supplies arrive by truck, with 95 percent international supplies transported by water.

Supply chain management for Polaris has three wings. The company tries to minimize lead times for purchasing materials, logistics to ensure the plants can continue, and the movement of parts between facilities.

Arctic Cat gets plastics from Lakeville and central Iowa, engine components from Europe, finished engines from Japan, and gears from India. The big competition with Polaris has impacted the capacity with regional suppliers of paint and deck vans.

In the past there has been an advantage to having both recreational vehicle companies near each other, including supply base and a good working relationship.

Mattracks tries to buy as much locally as possible. The company has many vendors throughout Minnesota and North Dakota.

Transportation Issues

Polaris' transportation issues with employees in Roseau are all weather related. There are multiple back roads that are not cleared in a timely manner preventing people from getting to work. This last winter the weather caused the plant to shut down. Polaris' employees have a lot of weather related accidents.

It's hard for Polaris to get trucks to Roseau. It's become very expensive to get trucks because ideally they would deliver all over the country in a drop and loop system. Polaris has dedicated drivers, but there are not enough of them.

Transportation is hard for Polaris, especially in the winter time. The company tracks loads to the minute. Transportation is Polaris' biggest budget item, and the company is running close to capacity. If there are no trucks available, the plant shuts down.

Minnesota roads are critical to Polaris's business. Most supplies come in from the St. Paul cross dock up Highway 32 or 59. Supplies can get stuck in Detroit Lakes or Mahanomen due to MnDOT rules.

Transportation is critical for Arctic Cat. It's over ten percent of the company's total cost structure so on-time delivery of product ensures production can occur smoothly. Being late causes delays in the plants and causes waste. Arctic Cat has begun to deliver specific loads to specific docks to increase the efficiency of use. The company can only fit 8-10 vehicles per truck so it needs to be efficient.

Arctic Cat's transportation challenge is to be on-time, accuracy, and quality control. There are 1,400 parts that need to work together. The company used to have truck problems being on-time but consolidating carriers and satellite tracking have corrected those problems.

Highway 59 is a major loop for Arctic Cat, but it's tough to get the product to Highway 10 because of the road condition. The company tests the strength of its crates for shipping on Highway 2 to Superior Wisconsin, because its truck drivers say this is the worst stretch of road.

Rail has become a real issue for Arctic due to weather and increased activity in the oil fields. Rail has always been the best cost mode, but big delays have caused the company to use tandem trucks to get product to manufacturing facilities – even though it's more expensive, the company has to have the product.

Mattracks gets its supplies and ships its products by truck. The company tries to build up product on hand in slow periods with its busy season from October to March and with more trucking and product delivery then.

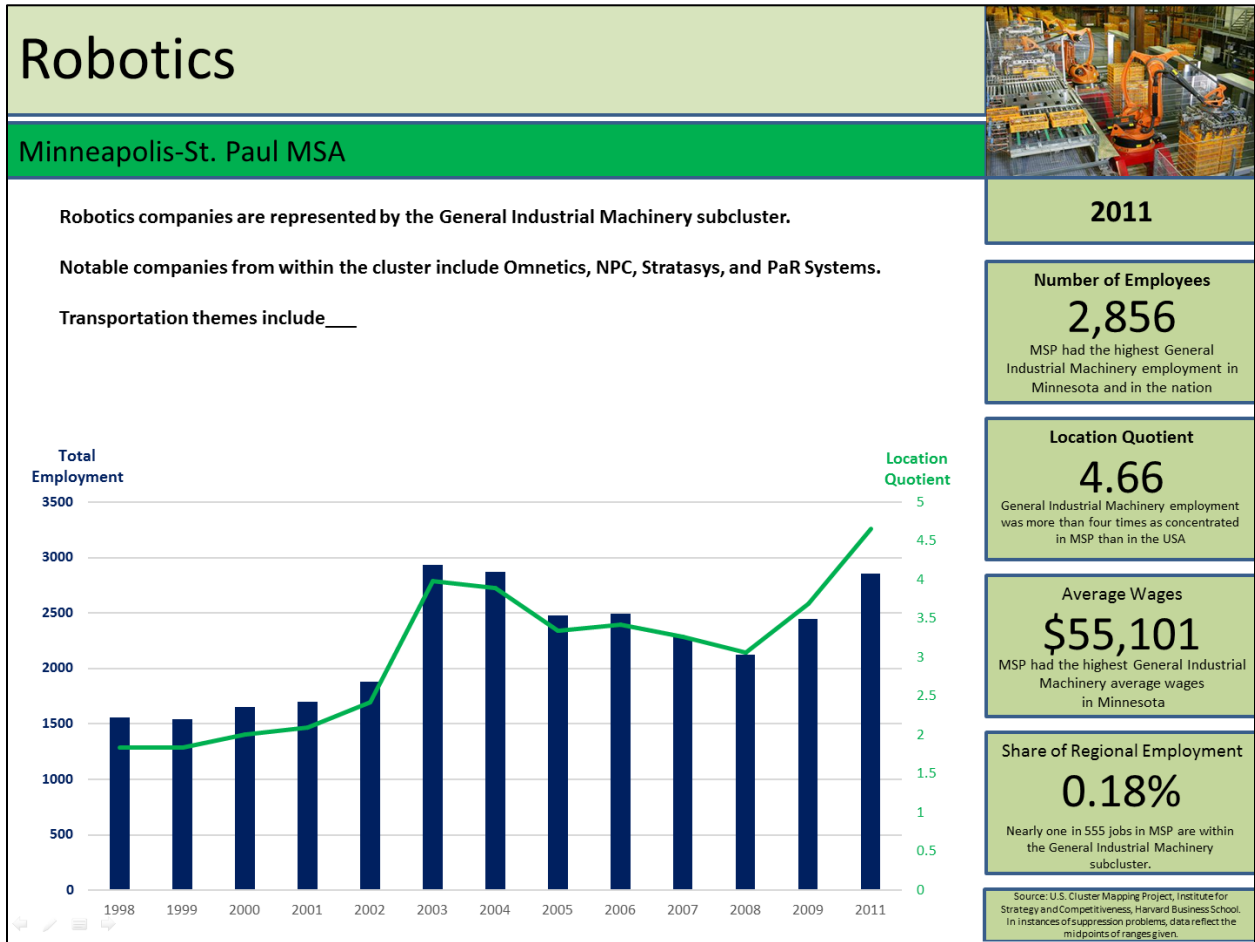
Competitiveness Issues

Polaris has experienced 19 straight quarters of growth, 80 percent of which is from side-by-sides and ATVs. Polaris is planning a lot of expansion, but the company is not able to expand in Roseau due to labor constraints.

Polaris considers transportation a huge issue in its ability to compete. Retail floor management influences the company's transportation requirements. Polaris tries to get delivery time to 14 days but now is going up to 30 or 40 days from order to delivery. Polaris' biggest initiative right now is decreasing lead time.

In Thief River Falls there is low unemployment, so it has been hard for Arctic Cat to find employees. Digi-Key, which is right next door to Arctic Cat's plant, has had to bus in employees from local cities, but Arctic Cat hasn't done that yet. Last year Arctic Cat couldn't get to full employment until August, although its season starts in April.

4.11 Robotics Cluster - Minneapolis-St. Paul MSA



The Minneapolis-St. Paul region is a global leader in ground and industrial robotics, including basic and applied research institutions, established firms, and young companies. MSP’s strength in robotics stems in part from the region’s strength in bioscience, agriculture, mining, retail, and industrial manufacturing. In addition to benefiting these traditional industries, robotics is also at the forefront of some of the state’s emerging industry strengths such as security and defense. Robotics Alley was founded to create public and private partnerships to enhance the emerging robotics cluster. The Global Robotics Innovation Park (GRIP) in Minneapolis is a research park, business incubator and hub for the entire robotics industry in the Upper



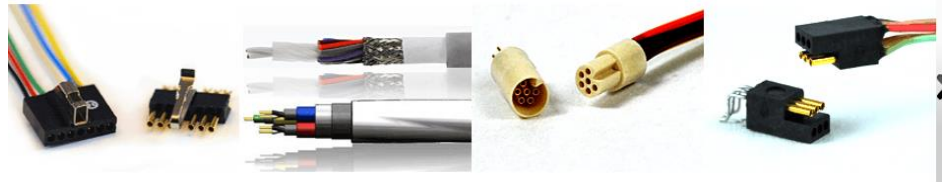
Source: Center for Distributed Robotics, University of Minnesota
<http://distrob.cs.umn.edu/scout.php>

Figure 4.13 The Scout “Throwable” Robot

Midwest. Robotics research at the University of Minnesota, particularly UMN Scout sensing robot, has received national recognition.⁵

Robotics as an emerging cluster is tied with many existing clusters in the MSP region, notably medical devices, aerospace and defense-related clusters. Much of the robotics employment falls within the general industrial machinery subcluster of the metal manufacturing cluster. This subcluster accounted for 2,856 jobs in the MSP region in 2011, with average wages of \$55,101. The share of general industrial machinery employment in the MSP region was over four times the national average, with a location quotient of 4.66. Among the robotics firms in the region are Omnetics, NPC, Stratasys, and PaR Systems.

Omnetics is a worldwide designer and manufacturer of micro and nano miniature interconnect products, featuring commercial off-the-shelf, standards and custom connectors for industries such as military, aerospace, defense, medical and other technology-oriented OEMs. The company makes all types of electrical connectors from surface mounts to harnesses. Omnetics has 230 employees at its Fridley, Minnesota, location.



Source: Omnetics website <http://www.omnetics.com/>

Figure 4.14 Examples of Omnetics Connectors

NPC Robotics of Mound, Minnesota, specializes in rapid design, prototyping,

and testing motion

systems. NPC does not

manufacture products but typically outsources the production. NPC originated with eurithane filling of Bobcat tires, which transitioned to filling wheelchair tires. The company then began working in rebuilding wheelchair motors, and soon began designing motors for hobby robotics with an emphasis on battle bots. The company then received a government contract to motorize Humvee turrets and have since worked largely in motorized motion control. Other applications include first responder robotic solutions for law enforcement and entertainment (e.g. R2D2 motors and wheels). NPC works a lot in 3D modeling and is currently purchasing a 3D printer for faster prototyping.

NPC currently has nine full-time and two part-time employees. The company recently purchased two buildings next door to their current locations and do not need to hire significantly more employees to expand its growth.

⁵ Munnich, L., J. Dworin, N. Tilahun, M. Schmit. Minneapolis-St. Paul Regional Cluster Competitiveness Study. State and Local Policy Program, Humphrey School of Public Affairs, University of Minnesota, 2013, p. 67.

Customers

Omnetics customers are all over the world. The company's biggest customers are in Austria and Germany. Omnetics business is heavily focused on the medical implant industry as well as aerospace and military. The company also does a small amount of commercial business. Major business customers are Honeywell and Lockheed Martin.

NPC Robotics customers include the military and commercial clients such as Honeywell and Disney Robotics. NPC also has a hobby robotics online store with customers nationwide for niche products. Larger customers in the last three years have been in Ohio, Texas, and Pennsylvania.

Suppliers

Many of Omnetics suppliers are in the Twin Cities and within an hour of the company's location. The company gets pins, insulators and metal housings locally. Plate pins come from the east coast and sockets from overseas. NPC suppliers are in Dallas, Arkansas, Maryland, Michigan, and some in the Minneapolis-St. Paul region. The company does due diligence to find the best suppliers and prefers to use local or Minnesota companies if possible.



Source: NPC Robotics website <http://npcrobotics.com/about-npc/history/>

Figure 4.15 NPC Robotics Designed Turret Drive Systems for U.S. Army

Transportation Issues

The primary transportation issues for Omnetics are getting the parts in and getting the final product out. There aren't any logistical issues because everything is so small. Omnetics ships 18-50 packages per day by FedEx or UPS or by other contract shipper. NPS also typically ships by UPS and FedEx and uses private commercial transportation service providers, primarily LTL depending on order size. NPC has figured out its way around most of its transportation challenges. Most customers do an FOB origin model so it doesn't make money from shipping.

