Applying Industry Clusters to Intelligent Transportation Systems: A New Framework for Analysis

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Executive Summary

Information and telecommunication technologies are transforming the way companies connect and interact with their workers, their upstream suppliers and downstream buyers, other businesses in the industry or local economy, as well as the end consumer. While these technologies have opened doors for new strategic models at the firm level, much less is known about their impact on industry clusters and regional economies overall. This is especially true in rural areas.

In order to understand how ITS is affecting rural economies, interviews with representatives from firms in the recreational transportation equipment industry and the wood products cluster in northwest Minnesota were conducted. The primary goal of this research is to analyze ITS use from the industry cluster perspective developed by Michael Porter rather than at the individual firm level. It is hoped that this analysis will lead to recognition of regional transportation, communication, and technology concerns and reveal avenues of further ITS development and implementation to keep rural economies competitive. This report has four primary objectives:

1. Apply the industry cluster analytical technique to better understand the role of transportation and technology in rural industries
2. Assess current ITS use in a rural industry cluster
3. Determine how ITS may be affecting a rural industry cluster
4. Explore future roles for ITS in rural industry clusters

ITS is enhancing the competitiveness of the cluster’s rural location. Continued cooperation among large and small firms and continued support from ITS developers is needed to ensure the health of the cluster. ITS use ranges considerably between the two clusters but new technologies are being installed to make shipping, inventory tracking, and communication between companies inside and outside of the region more efficient, particularly in the recreational transportation equipment cluster. The larger firms are leading the way for the smaller firms in ITS adoption, but smaller firms are reluctant to invest in new systems due to cost, lack of qualified personal, and perceived impracticality at their current level of business.
“Applying Industry Clusters to Intelligent Transportation Systems: A New Framework for Analysis”

Introduction

Recent changes in information and telecommunication technologies have had a dramatic impact on the way we live and work. Information technologies – from desktop computers to remote sensors – have transformed how we collect, manage, understand, and communicate information. Meanwhile, telecommunications breakthroughs such as wireless technologies have granted us unprecedented flexibility in our ability to connect with others, all at decreasing real costs. Intelligent Transportation Systems (ITS) are designed to enhance information and telecommunications technologies for existing transportation systems, making them smarter, safer, more efficient, and laying the foundation for new modes of transportation.

For many businesses, information and telecommunication technologies are equally transformational. These technologies affect the way businesses connect and interact with employees, upstream suppliers and downstream buyers, other businesses in their industry or local economy, and the end consumer. While these technologies open doors for new strategic models at the firm level – supply-chain management and direct marketing strategies – much less is known about their impact on industry clusters and regional economies overall. This is especially true in rural areas. This study explores the impact of ITS technologies on rural industry clusters. There are four primary objectives of this study:

1. Apply the industry cluster analytical technique to better understand the role of transportation and technology in rural industries
2. Assess current ITS use in a rural industry cluster
3. Determine how ITS may be affecting a rural industry cluster
4. Explore future roles for ITS in rural industry clusters

To better understand the role that ITS technologies play in rural industry clusters, this paper presents a summary of ITS use and its affect on the recreational transportation equipment cluster and the wood products cluster in rural northwestern Minnesota. These clusters were identified in previous State and Local Policy Program (SLPP) research at the University of Minnesota’s Hubert H. Humphrey Institute of Public Affairs.
Industry Cluster Framework

State and local economic development is fundamentally about increasing prospects for “place prosperity,” or, in other words, for improving the economic outcomes for residents of a given city or region. Since a region’s economic vitality has historically been linked to its industry mix, one of the most critical elements of state and local economic development policy is identifying, promoting, maintaining, and enhancing the competitiveness of industries that serve as the drivers of a regional economy.

With the gradual shift toward global and open economies, identifying the economic drivers of a region has become increasingly important and challenging. In the 1970s and 1980s, competition from both domestic and international, low-cost production locations overwhelmed established industrial regions and caused substantial de-industrialization of United States regions such as the Northeast and Midwest. In the face of this trend, a body of literature developed that endeavored to explain notable success stories, such as the shoemaking industry in northern Italy, industrial machinery in Germany and Japan, and high technology in Silicon Valley and Boston. In particular, these accounts noted the tendency of firms, both within a given industry and across related ones, to “cluster” spatially. This was most evident in industries where constant innovation in products and processes fostered self-sustaining regional competitive advantages on national and global levels.

The most compelling and lucid explanation of the cluster effect is from The Competitive Advantage of Nations by Michael Porter. Industry clusters are, in sum, geographic concentrations of competitive firms in related industries that may or may not do business with each other but share similar needs for talent, technology, and infrastructure that, in turn, creates a source of jobs, income, and export growth for a region. In simpler terms, it is a localized form of agglomeration economies. Before Porter’s theories on industry clusters, economists often discussed a region’s comparative advantage as being based upon cheap inputs or low-cost labor. Porter, however, theorized that successful industry clusters could be explained and analyzed in terms of a “diamond of advantage” that drives innovation and results in a competitive advantage. This diamond consisted of four interrelated elements (Figure 1):
• **Factor conditions** – regional advantages such as human capital, physical resources, local specialized skills and knowledge, capital resources, and infrastructure can make a collection of firms more conducive to success; but disadvantages may also drive innovation.

