

Rural Knowledge Clusters:
Innovation and Vitality in America's Rural Communities

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State and Local Policy Program
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Table of Contents

I.	Introduction	3
II.	Year One Revisited	3
III.	The Rural Community Vitality Conference	5
IV.	Rural Knowledge Clusters: Exploring The Role of Institutions in Northwest Minnesota's Recreational Vehicle Industry	9
V.	Developing Rural Knowledge Indicators	20
VI.	Industry Clusters & Intelligent Transportation Systems: A New Framework	36
VII.	Looking Forward to Year Three	51
VIII.	Bibliography	53
IX.	Appendix	54

I. Introduction

This report constitutes the research activities and findings for the second year of the *Globalization and Knowledge Clusters for Rural America* project, which is now entering its third and final year. The scope of the project has been organized around a basic proposition: to explore and to test hypotheses that describe the effects of globalization on rural economies. Embedded in this proposition are two key components, the first of which is that rural, regional economic vitality can be understood as a function of "knowledge clusters." This is an idea that builds upon well-known theories of industrial location, but includes the components of local institutions and history as important drivers in the success of rural, regional economies. The second key component is that globalization effects a loss of national sovereignty with respect to economic policy, thereby shifting certain policy features both upward to the international level and downward to the state and local levels. Specifically, the project seeks to explore and describe the mechanics of institutional capacity building as a response to globalization, at the rural and regional level. We note here at the outset, that this question of institutional capacity in relation to the phenomenon of globalization will be a major research component of this third year.

II. Year One Revisited

The first year of the project focused on moving from "rural knowledge clusters" as a concept toward a useful model that could describe rural, economic vitality. Rural knowledge clusters can best be understood as innovative, interrelated groups of firms located outside metropolitan areas, deriving competitive advantages through accumulated, embedded and imported knowledge among local actors and institutions. It builds upon the influential work of Michael Porter and his use of industry clusters, as well as the work of regional economist Stuart Rosenfeld, who has done much to apply the model to the rural context. The model seeks to explain the dynamism of vital, rural economies as a function of three key factors:

- **Competitive advantage:** current factors related to supply or demand conditions, related industries, or local rivalry that give local firms a market advantage.
- **History:** an historical base of knowledge about an industry or technology that has given rise to current sources of competitive advantage.
- **Institutions:** formal and informal institutions that develop around clusters to support the creation, diffusion, and import of knowledge.

Of course, we should remember that this model is motivated by the (now well-established) fact that the backbone of rural economic success, namely access to low-cost labor and primary resources, has been usurped by the increasingly open markets resulting from globalization. It is widely accepted that economic activity in developed countries, whether local, regional or national in scope, and whether rural or urban in context, must compete on innovation and high value-added production. For myriad reasons, both economic and demographic in nature, rural areas have been seriously challenged by this shift, one that relocates the source of competitive advantage to now being primarily a function of knowledge; it is today commonplace to refer to industries competing in a knowledge-based economy.

In addition to establishing a model for rural knowledge clusters, the first year of the project involved a series of case studies that applied the model to different regions in the state of Minnesota. Four different knowledge clusters emerged:

- ***Mankato area:*** wireless technologies and radio frequency technologies
- ***Alexandria area:*** automation and motion control technologies
- ***Northwest Minnesota:*** recreational transportation equipment
- ***Winona area:*** advanced composite materials
- ***Southwest Minnesota:*** precision agricultural equipment

Key findings from the case studies are summarized as follows:

History and context are important in the development of rural knowledge clusters.

The entrepreneurial behavior of key individuals in the local history of each region has been of paramount importance in determining the growth path of the cluster. Additionally, environmental factors have helped shape a climate conducive to innovation and entrepreneurship, and the importance of such "place" characteristics plays a central role in the knowledge cluster model.

A core knowledge base can be instrumental in driving multiple industries and applications.

Such a base of knowledge is often a driver of innovation across a broad range of industries. Entrepreneurial cross-fertilization, whereby the local knowledge base informs new technologies, products and markets, is an important feature of the model. Finding new applications for the local knowledge base relieves the constraint on firms that fear becoming "too specialized"; such overspecialization has obvious ramifications in terms of the market vulnerability.

The acquisition of local firms by non-local firms can either bolster or threaten the vitality of rural knowledge clusters, depending of the circumstances.

The core of all those clusters examined in Minnesota was the result of one or two local firms that ultimately generated spin-off and related activity. These firms have maintained a very important influence over the development of the community. And while mergers and acquisitions are not a new phenomenon, in the era of globalization, they have become increasingly commonplace. For rural knowledge clusters, the net effect of having a locally owned firm acquired by a non-local entity varies from case to case. The most important factor under such circumstances is whether or not innovative activity remains a central function of those productive facilities that stay local.

Two different strategic approaches can boost the vitality of rural knowledge clusters: an "institutional" strategy and an "entrepreneurial" strategy.

It is clear that in order to maintain the economic vitality of a rural knowledge cluster, local actors must think strategically about it. Two general categories for strategic action have emerged:

Institutional Strategies - developing consensus around the need for new or enhanced local institutions to address key competitiveness issues facing the cluster. Such institutions--when developed effectively--may represent a key competitive advantage, or alternatively, provide the kind of support necessary to overcome disadvantages.

Entrepreneurial Strategies - focus on creating an environment that is supportive for start-up and spin-off firms, as new ventures often extend the region's knowledge base into technologies and product markets. Further, they mitigate the risk of overspecialization and reduce the cluster's reliance on the success of a small number of larger firms.

Developing comparable quantitative indicators of knowledge is difficult.

This operation represents a key piece of the project conducted in the second year.

As a result of the first year's findings several components of a rural knowledge cluster approach to economic development were identified. First, understanding the local knowledge base is absolutely crucial as a first step towards developing a plan for action. Secondly, as a key strategy, linkages between firms and the local institutions that support them must be encouraged. The corollary to this point is that strategic action should also focus on creating an environment whereby innovation is emphasized. Finally, economic development is not the result of one actor or even one set of actors. There are various groups of actors that all play an important role in identifying and fostering the knowledge base that supports economic activity. It is incumbent upon local and regional actors that a shared vision is promoted, that any strategic action take advantage of the strengths that come from partnerships.

III. The Rural Community Vitality Conference

The second year began with the Rural Community Vitality Conference, held at the Hubert H. Humphrey Institute for Public Affairs at the University of Minnesota in Minneapolis on September 13-14, 2002. The conference drew in research and practice analogous to the project focus, produced by partners from throughout the United States. Its purpose was not to sell the concept per se, but to use the mid-project timing to present what has been learned and to stimulate dialogue on these issues in hopes of creating better research tools and dissemination of knowledge. It can best be described as the first step in moving from a conceptual approach toward the real application of the project's findings among three important perspectives of rural development: the practitioner, the academic, and the policy maker.

A basic premise of the conference was that rural America is confronting very serious development challenges, and is burdened by a disproportionate share of economic poverty. And while individual communities do indeed face individual circumstances, rural communities can benefit from meeting these challenges collectively. The relationship between rural communities and globalization has been almost uniformly characterized by its negative qualities and one of the principal aims of the conference was to help redirect thinking on this subject by recognizing the ways in which rural communities can benefit from global trends.

Below is a brief list of what emerged as major developmental challenges facing rural communities:

- A lack of certainty about farming incomes due to commodity price squeezes, deregulation of agricultural industries due to globalization, and increasing environmental regulations imposed on agriculture;
- A lack of public and private investment;
- A lack of appropriate infrastructure, especially telecommunications;
- Loss of jobs and people to urban areas;
- Loss of political influence in decision making;
- Corporate farming that has a negative impact on rural communities;
- Urban values that are being imposed on rural communities; and
- The reflection that agriculture is seen as an "old," sunset industry.

Globalization and the Rural Economy

There is a need for rural communities to re-imagine themselves. Some of the development tactics of the past, such as business relocation incentives are now widely criticized as short-sighted. Rural communities have no choice but look closely at their strengths and take ownership for a development strategy. Communities need to equip themselves with the resources necessary to manage national and global forces over which they have no control, and in many cases this means competing on knowledge. For example,

in the state of Minnesota, nearly half of all new jobs will require at least a bachelor's degree, something that less than a quarter of new entrants to the workforce possess. There is also the general phenomenon of out-migration, as some of the brightest students leave the state for higher education and potentially for life, which can be particularly acute in rural communities. It's important to remember that this is happening at a time when technology makes the competition for knowledge and service jobs international in scope.

Another response to the global economy is to consider how communities differentiate themselves. This may mean that a community has to think of itself as a product and consider how to present itself in a way that will make it a desirable place. Rural communities need to look for what makes them distinct both historically and culturally — not just in economic terms. To conceive of development in purely economic terms is a mistake, as it is equally those aspects of social and cultural life that contribute to a community's long-term vitality.

Communities also need to consider how they globalize their visions and the strategies they want to use to pursue those visions. Local employers, trade groups, schools, and other institutions have important roles to play when it comes to developing these visions and making them a local reality. Traditionally, trade in farm products has been the strongest local connection to the global economy for many rural areas, but the volume of international trade in agricultural markets remains low, accounting for less than 10% of global food consumption. It is believed by many that agricultural policies that persist in creating a system of commodity subsidies for rural farm communities will only hasten their decline. However, increasing global demand for differentiated agricultural products — driven by consumers — could help rural economies in that interest among new and younger farmers may be in moving away from the commodity approach.