Competitiveness Issues

Overall, transportation is a small percentage of the NPC pricing model and does not play a major role in its ability to compete.

\$12.8 billion in 2013 and a total workforce of over 11,000 employees company-wide, with 1,100 of these located at their headquarters in Eden Prairie, Minnesota.

FedEx Corporation is one of the world's largest integrated transportation and logistics companies, providing a variety of services to shippers, ranging from express courier services to ground transport and supply chain services. Initially founded in 1971 as Federal Express Corporation, Federal Express began operations in 1973 as an express parcel delivery company. The company expanded through major acquisitions to begin offering new lines of service including small package ground service, expedited shipping, freight forwarding, and less-than-truckload freight services. The reorganized company is renamed FedEx Corporation in 2000. The company is divided into a number of operating units (subsidiaries), each of which focuses on a specific set of services and which has its own logo. As of 2013, FedEx Corporation reported \$45 billion in annual revenues and an estimated 300,000 team members worldwide.

Customers

C.H. Robinson's customers are the shippers who retain their services to source carriers for their shipments. The company handled 11.5 million shipments from 42,000 different customers located worldwide during 2012. C.H. Robinson uses all modes to arrange shipments, but truck and to a lesser extent, rail are used for most domestic shipments. Some intermodal shipments are used, but this tends to be a niche market and confined mostly to containerized freight.

The suppliers that C.H. Robinson uses are the carriers with whom it contracts to handle shipments. The company works with over 56,000 contract carriers worldwide, mostly motor carriers along with a few air freight carriers, ocean carriers and freight railroads. Among the motor carriers C.H. Robinson contracts with, only about 450 of them are 'large carriers', defined as having a fleet of 500 or more trucks.

Similar to C.H. Robinson, FedEx's customers are its shippers, and its suppliers include the independent contractors and companies with whom it works to provide some transportation services (e.g. USPS provides final delivery for the FedEx SmartPost service).

Virtually all modes are used to deliver shipments, and vary according to the operating unit with which the shipment is associated. For example, FedEx Express provides rapid, reliable, time-definite deliver to over 220 countries and territories worldwide. FedEx Freight is the market leader in providing less-than-truckload services across all lengths of haul and other freight services, including palletized freight shipments. FedEx Ground is the leading North American provider of ground small-package delivery service, providing service to the U.S. and Canada. This service typically focuses on local hubs, with independent contractors who do pickups and deliveries. FedEx Ground provides time-definite, 1 to 5-day deliveries to locations in all U.S. states as well as Canada.

Transportation Issues

Since C.H. Robinson serves mostly as a third-party logistic service, its transportation issues mostly derive from its ability to find carriers with available capacity in a timely manner. Capacity rates matter greatly for shippers and the availability of 'surge' capacity – the need to find large amounts of carrier capacity for a single point in time – is a major issue for C.H. Robinson and its competitors. Load balancing is another common issue for the company and its

customers. Customers located in more remote, rural areas often face higher rates and are more difficult to serve due to the inability to find return shipments. The result is a greater amount of deadheading, which raises carrier costs. A third common issue is the fluctuation of costs due to variation in fuel prices and vehicle availability. While it is difficult to control the former, the latter can be managed to some extent through the use of advanced information systems.

Every transportation provider must contend with road closures due to severe weather events, as well as longer-term closures for major construction projects. Another issue is the physical condition of the infrastructure, especially the condition of pavements and bridges. Deterioration in the condition of this infrastructure can affect operating costs for the various road-based modes. A third, and related, issue is delays due to congestion on highway networks. Since many shipments either originate or have destinations in urban areas, congestion on urban road networks can be very costly in terms of wasted time and fuel.

Competitiveness Issues

C.H. Robinson's main competitors are the internal transportation and logistics departments of larger companies, other third-party logistics providers and other large carriers (e.g. Transport America) and brokers. Since these companies largely serve the same customer base, they must provide service to the same locations served by C.H. Robinson. In order to improve its competitiveness, C.H. Robinson has gradually expanded to provide a full range of services to customers, from basic brokerage services to a full range of logistics and sourcing activities. Underlying this transformation has been the development of advanced information technologies. In 2012, the company launched Navisphere, an information technology platform that provides real-time information to the company's satellite locations in order to assign loads to various locations. This information allows them to more effectively manage their capacity and find carriers on shorter notice.

FedEx has many competitors, since each of its operating units target specific types of markets. For example, in the express business, its closest competitors include companies such as UPS, DHL, and TNT Express. For FedEx Freight, competitors include most LTL carriers. FedEx Ground competes with other parcel services, and the USPS in the case of FedEx Home Delivery. FedEx Supply Chain generally competes with other third-party logistics companies, including C.H. Robinson. FedEx Office (formerly FedEx Kinko's) competes with other printing and office supply/services stores.

One way that FedEx actively attempts to improve its service is to broaden and expand its networks and the variety of services it provides. This can also include identifying specific industries and markets. For example, in the Twin Cities region, FedEx works with companies in the Life Sciences and Medical Devices industries in order to provide transportation and related services. Other related industries, such as health care, tend to be vertically integrated providing potential markets for a variety of transportation and logistics services.

Another way that FedEx seeks to improve its services is through technological improvements. It continues to look for ways to upgrade its aircraft fleet, and improve fleet fuel economy. FedEx constantly seeks information technology upgrades to improve its customer service systems.

Chapter 5 Synthesis

The clusters examined in this study differed in that some were statewide with high location quotients in most of the 25 Minnesota regions; other clusters were strong in a multiple regions but not most regions; and some were strong clusters in single regions (Table 4.1). The following is a synthesis of what we learned from this study by the geographic scope of the clusters – statewide, multi-region or single region. The transportation and logistics cluster is discussed separately. Two emerging clusters are also identified and discussed here.

5.1 Statewide clusters: Processed food (21), heavy machinery (19)

Processed food is a statewide cluster with 21 of 25 Minnesota metropolitan and micropolitan regions having location quotients of 1.3 or higher. The state employed 30,098 in the processed food cluster in 2011 with an average annual wages of \$48,221. The statewide location quotient for processed food is 1.52. The processed food industry in Minnesota includes major food industry leaders such as Cargill, Hormel, General Mills, Jenny-O, and Schwan's. The processed food cluster is highly dependent on a reliable and smooth road system to move live animals for processing and to move perishable processed food by truck on a timely basis. The cluster also relies on rail transport to reach coastal and international markets.

Heavy machinery has strong concentrations in 19 of the 25 Minnesota regions. Production technology and heavy machinery provided 28,672 jobs with an average annual wage of \$56,491 in 2011. The statewide location quotient for this cluster was 1.53 in 2011. An example of a Minnesota heavy machinery company is AGCO, an agricultural equipment manufacturer. AGCO's plant in Jackson, Minnesota, near I-90, employs 1,350 to 1,400 people and assembles farm equipment--tractors, sprayers and spreaders. AGCO relies on good access to the interstate system to move supplies for assembly of equipment and to move assembled equipment to markets throughout the U.S.

5.2 Multi-region clusters: Health services (13), forest products (10), publishing and printing (10), hospitality and tourism (6), medical devices (5)

Health services is usually considered a local cluster, since it serves the local population. However, 13 of Minnesota's 25 regions have location quotients of 1.3 or higher, indicating that the health service industry in these regions are serving populations beyond the region and could be considered a traded cluster. One Minnesota region in particular, Rochester, Minnesota, is the home of the Mayo Clinic, which serves much of southern Minnesota and southwest Wisconsin, but also is a tertiary health provider for the U.S. and international patients. Rochester is a small metropolitan region located about 80 miles south of the MSP region. The Mayo Clinic faces a number of transportation challenges as a tertiary care center in terms of bringing in patients, employee transportation, emergency response, supply chain management, and daily air transport of samples for lab testing. The State of Minnesota is making a \$500 million investment in Rochester to improve its downtown and make it a more competitive location. The Mayo Clinic itself is planning a \$5 billion investment in its Rochester location.

Table 5.1 Summary of Transportation Characteristics of Firms in Competitive Clusters

Industry Cluster	Transportation Issues	Primary Freight Modes Used	Important Service Characteristics	# of MN Regions
Construction Materials (Granite)	Varying state regulations; customs delays; fuel costs	Truck (flatbed), Rail, Water	Reliability, Safety	1
Forest Products	Rail capacity and equipment; need for intermodal facilities	Truck, Rail	Cost, Transit Time, Reliability	10
Glass	Specialized carrier availability; labor access; weather delays	Truck, Water, Air	Cost, Reliability, Transit Time	1
Health Services	Regional air access; reliability of shipments; improved air navigation	Air, Truck	Reliability, Safety	13
Heavy Machinery	Road conditions; truck availability; weather-related delays	Truck, Water, Rail	Cost, Reliability	19
Hospitality and Tourism	Regional air access; highway access from points west	Truck	Reliability, Transit Time	6
Medical Devices	Airport access; congestion delays; shipment reliability	Air, Truck	Safety, Reliability, Cost	5
Printing and Publishing	Weather-related delays; customs delays	Truck (LTL and small parcel), Water	Cost, Reliability, Transit Time	10
Processed Food	Carrier availability; shipment reliability; regulatory consistency	Truck (truckload), Rail, Water	Safety, Transit Time	21
Recreational Vehicles	Weather-related delays; infrastructure condition; carrier availability	Truck, Water, Rail	Cost, Reliability, Safety	1
Robotics	Speed of shipments	Truck (LTL and small parcel), Air, Water	Cost, Transit Time	1
Transportation and Logistics	Congestion delays; infrastructure condition; carrier availability	Truck, Air, Rail, Water	Safety, Reliability	4

Forest products has a strong employment concentration in 10 of Minnesota's 25 regions. NewPage is a paper manufacturer in Duluth that produces supercalendered paper used for catalogs, magazines, advertising inserts, flyers, and other commercial printing. The company located this plant in Duluth in 1987 in part to take advantage of rail service but has had to reduce its reliance on rail from 80 percent to 50 percent due to availability of the types of rail cars needed for moving large rolls of paper. The company is interested in future intermodal opportunities for transporting paper from Duluth.

Publishing and printing is a strong industry in Minnesota although the printing industry continues to be challenged by digital media alternatives. In 2011 there were 23,638 employees in Minnesota's printing industry with annual wages of \$48,236 and a location quotient of 2.29. Ten of Minnesota's 25 regions have location quotients of 1.3 or higher for publishing and printing. Taylor Corporation is a family of companies headquartered in Mankato with over 80 subsidiaries located throughout the U.S., Canada, Mexico, and parts of Europe and Asia. While the company has expanded over time into areas such as marketing, packaging, and retail solutions, the bulk of its sales tend to be concentrated among published and printed products, including business cards, children's books, and wedding invitations. Timeliness of shipments is a critical transportation issue for Taylor, since it allows them to maintain lower inventory levels. Shorter lead times made possible by this and other logistics improvements gives them an advantage over their competitors.

Hospitality and tourism employs 52,779 in Minnesota with average annual wages of \$32,091. While the statewide location quotient is 0.84, six of Minnesota's regions have location quotients of 1.3 or higher. The Brainerd Lake region is a popular summer tourist destination with 2,378 jobs and a location quotient of 2.64 in 2011. The Brainerd area is known for its resorts – Grand View, Madden's and Cragun's. These resorts rely on good road access for customers as well as suppliers of food and other hospitality essentials. Daily air service to St. Cloud is seen as a benefit for the Brainerd resorts. Grand View Lodge sees opportunities for attracting more customers from North Dakota with the increased wealth from the oil boom.