• **Demand Conditions/Home Demand** – the nature of home demand for a product can dramatically affect development of a given product or service; strong home demand can lead to faster innovation among local firms vying for a local market.

• **Related and supporting industries** – when networks of buyers and suppliers are in close proximity, this can create faster and more active information exchange, collective learning, and supply-chain innovation.

• **Industry strategy, structure, and rivalry** – a climate that fosters both intense competition among localized producers, yet cooperation and collective action on shared needs, is most fertile for innovation and regional competitive advantage.

In addition to the four key elements, Porter also included a role for government and chance, which can play significant roles in the early development or location of industry clusters. Figure 1 illustrates several examples of ITS technologies within the diamond of advantage framework. These examples focus on potential uses of ITS technologies by rural industry clusters and are not all-inclusive.

Beginning in 1995, the State and Local Policy Program (SLPP) at the University of Minnesota Humphrey Institute of Public Affairs conducted industry cluster studies in five regions throughout Minnesota\(^2\). In consultation with local officials, each study
examined four industry clusters using Porter’s diamond of advantage framework discussed above. The diversity of industries found in greater Minnesota is quite striking (Table 1). While these industries are in various stages of maturity, each is important to their regional economy.

Given the difficulty of maintaining and enhancing rural economies and industry clusters, this research is but one step toward understanding what can be done to strengthen rural economies with the help of ITS applications. This research demonstrates that intelligent transportation systems are one part of improving the transportation and information infrastructure in rural areas; however, technology needs and progress very significantly from cluster to cluster and region to region.

Table 1

<table>
<thead>
<tr>
<th>Twin Cities</th>
<th>Southeast Minnesota</th>
<th>Southwest Minnesota</th>
<th>Northwest Minnesota</th>
<th>Northeast Minnesota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing and Publishing</td>
<td>Composites</td>
<td>Computer and Electrical</td>
<td>Recreation and</td>
<td>Forest Products</td>
</tr>
<tr>
<td>Computers and Software</td>
<td>Food Processing</td>
<td>Components Manufacturing</td>
<td>Transportation</td>
<td>Information Technology</td>
</tr>
<tr>
<td>Medical Devices</td>
<td>Printing, Publishing, and Software</td>
<td>Value-Added Agricultural Cooperatives</td>
<td>Equipment Manufacturing</td>
<td>Health Services</td>
</tr>
<tr>
<td>Machinery and Metalworking</td>
<td>Industrial Machinery and Computer Manufacturing</td>
<td>Agricultural Equipment Manufacturing</td>
<td>Wood Products</td>
<td>Tourism</td>
</tr>
<tr>
<td>Financial Services</td>
<td>Dairy Processing</td>
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</tbody>
</table>

The Industry Cluster Approach

Although Porter maintains that all four components of the diamond of advantage are needed for successful and innovative clusters, SLPP researchers have discovered that not all of the four components of the diamond of advantage must be within a small geographic proximity in order for the cluster to be functional. For example, with reliable telecommunication and transportation connections, firms can maintain relationships with customers and suppliers via email and fax, communicate complex information through a supply chain over the Internet or other private network, and utilize efficient just-in-time shipping. For an industry cluster to be functional and not geographically close, however, there must be an adequate infrastructure for both
communication and transportation. This is especially true in rural areas where clusters are more likely to be spread over a larger distance.

Through interviews with firms in northwest Minnesota, this research analyzes ITS use within Porter’s diamond of advantage framework. The survey questions focus on ITS’s effect on demand and factor conditions, firm rivalry and strategy, and firm relationships in the cluster. By understanding how a cluster uses ITS technologies, it is hoped that the technological needs of the cluster as a whole, and hence the regional economy, can be made stronger, more efficient, and more competitive. Although the goal of this research is to assess a rural industry cluster’s ITS use, the broader objective of this paper is to show how Porter’s diamond of advantage framework can be used to analyze a specific aspect, such as technology and transportation, of an industry cluster.

**Methodology**

This research involves three tasks: selecting the industry clusters to study, consulting with rural economic development and industry cluster experts, and conducting a series of interviews with businesses in the clusters to evaluate current ITS use and its potential roles for further use.

*Task 1: Identify rural industry clusters and select a cluster for a case study.*

The recreational transportation equipment cluster, located in northwestern Minnesota, and the wood products cluster, located in north-central Minnesota, was selected for closer examination. The recreational transportation equipment (referred to at the RTE cluster from here on) cluster consists of two key manufacturers, Polaris and Arctic Cat, as well as a series of firms that supply one or more of these hub producers. The wood products cluster includes a small number of national manufacturers and many small, locally based loggers and manufacturers. In order to protect an individual firm’s privacy, no firm has been directly identified in the summary of results.