The Importance of Innovation to the Rural Economy

Entrepreneurship is a basic element of every economic strategy. Economic development necessarily involves community development, with particular attention given to those who are the innovators. But it's a mistake to equate innovation with high technology; markets are not circumscribed by high-tech innovation. For instance, one conference panelist highlighted the phenomenon of “serial entrepreneurship” whereby one person opens one type of retail shop, then re-opens a downtown theatre, then a new restaurant etc.

A more sobering insight regarding the role of entrepreneurship in rural areas, however, was that in certain places, there's a feeling that someone else will provide a job, and there isn't a sense that someone can start their own business. There needs to be an emphasis on the importance of risk taking, and one presenter called innovation an act of “deviant behavior,” and encouraged “willingness as a society to tolerate people who are going to try things differently.”

Often entrepreneurship and innovation are conflated with technology. Conference panelists were quick to point out that while technology certainly has an important role in economic development and thus in rural community development, the case for technology can be easily overstated. In recent years, much has been made of the potential impact of broadband technology on rural areas. It was suggested, however, that although broadband could increase technological capacity, is not an economic “driver.” It is not a leading-edge solution to a community without a vision of how it wants to develop. One presenter shared anecdote concerning rural areas in Australia that lobbied to get broadband technology but, once they got it, they didn't know what to do with it.

Rural Institutions and the Promotion of Innovation and Knowledge Creation

Rural areas comprise almost 20% of the population in the United States, but they have only about 12% of all adults with a four-year college degree. The fact is that smart, young workers are being drawn to metro areas and that high-growth areas in the economy are in fact concentrated in urban, not rural, areas. It raises an important issue regarding the nature of partnerships in rural development strategy. One of the

conference panelists, Kevin Kopischke, president of Alexandria Technical College in Alexandria, Minnesota, challenged other colleges to participate directly in the business interests of their regions, asking: "Can you do what you want to do to respond to what industry expects of you?" And while he indicated that faculty often respond by telling him that their focus is in teaching, not market research, Kopischke suggests that a corner has been turned, one that faces a market-based philosophy of higher education.

One of the biggest challenges in rural development is creating employment opportunities. Of course employers desire an educated and trained workforce but in many cases are unable or unwilling to make the investment as a single employer. It was suggested that those who conduct cooperative training with other companies are likely to develop training programs with other firms in their industry and unlikely to cooperate with firms in their supply chain. Gary Green, professor and chair of the Department of Rural Sociology at the University of Wisconsin–Madison believes that the firms that could benefit most from cooperative training arrangements —such as small businesses with a large percentage of unskilled workers — are the least likely to work together to provide training. "Education and training are key factors in rural development," he noted, but he also said that providing education and training are challenges in rural America because there are fewer people to educate and many rural areas are not served by community colleges.

Devolution, Local Capacity, and Rural Development

Increasing local decision making has clear benefits, but many who work in the field expressed concerns about how this idea of devolution is being put into practice. For example, consider how Boone County, Missouri, has been charged with managing water quality through the Environmental Protection Agency (EPA) and the state Department of Natural Resources. Boone County Commissioner Karen Miller, president-elect of the National Association of Counties, described how this responsibility has come without the ability to create a funding mechanism to pay for compliance or adequate authority to address the issue.

"Devolution is a word that can be synonymous with 'unfunded mandate,'" Miller said. When local governments are given responsibilities without resources they are hard-pressed to make cuts elsewhere. "What are we supposed to do, cut public health? Reduce planning? We don't have a lot of fluff," Miller said.

The shift in how and where policy making takes place, due to the effects of globalization will likely be a persistent issue for rural communities. Two principal issues have emerged in this context. It is clear that this shift increases the level of responsibility at the local level, and as such, the question of whether local governments have the fiscal resources necessary to provide those additional services that come with increased responsibility is appropriate. Beyond the difficult matter of fiscal resources, however, there is also the question of institutional capacity. This policy devolution has been characterized as a "federal-state" dynamic, making the impact of the shift on rural communities difficult to assess. According to David Freshwater, a Professor of Agricultural Economics at the University of Kentucky, "rural communities don't have a leg to stand on when they're just acting under the umbrella of the states."

Development policy requires strategic planning and good decision-making and so there was concern that this aspect of the shift has not been adequately accounted for. Strengthening the capacity of local communities to deal with increased responsibility for development planning requires investment in training and education as well as in technology that does not always reach governance units in rural communities. However, among conference panelists, there was also some optimism expressed regarding this strategic shift in policy making. As local communities are forced to take ownership for development issues, the potential for stronger and more durable partnerships between states and local communities becomes possible and perhaps even necessary.

Shifting Demographics: Latinos Changing Rural America

According to USDA statistics, Hispanic people are settling in rural America faster than any other racial or ethnic group. Claudia Fuentes, executive director of Hispanic Advocacy for Community Empowerment through Research (HACER), said, "In some rural Minnesota communities, Latinos account for about one-fourth of all residents." She said that the Latinos who are coming to Minnesota "are in their prime child-bearing years," and that this infusion of Latino children has helped rural schools avoid closure or consolidation due to shrinking enrollment. These new students have brought more state school aid to local districts, since the aid is based on a per-pupil formula. Fuentes noted, "Latinos will become the new majority statewide and nationally. Our state will have to rely on students of color for its social and workforce needs."

Researcher and Humphrey Institute professor Katherine Fennelly listed the "links of incorporation," which make for a fuller, more meaningful life for new residents: secure employment, establishment of credit and legal status, and freedom from discrimination. She also listed workers' rights, including a living wage, reasonable benefits, and safe working conditions, as key issues to be addressed by rural communities and the companies that locate there.

Fennelly challenged rural community leaders: "What kind of questions are you asking *before* these businesses come in?" For example, what commitment will the company make to respond to local needs? She noted that while some middle managers are interested in the community, without the involvement of upper management or town leaders, "we won't get to where we want to go." Former Minneapolis mayor and current Humphrey Institute senior fellow Sharon Sayles Belton summed up the conversation this way: "Quality of life and culture — what do they mean in terms of new populations? We have to find a way to be energized by this conversation."

Themes in Successful Rural Development

Conference panelists shared a belief in adaptability, not conformity as rural communities look for examples as to how best to pursue development. Implementing the success story of another community is not simple about adopting it wholesale, but rather adapting it to the local context. Every model is a context in a particular point in time. Success in one community may not be desirable for another community. However, it was underscored repeatedly that successful rural economies emphasize education, an entrepreneurial attitude, a strong sense of ownership and belonging to a human community, while making use of the tools and resources of their age.

Successful rural development may require what can be thought of as "interdisciplinary thinking," combining economics, sociology, demography, geography, political science, and more. Although, there was widespread agreement that communities need to beware the temptation to act fast without defined plans. One panelist offered the following advice, "If you aren't prepared to sustain the effort for at least five years, then don't start. Rural development is a journey, not a destination," "

Where do we go from Here?

There is no federal policy specifically tailored to rural America, a rather surprising fact given the expanse and challenges of rural communities. However, the fact that more people are talking about such a policy should be viewed as positive step. One theme was clear throughout the conference: successful rural economies are intentional, not accidental. They require sustained, committed work by people who have purpose and passion. Those involved in rural economic development must actively decide how to steer the fate of their communities or they run the risk of being drawn into a global economy that simply exploits them for their human and natural resources, as well as facing the continuing trends of losing their

younger, better-educated workers to the urban center.

Conference speakers and audience members made clear that the task of reviving rural economies is large and complex, but not impossible. Every available resource and innovation must be considered. Individual entrepreneurship must be nourished, the support of institutions enlisted. The driving question for economic development specialists is not “Can rural development be done?” but “How can it be done?” There seemed a consensus that for the struggling rural economy, this question will best be answered by invoking two vital principles: energetic optimism and sobering realism.

What follows is a compendium of the research undertaken in the second year of the project. This includes a regional pilot project that was launched in partnership with local actors in the Northwest Minnesota region, to examine more closely the current and future role that institutions play in supporting the region's knowledge base. It also includes a project to identify the role that Intelligent Transportation Systems plays within the cluster (within the same economic region). Further, the difficult operation of identifying and describing quantitative indicators of knowledge activity was undertaken and completed, and the findings are presented here. Finally, steps for the third and final year have been outlined, among which will be efforts to implement various outreach and education programs designed to raise awareness and promote the rural knowledge cluster approach to economic development.

IV. RURAL KNOWLEDGE CLUSTERS: EXPLORING THE ROLE OF INSTITUTIONS IN NORTHWEST MINNESOTA'S RECREATIONAL VEHICLE INDUSTRY

Introduction: Surviving in a Rural Economy

The impact of globalization, both in terms of the opportunities it affords and the challenges it presents, is now a well-established feature of economic development. Due to increased openness in markets, economies can no longer depend on protection from global competition. Industries that prosper in the current climate are those characterized by innovation and high-value added products. Industries that suffer and are in decline are those supplying standardized, low-value added products; in short the product markets that have become highly susceptible to global competition.

In the context of rural economies, global competitiveness has often had dramatic effects. Rural economies, in large part, have traditionally supplied low-value added markets, and in recent years their decline has been well documented. The historical components of competitive advantage for rural economies, namely access to primary goods and low production costs, have been compromised by globalization. Traditional agriculture and basic manufacturing have long been the economic backbone of rural communities. These two industries in particular have been subjected to increasingly competitive sources as globalization has taken shape.