Minnesota has 22,637 jobs in the medical device cluster with average annual wages of \$73,624 and a location quotient of 2.48. Five of the 25 regions in Minnesota have location quotients of 1.3 or higher. Medical devices is perhaps the premier industry cluster in the MSP region, with a location quotient of 3.96. Medtronic started in northeast Minneapolis, and other major medical device companies have major operations in the region, Boston Scientific, St. Jude, Starkey Labs, among others. The medical device cluster relies heavily on air transportation for shipping its products.

5.3 Single region clusters: Granite, glass, recreational vehicles, footwear, mining

Five clusters were studied that had high employment concentrations in a single region of the state. The granite industry in St. Cloud is part of the cut and crushed stone subcluster of construction materials, which has a location quotient of 10.32. Cold Spring Granite has provided the granite for major monuments such as the Franklin Delano Roosevelt and Martin Luther King memorials in Washington, DC, as well as for the World Trade Center in New York City. Fuel costs and reliable shipping are critical for Cold Spring Granite. I-94 is the primary route for moving granite to Cold Spring for production and finished product to customers. Cold Spring and other granite companies in the St. Cloud area use black granite from China and India for

laser-etched headstones. This granite is shipped by boat to Tacoma, Washington, by rail to the Twin Cities and by truck to St. Cloud. Rail delays due to the Williston oil boom and bad weather have slowed these shipments recently.

The glass industry in the Owatonna-Faribault-Northfield region in southeast Minnesota employs 1,925 people and has a location quotient of 124.62. Several firms provide a variety of high-value glass treatments that are marketed primarily to commercial clients around the U.S. and overseas. These operations account for a significant share of regional employment in the U.S., with the industry directly employing over 1,900 workers, or over 10 percent of the region's total employees. The largest single company in the glass cluster is Viracon, an Owatonna-based architectural glass fabricator which is the city's second-largest employer with 1,446 local employees. Timely delivery of its finished product is a major issue for Viracon. Since many of their customers are developers of commercial properties and general contractors, it is critical that the glass panels arrive at the scheduled time. Delays in the delivery of its product can result in delays for construction projects as a whole and higher construction costs.

The recreational vehicle industry in northwest Minnesota has been a very competitive industry with a location quotient of 17.22. The snowmobile industry led by Polaris and Arctic Cat has moved into other recreational vehicles and has experienced rapid growth in recent years. The sparsely-populated area of the state relies on a high-quality workforce and a strong transportation and logistics system to respond to customer demand in a global market. Workforce shortages as well as capacity constraints in transportation and logistics are becoming challenges for the two companies as they experience growth and increased global demand.

Red Wing Shoe Company is unique to the shoe industry because they are one of the few companies that still manufactures shoes in the United States. Although the future competitive vision involves expanding to global markets, domestically, Red Wing Shoes is still the preferred boot for many workers in the construction, manufacturing, and transportation industries. Unlike other U.S. based companies that manufacture their product abroad, Red Wing Shoes follows OSHA (Occupational Health and Safety Administration) standards for safety (steel toes, leather and sole thickness), and their boots are the preferred brand for many laborers. Many union contracts, for example, stipulate that Union Laborers are allowed two new Red Wing Shoes boots each year, paid for by the company they work for. These contracts make up the majority of business for the shoe company.

The iron deposits in the Duluth Complex along the Mesabi Iron Range in the northern section of Minnesota are rich with high-quality deposits of iron ore. This abundance of material underpins the competitive advantage of the mining industry in Minnesota, creating opportunities for the development of an economy for an entire quadrant of the state based on the ability to extract minerals from a relatively narrow scratch of the earth's surface. Rail and water transportation are critical components for the mining industry in northern Minnesota and will continue to be important as new mining activities are developed in the region.

5.4 Transportation and logistics cluster

As a major hub for transportation networks in the Upper Midwest, the Minneapolis-St. Paul MSA has developed a significant industry cluster focused on transportation and logistics activities. A large component of this industry cluster (63 percent, as measured by employment)

is a subcluster focused on air transportation, owing the region being home to a major international airport and a hub for Delta Airlines. Another significant subcluster encompasses activities related to transportation arrangement and warehousing. The transportation and logistics industry cluster employed over 28,000 workers in the Twin Cities region alone as of 2011, with average wages in the cluster topping \$54,000.

Two major players in the transportation and logistics cluster are C.H. Robinson and FedEx. C.H. Robinson Worldwide, Incorporated, is a major third-party logistics provider, offering freight transportation and logistics, outsourcing services, produce sourcing, and information services to customers through a network of offices on five continents. The services offered to clients range from traditional brokerage services (e.g. spot market and surge capacity services) to more integrated types of logistics and information services.

FedEx Corporation is one of the world's largest integrated transportation and logistics companies, providing a variety of services to shippers, ranging from express courier services to ground transport and supply chain services. One way that FedEx actively attempts to improve its competitiveness is by expanding the reach of its networks and the variety of services it provides. This can also include identifying potential customers within existing markets. For example, in the Twin Cities region, FedEx works with companies in the Life Sciences and Medical Devices industries in order to provide transportation and related services.

5.5 Emerging clusters: Robotics, Water Technology

The Minneapolis-St. Paul region is a global leader in ground and industrial robotics, including basic and applied research institutions, established firms, and young companies. MSP's strength in robotics stems in part from the region's strength in bioscience, agriculture, mining, retail, and industrial manufacturing. In addition to benefiting these traditional industries, robotics is also at the forefront of some of the state's emerging industry strengths such as security and defense. Robotics Alley was founded to create public and private partnerships to enhance the emerging robotics cluster. Companies in this emerging cluster include Omnetics, NPC, Stratasys (3D printing), and PaR Systems.

Rapid global population growth, particularly in Asia and Sub-Saharan Africa, has led to exponentially increasing needs for global water infrastructure and technologies. Accordingly, water technology clusters have emerged across the globe to meet the growing demand for clean water and wastewater processing. With over \$729 million in water technology related exports produced by hundreds of local companies including several fortune 500s and a location quotient of 1.39, the Minneapolis/St. Paul (MSP) region has quickly risen to become a rising star in water. Key companies in the emerging water technology cluster include Pentair, Ecolab, 3M, Aeration Industries, Creative Water Solutions, among others.

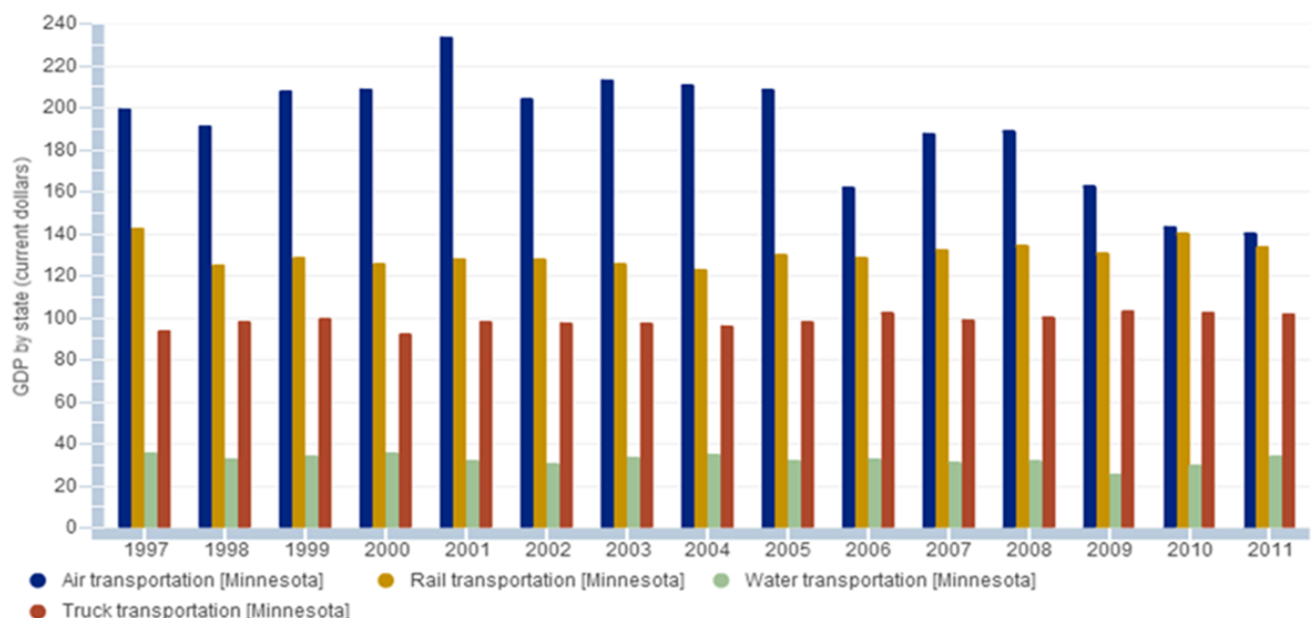
5.6 Minnesota transportation issues and economic competitiveness

Minnesota is centrally located within the U.S., with rich natural resources of water, minerals, agriculture and forest products, but with a relatively small market with 2 percent of the U.S. population. The region is a global business hub with a high concentration of corporate headquarters and managerial and professional talent located in the Minneapolis-St. Paul region. The competitiveness of the Minnesota economy in a global marketplace is dependent on a well-functioning transportation system in all modes—truck, air, rail, and water.

- Access to global markets requires rail and truck to reach coastal ports.
- Air transportation is critical for high value, low weight, time sensitive products such as medical devices or Mayo lab testing samples.
- Air service is important for customers at MSP, St. Cloud, and Rochester, Duluth, as well as other Minnesota cities
- Highway access and reliability is critical for key statewide clusters such as processed food, heavy machinery.

Minnesota has a diverse set of talent-driven traded industry clusters that provide products and services nationally and globally. The state’s central location in the continental U.S. requires a robust multimodal transportation system, including trucks, air, rail, water freight modes. All of these clusters rely on trucks for “last mile” as well as long-distance deliveries of supplies and customer products on a reliable, timely and cost-effective basis. By and large the Minnesota system of roads is working well for Minnesota companies, but the system needs to be consistently maintained and improved to assure the future competitiveness of these companies.

For future competitiveness, Minnesota’s transportation system will require new and ongoing investments to assure reliable, safe and quality road access for Minnesota companies and their employees; to establish new intermodal connections; and to maintain, replace and make needed improvements in existing transportation. In addition, Minnesota’s special winter weather challenges require continuous improvements in MnDOT’s 511 weather information and operational systems as well as public and private technology and system improvements. Minnesota’s economy is more dependent on rail than other states. Minnesota’s rail transportation share of gross state product (GSP) has been about 40 percent higher than the U.S. rail share of gross domestic product from 1997 to 2011 (Figure 2). With U.S. population more concentrated in the east and major ocean ports providing access to global markets on the east and west coast, rail is a particularly important transportation mode for key Minnesota industries such as agriculture, processed food, mining, paper and forest products. Air transportation is also relatively more important to Minnesota’s economy than other states, with a 40 percent higher GDP share than the U.S. as a whole. Minnesota’s air transportation GSP share has declined significantly since 2001 when it was 140 percent higher than the U.S.



Source: U.S. Bureau of Economic Analysis

Figure 5.1 Minnesota’s GDP Share Specialization by Transportation Mode, 1997 to 2011

average, perhaps in part because of the Northwest Airlines/Delta merger and shift of the company headquarters and business operations to Atlanta. Minnesota clusters where air transportation is particularly important are the medical devices c in the Minneapolis-St. Paul region and health care (Mayo Clinic) in Rochester. However, the MSP international airport and regional air transportation systems are important to other industry clusters as well. The Minneapolis-St. Paul region has a large concentration of corporate headquarters, with 19 of the Fortune 500 firms located in the region, including 3M, Target, General Mills, United Health, among others. These international firms require access to a strong international airport.