These clusters were chosen for several reasons. First, the recreational transportation equipment cluster is a successful and growing cluster despite being located in the most sparsely populated region of the state. Additionally, this cluster is considered a “classic” industry cluster due to its strong manufacturing base, internal cooperation and
competition between producers, local supply networks, significant economic importance to the region, strong local and national demand, and for not relying strictly on cheap labor or locally available raw materials. Finally, because the cluster is facing increasing competition from foreign and domestic markets, the region must find new ways to be innovative and more efficient.

The wood products cluster was chosen primarily because of its historic importance to the regional economy, direct ties to local raw materials, which is a contrast to the RTE cluster. The wood products cluster is also facing increasing competition, particularly from Canadian manufacturers, that make finding ways to increase efficiency and competitive advantages more important. These two clusters have significantly different needs and resources, but both are facing competition from outside producers.

**Task 2: Convene national rural cluster experts for consultation.**

National experts on industry clusters and rural development were assembled for a research roundtable in the Twin Cities in October 2001. The roundtable was convened to discuss the current state of academic and practitioner research, new theoretical models, and potential case studies for rural industry clusters. While the roundtable discussed many topics related to rural economic development, two findings were particularly important for understanding the intersection between rural industrial clusters, information technologies, and transportation technologies:

- Scale and proximity of rural clusters: rural industry clusters tend to lack the agglomeration and scale more common in metropolitan clusters. They may be spread across wider geographic distances, resulting in greater reliance on transportation services to link buyers and suppliers and on information services for communicating with clients and collaborators.
- Rural disadvantages in producer services: producer services, such as financial, information technology, research and development, engineering, management consulting, and transportation services (particularly high-end or sophisticated services), remain highly concentrated in metropolitan areas. These services tend to be “catalytic” in nature, helping companies to innovate, collaborate, and research new markets. Thus, the relative disadvantage of rural areas due to small scale would tend to be self-perpetuating. This suggests the potential for local or region-wide collaborative solutions to overcome high costs associated with accessing new technologies.
The surveys, discussed in more detail below, strongly indicate that the problems identified by the roundtable participants are indeed barriers in northwest Minnesota and that ITS is playing a role in overcoming these disadvantages, though much more so in the RTE cluster.

Task 3: Conduct industry interviews regarding supply chain relationships and examine the importance of the related transportation and information technologies.

Several firms of varying sizes were interviewed during January 2003 and March 2003. Questions were asked about current ITS use and how ITS use is affecting business relationships within their supply-chain. The types of questions asked include:

- How did transportation and communication costs affect your firm’s location?
- How do you communicate with suppliers and consumers?
- How do you transport your products? What kinds of transportation and information networks are used to link firms to suppliers and customers?
- Are you involved in any type of computer or communication network that connects you to other firms in the region?
- Have your transportation needs changed in recent years?

One of the goals of this project is to determine if ITS technologies could have a greater role in rural economic development, particularly in relation to rural industry clusters. While this report will not recommend specific strategies for individual firms, the industry interviews did reveal some trends for potential ITS implementation that will need further exploration and discussion beyond this study.

Northwest Minnesota Geography

Northwest Minnesota is home to approximately 88,472 people in seven counties: Kittson, Marshall, Norman, Pennington, Polk, Red Lake, and Roseau (Figure 2). The western edge of the region is primarily farmland located in the Red River Valley and the eastern portion is mostly forests, lakes, and wetlands. No interstate highway crosses the region, though Interstate 29 runs north-south along the North Dakota border and Interstate 94 runs east-west immediately south of the region. US Highway 2 also runs east-west through the southern portion of the study area.
# Figure 2: Study Region

![Study Region Map](image)

## Table 2 – Northwest Minnesota Key Facts

<table>
<thead>
<tr>
<th>Category</th>
<th>Data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population (2000):</strong></td>
<td>88,472*</td>
<td>Census Bureau</td>
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<tr>
<td>Major Cities:</td>
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<td></td>
</tr>
<tr>
<td>Crookston:</td>
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<td></td>
</tr>
<tr>
<td>East Grand Forks:</td>
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<td></td>
</tr>
<tr>
<td>Thief River Falls:</td>
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<td></td>
</tr>
<tr>
<td>Roseau:</td>
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<td></td>
</tr>
<tr>
<td><strong>Population Density (pop/sq mi):</strong></td>
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<td>(Twin Cities: 601; MN state: 62)</td>
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<tr>
<td><strong>Population Growth (1990-2000):</strong></td>
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<td>(MN non-metro: 4%; US non-metro: 9%)</td>
</tr>
<tr>
<td><strong>Per Capita Income (2000):</strong></td>
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<td>(MN non-metro: $24,134; US non-metro: $21,847)</td>
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<td><strong>Per Cap Inc Change (1990-2000):</strong></td>
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<td>(MN non-metro: 54%; US non-metro: 48%)</td>
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<tr>
<td><strong>Job Growth (1990-2000):</strong></td>
<td>16%</td>
<td>(MN non-metro: 25%; US non-metro: 18%)</td>
</tr>
<tr>
<td><strong>Farm Employment (2000):</strong></td>
<td>14%</td>
<td>(MN non-metro: 9%; US non-metro: 6%)</td>
</tr>
<tr>
<td><strong>Manufacturing Employment (2000):</strong></td>
<td>16%</td>
<td>(MN non-metro: 15%; US non-metro: 15%)</td>
</tr>
</tbody>
</table>