Furthermore, rural decline has been exacerbated by the structural phenomenon of out-migration from rural communities, (which is an often cited explanation for the economic performance gap between rural and urban economies.) The problem of out-migration also contributes to the inability of rural businesses to compete on scale and may inhibit specialized division of labor, two important factors that put rural economies at a further disadvantage. The story of rural decline is underscored by other measures such as average wages, educational attainment, occupational composition and patent activity. In all of these categories, there is a significant statistical gap between rural and urban communities.

The economic success of rural communities largely depends on transitioning away from markets in which their competitive advantage has been usurped by globalization and toward innovative high-value added production. In short, rural economies face the challenge of competing in a knowledge-based economy. The challenge for policy makers, for economic and workforce development professionals and for business leaders alike is to seek to understand the mechanics of high performance economies (both rural and urban) and the role that knowledge plays. Ideally, such analysis will contribute to the strategic promotion of those sources of economic vitality that sustain communities.

The Industry Cluster Framework¹

The dynamics of industrial districts have a long history among economic theorists, and the seminal work of Marshall, Young and Weber laid the groundwork from which regional science and industrial location theory emerged in the 1950s and 1960s. 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, regional success stories.² 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.

More recent analyses of regional development have built upon the influential work of Harvard business economist Michael Porter, and the model of industry clusters.³ His work in this area builds upon the cluster studies of the 1970s and 1980s, but fuses it with theories of entrepreneurship, institutional economics and social capital as well as the fundamentals of business strategy in such a way that the result may be legitimately described as a renaissance of regional development theory. Porter's use of the industry cluster model has now become a basic component in describing the mechanics of regional economies.

The industry cluster framework suggests that innovative businesses compete by producing high-quality, value-added products in an economy where high-volume, low-value products can be produced at lower cost in other parts of the world. He argues that the innovative capacity of regional businesses may be strengthened by their involvement in industry clusters – geographic concentrations of firms in related industries that do business with one another and share needs for similar talent, technology, and infrastructure. Innovative businesses and competitive industries are, in Porter's view, the foundation for prosperous regional economies.

In the *diamond of advantage* model, Porter identifies four aspects of industry clusters that may facilitate innovation. First, he suggests that *factor conditions*, such as the availability of specialized labor and infrastructure, influence the innovative capacity of regional businesses. Porter also cites *home demand* – local customers who push businesses to innovate and whose needs and tastes may anticipate global demand – as an important driver of innovation. A third aspect of industry clusters that may encourage

¹ Information in this section summarizes previous work by the State and Local Policy Program. For more detail, see:

Munnich, L. W., Bau, M. M., Skelton, R. A., Warner, J. P., & Muesing, B. J. (1998). *Northwest Minnesota industry cluster study*. State and Local Policy Program and Minnesota Extension Service.

Munnich, L., Schrock, G., & Bonelli, A. H. (2002). *Rural knowledge clusters: Implications for Minnesota State Colleges and Universities*. State and Local Policy Program.

Munnich, L. W., Schrock, G., & Cook, K. (2002). *Rural knowledge clusters: The challenge of rural economic prosperity*. United States Economic Development Administration.

² The shoemaking industry in northern Italy, industrial machinery in Germany and Japan and high technology in Silicon Valley and Boston are often-cited examples.

³ Porter, M. (1990). *The competitive advantage of nations*. New York: The Free Press.

innovation is *related and supporting industries* – local supplier industries that may create business infrastructure or foster spin-off activities. Finally, Porter maintains that *industry strategy, structure, and rivalry* spur innovation, as local industries motivate one another through competition and cooperate on shared needs.

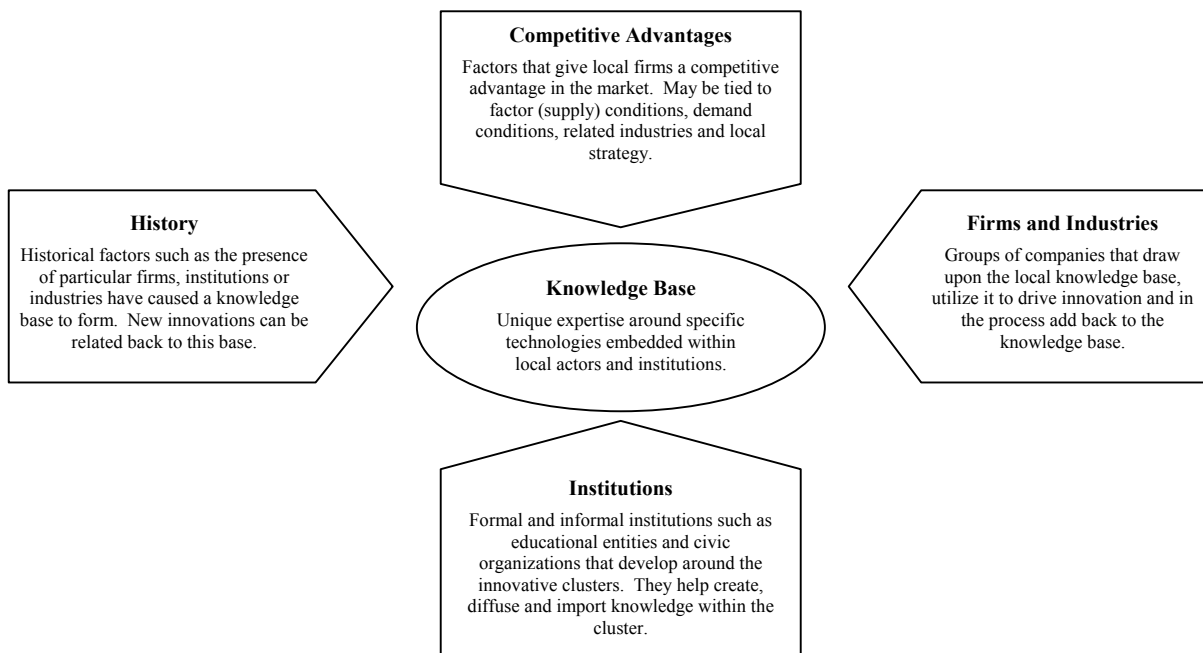
Knowledge Clusters: An Extension of the Industry Cluster Framework

Although Porter does not explicitly include knowledge in his diamond of advantage model, specialized knowledge is closely related to each of the model’s four components. For instance, individuals and firms affiliated with industry clusters may derive important knowledge of processes, technologies, and markets from their interactions with specialized labor pools. Demanding local customers, innovative suppliers, and competitors may also provide firms with valuable knowledge. Recognizing these connections, the State and Local Policy Program has developed a model of knowledge clusters. This model builds on Porter’s diamond of advantage, emphasizing the role of knowledge as a driver of innovation and a source of competitive advantage.

In addition to the four components of the diamond of advantage, the knowledge cluster model incorporates the influence of history and institutions on cluster development, growth, and competitive advantage. Specialized knowledge – and, consequently, innovation – may be derived, not just from the diamond of advantage, but also from a local historical base of knowledge about an industry or technology. Regions may benefit, for example, from knowledge embedded in industry employees or local residents. In addition, formal and informal institutions may support the development and maintenance of knowledge resources. Universities, technical colleges, economic development entities, and nonprofit organizations are some of the many institutions that may contribute to a region’s specialized knowledge base.

While the knowledge cluster model is applicable to both urban and rural economies, the State and Local Policy Program has focused considerable attention on rural economic vitality. In particular, the SLPP has explored the nature and performance of *rural knowledge clusters*, or knowledge clusters centered outside of major metropolitan areas. Rural knowledge clusters, like industry clusters, comprise networks of innovative, interrelated firms. However, rural knowledge clusters are unique in that their chief source of competitive advantage is knowledge. In particular, firms within these clusters derive competitive advantage from specialized knowledge about specific technologies, processes, and markets.

Rural Knowledge Cluster Framework



A Knowledge Cluster in Northwest Minnesota

In 1998, the State and Local Policy Program conducted a study of industry clusters in Northwest Minnesota.⁴ Among the clusters examined was the recreational transportation equipment cluster, which includes two key regional manufacturers, Polaris and Arctic Cat--makers of final goods such as snowmobiles, all-terrain vehicles, watercraft, buses, and track conversions for four-wheel drive vehicles--along with associated suppliers and retailers. The cluster is centered in Roseau and Thief River Falls, where the two largest domestic producers of recreational transportation equipment have operated for nearly half a century.

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.

The 1998 study involved interviews and focus groups with business representatives from the recreational transportation equipment cluster, and focused on the components of Porter's diamond of advantage as they related to the cluster. With regard to factor conditions, these industry leaders expressed satisfaction with the strong work ethic of regional workers, low labor and transportation costs, abundant open space for expansion, and a corporate culture that encourages employees to "live the product." On the other hand, business representatives reported shortages of workers with certain manufacturing skills. Further, interview and focus group participants felt that the region's post-secondary institutions were not adequately preparing students for jobs in the region.

Turning to the other components of the diamond of advantage, business representatives acknowledged strong home demand for recreational transportation equipment. In particular, industry leaders suggested that Minnesota's natural amenities, climate, and snowmobile trails created considerable demand for snowmobiles across the state. Industry leaders also noted a growing demand for watercraft and all-terrain vehicles. When asked about related and supporting industries, business representatives reported that regional and state supplier networks played an important role in their operations. With regard to firm strategy, structure, and rivalry, interview and focus group participants described intense inter-firm competition. At the same time, industry leaders reported that firms in the cluster sometimes cooperated and exchanged ideas.