Water transportation is limited in Minnesota, although the state has significant ports in Duluth and on the Mississippi River. Minnesota's water transportation share is 40 percent of the national average. Since water transportation is the most cost effective mode in transporting products globally, Minnesota depends on rail, trucks, and intermodal transportation to reach global markets and suppliers. Mining in northeastern Minnesota relies on the Duluth port in exporting through the Great Lakes.

Winter weather poses special challenges for Minnesota economic competitiveness. Rail delays during severe winter adversely affect the granite industry cluster in St. Cloud and the paper cluster in Duluth. Air transport disruptions due to weather at the Rochester airport have imposed significant delays and costs to Mayo Clinic in timely delivery of lab samples from throughout the U.S. Road network disruptions and delays due to weather adversely affect processed food, recreational vehicles and other clusters critical to the Minnesota economy.

Chapter 6

Recommendations

Industry cluster mapping and analysis can be a useful tool for transportation planners and policymakers. These are a few areas where a cluster-based approach could enhance transportation planning.

6.1 Statewide Freight Planning

As Minnesota updates its freight plans, information about which industry clusters are most important to the state economy and specific information about how transportation costs influence cluster competitiveness could help in framing these plans. This information can deepen the analysis that goes into developing the freight plans and provide a more specific set of priorities based on ensuring that transportation investments support future cluster competitiveness.

6.2 Regional Transportation Strategies

While a few competitive clusters are statewide in scope, many of the clusters analyzed in this study were competitive in just one or a few regions of the state. Regional transportation leaders may find the cluster approach useful in developing regional transportation plans and in improving transportation services to support the competitiveness of regional businesses. The district engineer for District 8 in southwest Minnesota initiated outreach to manufacturers and carriers in his region which used an analysis of competitive clusters in selecting the companies to interview. The purpose of these interviews was to learn firsthand how well MnDOT was meeting the transportation needs of manufacturing firms and what improvements could be made. The success of this project has now led to a similar outreach initiative to manufacturers and carriers led by the district engineer in District 4 in west central Minnesota.

Regional planning organizations could also use a cluster approach in prioritizing transportation investments to address workforce-related transportation issues as well as freight issues. These regional organizations may also influence land-use/transportation issues that could affect the competitiveness of regional clusters.

6.3 Transportation Investments to Promote Economic Competitiveness

Minnesota could use a cluster mapping and an industry cluster approach as a means of identifying and prioritizing targeted investments to promote economic competitiveness. For example, Minnesota has a collaborative Transportation Economic Development (TED) program between MnDOT, the Minnesota Department of Employment and Economic Development (DEED), and the Public Facilities Authority to fund construction, reconstruction, and improvement of state and local transportation infrastructure in order to:

- create and preserve jobs
- improve the state's economic competitiveness
- increase the tax base
- accelerate transportation improvements to enhance safety and mobility
- promote partnerships with the private sector

The program provides state funding to close financing gaps for transportation infrastructure improvement construction costs. These improvements are expected to enhance the statewide

transportation network while promoting economic growth through the preservation or expansion of an existing business--or development of a new business. Criteria for funding under this program might include a demonstration that the funding will improve the competitiveness of a critical statewide or regional cluster or clusters.

Another Minnesota program funded by the Legislature could benefit by a focus on competitive clusters. The 2013 Minnesota Legislature created the Corridors of Commerce program by authorizing the sale of up to \$300 million in new bonds for the construction, reconstruction and improvement of trunk highways (15). The Minnesota Legislature provided an additional \$31.5 million in funding during the 2014 legislative session. The program's goals are to:

- Provide additional highway capacity on segments where there are currently bottlenecks in the system.
- Improve the movement of freight and reduce barriers to commerce.

The Corridors of Commerce program could use data from cluster mapping and cluster competitiveness analysis to help prioritize these investments.

6.4 Intermodal Connections and Investments

Cluster mapping and interviews may help to identify opportunities to reduce transportation costs and expand capacity to support competitive clusters through improved intermodal connections between roads, rail, water and air. Strategic investments or policy decisions to make rail, water or air transportation more accessible, less costly or more reliable could enhance the competitiveness of important clusters to a region.

6.5 Public-private partnerships and collaboration

A systematic approach to analyzing and reaching out to competitive regional clusters may lead to new collaborations among transportation professionals and industry cluster leaders, improving the effectiveness of transportation services and making more strategic transportation investments. The increased public-private collaboration may also encourage greater collaboration among public agencies that is necessary in addressing the transportation challenges identified through the cluster-based process.

Chapter 7

Conclusion

The clustering of firms in a given industry in urban areas of various sizes will remain a topic of great interest to both academics and practitioners in fields of economics and transportation in the years to come. This study demonstrates the potential for practical applications of the industry cluster approach in both understanding the transportation needs of firms within competitive industry clusters and in understanding the role that transportation networks and services play in supporting the development of such clusters.

The approach adopted in this study, namely looking at industry clusters in different regions of the state and differentiating between single-industry clusters, multi-region clusters, and clusters that are more statewide in character, indicates that different types of lessons may be drawn from each. For example, the transportation needs of firms in competitive industry clusters that are found throughout a state may help transportation planners provide a basis for broad-based policies relating to freight movement or maintenance operations. On the other end of the spectrum, examination of firms in single-industry clusters may yield insights about policies which are highly specialized and locally targeted, such as efforts to improve regional airline service. We have also highlighted other policy areas that might be informed by an industry cluster-based approach, including intermodal freight connections and opportunities for collaboration between transportation agencies and local industry stakeholders on key funding and investment decisions.

Despite its promise, the industry cluster approach described here is not without limitations, and any prospective user of this approach should be aware of them. First, it is important to note that the industry cluster approach, as originally conceived, was targeted towards larger urban areas with generally more diverse economies. As adopted in the current study, it is applied not only to larger urban areas, but also to regions that meet the U.S. Census definition of a micropolitan area. This increases the chances that a competitive industry cluster, as defined here, may be dominated by a single large firm or very small number of firms, rather than the larger, more robust clusters of firms found in metropolitan economies.

Second, the approach of interviewing firms in competitive industry clusters is somewhat limited in terms of its generalizability. Due to resource constraints and the time and labor-intensive process of conducting interviews, it is often not possible to interview more than a couple of firms in a given industry cluster. This raises some concerns about the representativeness of the firms chosen relative to their industry as a whole. The firms that are ultimately chosen may vary considerably from others classified within the same cluster in terms of size of operation and the type of product being produced.

Thirdly, it is important to note that this study follows the convention of using industry employment as a basis for identifying clusters as competitive. While employment generally tends to correlate reasonably well with other measures of economic activity, there may be some industries for which other types of measures might be preferable. Examples might include various types of manufacturing industries that have increased their productivity and become relatively less labor-intensive over time. Focusing on employment as a measure of activity in

this case might overstate the decline in competitiveness in the industry over time, relative to another measure such as industry earnings which might give a better sense of the industry's degree of export orientation and overall competitiveness.

Finally, an underlying theme of an approach focusing on competitive industry clusters is that economic efficiency is an overriding objective of the analysis. Targeting competitive industry clusters may yield more productive investments overall, especially as related to freight movements, but it may also be at odds with other policy objectives that seek to ensure a more even distribution of resources across space, between industries, between modes, or between passenger and freight needs. It may also result in "lock in" effects, whereby industries or locations that receive additional investment due to their initial competitive position ultimately become more competitive relative to other in-state industries or locations and thus command more resources, creating a feedback cycle in the allocation of transportation resources. This type of outcome represents an important tradeoff that must be considered in the use of the cluster approach.

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Appendix A: Cluster Selection Matrix

Appendix B: Interviews by Cluster, Location, Company and Contact

Interviews by Cluster, Location, Company and Contact

Cut and Crushed Stone – St. Cloud

- Coldspring Granite Company - Theresa Cervantez
- Sunburst Memorials - David Fischer

Forest Products - Duluth

- Lake States Lumber - Jay Baker
- New Page Corporation - Mary Tourville

Glass - Faribault

- Lite Sentry Corp - Gary DiDio
- Viracon Inc. - Troy Hansen
- Sage Electrochromics - Rick Caron

Healthcare – Rochester

- Mayo Health - Tim Geisler

Heavy Machinery – Fairmont & Jackson

- Henway Manufacturing - Mel Breitbarth
- Easy Automation - Ann Schultz
- AGCO - Craig Jones

Hospitality and Tourism – Brainerd

- Grand View Lodge - Mark Ronnei
- Northwoods Dock and Service - Tim Mueller

Medical Devices – Minneapolis – St. Paul

- Medtronic - Sam Ingram
- Boston Scientific - Mike Alcott

Printing and Publishing - Mankato

- Coughlan Companies - Maryellen Coughlan
- Taylor Companies - Jay Parker
- The Creative Company - Keith Haefner

Processed Food - Worthington

- JBS USA - Gerald Pederson
- Merck Animal Health - Pat Williams
- New Vision Co-Op - Don Buys

Recreational Vehicles – Northwest Minnesota

- Arctic Cat - Paul Fisher
- Mattracks - Jamie Reese
- Polaris - Paul Gumeringer

Robotics – Minneapolis – St. Paul

- NPC Robotics - Paul Dickie
- Omnetics - Twila Geier

Transportation and Logistics – Minneapolis – St. Paul

- CH Robinson - Jason Craig
- FedEx – Bill Goins

Appendix C: Project Description and Interview Guide

Transportation Planning to Support Economic Development in Minnesota

PROJECT DESCRIPTION AND GOALS Historically, policies oriented toward the use of transportation infrastructure to promote economic development have focused on infrastructure as the magnet for firm location, with little regard for the characteristics of each specific industry. This project seeks to identify the relationship between transportation and economic development by investigating how firms use transportation networks and what role they play in the formation and growth of industry clusters. It is expected the results will yield valuable insights into how transportation functions as an input within industry clusters, and how it can inform economic development strategies tailored to certain locations and industries.

METHODOLOGY AND SCOPE The Humphrey School's approach combines quantitative and qualitative techniques to geographically identify competitive industry clusters in Minnesota's metropolitan and micropolitan regions and to further investigate the role of transportation in these industry clusters.

- *Competitiveness Analysis* Industries in every micropolitan and metropolitan were analyzed by specialization base on employment concentration and change over time.
- *Cluster Selection* Using a new cluster mapping tool developed by a Harvard Business School team, clusters were identified. Twelve clusters were selected by the MnDOT technical advisory panel on the basis of the competitiveness analysis; six in metropolitan areas and six in micropolitan areas.
- *Interviews and Site Visits* The project team will conduct 20-40 interviews with representatives from companies across the selected clusters.
- *Analysis* Using the information collected through focus groups, interviews, and site visits, the project team will analyze and synthesize the qualitative results, looking for patterns and common issues among regions and clusters.

OBJECTIVES From this study, researchers expect a more in-depth knowledge of the role of transportation in the economic development process at a micro-level. The findings are expected to reveal the multitude of ways in which firms make use of different modes of transportation in their production processes, from increasing the potential pool of highly skilled labor to using air, truck, or rail freight to ship inputs and finished goods. The information compiled from this study may be valuable for

- designing policy toward transportation and economic development that is focused on specific industries or geographic location;
- developing long-term, strategic investment policies to promoted economic development tailored to the variety of economic conditions that exist around the state.

Project timeline: July 2013 to December 2014

Project contact: Lee Munnich, State and Local Policy Program Director, (612) 625-7357

Transportation Planning to Support Economic Development in Minnesota

INTRODUCTIONS

We appreciate you taking the time to meet with us and share this information. We estimate the interview should take around an hour. We will share the draft section about your cluster before the final draft of the report is released. If you have any changes or corrections related to your interview, we will gladly make those corrections.

GENERAL QUESTIONS

1. What is your average annual sales? _____
2. Approximately how many people are employed at this location? _____
3. Generally, what skills do your employees have?