Source: Bureau of Economic Analysis; income change data in nominal terms, not adjusted for inflation

* Data in table are for region that includes: Kittson, Marshall, Norman, Pennington, Polk, Red Lake, Roseau counties (Region 1).
ITS Industry Cluster Evaluations

The first part of the industry cluster analysis focuses on a case study of the recreational transportation equipment cluster. The second part is a less in depth summary of ITS use in the wood products cluster due its smaller reliance on ITS technologies. These assessments are organized within the industry cluster evaluation framework: factor conditions, demand conditions, related and supporting industries, and industry strategy/rivalry. After the case study and analysis, there is an analyses of how ITS is affecting the clusters, which is followed by a brief examination at the potential for future ITS development in the cluster. While the number of firms surveyed was relatively small, certain trends did emerge. Throughout this analysis, the terms “larger firms” and “smaller firms” are widely used. Due to the small sample size, these general terms were adopted to broadly refer to businesses in northwestern Minnesota. Larger firms refer to those companies that ship a significant percentage of their products outside of the region, have more than fifty workers, and are drivers of the local economy. Smaller firms generally refer to those companies with fewer than fifty workers, sell a larger percentage of their products to other firms in the region, and supply the larger firms in the region.

ITS and the Recreational Vehicle Cluster

The recreational transportation equipment cluster in northwest Minnesota includes well-known final goods manufacturers such as Arctic Cat and Polaris as well as many smaller producers and suppliers. While the region is traditionally known for its snowmobile production, other products such as all-terrain vehicles (ATV’s), jet skis, and track conversions for four-wheel drive vehicles are taking on an increasingly important role. The larger manufacturers have historically produced final consumer goods primarily for the upper mid-west; however, in recent years, their markets have expanded both nationally and internationally. The smaller manufacturers in the region produce supplies for other firms in the region and some limited final goods as well as products for other manufacturers in the rest of Minnesota and to a lesser extent the rest of North America and for international export.
For the most part, the interviewed firms reported expanding operations despite the recent economic slowdown. In fact, several of the firms expressed concern over keeping up with demand, locating additional qualified workers, and wanting to slow growth in order to re-evaluate their current position and customer base. Part of this re-evaluation for many firms has included updating, or at a minimum, assessing their current technology use.

**Factor Conditions**

- The distance from major markets and transportation connections has increased pressure for efficient, cost effective, and reliable transportation. This is a concern for the larger firms that ship considerably more final goods out of the region and for all firms that ship supplies into the region.
- All of the interviewed firms use some form of product, inventory, or supply tracking, though sophistication varies widely.
- All of the interviewed firms have access to high-speed Internet but not all firms have a web site or use the Internet to aid transportation or communication.
- There is an interest in distance learning by many of the firms and a few are considering long distance training accessible through the Internet.
- Given the distance between towns in the region and major markets outside of the region, manufacturers in the region are concerned with the current and future conditions of roads and highways.
- There is potential for increased use of travel information, specifically weather monitoring and road construction inside and outside of the region.

On average, most firms in northwest Minnesota are six or more hours from the nearest large metropolitan area, the Twin Cities. Although the cluster’s location does help drive technology innovation and has increased the necessity of incorporating product and supply tracking technologies, competitive forces are equally important. According to the firms, competitive forces inside and outside of the region have required those technologies be adopted in order to remain viable. In some cases, the producers and suppliers require advanced telecommunication technologies be used in order to have any business-to-business relationship.

Since moving supplies and products in and out of the region is a major concern, businesses require fast, cost effective, and reliable shipping companies; however, on-time service was rated as the most important aspect of shipping. The larger firms ship
products almost exclusively by truck with independent shipping businesses. The smaller firms do use independent shippers but also rely on nationally known package shipping services such as UPS and Federal Express. Through UPS and Federal Express, firms are able to use near real-time tracking services, however, this is not the case with all independent contractors. The larger firms in the region are moving toward, and some already require, shipping contractors to have real-time tracking or other similar services. This is being done for two reasons. First, it helps to streamline shipping costs and reduce backlogs. Secondly, it helps to ensure on time deliveries for distributors and end consumers. The larger firms have also begun to integrate real-time tracking into their just-in-time (JIT) shipping systems to increase the reliability of their JIT schedules.

While larger firms already use relatively sophisticated supply, inventory, and product tracking systems, the same is not true for many of the smaller firms, but the need for such software in the future is recognized. There were several reasons cited for not implementing full just-in-time methods or other electronic inventory management projects. Some firms simply did not see the need given their current business level; however, all firms agreed that the need is growing, especially for cost control and product tracking purposes. Quite often, the push for new technologies is due to business partners using such systems. However, all of the firms were particularly concerned about implementation costs, time, and support. One firm shared a story of the struggle over implementing a new software program that proved to be time-consuming to learn and vendor support was lacking. While most firms see the long-term necessity for using ITS-related tracking programs, many have found it difficult to justify the perceived short-term cost.