The recreational transportation equipment cluster has been a successful and growing cluster despite being located in the most sparsely populated region of the state. It is considered a "classic" industry cluster due to its strong manufacturing base, internal cooperation and competition between producers, as well as local supply networks, significant economic importance to the region, strong local and national demand, and

⁴ For purposes of this study, Northwest Minnesota was defined to include Beltrami, Clearwater, Hubbard, Kittson, Lake of the Woods, Mahnomen, Marshall, Norman, Pennington, Polk, Red Lake, and Roseau counties. A detailed profile of the region and results of the industry cluster study are available in Munnich, L. W., Bau, M. M., Skelton, R. A., Warner, J. P., & Muesing, B. J. (1998). *Northwest Minnesota industry cluster study*. State and Local Policy Program and Minnesota Extension Service.

for not relying strictly on cheap labor or locally available raw materials. Further, because the cluster faces increasing competition from foreign and domestic markets it must find ways to be innovative and efficient, which are key indicators of specialized knowledge. As a result, the State and Local Policy Program extended the industry cluster study to explore the possibility that the recreational transportation equipment industry has characteristics of a rural knowledge cluster.

Preliminary evidence suggests that, consistent with the knowledge cluster model, regional history and institutions have influenced the cluster's development. History, in particular, has shaped the cluster since its founding. Snowmobiles were developed in Northwest Minnesota because the region's winter climate necessitated snow-friendly forms of transportation. Since the major snowmobile manufacturers were established, employment in these and related companies has endowed residents of the region with substantial knowledge of snowmobiles and other recreational transportation equipment. What is more, Northwest Minnesota residents have developed specialized knowledge of the cluster's products by using them. Regional consumers of recreational transportation equipment are demanding, with tastes that anticipate broader consumer desires. This exigent home demand encourages innovation by cluster businesses. Finally, the competition among cluster firms reflects, at least in part, the competitive snowmobile racing culture that they support.

Unlike history, regional institutions did not significantly influence the establishment of the recreational transportation equipment cluster. More recently, however, institutions may have contributed to the importation, development, and diffusion of cluster-related knowledge. In particular, early evidence suggests that educational institutions may support knowledge diffusion through customized training and contribute to knowledge development through process improvement.

Exploring Knowledge in the Recreational Transportation Equipment Cluster

The framework for *rural knowledge clusters*, which essentially promotes the idea that the competitive advantage found in vital, rural economies is the result of specialized knowledge, incorporates two key concepts. The first is that such clusters “exhibit a path of *historical* development and evolution to the local knowledge base.” The second is that both formal and informal *institutions* may foster “the creation, diffusion and renewal of the local knowledge base.” The purpose of this report is to extend the State and Local Policy Program's preliminary examination of Northwest Minnesota and the recreational vehicles industry cluster first identified back in 1998. In particular, the study seeks to explore the relationship between the specialized knowledge base associated with the cluster and regional institutions. Goals of the study are as follows:

- Describe the knowledge base associated with Northwest Minnesota's recreational transportation equipment cluster.
- Identify institutional supports for knowledge resources within the cluster.
- Identify additional roles regional institutions might play in the development and maintenance of the cluster's knowledge base.
- Generate a basis for research in other rural clusters.

Methodology

To explore the knowledge base and institutional supports underlying the recreational transportation equipment cluster, in-depth, semi-structured interviews were conducted with representatives of universities, technical colleges, and economic development entities in Northwest Minnesota. Supplementary interviews were conducted with representatives of foundations, nonprofits, and

government agencies when these organizations interacted substantially with businesses in the cluster. Respondents from each type of organization were identified using public databases and directories, and through the personal networks of project partners at the Department of Trade and Economic Development, Northwest Technical College, the Northwest Minnesota Foundation, and the Headwaters Regional Development Commission. Interviews were conducted by telephone between January and April 2003, and covered a range of topics, including communication between businesses and institutions, institutional supports for knowledge maintenance and development, and other types of assistance provided to the cluster.

Indicators of Specialized Knowledge

A basic economic indicator for a concentration of knowledge is the location quotient. The location quotient (hereafter referred to as LQ) is a technique used to compare activity in the local economy to a reference economy. The LQ is defined as the ratio of the share of an industry's employment in the local region to the share of that industry's employment in the reference region. For example, if a particular industry represents 2 percent of the Northwest Minnesota economy and 1 percent of the US economy, then its LQ is 2.0 ($2.0\% \div 1.0\% = 2.0$).

In this way, the LQ measures the relative concentration of an industry in a local area compared to the reference area. An LQ greater than 1.0 indicates that a local area has a relatively greater concentration of an industry than the reference area, while an LQ of less than 1.0 indicates that an industry is relatively less concentrated in an area.

In 2001, the LQ for the *manufacturing* sector in Northwest Minnesota, using the US economy as the base, was 1.6. This confirms that the sector is indeed a vital part of the regional economy. Furthermore, if we "drill" a little deeper into the manufacturing sector (meaning we look at more specific industry classifications), we find that the LQ for *transportation equipment manufacturing*, in which is embedded the manufacture of recreational vehicles, is 4.6. This indicates that this sector is more than four-and-one-half times as concentrated in Northwest Minnesota compared with the national economy.

The concentration of knowledge may be indicated by other measures as well. For example, educational attainment is perhaps the broadest measure of human capital commonly available. A highly educated workforce is thought to correlate with, among other things, higher wages and a higher degree of community prosperity. By consequence, educational achievement may contribute directly to a region's long-term economic vitality. Although there are a variety of factors that influence educational attainment, one of the most salient with regard to rural communities is the pattern of migration. Rural communities can experience a net out-migration of well-educated workers (brain drain) or can attract well-educated workers from other locations.

The most common statistical benchmark employed to indicate educational attainment is the fraction of the adult population 25 years old and older that has completed a four-year degree or higher level of education. According to Census Bureau data, between 1990 and 2000 there was an average net increase in this parameter of approximately 3% among non-metropolitan communities in the US. By comparison, between 1990 and 2000, Northwest Minnesota experienced a net increase of approximately 4%. At the individual county level, 2000 census data show that among non-metro counties in the US, on average, approximately 15.9% of the population had attained the educational level of a 4-year degree or higher. By comparison, in NW Minnesota four out of twelve counties exceeded this level: Beltrami, Hubbard, Lake of the Woods and Polk (Beltrami ranked the highest with 23%).

Does this translate into higher than average wage levels for those employed in the recreational vehicles cluster? If one makes a comparison within the region of Northwest Minnesota itself, the answer is yes.

The average weekly wage in 2001 for the region in general was approximately \$457, whereas the wage level for *transportation equipment manufacturing* firms was approximately \$617; however, this is well below the wage levels at the state level (\$709), the Twin Cities metro (\$991), and the national level (\$974).

An important caveat here is the issue of data suppression. The NAICS classification system recognizes the recreational vehicles industry under the code **336999 “all other transportation equipment manufacturing.”** However, due to concerns over confidentiality, public data for this NAICS code is simply not available at the regional level. This means that we are only able to look at wage levels at the much more general level of transportation equipment manufacturing (NAICS 336). In so doing, we are comparing wage levels with such activities as automobile manufacturing, aerospace and aircraft manufacturing, ship building, as well as military armored vehicle and tank manufacturing. As such the wage comparison may be unduly weighted toward these other activities.

The cluster – and the region – benefits from knowledge of competitive manufacturing processes and an entrepreneurial manufacturing culture. In the interviews conducted it was often suggested that the region’s competitive advantage derives from “an improved workforce in manufacturing,” along with “manufacturing talent and education.” In fact one respondent in particular reported that Northwest Minnesota provides an environment in which manufacturing is “endemic to the culture.”

Firms in the recreational transportation equipment cluster play a central role in creating this climate, but the manufacturing culture and expertise benefits other manufacturers as well. One of the respondents interviewed mentioned a company he had worked with decided to locate in the region, rather than in North Dakota, because of the entrepreneurial manufacturing environment and the concentration of small manufacturing businesses in Thief River Falls.

For example, if we look at data that describes wood product manufacturing we find indications that Northwest Minnesota exhibits a high degree of specialization in this industry. Using the same quantitative approach as above, the LQ for the general category of *wood product manufacturing* (NAICS 321), in 2001, is 2.89, meaning that the concentration of regional employment is nearly three times that of the national economy. Again, as we drill down into more specific industries within wood product

Table 1 – Northwest Minnesota Key Facts

Employment Concentrations	
<i>Manufacturing</i> (NAICS 31)	
Location Quotient:	1.6
2001 Employment was more than 1½ times more concentrated compared with US as a whole	
<i>Transportation Equipment Manufacturing</i> (NAICS 336)	
Location Quotient:	4.6
2001 Employment was 4½ times more concentrated compared with US as a whole	
<i>Engineered Wood Products</i> (NAICS 32121)	
Location Quotient:	9.67
2001 Employment was nearly 10 times more concentrated compared with US as a whole	
Per Capita Income (2001)	
NW Minnesota:	\$23,764
Non-metro Minnesota:	\$28,288
Non-metro US:	28,158
Industry-specific Income (2001)	
Manufacturing:	\$30,420
Transportation Equipment Mfg:	\$32,084
Engineered Wood Products:	\$48,152
Educational Attainment (2000)	
% Population over Age 25 with 4-yr degree or higher	
NW Minnesota:	17.5
Non-metro US:	15.9
% change from 1990	
NW Minnesota:	4
Non-metro US:	3

Source: MN Department of Economic Security & US Bureau of Labor Statistics; income data in nominal terms, not adjusted for inflation

* Data in table are for region that includes: Beltrami, Clearwater, Hubbard, Kittson, Lake of the Woods, Mahnomen, Marshall, Norman, Pennington, Polk, Red Lake, Roseau counties (Regions 1& 2).

manufacturing we find that *veneer and engineered wood products* (NAICS 32121) has an LQ of 9.67; employment in this industry is nearly ten times more concentrated, regionally, compared with the US economy as a whole. Further, the wage level for engineered wood products is significantly above the national average. In Northwest Minnesota, in 2001, average weekly wage in this industry was approximately \$926, while the national average was only \$627.