4. Are there any transportation issues associated with your employees getting to and from work?

5. Please describe your company's primary products.

6. How have new technologies changed the way you do business?

7. Is your company planning an expansion? _____

8. If so, how important will transportation and logistics be in this decision?

Location

1. Why are you located here? *Historical accident, raw materials access, partnerships*

2. How long have you been in this location?

3. Do you have other locations?

4. What roles do they play in product distribution?

5. What are the strengths of your current location in meeting your firm's transportation needs?

7. What is the role of supply chain management in your company?

8. What are your transportation challenges or concerns in receiving inputs and shipping products?

COMPETITION

1. Broadly, what role does transportation play in your ability to compete?

2. Who are your major competitors and where are they located?

TRANSPORTATION

1. Do you transport your products in-house or contract with private commercial transportation service providers?

2. Could you discuss and prioritize the importance of the following factors as they affect your transportation decisions? *Transit time, cost, safety, reliability, other*

Appendix D: Cluster Definitions

Cluster Definitions

Clusters are based on the North American Industry Classification System (NAICS) codes used by the Federal government to classify businesses for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. economy.

Construction Materials

The Construction Materials cluster encompasses any business that may mine, cut, produce, or distribute any item used in general construction. This is a diverse cluster that includes:

- Wood Container and Pallet Manufacturing
- Brick and Structural Clay Tile Manufacturing
- Rubber Product Manufacturing
- Processed and Blown Glass Manufacturing
- Vitreous China Plumbing Fixtures
- Cut Stone and Stone Product Manufacturing

Forest Products

Within the Forest Products cluster are industries that include:

- Paper Manufacturing
- Wood Window and Door Manufacturing
- Sanitary Paper Product Manufacturing
- Cut Stock, Resawing Lumber, and Planing
- Newsprint Mills
- Prefabricated Wood Building Manufacturing

Heavy Machinery

Within the Heavy Machinery cluster are industries that include:

- Farm and Garden Machinery and Equipment Merchant Wholesalers
- Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing
- Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing
- Farm Machinery and Equipment Manufacturing
- Fluid Power Pump and Motor Manufacturing
- Overhead Traveling Crane, Hoist, and Monorail System Manufacturing

Hospitality and Tourism

The Hospitality and Tourism cluster includes industries directly and indirectly related to tourism.

- Hotels and Motels
- Passenger Car Rental
- Racetracks
- Bed and Breakfast Inns
- Charter Bus
- Spectator Sports
- RV Parks and Campgrounds
- Taxi Service
- Amusement and

Medical Devices

The Medical Devices cluster relies heavily on technology and includes the following types of manufacturing:

- Surgical and Medical Instrument
- Ophthalmic Goods
- In-Vitro Diagnostic Substance
- Surgical Appliance and Supplies
- Electromedical and Electrotherapeutic Apparatus
- Biological Product
- Dental Equipment and Supplies
- Irradiation Apparatus

Processed Foods

The Processed Foods cluster encompasses any business that may produce human or animal food or related businesses like food storage. This is a diverse cluster that includes:

- Dry Pasta Manufacturing
- Dog and Cat Food Manufacturing
- Breweries
- Flour Milling
- Paperboard Box Manufacturing
- Metal Can Manufacturing
- Animal Slaughtering
- Rendering and Meat By-Product Processing
- Grain and Field Bean Wholesalers

Production Technology

Production Technology is a diverse cluster that includes manufacturing of many different items. These may include:

- Packaging Machinery
- Air and Gas Compressor
- Gasket, Packing, and Sealing Device
- Fluid Power Valve and Hose Fitting
- Welding and Soldering Equipment
- Plate Work
- Ball and Roller Bearing
- Relay and Industrial Control
- Cutting Tool and Machine Tool Accessory

Publishing and Printing

The Publishing and Printing Cluster includes traditional paper printing but also new media like music and signs, and all supporting and related industries. Example industries include:

- Book Publishers
- Sign Manufacturing
- Printing Ink Manufacturing
- Commercial Photography
- Music Publishers
- Die Cut Paper and Paperboard Office Supplies
- Internet Publishing and Broadcasting
- Media Buying Agencies
- Envelope Manufacturing

Manufacturing

Recreational Vehicles

The Recreational Vehicles Cluster encompasses vehicle manufacturing and all other support industries. Some of these industries include:

- Light Truck and Utility Vehicle Manufacturing
- Gasoline Engine and Engine Parts
- Motor Vehicle Steering and Suspension Components Manufacturing
- Motor Vehicle Brake System Manufacturing
- Motor Vehicle Seating and Interior Trim Manufacturing
- Rubber and Plastics Hoses and Belting Manufacturing
- Motor Vehicle Metal Stamping
- Special Die and Tool, Die Set, Jib, and Fixture Manufacturing
- Carburetor, Piston, Piston Ring, and Valve Manufacturing

Appendix E: Graduate student team cluster projects

Transportation Planning to Support Economic Development in Minnesota

Graduate student team cluster projects

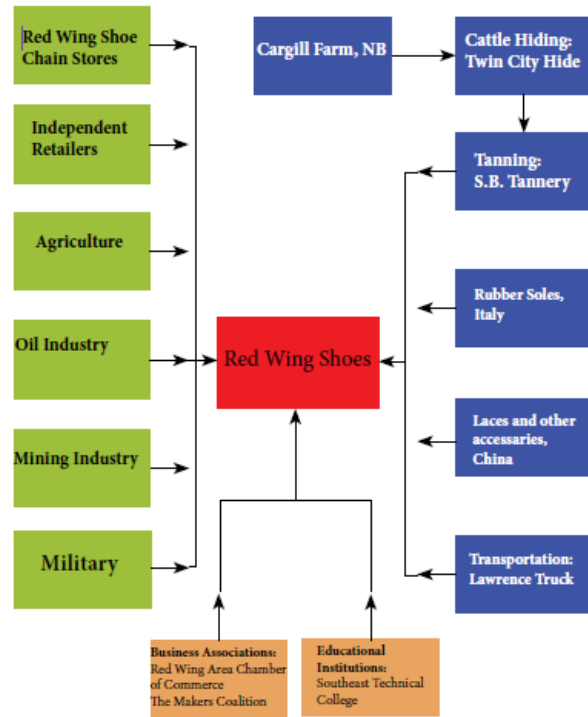
Humphrey graduate student teams in the PA 5590 “Economic Competitiveness: Firms, Clusters and Economic Development” course during the 2013 fall semester prepared regional industry cluster reports. These were:

- **Red Wing Shoes Company Cluster** by Jason Buck, Lauren Tjernlund, and Seunghoon Oh
- **Minneapolis/St. Paul Water Technologies: An emerging cluster in the Twin Cities** by Addison Vang and Joel Huting
- **Industry Clusters: Mining Minnesota’s Iron Range** by Robert Clarksen, Chuqing Dong, Filza Nassir, Leah Palmer

The following are highlights from the three reports, transportation issues, and policy recommendations.

E-1 Red Wing Shoes Company Cluster

Red Wing Shoes has three U.S. locations where they manufacture boots. Two are located in Red Wing, MN, and one in Potosi, Missouri. Though the majority of shoes are manufactured in Red Wing, it is actually cheaper to manufacture the shoes in Potosi because the labor is less expensive since Missouri is a “Right-To-Work” and the workforce is not unionized. However, since the story began in Red Wing and the owners have very strong ties to the community, more people are employed at the Red Wing location and therefore more shoes are produced there. From start to finish, there are many different parts and locations involved in the manufacture of a single Red Wing Shoes boot.



Red Wing Shoe Co. Cluster Map

Red Wing Shoe Company is unique to the shoe industry because they are one of the few companies that still manufacture their shoes in the United States. For the Sweasy family, owners of Red Wing Shoe, they choose to keep the company and manufacturing primarily in Red Wing, MN, because of community ties. However, Red Wing Shoes knows that the numbers don’t lie. The cost of producing a pair of boots in Red Wing is \$75 versus less than \$40 if done in China. Therefore, Red Wing Shoes is aware that it needs to find other ways to remain competitive in the shoe industry. One way is by selling their

shoes to the international market, which currently accounts for about 15% of the company’s sales (Peter Engel Interview 10/30/13). CEO of Red Wing Shoes, echoed this sentiment, saying, “I think the footwear business is going through a lot of consolidation. There are fewer bigger companies and they’re generally global. So one of the strategies for success is to become a global business (Minneapolis/St. Paul Journal, 11/2/97).” Today, Peter Engel, head of marketing at Red Wing Shoes, confirms that the goal is the same and growing into a more global company is still a top priority.

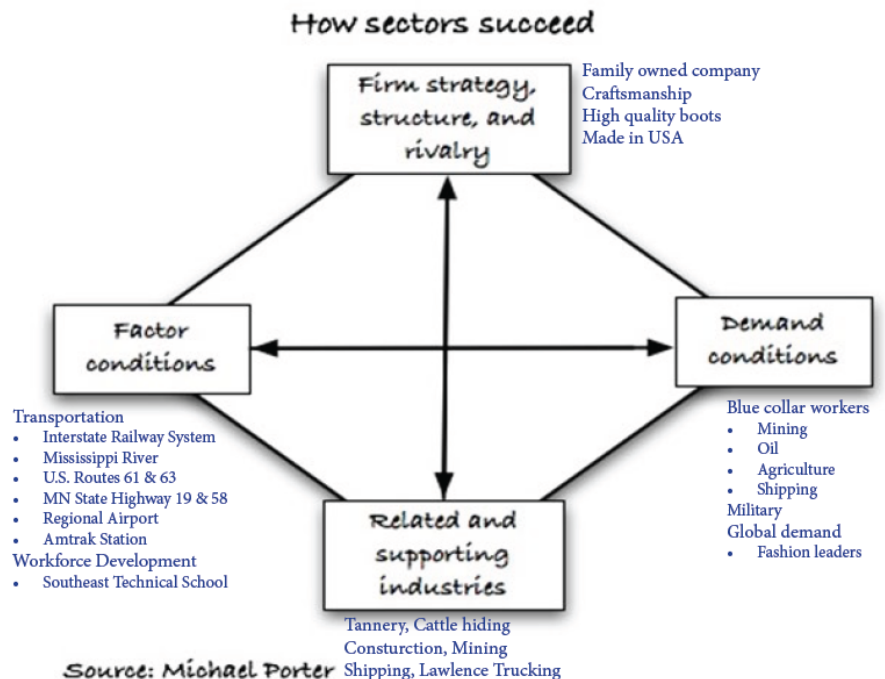
Although the future competitive vision involves expanding to global markets, domestically, Red Wing Shoes is still the preferred boot for many workers in the construction, manufacturing, and transportation industries. Unlike other U.S. based companies that manufacture their product abroad, Red Wing Shoes follows OSHA (Occupational Health and Safety Administration) standards for safety (steel toes, leather and sole thickness), and their boots are the preferred brand for many laborers. Many union contracts, for example, stipulate that Union Laborers are allowed two new Red Wing Shoes boots each year, paid for by the company they work for. These contracts make up the majority of business for the shoe company.

Transportation Issues

Red Wing shoes is perfectly located, close to the Twin Cities of Minneapolis/Saint Paul and near an interstate railway system, making it easy for the company to ship and receive vital goods for the shoemaking process.

Additionally, it is located on the Mississippi River, which was key to the initial growth of the city as a whole and helped bring settlers and supplies to the region. In terms of ground transportation, Red Wing has U.S. Routes 61 and 63, and MN State Highways 19 and 58. There is also a regional airport located in Red Wing that has been used on occasion by business associates of Red Wing Shoes. As well, Red Wing’s Amtrak Station is served by Amtrak’s Empire Builder with almost daily service in each direction between Chicago, Seattle, and Portland.

Porter Diamond Model applied to Red Wing Shoes Co.