A recent report from Minnesota Technology found that Internet use and access is virtually ubiquitous throughout rural Minnesota. That has certainly proven true in northwest Minnesota for the RTE cluster. All of the firms surveyed in this cluster use high-speed Internet connections; however, not all of the firms have web pages for business-to-business or business-to-consumer sales and information. The larger firms tend to have both business-to-consumer and business-to-business web sites for sales and information distribution. Few of the smaller firms have web pages, but several of the
businesses are considering adding a web page for information dispersion and possibly direct sales.

The physical infrastructure of the region is increasingly a prominent concern. Since northwest Minnesota is a considerable distance from most major markets and has relatively few major highways, road maintenance is extremely important. While ITS is helping firms maintain their business in northwest Minnesota, without well-maintained roads, heavy shipping would be hampered.

Though not addressed in detail and not widely used, a few companies also use tracking technologies to adjust schedules in case weather should interfere with shipping in production. Northwest Minnesota is known for its cold weather and blizzards, which have the potential to severely affect shipping for days at a time. While the last several winters have been relatively mild, firms using this technology are able to route drivers along the best roads in case of road closures due to storms as well as rail cargo to adjust schedules as needed.

**Demand Conditions/Home Demand**

- Company web sites are common among the larger firms and developing in the smaller firms.
- Demand conditions in the region, nationally, and internationally are forcing all of the firms to cut costs and make the entire manufacturing process more efficient.
- Foreign demand is increasing and ITS is helping to coordinate shipping.

With the Internet boom in the late 1990’s, one would think that nearly every company would have a fully interactive web site with direct sales. This, however, is generally not the case and is perhaps another lesson of the tech boom. Larger firms such as Polaris and Arctic Cat have advanced and interactive web sites, but these sites are primarily for information distribution with some limited direct sales that are often for small accessories and clothing, which make up a very small percent of total sales. Several other firms that do not have web sites either do not see the need or are in the process of designing or deciding on a purpose for a new web site. Ironically, one of the smallest firms in the region is also the most dependent on the Internet with over 60% of
sales linked to the firm’s web site. The owner stated that without continued Internet access the business would not have the level of business it currently has.

Increased regional, domestic, and overseas competition is forcing all companies to cut costs wherever possible and to make manufacturing more efficient. Larger firms placed a particularly heavy emphasis on increasing transportation efficiency since a bulk of their final products are shipped out of the region and can add substantial costs to the final products. ITS tracking technologies are allowing larger firms to get products where they are needed, when they are needed more efficiently. ITS technologies are also helping firms make certain that supplies are delivered on time to ensure that manufacturing lines do not shut down and inventories sit idle—both of which add to the cost of the final product.

As much as 10 percent of total sales for larger firms are due to foreign sales and demand is increasing. While all of the firms primarily transport products by semi-trucks, companies also use rail and ship to get products overseas. This requires an increased level of coordination between trucks, rail, and ship, which is being aided by ITS.

**Related and Supporting Firms**

- Up to 30% of larger firms’ supplies originate in northwest Minnesota.
- Relatively sophisticated supply-chain management technologies are common among larger and mid-size firms.
- Larger firms are moving toward systems that require suppliers, transporters, and distributors inside and outside of the region to connect to their computer systems and follow their production schedules.
- Almost all of the surveyed firms use network connections to transfer design files, though some are more advanced than others.

Larger firms tend to be the drivers of technological change in the region, which is likely due to their more advanced human resources and capital as well as their need to compete directly with international firms outside of the region. Some of the larger firms have only recently begun to require that most or all of their suppliers use compatible supply-chain management technologies; however, implementation of these technologies varies. When asked why smaller, local suppliers were not always required to participate in electronic supply-chain management systems, the most common response was practicality. Since the suppliers in the region are considerably closer than suppliers
outside of the region, larger firms, at least until recently, simply telephoned, faxed, or emailed orders to their local suppliers. This is changing as larger firms move toward fully integrated supply-chain electronic management systems based on just-in-time shipping ideas. Although firms have different timelines for making this transition, it is occurring.

Since smaller firms have expressed concern over the cost and time of implementing such technologies, those that do participate often only connect to the firms that require it. In an attempt to move smaller firms into such systems, larger firms have offered limited training programs to educate suppliers in and outside of the region on the new systems. This, however, does not force smaller firms to add internal systems to track their suppliers, inventories, or final products. Smaller firms do recognize the need to install more advanced inventory control systems in the future but no definitive timelines were given.

In association with using ITS technologies to track materials through the supply-chain, all of the RTE cluster firms either were transferring data files via the Internet or expressed interest in learning how. All firms using this relatively simple technology lauded the convenience and efficiency of transferring CADD (computer aided drafting and design) over high-speed networks. One smaller firm stated that transferring CADD files over high-speed networks decreased the time needed to produce new parts because updated designs can be worked on in two locations and continuously revised without stopping production or waiting for redesigns from other firms.