Support for Knowledge Resources: Information Sharing

The intent of this study is to examine more deeply the relationship between the industry cluster centered on recreational vehicles and the educational and economic development institutions that support the region. Principally, it seeks to do two things: 1) discover how these institutions currently support the industry cluster and 2) offer insight into how the relationship might be made stronger in order to capitalize on the talent and knowledge that exists in the region, thus contributing to its continued vitality.

Regular communication with regional businesses enhances the ability of institutions to provide appropriate supports and services. It is evident from interview responses that university representatives, economic development professionals and business leaders in the region each have their own well-established networks. It is through this network that the needs and activities of regional businesses are generally communicated.

There are a variety of ways by which educational institutions learn about business needs. Custom training and outreach centers continue to be the most important vehicles through which educational institutions liaise with the business community. Additionally, several higher educational institutions have advisory committees that include regional business leaders. Another important point of contact comes from educational representatives acting as consultants and going out into the business community to both uncover and address existing needs. One university representative learned of business needs through continuing education students who were employed in local businesses. Other sources of systematic information sharing include focus groups and questionnaires, outreach by designated staff members, and internships for both students and faculty.

Like representatives of educational institutions, there are numerous channels through which economic developers learn about the needs of regional businesses. Most representatives of economic development entities obtained information about businesses from professional contacts that work with local companies and have first hand knowledge of their needs. Representatives of banks, government agencies, foundations, regional development commissions, and chambers of commerce were cited as the main sources of information, along with public officials, other economic developers, and the region's Small Business Development Center. Several economic development workers learned of business needs through boards of directors that included business leaders. Others reported that they regularly initiated contact with the businesses in their area. Finally, some economic developers stated that businesses approach them directly with requests for assistance.

Many of those interviewed indicated that simple word of mouth was a very common source by which information about business needs and activities is communicated. This type of informal channel may be a result of the many small, close-knit communities of Northwest Minnesota and clearly underscores the kinds of personalized networks that dominate in the region. However, what appears to be a major challenge is information sharing on a regional platform; there still appears to be a tendency toward atomization.

There is widespread contact between individual businesses and individual institutions; however, attempts to create opportunities for all parties (higher eds, development/workforce professionals and business leaders) to come together to communicate ideas and needs that may be considered regional in scope are less successful. For most institutional representatives, advisory committees and personal networks that

connect with individual business leaders are the norm. Others indicated that chamber of commerce meetings functioned as forums for regional dialogue; one technical college representative reported that his community had a regular, open meeting at which elected officials and industry leaders could discuss pressing issues.

What is clear is that institutions in the region make a tremendous effort to create opportunities for all stakeholders to come together to help give shape to regional issues. Further, there does appear to be consistent lines of communication between higher education representatives and economic/workforce development professionals. The principal constraint is time.

There are a hundred agencies trying to hold regional forums on this or that, and they don't get much participation from business. They [the businesses] are busy trying to do their work...the regional thing isn't core from the business perspective. [They] are pushed for their survival, so they can't spend a lot of time if they don't see a return...
(**Don Sargeant**, Chancellor University of Minnesota, Crookston)

This is indeed a challenge in terms of coordinating policy efforts designed to capitalize on forms of specialized knowledge and sources of innovation. Broad level, structural analysis is meant to aide in strategic planning, such that resources are focused in a way that helps foster the economic health of the region.

Support for Knowledge Resources: Skills Training

How is institutional awareness of business needs translated into supports for knowledge resources? With respect to the recreational vehicles cluster and as well the general climate of manufacturing, regional institutions appear to be most active in supporting the maintenance and diffusion, rather than the importation or creation of specialized knowledge. In particular, representatives of regional universities and technical colleges reported providing employees in the cluster with training – and, consequently, skills and knowledge – essential to the success of the cluster. But skills training and knowledge diffusion should not be confused with innovation and entrepreneurial spirit.

Representatives of educational institutions and economic development entities suggested that, to remain competitive in the new economy, manufacturing businesses require well-trained workers with substantial technical knowledge. The dissemination of this knowledge to regional residents is particularly important. As was the case in the original Northwest Minnesota industry cluster study done in 1998, regional businesses in the cluster still face shortages of well-qualified workers.

The type of training most frequently provided to cluster employees is custom training, or training tailored to the needs of individual businesses. Institutional representatives explained that businesses seek custom training for their current employees and, in many cases, arrange for the training to be offered on-site at the business. One example of this is the offering of courses in *manufacturing management* to the employees of a large manufacturer of recreational transportation equipment. Another example involved contract training in the quality area of manufacturing. In general technical colleges provide a wide variety of custom training services. This is perhaps the most direct way in which regional educational institutions contribute to the support and maintenance of the knowledge cluster.

However, in addition to training for individual businesses, educational institutions provide several types of applied education related to manufacturing. One of the region's technical colleges offers custom training in connection with regional high schools to provide youth with the skills demanded in local industries. Another technical college representative reported that his institution was working with manufacturers to develop skill-based credits that could be applied to a manufacturing degree. It appears that regional institutions, while not necessarily involved in the *creation* of knowledge, do exhibit an

entrepreneurial approach in providing access to knowledge opportunities. This may be an important factor in the success of the knowledge cluster.

The general curriculum of universities and technical colleges appears less responsive to business needs than the services of custom training centers. Nevertheless, institutional representatives described some adjustment of degree and certificate programs to accommodate regional businesses. For example, technical college representatives repeatedly emphasized that the adaptation of curriculum to meet business needs was central to the mission of technical institutions. One in particular, recently established a welding certificate that enabled local workers to obtain welding internships at major companies within the cluster. Similarly, the university representative who described his institution's manufacturing management training reported that the training might eventually be converted into a university degree program, available to workers not yet employed in the cluster.

Support for Knowledge Resources: Knowledge Creation

Institutions don't always contribute directly to the development of new knowledge, which is ultimately what drives innovation. Representatives at higher educational institutions and economic development entities agreed that businesses in the region were the chief developers of new knowledge – driving innovation within the cluster – and that businesses are responding and adapting more quickly to changes in the economy than were their organizations. However, institutions clearly support knowledge development among businesses in two ways.

First, the higher education community serves as a neutral party for businesses to “bounce ideas off.” Because businesses may not always be comfortable talking about or sharing their new ideas with competitors, the expertise among the academic community becomes an important outlet. For example, imagine a company utilizes a particular piece of engineering software and is seeking to adapt it to a new process. In consultation with a regional institution's faculty members, the two parties not only find a solution to the problems associated with the new process, but also advance the company's general understanding of how the software technically functions. Interestingly, it was suggested that the increasing involvement of higher education institutions in custom training may compromise this role – taking money from businesses may deter businesses from using educational institutions in this capacity because they may be seen as no longer neutral.

Perhaps the chief form of encouragement for new knowledge development comes through the support of small businesses and new businesses/entrepreneurs that may spin off the cluster with new ideas; this is one of the principal roles for regional development institutions. Again, it is important to recognize that the ideas come from the business community. However, ideas need support to make anything happen: financing, business planning, etc. Economic development professionals expressed concern that small businesses – typically, spin-offs are small – have a difficult time making it in the region and consequently needed more help than larger, more established businesses.

This underscores an important recognition among institutions in the region: understanding what type of support is best for what type of business. It was suggested that training, or direct help with knowledge resources, is more effective for established businesses. Younger businesses, though, often benefit simply from a supportive environment in which people with ideas are able to successfully realize them.

As emphasized above, institutions in Northwest Minnesota are less involved in the importation of specialized knowledge than they are in knowledge diffusion. However, this is not to suggest that institutions are never involved in knowledge development. The present study provides some evidence of institutional involvement in the importation of cluster-relevant knowledge.

Interview and focus group participants reported that educational institutions and economic development entities provide businesses with information about technologies and processes that help them remain competitive. This may include, for example, financial support for and access to *automation technologies* for those companies facing a shortage of quality workers. Automation technology also encourages the acquisition of new skills by cluster employees, allowing local companies to secure business that might otherwise be lost to competitors. Other respondents affirmed the importance of automation and suggested further that *lean manufacturing* processes were also essential to the success of cluster businesses.

Support for Knowledge Resources: Small Business Development

Several respondents mentioned the region's Small Business Development Center as a resource for business supports. One university respondent affiliated with the center noted a growing interest in "the beginning of economic activity," and the ultimate realization of entrepreneurial ideas through successful businesses.

The Small Business Development Center works to "create an environment where people who want to start economic activity can find the resources they need to do so," offering classes and seminars in how to start and run businesses. Representatives of economic development agencies suggested that support for entrepreneurs is important. However, there is clearly a tension present. There is always competition for scarce resources and an ever-present concern that substantially more assistance is required for "start-ups" compared with existing businesses. There is a current of thought that indicates there simply aren't the resources to support all entrepreneurs who want help, and that there may be higher returns, or more "bang for buck," in supporting existing businesses.

At the same time, as the traditional agricultural sector continues to decline, people's survival instincts turn to small business opportunities. The challenge for development professionals is the process of evaluation in allocating resources. Do the structural features of the regional economy enter into this evaluative process? Do those entrepreneurs with businesses plans connected to the "cluster" have an advantage in securing resources? Are they more likely to be counted as survivors? These are perhaps important questions that at present do not have clear answers.