Having the “Made In America” stamp on the boots is definitely a valuable strategy for Red Wing Shoes, however, Red Wing Shoes is diversifying its global manufacturing footprint to better compete with other shoe manufacturers. Locally, there are many supporting and relating industries that contribute to the success and competitiveness of

Red Wing Shoes. S&B Tannery, for example, is located across the street and supplies beautifully crafted leather to Red Wing Shoes in which they cut and design into durable boots. Also both Twin City Hide Co., who provides the “wet blues”, and International Paper, who create the boxes for the shoes, support and sustain Red Wing Shoes Co. and their manufacture process. The construction, mining, and shipping industry in the Midwest and throughout the U.S. support Red Wing Shoes by purchasing their boots from there and requiring union contracts to allow for Red Wing Shoes to be the preferred boot. Lawrence Trucking, a trucking company located in Red Wing, MN transports much of the manufacture supplies to Red Wing Shoes. All of these relating and support industries are the driving force behind Red Wing Shoes present day success.

Policy Recommendations

1. Invest in Workforce Education and Development

In discussions with Red Wing Shoes’ head of Marketing, Peter Engle, a major worry for the company in the near future is workforce development. As garment and shoe manufacturing have moved overseas, the workforce in Red Wing, as in most of the country, has stopped developing the specialized skills needed in the shoemaking industry. To combat this loss of craftspeople, and to ensure that quality products will be made in Red Wing well into the future, investing in workforce development is important in keeping Red Wing Shoes a viable American made



Global Market for Red Wing Shoes

brand. With Red Wing Shoe’s aging workforce, Engle noted, “It’s difficult to find new employees that not only want to come work in Red Wing, but also have the technical skills to manufacture our product.” To find a solution to this problem, we recommend looking at

the model created by another Minnesota based company, J.W. Hulme. J.W. Hulme manufactures their product in Saint Paul, Minnesota, and has faced the same problem of finding skilled craftspeople to manufacture their product. The solution J.W. Hulme developed was helping to create a non-profit organization called The Maker’s Coalition in partnership with the United Way. What The Maker’s Coalition has developed, in conjunction with Dunwoody Institute in Minneapolis, Minnesota, is a six month program to train the next generation of American garment craftspeople.

What we recommend is that Minnesota State College Southeast Technical, with the help of The Maker’s Coalition, develop a curriculum to train Red Wing area residents in the skills needed to carry on the tradition of American excellence at Red Wing Shoes. To further the goal of developing this program, the State of Minnesota should enact legislation that offers grants to help cover some of the cost of this specialized education. With the endorsement from the state,

this program should attract enough candidates to help maintain and grow the quality workforce of Red Wing Shoes.

2. Repeal Warehouse Tax

During the 2013 Legislative Session, there were a number of tax increases that were passed to help balance the state's budget and pay for new initiatives, such as all-day Kindergarten. Among new taxes that were enacted is a Warehouse Tax that is set to take effect on April 1, 2014. What this tax does, is levy a sales tax on warehousing storage services. You are not subject to this tax if you are housing your own raw materials used in manufacture or your finished goods in a warehouse you own, only if you lease this space to others. As well, if you are a logistics company using your warehouse to store goods while they are in transit, you will be subject to the tax.

If you are a company with excess warehousing space and would like to lease this extra space, you will be subject to Minnesota State sales tax on this lease. This law is causing Red Wing Shoes to defer building new warehouse space in Red Wing. Red Wing Shoes is currently considering adding a \$20 million distribution and warehouse to help handle expansion of the product line in the future.

Currently the company is deciding between building the warehouse in their headquarter city or adding this development to property they own in Potosi, Missouri. Why this is a debate for the company, initially this warehouse space will be too large and they would like to lease the excess space they are not using. With Minnesota's sales tax that will add 6.875% to the cost of a lease, Red Wing Shoes fears they will lose this business opportunity to Wisconsin border cities.

In an industry with razor thin margins, the cost of making a pair of boots in Minnesota is \$75 versus \$40 in China, every dollar counts. By repealing the Warehouse Tax, Red Wing Shoes will be more apt to build their new warehouse in Minnesota and protect and grow Minnesota jobs.

3. Protect the Prairie Island Nuclear Facility/Create a 20 Year Plan

The Prairie Island Nuclear Facility is Red Wings' number one property tax generator. For fiscal year 2012, the plant was responsible for 40% of all of Red Wing's property tax collections, or about \$14M. With expansion and upgrades that are currently underway, by 2016 these tax collections are expected to grow to \$19M or 48% of all property taxes collected in the city. This creates both an opportunity and a dilemma for the city of Red Wing. Currently, the Prairie Island plant subsidizes the property tax base of Red Wing and keeps these taxes low. The city of Red Wing needs to leverage their low property tax rates to help grow the city's population and commercial base. In conjunction with the Chamber of Commerce, the city needs to advertise these strengths and lure investment to Red Wing.

To this point, leaders from Red Wing need to ensure that the State of Minnesota stays friendly toward nuclear power. While Prairie Island is safe and one of the largest electricity producing plants in Xcel Energy's portfolio, policy changes can happen quickly and erode these advantages. With the help of the regions State Representative and Senator, these policy makers should work to keep policy in line with the productive attributes of Prairie Island.

As well, the useful life of Prairie Island is estimated at only twenty more years. The city of Red Wing should fund a study on the effects of a shutdown of the plant and what it will do to the property tax and job base. Given the large lead time, the city should be well prepared for the time when the Prairie Island plant is decommissioned. If growth initiatives are undertaken, the closing of the plant should not decimate the city.

4. National Policy Recommendation

The challenge facing the shoe manufacturing industry comes as corporate America begins a pattern of globalization that has seen US companies relocate manufacturing jobs overseas for the past 30 years. However, there are numerous tax cuts, stimulus programs, and educational training options that the US Government could initiate to promote shoe companies to manufacture in the U.S. and U.S. consumers to only buy “Made In America” products. The question is will the government choose to do so?

Currently, there is a threat coming from a trade agreement in the White House, in which the US government is negotiating with nine Asian countries. The trade agreement is known as the Trans-Pacific Partnership that seeks the elimination of tariffs that the US currently imposes on shoes the Asian countries export to the US. However, many US shoe manufacturers argue that the tariffs should be kept because the Asian governments already heavily subsidize many of their own shoe industries. Though there has been no signing of the agreement yet, this paper recommends in agreement with many other US shoe manufacturers, including New Balance, that this trade pact should not be signed. If signed, the shoe industry in the US will suffer greatly and the already struggling firms will see a huge rise in costs and pressure from competition. Red Wing Shoes will definitely see the negative impacts of this agreement if signed by the US and their future success will be threatened.

**CRAFTING THE FINEST
FOOTWEAR FOR WORK & PLAY**

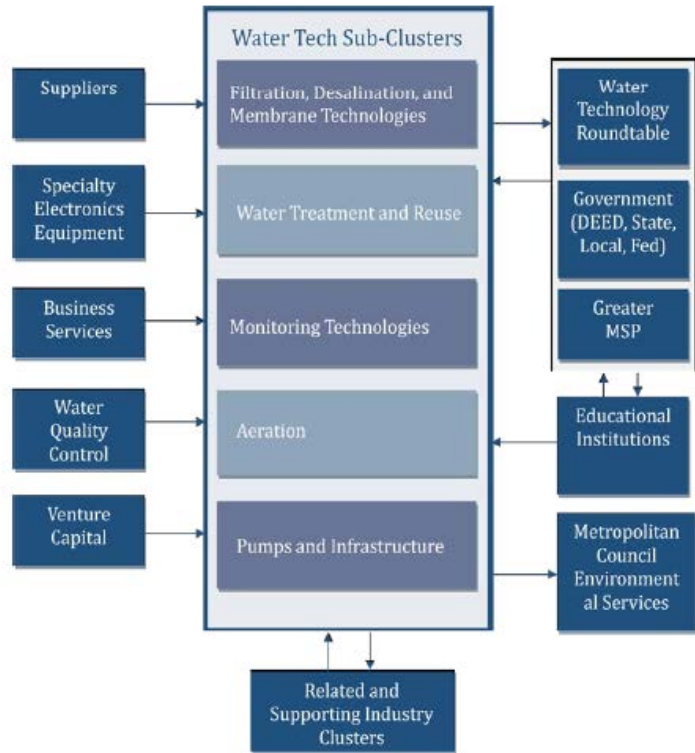


E-2 Minneapolis/St. Paul Water Technologies: An emerging cluster in the Twin Cities

Rapid global population growth, particularly in Asia and Sub-Saharan Africa, has led to exponentially increasing needs for global water infrastructure and technologies. Accordingly, water technology clusters have emerged across the globe to meet the growing demand for clean water and wastewater processing. With over \$729 million in water technology related exports produced by hundreds of local companies including several fortune 500s and a location quotient of 1.39, the Minneapolis/St. Paul (MSP) region has quickly risen to become a rising star in water.

In this paper, the emerging water technology cluster in the Twin Cities was analyzed. First, the competitive position of the MSP region was explored. Diamond analysis was used as a tool to identify the relative competitive advantages and disadvantages of the region for the development of a water technology cluster. Next, a list of water technology companies in the region was compiled and interviews were conducted with many executives at top water technology companies and water policy leaders in the region. These interviews provided qualitative insights into the issues faced by the organizations and a more in depth understanding of the products and layout of the industry. A cluster map was then produced to develop an understanding of how various components of the cluster interrelate. A location quotient was derived to determine the density of water technology employment in the Twin Cities vs. the United States. Next, analysis was conducted of other water clusters in the nation and in the world to gain knowledge of practices and policies that have improved or hindered water cluster competitiveness. Finally, policy recommendations were produced to help stimulate and further develop the cluster.

Minneapolis/St. Paul Water Technology Cluster Map



Transportation Issues

The Minneapolis/St. Paul region has good overall infrastructure to support the development of a water technology cluster. The MSP International airport is the 17th busiest in the United States and 41st busiest airport in the world. It is the third largest hub for Delta Airlines and is the home airport for Sun Country Airlines. Travel and Leisure magazine ranked the airport as “America’s Best Airport” based on a vector of metrics including flight delays, design, amenities, food and

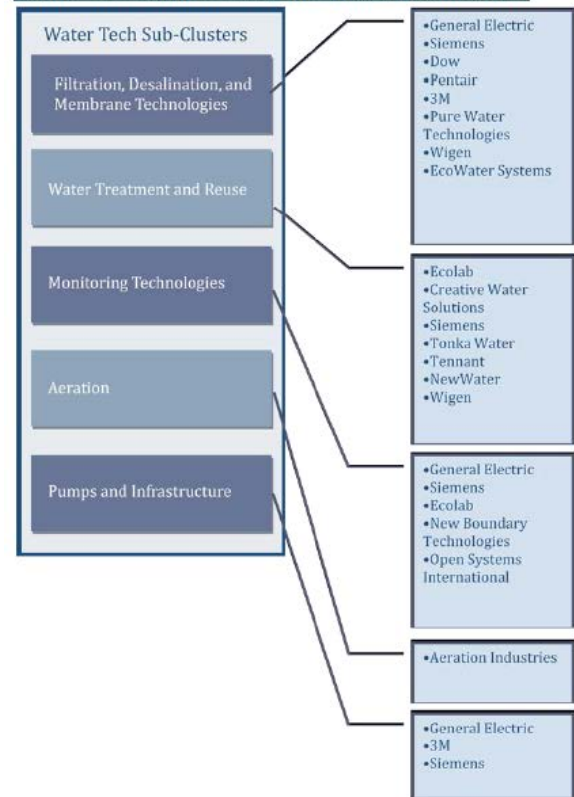
drink, check-in and security, service, transportation, and location. Linking the airport to downtown Minneapolis is the Metro Transit Hiawatha Light Rail Line along with a host of bus and taxi services linking the airport to St. Paul along with other regional cities.

The region also has a well-developed network of interstate highways and roads to support transportation of water technology products.