**Firm Strategy and Rivalry**

- Although in its early stages, several firms have recently formed a cooperative association that could potentially be used to combine resources to make transportation more efficient and new technology and business training cheaper.
- Transportation is no longer considered a sunk cost by many of the firms but is instead a flexible cost that can be adjusted to make a company more competitive.
- History has rooted the firms in the region and none foresee any reason to change locations. ITS-related technologies are considered an important tool for remaining in the region.
The Manufacturers Association is a newly formed organization in northwest Minnesota. Although the Manufacturers Association is still in its early phase of creation, the interviewed firms that participated in the first meeting of this still-forming organization expressed interest in its potential as a better network for companies to share training opportunities, information, and strategies. One firm in particular was interested in learning new software for tracking inventory and CADD applications but was unable to do so individually because of the cost. It was this firm’s hope that the Manufacturer’s Association could organize firms to share costs on such training.

According to the larger firms, ITS technologies that track supplies, final products, and inventories have drastically changed the way their companies view shipping. Previously, shipping costs were considered a static part of doing business. Products needed to be shipped or there was simply no business. Although this basic premise has not changed, what has changed is that shipping costs are now considered more flexible. ITS technologies have made it easier to order and track supplies coming into the region. The larger firms reported losing several thousand dollars an hour if assembly lines shut down due to late arrival of supplies. One firm cited that new tracking technologies have decreased assembly line shutdowns by as much as 70 percent. By being able to quickly order and accurately track supplies, firms in the region are able to maintain JIT schedules without retaining large inventories. To make this change successful, however, requires ITS technologies to be installed at all levels of the supply-chain. Not all companies have taken this step. Smaller firms fear the cost and time commitments of installing these technologies, particularly if the technologies do not pay off. It is likely, however, that many smaller firms will be forced into these technologies due to their reliance on business from larger firms, which tend to use more sophisticated ITS technologies. Larger firms indicated a continued desire to decrease or, at a minimum, stabilize shipping costs into the future in order to remain competitive with international companies that often have lower manufacturing costs.

All of the interviewed firms plan to stay in northwest Minnesota and continuously update business methods to stay competitive. Tracking technologies have made traveling and shipping more efficient and firms are able to plan supply lines down to the hour. This would be virtually unattainable without real-time or near real-time supply and
product tracking technologies. Firm rivalry both inside the region and outside the region is one of the primary drivers of these innovations.

**ITS and the Wood Products Cluster**

The wood products cluster is in a notably different position than the recreational transportation equipment cluster in terms of ITS usage, implementation, and planning. The RTE cluster has a larger market outside of northwestern Minnesota and a more complex supply-chain in terms of inputs and the number of companies in the chain. Although there are a few wood-based companies in northwestern Minnesota that sell products to the national and international market, most of the firms’ sell their products in the upper Midwest or, more commonly, throughout Minnesota. While the RTE cluster is larger, the wood products cluster is no less important. Nevertheless, the wood products cluster certainly has different needs and is adopting technology at a different rate.

Despite the common need for wood, the products manufactured by the wood products cluster are quite diverse. The cluster manufactures products ranging from paper, hockey sticks, roof trusses, wood paneling, to entire homes. While the wood products cluster includes such well-known companies as Potlatch, Marvin Windows, and CB Hockey, these companies do not directly compete like the primary companies in the RTE cluster, and these companies have different, non-competing supply chains. Generally speaking, the wood products cluster does not have the same forces driving technological change as the RTE cluster.

Although northwestern Minnesota is home to abundant natural resources and industry growth during the 1980’s and 1990’s, the wood products cluster has been hurt by the current ailing economy and increasing competition from Canadian manufacturers. Large and small firms alike are feeling the pinch from cheaper Canadian and other foreign inputs in spite of the fact that northern Minnesota is rich in wood resources. Despite increasing competition and rising costs of business, the wood products cluster has not moved toward adopting ITS technologies at the same rate as the RTE cluster. The industry cluster analysis focuses both on ITS use and on factors that might be affecting ITS technology adoption.
Factor Conditions

- The majority of products created by the wood products cluster are sold in northern Minnesota.
- Few of the firms have adopted product, inventory, or supply tracking technologies.
- All of the firms use the Internet and email, and a majority of firms have a web site, but the Internet does not play a major role in business transactions.
- Physical transportation conditions are considered adequate by most firms.
- Most products are shipped via private or company owned trucking operations, but UPS and Federal Express are also major carriers for wood products.

Although the wood products cluster faces many of the same challenges as the RTE cluster, there are important differences. Both clusters are far from major metropolitan markets, face similar physical transportation limitations, are under increasing competition from foreign suppliers, and transportation prices are increasing. Since the major market for the wood products companies is, quite literally, their own back yard, few of the companies expressed the need for tracking technologies. Many of the wood products companies are relatively small, with fewer than ten workers, and cannot justify the cost of installing supply or product shipping technologies when they have only a handful of suppliers and consumers. Additionally, several of the firms ship their own products on company owned trucks due to special shipping needs for bulky products and unique product designs. Like the RTE cluster, UPS and Federal Express play a key role in shipping products in and outside of the region. UPS and Federal Express are also the primary providers of product and supply tracking via their web site. A few private shipping companies and rail shipping providers do offer tracking technologies, but none of the wood products companies expressed an intense desire or need for those technologies.