Looking to the Future

There are many possibilities for increasing the level of support for industry in Northwest Minnesota. These grow out of the responses that inform this report and include extending educational opportunities beyond custom training by making general curriculum offerings of local educational institutions even more responsive to needs of local businesses. This would help to foster cluster-relevant skills in residents of the region— young adults and other workers – that may not yet be employed; it would contribute directly to their potential employment opportunities and may be an important step in creating the kind of workforce the cluster industries will require. To the greatest extent possible, training people to do jobs they can do in the region is likely to sustain the economic vitality in Northwest Minnesota. While job opportunities aren't the only reason young people leave the region, it is an important one and by linking education to employment, the odds of slowing out-migration improve.

There is general agreement that expanding the currently available supports for small and start-up businesses should be pursued. The previous SLPP knowledge cluster report suggests that start-ups need to be encouraged, as in many ways start-ups are an indication of entrepreneurial spirit and often reflect innovation; relying on major businesses alone to sustain the region's economy may lead to loss of vitality and dynamism. While many economic developers felt that they got more "bang for their buck" with the

more established businesses, particularly in terms of job creation (they reported that bigger, more established businesses were able to create more jobs and were more likely to stick around in the area), there may be yet long-term gains associated with supports for small businesses; the issues of entrepreneurial activity must be weighed carefully. It may be useful to examine more closely the process of evaluating how resources for new business initiatives are allocated.

In addition to business supports – in the form of business tools to help innovative businesses succeed – there is agreement that, as much as possible, institutions should provide direct assistance with innovation. That is, institutions could play a more direct role than they currently do in supporting the development of new specialized knowledge. For example, representatives of universities and technical colleges didn't report that their institutions were doing a great deal of research that was applied in regional businesses. Many of the innovative ideas were coming directly from the business community, after which educational institutions become involved in secondary support roles. The region's educational institutions, in particular, may be able to generate widespread and considerable economic benefits from redirecting resources to focus more on innovation, becoming more involved in applied research and the generation of knowledge resources, and going beyond "customized training." Similarly, economic development agencies may be able to focus more on innovation – not simply job creation, financial assistance, and business tools. There is a great need to provide assistance in creating intellectual capital and an environment that is conducive to innovation.

All of this requires shifting the paradigm so to speak. It means that the institutional environment that supports the local and regional businesses must focus on emerging trends in knowledge development and creation. Knowledge development is always happening and the methods for fostering it are always changing; it is a highly dynamic process. This simply underscores how vital the industry-institutional relationship is if regional economies are going to stay competitive. It means that institutions need to be on the leading edge of how knowledge is transforming the business and industries they support. One economic developer mentioned that his organization was looking at how to help with benchmarking and knowledge sharing for industry improvement. He expressed his belief that this kind of approach is what will keep Minnesota ahead of the curve in knowledge management.

In conclusion, it is important to increase awareness among key players: educational institutions, development professionals, business leaders and policy makers about the importance of job enrichment and the role that knowledge plays in this regard. Almost all institutional representatives interviewed felt that there has long been an overemphasis on the *number* of jobs created by a policy intervention or service program, compared with the actual *quality* of the jobs created. If the industry cluster, particularly one that relies heavily on manufacturing, is to remain competitive, it must continue the shift to lower-volume, higher-value production. The development of more high-tech jobs and the corresponding skilled, knowledgeable workforce facilitate this shift. In this regard, the implication is that job quality and job enrichment, over and against job creation, are absolutely essential to the cluster's long-term success.

V. Developing Rural Knowledge Indicators

Overview and Methodology

The purpose of this memo is to describe and illustrate a range of possible indicators of the presence of knowledge workers and knowledge-based industry clusters in rural communities. In general we propose that the analysis of rural economies should follow a three-step process. First, we should assess level of knowledge in a rural economy, second, identify candidate knowledge related specializations or industries, and third, assess the relative strength of those knowledge specializations. We should consider aggregate generalized measures of knowledge-related activity, including a mix of demographic, economic and other

factors. Once generalized data have indicated the presence of candidate instances of knowledge creation in particular industries, there are some industry-specific measures we can use to test the relative importance of these candidates.

Until now, the study of knowledge-based industries has focused primarily on relatively large industry clusters, composed of many firms, and employing thousands of workers in large metropolitan areas. These large industry clusters, like Silicon Valley, are extremely visible and it is difficult to miss their existence and economic importance.

Detecting and documenting the presence of knowledge-based industry clusters in rural areas is more difficult because their scale is so much smaller. An economically significant cluster in a rural economy may consist of only a handful of firms, employ only a hundred (or few hundred people) and may escape attention, unless we have some particular reason to know of its existence. The availability of economic statistics also hinders our ability to detect these smaller industry clusters—data for individual firms is unavailable, and in rural areas, data on economically significant groups of firms may be aggregated into larger industry groupings that make them almost invisible.

We define rural industry clusters in almost an inverse fashion. We mean groups of businesses (as opposed to single firms) not located in a metropolitan area and not depending primarily on the simple existence of a local natural resource as a source of competitive advantage. Some knowledge-based industries may start as resource based industries, but may develop further, creating and applying specialized knowledge that then becomes a source of advantage. For example, the California wine grape industry may have initially owed its establishment primarily or solely to the existence of favorable climate and soils for grape cultivation, but has subsequently developed a sophisticated knowledge base and skills involving grape cultivation, wine making, marketing and a host of related fields.

Our primary focus is on traded sectors of the economy, those businesses that sell their goods and services in competition with firms in other locations. Some businesses may start out as exclusively local economic activity (i.e. selling all of their output to local consumers), but then move to production for sale outside their community, state or nation. Many microbreweries for example started as brewpubs (or homebrewers) serving only a local demand, but then grew to serve much larger markets.

The first two steps in our process are to identify the overall **level** of knowledge creation in a rural economy, and then to identify **candidate specializations** or industries in which knowledge is being created.

We have developed an extensive list of candidate indicators, which are generally neutral with regard to industry, i.e. they measure knowledge creation without regard to whether it is particular to one industry or not. Some of our indicators are appropriate only to the first question—the overall level of knowledge creation—while others can be used both to assess overall knowledge creation and identify candidate clusters. For example, the fraction of the population with a four-year college degree is a good overall indicator of the level of knowledge (question 1), but doesn't tell us anything about the specialization of knowledge in particular industries. By contrast, patent data can help us identify places with a relatively high amount of knowledge creation (patents per capita) as well as identify particular technological specializations that suggest candidate industry clusters for further analysis.

The third step in our process is to test the relative strength of these candidate specializations by considering a range of **industry specific measures** of knowledge-creating activity. There are many possible indicators that are specific to the presence of particular industries, such as tabulations of listings in industry trade directories and databases. For example, in earlier work, we developed a series of nationwide indicators of biotechnology industry activity by tabulated databases of medical research spending and firm listings. Additionally, because these indicators are idiosyncratic to particular industries,

we will focus most of our attention on the process for identifying data sources, rather than on specific data sources.

For each indicator, a four-part analysis has been developed. First, we consider why each indicator might be conceptually useful in identifying and measuring the extent of knowledge-related activity in a particular geographic area. Second, the sources of data for this indicator are identified. Third, we describe how this indicator could be analyzed, and what the most useful statistics or threshold values would be for identifying industries. Fourth, where available, we provide a quick summary of the metro/non-metro division in this indicator, and a summary of national trends in this indicator. In the appendix to this memorandum, we provide tables with illustrative data for selected rural counties, using Oregon and Minnesota as test cases.

Economic Indicators

Employment Concentrations & Growth

Why this is important: The key characteristic of an industry cluster is specialization—that is, a higher than usual concentration of some productive activity is found in a particular location. A first step in the identification of industry clusters is to identify places with unusual concentrations of certain kinds of activity.

Data Sources: Detailed information on industry employment is available from state labor market information agencies. The most comprehensive and comparable series nationally is the Covered Employment and Wages (CEW) series, also known as ES-202 data. Nationwide data is available on-line through the Bureau of Labor Statistics Website (www.bls.gov/CEW), but there are considerable data suppressions in counties with small populations. Alternatively, some data can be obtained directly from state labor market agencies.

Analytical Approach/Descriptive Statistics: We can use location quotients to determine the relative concentration of certain industries in rural areas relative to statewide or national averages. Our analytical approach is to examine publicly available data at the lowest possible level of aggregation or to obtain confidential firm level data.

Metro/Non-Metro Results, National Trends Analysis: The location quotient is a basic measure used to identify localized concentrations of economic activity. It allows us to compare a local economy and a reference economy. Perhaps the best way to understand the usefulness of the location quotient approach is with a practical example. In this case, we are interested in comparing the concentration of economic activity in Northwest Minnesota with three different reference points: the US economy as a whole; the Minnesota state economy; and the Minnesota state economy minus the Twin Cities metro area. The use of different reference points is important because it allows us to see the differences in economic specialization between the reference economy and the rest of the nation, the rest of the state and Greater Minnesota. Having various reference points give us a more complete picture of the local economy and is meant to help us avoid making incorrect assumptions about how it functions.

The location quotient is defined as the ratio of the share of an industry's employment in the local region to the share of that industry's employment in the reference region. For example, if a particular industry represents 2 percent of the Northwest Minnesota economy but only 1 percent of the Minnesota economy, then its location quotient is 2.0 ($2.0\% \div 1.0\% = 2.0$). The location quotient measures the relative concentration of an industry in a local area compared to the reference area. A location quotient greater than 1.0 indicates that a local area has a relatively greater concentration of an industry than the reference area, while a location quotient of less than 1.0 indicates that an industry is relatively less concentrated in an area.