Minnesota has the nation’s fifth largest highway system with more than 140,000 miles of state, county and local roads, and more than 20,000 bridges. Interstate 494 connects the airport to Interstate 35W to Minneapolis and Interstate 35E to St. Paul. Interstate 394 connects the western suburbs to downtown Minneapolis, and Interstate 694 provides access to northern suburbs. Interstate 94 spans from the northwest metro through the downtowns of Minneapolis and St. Paul and then connects the eastern suburbs and Wisconsin.

However, the aging system is costly to maintain. Around fifty percent of the state’s highway pavements are more than fifty years old and forty percent of the bridges are more than forty years old. The Minnesota Department of Transportation reported that more than 14% of the state’s bridges were in fair or poor condition and 6.6% of highway pavements were in poor condition. In 2007, the eight-lane I35W Bridge collapsed into the Mississippi River in downtown Minneapolis killing 13 people and injuring 145.

Minnesota Companies in the Water Tech Cluster



The Minnesota Transportation Finance Advisory Committee was established in 2012 to develop recommendations for the next 20 years to fund and finance the state’s highways, roads, bridges, and public transport systems. The recommendations are as follows:

- Increase motor vehicle registration fees
- Increase per-gallon excise tax on motor fuels
- Add \$0.005 to the existing \$0.0025 sales tax for transit in the Twin Cities Metro
- Expand the option of the wheelage tax for 80 counties in Greater Minnesota
- Enable the local option for the formation of Transportation Improvement Districts
- Enable local option sales taxes for transportation in 80 counties without the need of a referendum
- Expand regional transit capital levy in entire seven-county Twin Cities metro and use funds for capital and operating needs
- Expand MnPASS system
- Employ Value Capture concepts around transportation improvements

A new, more novel approach to transportation funding under discussion in policy circles in Minnesota is the mileage-based user fee to replace or supplement the traditional gasoline tax

model. There are several GPS based technologies undergoing testing for this application including a test being conducted by MnDOT on smartphone based technology. This approach could provide more equitable outcomes with more efficiency, higher revenues, and increased environmental sustainability.

The region also has a well-established and developed freight railroad system for transporting goods. Class 1 railroads with major lines in Minnesota include Burlington Northern-Santa Fe, Canadian Pacific, Canadian National, and Union Pacific. In addition there are seven Class 1 subsidiary railroads and 17 Class 3 or private railroads.

Passenger transit is also well established in the region with an extensive bus system and a growing rail system. Metro Transit is the primary provider in the seven county region with over 70 Million annual bus rides, approximately 10 million annual light rail rides, and about 800,000 annual

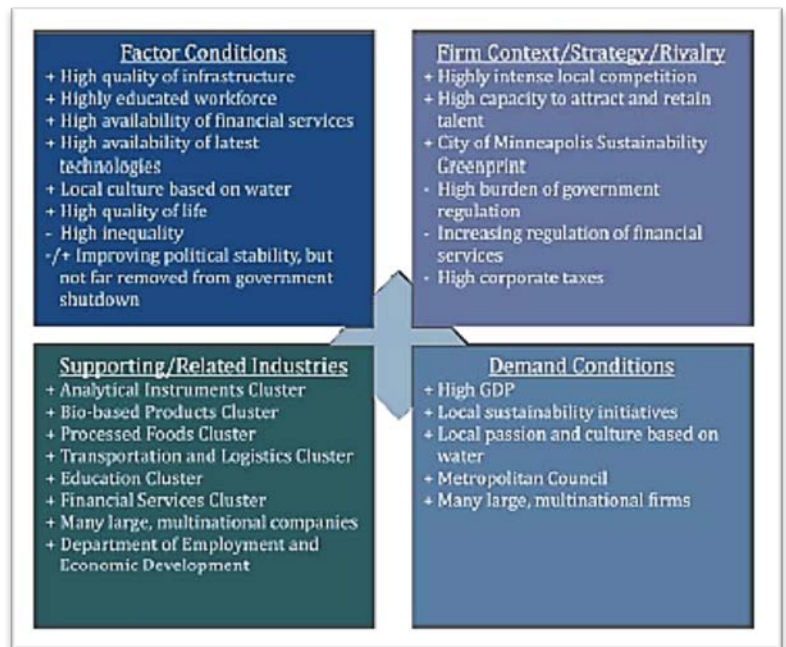
Commuter Rail rides. The region is a few months out from opening the second light rail line which will connect downtown St. Paul with Downtown Minneapolis. In addition, the Southwest Corridor Light Rail line is currently in the planning phase (Metro Transit). This line will provide service to many of the southwest suburbs where water technology companies are located. Figure 4 shows water technology companies in relation to major passenger rail and highway systems.

As Baby Boomers retire and are replaced by Millennials, it is important for us to consider their transit desires when strategizing as a region to increase competitiveness. A recent APTA study found that communities that attract Millennials have a multitude of transportation choices. In this context, it will be important for the region to continue to invest in transit infrastructure.

Policy Recommendations

1. Agricultural Accountability

Hold the agricultural sector accountable for water pollution and environmentally damaging fertilizer runoffs. Farmers' exemptions from pollution control laws is an area that has major implications for water technology. Agricultural businesses are exempted from the Clean Water Act and many other pollution laws, however, farmers are the nation's largest water users and polluters in the nation.⁷⁸ Minnesota Statute 272.02 (Exempt Property) subdivision 10 (personal property used for pollution control) states that "Personal property used primarily for the abatement and control of air, water, or land pollution is exempt to the extent that it is so used, and real property is exempt...as part of an agricultural operation."⁷⁹



Water Technology Cluster Diamond

One possible step towards changing the laws would be to have some legislation enforcing the agricultural sector to monitor the amount of pollutants they produce in all areas of their production from their direct site to the surrounding areas. Pollution monitoring from the agricultural sector could lead to better policies to protect Minnesota's water system. If the law imposes more responsibilities and liabilities towards farmers in the agricultural sector it would open a new area that has been inaccessible to the industry.

The policy would encourage the agricultural sector to be more conscientious of their production. It would also provide the industry access to a sector that has been inaccessible. However, there needs to be considerations on the impact to the agricultural sector in decreased output and efficiency.

2. Lower Corporate Tax

Minnesota should consider lowering corporate taxes to encourage entrepreneurs and startups. The Small Business & Entrepreneurship Council recently reported that Minnesota ranks 45th in the nation for entrepreneur-friendly policies,⁸⁰ and in another study by The Tax Foundation had Minnesota ranked 47th in the nation. The highest ranked states in the nation, as done by The Tax Foundation, had no corporate or individual taxes.

3. Incubation center

A location specified as an incubator for innovation will help drive the water technology industry. An incubator would house individuals and organizations with the sole purpose of innovative technology. A mix of government, academia, and industry would provide quick and accessible resources to solving water problems, policies, and technical issues. Paige Novak, co-director of the MnDrive Initiative in Advancing Industry, Conserving our Environment, suggests that there needs to be a space where all players can be involved. A center for incubation would provide a space to research technologies to be shared and showcased. In addition, the space would provide a testing ground for innovative technologies and a business recruitment tool for the water technology industry.

4. Support Entrepreneurs and Startups

Entrepreneurs and startup companies should be supported with all the necessary resources to succeed and grow the water industry in the Minneapolis-St. Paul region. Assistance in business, research, marketing, and some financial assistance should be provided for innovative projects. Israel provides a model to support startups. Their incubation programs provide marketing, research, and financial assistance to entrepreneurs and startup projects from the start of the project to being ready for commercialization within two years. Israel also provides innovative startups the opportunity to showcase their technologies during their Singapore International Water Week.

Minneapolis was recently ranked the 4th most friendly state in the nation for female entrepreneurs, according to Intuit, Inc. using data from Forbes magazine and NerdWallet.com, and other factors. There are several reasons for female entrepreneurial success. For example,

Minneapolis houses many women supported business organizations such as the Women's Business Development Center.

5. Water Technology Agency

Formation of a water technology agency supported by the government, industry, and academia is key to the success of a water technology cluster. The agency should be non-biased to any organization but should include board members from the government, industry or academia.

Greater MSP or a similar economic development agency could be charged with the success of the cluster in order to provide direction to all the various players and stakeholders within the water technology cluster. Modeling an agency after the Milwaukee Water Council and having the industry drive the agency is another option. Another model would be creating a pseudo government agency. Any of these options seem viable for a Minneapolis-Saint Paul cluster because: legislation has recognized water technology to be important to the economy of Minnesota with the MnDrive initiative, Greater MSP has shown interest in the cluster, and the large amount of water technology companies in the location.

6. Creation of Summit or Forum

The creation of a water technology summit or a similar event would greatly boost the economic region. It would provide the water industry of the region the opportunity to showcase innovative technologies to outside firms while attracting new businesses, and networking with other clusters. In addition, it could provide startup companies a platform to showcase their technologies and increase the company profile.

7. Address Disparity Issues

In order to sustain the water technology cluster in the Minneapolis-Saint Paul in the long-run, regional disparity issues must be addressed. Greater emphasis should be placed on after school programs from pre-k through high school and beyond directed towards disadvantaged communities. Summer programs in science and technologies with an emphasis on water issues and technology would encourage these students to pursue water related studies. Scholarships and grants should be provided for high achieving individuals from these locations to attend college. This would close the education gap and Minnesota's disparities while addressing the increasing minority and immigrant populations in disadvantaged communities.

E-3 Mining Minnesota's Iron Range

Iron is one of the most abundant metals in the earth. However, the global abundance of this basic element does not directly translate to accessibility to access iron on a profitable basis necessary to serve industry. Iron is only commercially viable for mining when it is deposited in concentrations that are large enough and of acceptable levels of quality relative to other minerals in rock. Fortunately for Minnesota, the iron deposits in the Duluth Complex along the Mesabi Iron Range in the northern section of the state are rich with high-quality deposits of iron ore. This abundance of material underpins the competitive advantage of the mining industry in Minnesota, creating opportunities for the development of an economy for an entire quadrant of the state based on the ability to extract minerals from a relatively narrow scratch of the earth's surface.

What is known collectively as the Iron Range is actually three distinct ranges with varying deposits of iron ore, with a fourth, the Cuyuna Range, slightly south of what is traditionally considered the Iron Range. For thousands of years, this land had remained pristinely intact, with enormous hills belying the rich deposits hidden beneath. The high demand for iron in the late 1800s brought curious prospectors into Minnesota, and by 1884, the first shipment of iron ore left the Vermillion Range. The next twenty years would see a flood of immigrants arrive from northern and Eastern Europe to work the land and settle scores of small communities bound together by a dependence on the mining industry. As the country moved through the Progressive Era of the early 1900's, these settlements developed into towns with schools, sanitation systems, and local governments. A co-dependence between management and labor existed that led to the mining companies themselves assisted civic leaders with these developments.