All of the interviewed firms use email and many of the firms have a web site; however, very few sales are completed via the Internet even for the largest companies. For those companies that have a web site, the most common purpose is for information distribution and various forms of advertising. None of the interviewed firms expected to increase direct sales via the web anytime soon.
Demand Conditions/Home Demand

- The major market for almost all wood products firms in northern Minnesota.
- There are a few international exports in the wood products cluster.
- Imports from Canada are a significant concern for nearly all interviewed firms.
- Many companies have a web site, but mostly for informational purposes and not for direct sales.
- Construction demand has increased the need for wood products.

As stated previously, the major market for the northern Minnesota wood products cluster is northern Minnesota itself. Additionally, the international export market for wood products out of this cluster appears to be shrinking while imports from Canada are increasing. According to the interviewed firms, imports were cheaper due to the high price of the American dollar compared to the Canadian dollar and not due to any technological advantage. Since many of the products are, for the most part, a basic commodity, there is little reason to ship products outside of the region, though a few companies do manufacture unique wood products that compete in regional and national markets.

Like the RTE cluster, the Internet is important for distributing information, but few of the companies see this as a source for direct sales. Several of the companies mentioned that their current buyers have been the same buyers for years and that the current buyers are unlikely to change anytime soon. A few of the companies do sell to distributors with larger markets, but, again, these sales are based on long-term relationships with little need for change, according to the surveyed firms.

Although the recent economic slowdown has dampened the need for construction materials, a strong consumer of wood products in northern Minnesota is the housing market. However, none of the companies expressed a need for a higher level of technology to take, build, or distribute wood products orders for the housing construction industry. The short distance for travel and the relatively small size of companies and sales does not necessitate a more integrated, electronic system.
Related and Supporting Firms

- The supply-chains and inputs for most companies are relatively small and consist of a few local or national firms.
- Only the largest firms use ITS tracking technologies such as just-in-time shipping between firms. When they are used, it is usually with parent or sister firms outside of the region.
- Supply-chain management technologies are not common among the wood products cluster firms.
- Unlike the recreational transportation equipment cluster, the wood products cluster does not have a collection of competing firms that drive technology adoption among other firms.

Since wood is the primary input for all of the wood products firms, most of the companies have standing orders for loggers both in and outside of Minnesota. Surprisingly, many of the interviewed firms import wood from other states and countries despite the abundant supply of wood in northern Minnesota. This is usually due to a need for a specific type of wood in the manufacturing process. Although the orders are often faxed and a growing number are emailed, only the largest companies use any ITS tracking technologies between firms. The small supply-chain length limits the necessity and complexity of supply tracking for most firms. While other supplies besides wood are needed in the manufacturing process, these supplies are also obtained with standing orders that are completed via phone, fax, and email. None of the companies indicated that they use an electronic ordering network or just-in-time shipping technologies to complete ordering or financial transactions.

Whereas the RTE cluster has large companies drive technology change down the supply-chain to improve efficiency and employ “lean” manufacturing methods, the wood products cluster has no single or collection of companies that drive technology adoption. Since the supply-chain is small and the number of inputs is limited, the firms did not see the transportation or communication process as an untapped source for increasing efficiency. The use of electronic file sharing, such as CADD files, is also uncommon among the wood products cluster.
Firm Strategy and Rivalry

- Transportation costs limit the market size for most wood products companies.
- None of the companies felt that changing locations would increase their competitive advantage

The sheer weight of transporting wood products and the proprietary truck trailer design required to ship many of the products increases the cost of transportation. Because of this, each wood products company has its own market region that may or may not overlap with a similar company that also has its own market region a given distance away. At a certain distance, it becomes prohibitively expensive for a company to transport its product because a competing company will be able to charge a lower price due to lower shipping costs. In northern Minnesota, these competing markets are well established and most of the firms haul their own products, particularly wood products made for the construction industry. Although some of the companies use cell phone to check on the drivers, as already noted, none of the surveyed firms use a higher level of technology to track incoming supplies or outgoing products. The small size of the market and the well-established supply chains, whether local or national, does not warrant a higher level of technology use according to most of the firms.

Although many of the firms plan or desire to establish larger markets, none of the firms expressed a desire to relocate to gain a larger market. Nearly all of the locally owned companies were established in the region and have not considered nor do they plan to consider moving outside the region to gain a larger market. A few of the locally established firms have since been bought by companies outside the region, and the investments made by the outside companies keep those firms in northwestern Minnesota. Of all the companies surveyed, only one company expressed a concern over the slow technology adoption by most firms and strongly felt that this would negatively affect the industry in the future, though no specific information was given. However, several firms did comment on the aging nature of ownership and workers in the region and cited that this factor may be holding back technology implementation and adoption of new manufacturing, communication, and transportation techniques.
ITS Potential for Industry Clusters

Clearly, ITS use, adoption, and implementation are not only different for each firm but for each cluster as well. Whereas ITS technologies are integral to the RTE cluster, the wood products cluster is much less dependent on such technologies. However, ITS technologies are but one of many parts of a successful rural industry cluster. While it is beyond the scope of this paper to prescribe specific ITS technologies that would benefit the two clusters, this section will draw upon themes from the interviews to show important ITS technologies being used now and to briefly describe how ITS needs are likely to grow.