In general, an LQ greater than 1.0 is taken as an indication that some portion of the particular economic activity is part of the traded sector, sometimes referred to as basic, which means that the extent of its market encompasses more than local demand conditions alone. The key assumption here is that an activity considered to be basic is thought to be an important economic engine in the local economy; to strengthen and grow the local economy, one ought to develop the basic activity. Further, an activity identified as basic may indicate a concentration of specialized knowledge and thus may be a candidate for a rural knowledge cluster.

So, we begin by looking for LQs greater than 1.0 at the highest level of aggregation in the North American Industry Classification System (NAICS). The most general level of classification is the two-digit level, which identifies what are understood to be sectors; NAICS encompasses twenty sectors in all. The following table shows the location quotients for Northwest Minnesota⁵ in comparison with the three reference economies, at the two-digit level. We can see from the table that there are several sectors that LQs greater than 1.0: Agriculture, Forestry, Fishing & Hunting; Manufacturing; Wholesale Trade; Retail Trade; Healthcare & Social Assistance; Accommodation & Food Services.

Location Quotients: Two-Digit Industry Groups in Northwest Minnesota, 2001

		Location Quotients		
NAICS	Description	Base = US	Base = MN	Base = MN (minus TC metro)
0	Total, All Industries	1	1	1
11	Agriculture, Forestry, Fishing & Hunting	2.29	3.56	1.63
21	Mining	0.32	0.58	0.23
22	Utilities	1.30	1.28	0.93
23	Construction	0.87	0.99	0.92
31	Manufacturing	1.62	1.44	1.19
42	Wholesale Trade	1.26	1.14	1.18
44	Retail Trade	1.14	1.16	1.00
48	Transportation and Warehousing	0.63	0.65	0.84
51	Information	0.62	0.65	0.89
52	Finance and Insurance	0.62	0.55	0.90
53	Real Estate and Rental and Leasing	0.34	0.38	0.62
54	Professional and Technical Services	0.29	0.33	0.63
62	Health Care and Social Assistance	1.38	1.26	0.99
72	Accommodation and Food Services	1.10	1.19	1.06
81	Other Services, Ex. Public Admin	1.20	1.17	1.19

We now have to decide which sectors are candidates for further exploration. Not every sector with an LQ over 1.0 should be considered an engine of economic growth, nor does it always indicate a concentration of specialized knowledge. We have to use the LQ in combination with other practical knowledge about the local economy to make these kinds of evaluations.⁶

⁵ Northwest Minnesota was defined to include Beltrami, Clearwater, Hubbard, Kittson, Lake of the Woods, Mahnomen, Marshall, Norman, Pennington, Polk, Red Lake, and Roseau counties.

⁶ A detailed profile of the region and results of the industry cluster study are available in Munnich, L. W., Bau, M. M., Skelton, R. A., Warner, J. P., & Muesing, B. J. (1998). *Northwest Minnesota industry cluster study*. State and Local Policy Program and Minnesota Extension Service.

In 2001, the LQs for manufacturing in Northwest Minnesota, taking account of each reference economy, suggest that this sector is a vital part of the regional economy. Accordingly, we chose to "drill down" into the manufacturing sector. In drilling down, we are moving from the general to the specific (from two-digit categories to 4-5-or-6 digit categories). In so doing, we are examining activity that is increasingly specific in its means of production. NAICS should be thought of as a "nested" hierarchy. It classifies the relative activity of businesses at increasingly detailed levels, moving from two-digit activities all the way down to six-digit activities.

The NAICS codes for manufacturing are 31-33; this means the classification code for every type of economic activity related to manufacturing begins with 31, 32 or 33. For example, one of the industries known to exhibit a high degree of specialization in Northwest Minnesota is the transportation equipment manufacturing industry, for which the NAICS code is 336. One can see that the three-digit code for this industry "rolls up" into the general, two-digit category of manufacturing. Another example of an industry known to exhibit specialization is the engineered woods products industry, for which the NAICS code is 3212 and which rolls up into the more general category of wood product manufacturing (NAICS 321). Again, this is an example of how the "nested" hierarchy of NAICS categories functions.

It is important to remember that publicly available data often suppresses details about specific industries to protect the confidentiality of individual firms. The following table describes all of the LQs, using our three reference points, for manufacturing industries in Northwest Minnesota for which there is publicly available data. We can see that the high LQ associated with manufacturing is attributable to strengths in several industries with high degrees of concentration. The high location quotients show that it is wood product manufacturing, particularly in veneer and engineered wood products and miscellaneous wood products that are the most concentrated in Northwest Minnesota. Other particularly strong concentrations are apparent in commercial refrigeration and transportation equipment.

Location Quotients: Selected Manufacturing Industries in Northwest Minnesota, 2001

NAICS	Description	Location Quotients		
		Base = US	Base = MN	Base = MN (minus TC metro)
31	Manufacturing	1.62	1.44	1.19
321	Wood Product Manufacturing	2.89	2.08	1.29
3211	Sawmills and Wood Preservation	1.58	5.64	2.44
32111	Sawmills and Wood Preservation	1.58	5.64	2.44
3212	Veneer and Engineered Wood Products	9.67	7.86	3.38
32121	Veneer and Engineered Wood Products	9.67	7.86	3.38
32199	All Other Wood Product Manufacturing	1.89	1.91	0.71
321999	Miscellaneous Wood Product Manufacturing	4.68	3.20	1.19
3327	Machine Shops and Threaded Products	1.19	0.63	0.65
3331	Ag., Construction, and Mining Machinery	1.49	0.85	0.46
3334	HVAC and Commercial Refrigeration Equip	2.55	1.47	2.10
33341	HVAC and Commercial Refrigeration Equip	2.55	1.47	2.10

336	Transportation Equipment Manufacturing	4.61	10.77	5.38
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Self-Employment Concentrations

Why this is important: One important clue to the presence of knowledge industry clusters in rural areas may be the number of self-employed persons in related industries. Due to the relatively smaller scale of rural economic activity, self-employment may be more common in rural clusters. Many of the enterprises that might support larger firms in an urban market may consist of a single person firm in a rural area.

Data sources: There are a variety of sources of data on self-employment, but the most useful for our purposes is the Non-Employer series published by the Census Bureau. The Census Bureau uses Internal Revenue Service tax returns to identify businesses with no payroll employment. Generally, these firms are business establishments that file taxes but are not connected to any other business entity that pays payroll taxes. There are more than 16 million non-employers with total receipts of more than \$700 billion. About three-quarters of all businesses are non-employers but they only account for about 3% of all business receipts.

Non-employer establishments can be any type of business ownership—sole proprietorship, partnership or corporation—and many non-employer businesses represent part-time business activities.

The non-employer data series is particularly valuable because it is reported by county and by NAICS (North American Industrial Classification System) industry code. Because there are many more firms in the non-employer category than the employer category, the non-employer data is far less likely to be suppressed to protect individual firm confidentiality in less populated rural counties. These data are published on an annual basis; the most recent data are for the year 2000. Data are available on the Census website at: <http://www.census.gov/epcd/nonemployer/>

Analytical Approach/Descriptive Statistics: We use the same general approach to analyzing non-employer data as we do in looking at employment data. Rather than look for concentrations of employment, however, we look for concentrations of establishments, i.e. non-employer firms, which we generally equate to self-employed individuals. We can use these data to estimate location quotients for numbers of self-employed individuals in different counties.

Metro/Non-Metro Results, National Trends Analysis: National level tabulations of this data series for metropolitan and non-metropolitan areas are not available from the Census Bureau. The importance of non-employer establishments varies substantially by industry, as national statistics illustrate. Non-employers are relatively unimportant in manufacturing industries, accounting for less than one half of one percent of all receipts. In contrast, they are quite important in real estate, professional services, education services, and arts, entertainment and recreation.

Establishments and Receipts, All Businesses and Non-Employers by NAICS Sector, 2000, United States

		Total	Nonemployers		Total	Nonemployers	
NAICS	Sector	000's	000's	Pct	\$Bill.	\$Bill.	Pct
0	All industries	N/A	15,440	N/A	N/A	586	N/A
11	Forestry, fishing & hunting, & ag support services	N/A	240	N/A	N/A	9	N/A
21	Mining	117	92	78.7	179	5	2.8
22	Utilities	31	16	50.6	412	1	0.1
23	Construction	2,547	1,890	74.2	946	87	9.2
31-33	Manufacturing	667	303	45.4	3854	12	0.3
42	Wholesale trade	859	406	47.2	N/A	31	N/A
44-45	Retail trade	2,950	1,831	62.1	2530	69	2.7
48-49	Transportation & warehousing	824	646	78.4	348	29	8.5
51	Information	289	174	60.3	629	6	0.9

52	Finance & insurance	1,074	679	63.2	2235	37	1.7
53	Real estate & rental & leasing	1,685	1,397	82.9	343	102	29.7
54	Professional, scientific, & technical services	3,265	2,650	81.2	661	81	12.3
56	Administrative & support & waste mgmt & remediation serv	1,169	892	76.4	313	17	5.4
61	Educational services	269	235	87.4	18	3	15.8
62	Health care & social assistance	1,699	1,168	68.7	450	31	6.9
71	Arts, entertainment, & recreation	773	693	89.7	99	14	14.4
72	Accommodation & foodservices	736	191	26	359	9	2.5
81	Other services (except public administration)	2,357	1,936	82.1	206	43	21

Wage Levels

Why this is important: Firms generally pay higher wages to higher skilled workers. The higher wages reflect their higher productivity, greater level of human capital, and may compensate them for the maintenance of firm-specific skills. In knowledge-based industries, we would expect average payroll per employee to be higher than industry-wide averages, reflecting these knowledge-differentials.