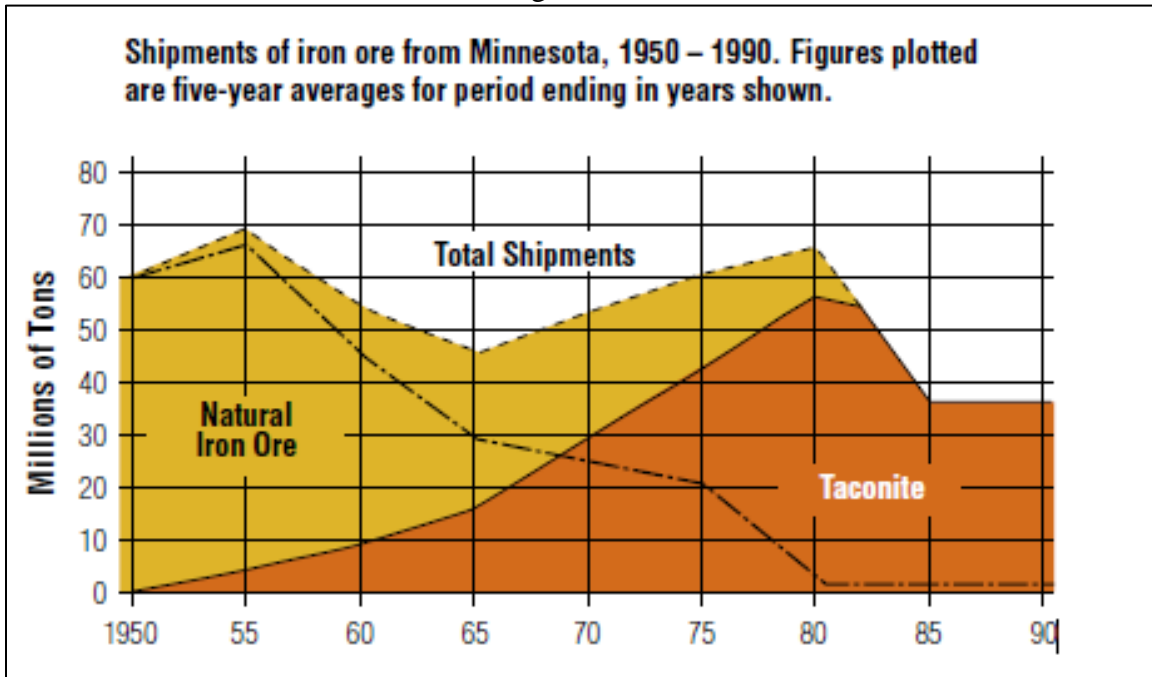


As the United States moved toward war with the Nazis in 1941, the need for iron increased greatly. During this time, over 600,000 tons of iron ore was extracted and shipping from the Iron Range—more than the previous fifty years of mining combined. As in other parts of the country in other industries, women filled the mining jobs left behind by men at war to keep the mines open and producing. After the war, the need for iron shifted from a war input to an industrialization input: more cars and more building meant that iron was still in great demand. But the land was tired and the easy-to-mine natural ore (or “direct shipping ore” – DSO) was rapidly thinning. Other, less concentrated iron ore, known as taconite, was available, but required more processing in order to be serviceable. An economic process for turning taconite into usable product was not yet invented and the depletion of natural ore brought the Iron Range into its first economic downturn.

Knowing that the Iron Range held an incredible amount of taconite, Dr. E.W. Davis at the University of Minnesota's School of Mines began researching ways to extract the iron from the taconite. Dr. Davis' pioneering research found that the taconite ore could be crushed into

powder, using strong magnets to extract the iron and roll it into pellets which are then heat hardened

Erie Mining and Reserve Mining Companies were the first to put Dr. Davis' innovations to work on a large scale, which required a capital investment of \$300 million in facility build-out. This gamble paid off and the taconite processing industry revived the depressed local economy and gave birth to a second iteration of iron mining in Minnesota.



The chart above illustrates the phase out of natural iron ore and the industry movement toward taconite. Taconite mining was slow to upstart, and the 1960s saw a period of painful growth. While natural ore lies shallow in mines, taconite is often found deeper, resulting in greater extraction costs to mining companies. In addition, processing facilities to make raw taconite ore into more concentrated pellets were expensive to build and firms were resistant to the large capital investments required. However, as the natural ore resource depleted quickly, companies had little choice but to turn to taconite.

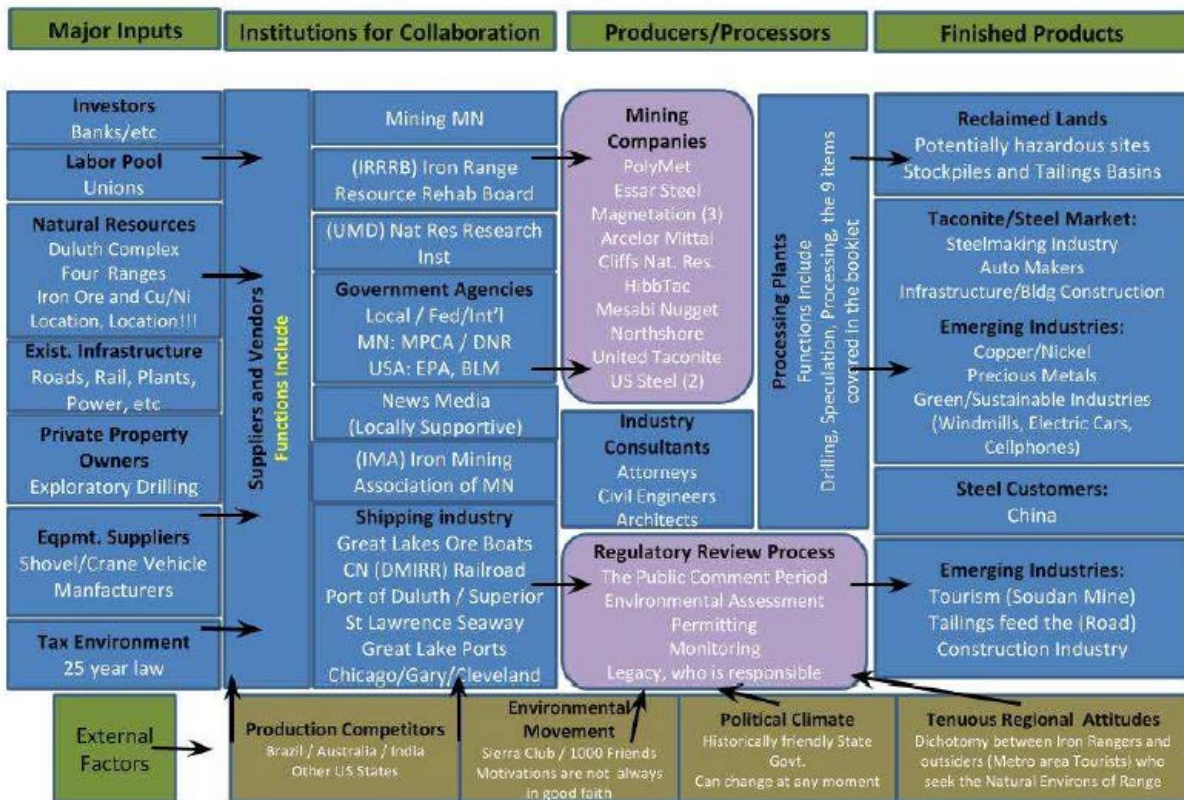
Taconite mining held strong until the 1980s, when declining domestic steel production and global overdevelopment of steelmaking facilities led to a major slowdown of mining in Minnesota. Between 1985-1986, two mines closed, resulting in hundreds of lost jobs. Once again, the Iron Range was thrown into an economic tailspin. Partly in response, the University of Minnesota at Duluth opened its Natural Resources Research Institute (NRRI) in 1983. The NRRI partnered with mining companies to reduce costs by improving operations and creating new efficiencies through technology, since many plants were still operating on the 1950s model pioneered by Dr. Davis. The NRRI provided a research and development backbone to help the industry survive this downturn. By 2002, the industry was back on its feet with new investments from merged firms, acquisitions, and non-American companies. Globalization had found the Iron Range.

On the Iron Range, we see an area that:

5. Is rich in iron ore that is suitable for mining due to its quantity and quality, particularly the soft hematite which was easy to extract and process compared to the harder ores found in Michigan.
6. Proximate to the Great Lakes for ease in transportation to the eastern Great Lakes area steel production mills of Pennsylvania and Ohio.
7. Home to a significant labor pool, initially formed of Eastern European immigrants with knowledge of blast furnace production, eager to establish themselves and work hard.

Cluster Map of Economic Competitiveness

Metal Mining on Minnesota's Iron Range



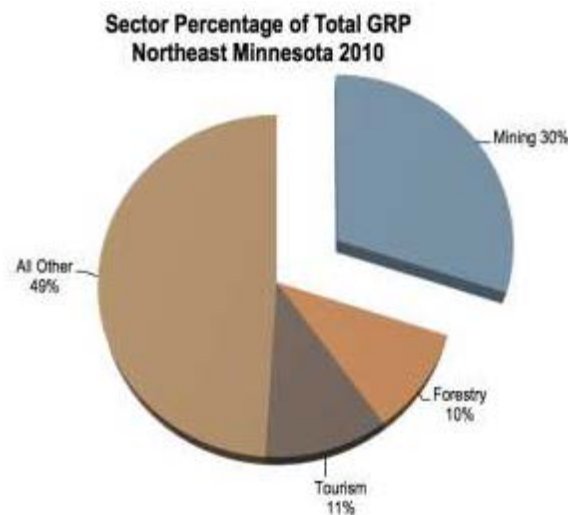
Transportation Issues

Transportation is the final link in iron ore production and an important factor in making it competitive. Typically ore moves by train to a Lake Superior port, then by ship to lower Great Lakes steelmaking centers. Through the years, continual efforts have been made to improve efficiency of iron ore transportation. Faster, larger vessels haul cargoes up to 60,000 tons – three times the capacity of ore boats in the 1960s – and a far cry from the Schooner Columbia, the first vessel to lock through the canal at Sault Ste. Marie in 1849 with 120 tons of iron ore. By enabling and facilitating transportation improvements, from ports to rail to roadways, government can positively influence those industries that rely on moving product across the country—and even across the globe. As discussed earlier in this paper, Essar's corporate strategy for competitiveness also relies on its "strategic location" near high quality ores, and the existence

of “multiple access points” to a “world class ground transportation infrastructure” serving the North American market, as well as connections to “multiple vessel options for the international seaborne market.”

Other companies appear to exploit location and connections to transportation resources in a similar fashion. For instance, Magnetation achieves some degree of competitiveness through its own investment in private transportation infrastructure. An example is the Reynolds Rail system the company has constructed at its hub location in Indiana. Magnetation cited “its central location capable of serving the Great Lakes region via connections to existing local and national rail networks (Toledo, Peoria & Western (TPW) and CSX Transportation)” among other reasons for choosing the location of this facility which supports their regional distribution efforts.

The mix of freight shipping opportunities available to Magnetation in this location create economic advantage by allowing economical routes to customers in Canada, Mexico, and the Atlantic seaboard by its connections to waterborne transport such as the Mississippi River Barge terminals and the Saint Lawrence Seaway system, and via rail transport to the Magnetation’s base iron ore operations in Minnesota.



Policy Recommendations

1. Environment

The government must continue to be the stewards of the natural environment through environmental regulation and careful screening policies. It is the duty of the government (local, state, federal) to ensure that our natural resources are protected for future generations, without preventing economic development. While we recognize that this is a precarious balance, we also urge policy leaders to continue their good works in this area.

2. Transportation development

The need for multimodal, cross-boundary transportation is key. Transportation is the backbone of this industry; being able to move ore out of the Iron Range to mills and production plants is essential. A chief reason for Essar Steel’s selection of the Iron Range location was the available shipping arteries in the region. Good public policy will enable the various facets of the transportation industry (public and private) to work well together and serve the needs of the mining firms in the area.

3. Workforce Development

Minnesota is unique in its public, state-wide support of education. The state’s distinctive funding strategies developed in the 1970s and dubbed the “Minnesota Miracle” have created an

environment which is hospitable to an education workforce that is ready and able to serve the needs of private firms. The state must ensure that this standard continues and that funding levels of K-12 programs remains equitable, despite the lower property values and tax base within the Iron Range.

Furthermore, leaders within the Minnesota State Colleges and Universities (MNSCU) system must continue to develop programs that provide a workforce that is ready to work. Tony Sertich, Executive Director of the IRRRB, told us during an interview that by 2018, 70% of jobs in the state will require some post-secondary education. As mining becomes more automated and less human-work intensive, the workforce must respond by being ready to move into other supporting roles, such as equipment maintenance or mechanical engineering.

Future generations do not face their father's or grandfather's industry; they must be adaptable and ready to expand their skills beyond basic mineral extraction in order for firms to continue to find a valuable workforce on the Range.