The recreational transportation equipment cluster is growing, and so is the cluster’s need for improved communication, information and inventory management, supply tracking, product tracking, and information distribution. However, while ITS has made crossing distances in the RTE cluster easier, there is still a certain level of convenience, historic connection, and cost-effectiveness to keeping suppliers and producers in relatively close proximity whenever realistically possible. The larger companies in the RTE cluster are driving technology adoption up and down the supply-chain, and that is likely to continue into the future. For smaller firms to survive, there must be continued technological support from ITS developers and from larger firms that are adopting the technologies first. Larger companies moving towards electronically integrated supply chains is intended to bring all suppliers closer electronically if not physically, however, suppliers in the region still have the potential to lose their competitive edge of being physically closer.

Since a great deal of the raw materials needed to make RTE-related product come from outside the region, in some cases as far as Europe and Japan, integrating just-in-time shipping with near real-time supply tracking makes it possible to rely on strict schedules that reduce inventories and ship final products to the proper place at the proper time. Firms in the region stated that moving to these technologies is essential to stay in business—not just because of the rural location. Without these technologies, smaller and larger firms would be significantly challenged by outside competition.

ITS has helped keep the rural RTE cluster competitive by increasing supply-chain transportation and communication efficiency. In order to continue the RTE cluster’s
success, companies will need to continue to innovate in the supply chain, adopt firm-size appropriate technologies, and communicate with other firms in the cluster to ensure efficient and compatible electronic systems. ITS has made it easier for the cluster to stay cohesive as well as competitive, but the various firms must continually monitor new ITS technologies to stay competitive with firms in and outside of the region.

The wood products cluster is in an entirely different situation. The small size of the market for many of the wood products firms limits the amount of capital investment and necessity for ITS technologies. While not every firm would benefit from implementing ITS technologies, there are firms in the region that, in the future, may benefit from ITS technologies. For this to happen, however, there must be a strong case for improved efficiency and low-risk to purchase ITS technologies. For example, basic inventory tracking and supply tracking technologies may be most beneficial. With many of the companies relying on raw materials from outside the state, a delay in shipment due to weather, road construction, or other problem could significantly hamper normal business activities.

Although there was not obvious distaste for new technologies in the wood products cluster, most of the firms simply did not perceive a need for sophisticated ITS technologies. In the immediate future, ITS adoption will likely come from larger firms that are supported by regional and national markets that require strict schedules in order to meet the needs of many consumers outside the region.

**Conclusions: ITS and the Industry Cluster Approach**

There is a future for ITS use in northwest Minnesota not simply because it is rural but because competition requires it. The challenge for ITS developers is to make user-friendly systems for smaller firms and to coordinate ITS technologies in cohesive, unified industry clusters. Arctic Cat, Polaris, Potlatch, and the myriad of other firms in northwestern Minnesota must continue to find rural northwestern Minnesota advantageous if they are to remain there. Simply providing them with ITS technologies will be insufficient—there must be support for ITS technologies, coordination between businesses, and expandability for growing businesses that may not need the most expensive technologies immediately. The smaller supplier firms must continue to
increase efficiency to remain competitive with firms inside and outside of the region and that efficiency will likely run through the supply-chain to the larger companies.

Firms in northwestern Minnesota are not independent of each other. There are long standing and historical relationships between many of them. If the cluster is to remain viable, particularly for the sake of the smaller companies, there must be cooperation and communication in the supply-chain, particularly in the recreational transportation equipment cluster. Given increased worldwide competition, larger companies will only remain in the region and keep local suppliers as long as it is financially reasonable to do so. Larger companies and smaller companies in close proximity retain a synergy from working with each other, and it is this symbiotic relationship that ITS is helping to maintain.

The industry cluster approach analyzes a collection of industries rather than single firms to better understand how regional economy drivers function together. Using this approach to analyze technology use in a cluster is a useful technique for understanding how firms in the cluster are communicating as well as finding their strengths and weaknesses. By recognizing how technology use is changing within the cluster, these strengths can be built upon and weaknesses addressed. This differs from evaluating a single company because a cluster is attached to far more jobs than any single firm. By finding ways of keeping an entire cluster competitive, existing firms will strengthen and other firms will be drawn into the mix to support the cluster and connect into the infrastructure.

The industry cluster analysis evaluates the current situation, addresses how local and outside demand affects the cluster, assesses firm strategy and rivalry, and analyzes the individual companies in the cluster. The key part of industry cluster analysis is understanding how and why firms interact and, how ITS is affecting those interactions both inside and outside of the cluster. This paper has provided a brief investigation of the situation and illustrated interactions in northwestern Minnesota that can be used for future analysis. The primary implication of using cluster analysis is that once the existing situation is understood and how its likelihood of change is evaluated, ITS experts can use the information to make recommendations to technology policy-makers, ITS developers, and to firms within the context of sustaining a regional economy.
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Endnotes


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