Alternatively, average wage levels may reflect firms with a different occupational mix—i.e. more high wage occupations as a fraction of their labor force. Differences in human capital productivity in cities have been shown to explain the observed wage premium for workers in urban areas (Rauch, 1993).

Data Sources: Detailed wage data are available from state labor market information agencies. Again, the most comprehensive and comparable series nationally is the Covered Employment and Wages (CEW) series, also known as ES-202 data. Nationwide data is available on-line through the Bureau of Labor Statistics Website (www.bls.gov/CEW), but of course, there are considerable data suppressions in counties with small populations. Alternatively, some data can be obtained directly from state labor market agencies.

Analytical Approach/Descriptive Statistics: Our objective here is to find industries with wage levels significantly above the national average for that industry. Our analytical approach is to examine publicly available data at the lowest possible level of aggregation (2 or 3 digit SIC classification) or to obtain confidential firm level data at the three or four digit level.

To demonstrate this methodology, we have examined covered employment and payroll data for industries in Oregon, and used a ten percent wage premium threshold to identify high wage industries (i.e. wages in Oregon must be at least ten percent above the national average for that industry in order to be selected).

Our analysis shows that 73 reportable 4-digit industries (out of a total of 850 four digit industries) had average wages at least 10 percent higher than the national average for their industry in 2000. Of 263 **3-digit** industries, 37 had average wages at least ten percent above the national average for their industry. The following table shows those 3-digit industries with at least 3,000 employees statewide in 2000, ranked by industry employment, with average wages of more than \$30,000 per year that had average annual wages at least 10 percent above the national average for their industry. They are for the most part manufacturing and wholesale segments of the regional economy. (Three construction sectors—electrical, plumbing and heavy construction also appear on the list but have location quotients of approximately one, indicating they are not unusually concentrated in the region).

Oregon's high wage, traded sector industries are concentrated in electronics and instruments, wood products and the metals industry. One other industry (apparel wholesaling) includes the state's only Fortune 500 company, Nike. The electrical utility industry also shows up as a well paid sector of the economy

SIC	Description	Jobs	LQ	Average Wage	Percent
367	Electronic components and accessories	33,290	4.0	89,884	138%
243	Millwork, plywood and structural members	19,747	4.8	34,326	114%
242	Sawmills and planing mills	14,339	6.4	37,664	126%
173	Electrical work	11,925	1.1	48,597	118%
171	Plumbing, heating, air-conditioning	11,769	1.0	44,041	118%
241	Logging	7,869	8.3	33,827	122%
162	Heavy construction, except highway	6,973	0.9	45,229	112%
513	Apparel piece goods and notions	6,703	2.5	72,150	156%
382	Measuring and controlling devices	6,056	1.6	74,880	119%
491	Electric services	6,041	1.4	87,691	135%
503	Lumber and construction materials	5,536	1.5	51,535	127%
249	Miscellaneous wood products	3,694	3.6	36,720	126%
332	Iron and steel foundries	3,393	2.2	47,263	113%
336	Nonferrous foundries (castings)	2,072	1.8	38,843	110%

Occupational Composition

Why this is important: Occupations may be a useful alternative means of characterizing the structure and development opportunities of a regional economy (Markusen & Schrock, 2001). Certain occupations are more likely to be involved in creating new knowledge than are others. In his book, *The Rise of the Creative Class*, Richard Florida argues that a segment of such occupations, primarily in the professional, managerial, and technical categories, account for the bulk of creative work in the economy (Florida, 2002).

Data Sources: Detailed occupational data for counties are collected as a part of the Decennial Census. Table P-50 of Summary Tape File 3 (STF 3) lists the number of employed males and females in six broad occupational groups—managers, professionals service workers, sales workers, construction workers and production workers—and further subdivides these groups into nearly 40 different occupational categories. These data are available at the county level through American Fact Finder (the Census bureau’s interactive, web-based data access tool.)

Analytical Approach/Descriptive Statistics: Our objective here is to find areas with unusually high concentrations of creative class individuals. Florida divides the creative class into two groups: the super-creative core and creative professionals.

Super-Creative Core

- Computer and mathematical occupations
- Architecture and engineering occupations
- Life, physical and social science occupations
- Education, training and library occupations
- Arts, design, entertainment, sports and media occupations

Creative Professionals

- Management occupations
- Business and financial operations occupations
- Legal occupations
- Healthcare practitioners and technical occupations
- High-end sales and sales management

For each of these groups, we can compute the proportion of the employed population that is either super-creative core or creative professionals. Counties with particularly high levels of creative class membership may be more likely to be centers of knowledge-related economic activity. In more rural communities, the numbers of persons in the super-creative core may be significantly influenced by the presence (or absence) of institutions of higher education, as a large number of college employees will be counted among the education, training and library occupations.

Metro/Non-Metro Results, National Trends Analysis: Nationally, creative occupations are much more likely to be found in metropolitan compared with non-metropolitan areas. About a third of the workers in metro areas, on average, are members of the creative class, as opposed to less than a quarter of the workers in non-metropolitan areas.

Creative Class for Metro and Non-Metro Areas, United States

Number	Metro	Non-Metro	Total
Super Creative Core	14,504,605	2,348,060	16,852,665
Creative Professionals	20,811,062	3,256,602	24,067,664
Creative Class	35,315,667	5,604,662	40,920,329
Total Workforce	105,526,814	24,194,698	129,721,512
Percent in Each Group	Metro	Non-Metro	Total
Super Creative Core	13.7%	9.7%	13.0%
Creative Professionals	19.7%	13.5%	18.6%
Creative Class	33.5%	23.2%	31.5%

Source: U.S. Census Bureau, Census 2000 Summary File 3, Table P-50

Particularly creative rural counties might have concentrations of employment in creative class occupations comparable to those in metropolitan areas. Using the nationwide metropolitan averages—14 percent for the super creative core and 20 percent for creative professionals—as thresholds, we can examine the data for Oregon counties (see Appendix). No rural Oregon counties have 14 percent or more super creative workers, and only two counties, Gilliam and Sherman, have 20 percent or more in the creative professions.

The table below shows the creative class occupational composition for Northwest Minnesota. We can see that the non-metro areas are very comparable with national averages, while the concentrations in metropolitan areas are somewhat higher.

Creative Class for Metro and Non-Metro Areas, Minnesota

Number	Metro	Non-Metro	Total
Super Creative Core	276,255	71,004	347,259
Creative Professionals	396,437	97,680	494,117
Creative Class	672,692	168,684	841,376
Total Workforce	1,857,171	722,875	2,580,046
Percent in Each Group	Metro	Non-Metro	Total
Super Creative Core	14.9%	9.8%	13.5%
Creative Professionals	21.3%	13.5%	19.2%
Creative Class	36.2%	23.3%	32.6%

Source: U.S. Census Bureau, Census 2000 Summary File 3, Table P-50

New Business Formation

Why this is important: One key measure of vitality of particular industries is the establishment of new firms. An above average rate of new firm formation, particularly in traded sectors may be an indication of the flourishing of a knowledge-based activity.

Data Sources: While there have been a number of efforts to collect and tabulate this data at the national, state and metropolitan levels, relatively few states have set up their own systems for reporting this information at the county level. Minnesota is one of the leaders in this area, having published its business tracking statistics for a number of years. This annual report calculates the number of new business startups (as well as expansions, contractions and closures) at the county level, for the entire state of Minnesota (Venegas, 2001).

Additionally, estimates of the number of new business starts in each county in the US are available from BizMiner.com for a fee. Using a proprietary database of 11 million US businesses, Bizminer estimates the number of new businesses established in the past year in each of 2,850 US counties. It then computes a “startup rate”—the number of new businesses started in the past year divided by the total number of businesses in operation in the prior year. <http://www.bizminer.com/>

Analytical Approach/Descriptive Statistics: Consistent with the notion that knowledge centers lead to more new business formations we focus on business startup data to identify counties with a high business startup rate. The Minnesota business tracking data report two annual (year over year) rates of changes for small business formations: the rate of growth in establishments (i.e. the startup rate), and the percentage increase in county-wide employment associated with startup firms.

Metro/Non-Metro Results, National Trends Analysis: We did not have access to national data for this report, and consequently are unable to analyze national trends in this indicator. Data for Minnesota show that seven counties had double-digit rates of new firm formation during 2000—Becker, Blue Earth, Chippewa, Crow Wing, Dodge, Scott and Sherburne.

Demographic Indicators

Educational Attainment

Why this is important: Educational attainment is one of the most broadly based measures of human capital available to us. Increasingly there are strong correlations between educational attainment and individual earnings, as well as between educational attainment and community prosperity (Gottlieb & Fogarty, 1999). There are also strong indications of agglomeration economies in well-educated people: people with higher levels of education tend to live in the same areas, work in the same kinds of firms, and marry one another (Costa & Kahn, 2000).

Educational attainment is influenced by a variety of factors, including the local education system, the types of jobs available locally, and patterns on in-migration and out-migration. Some rural communities may have particularly high levels of educational attainment because of the presence of local institutions of higher education—colleges have the positive effect of creating well-educated adults and by employing relatively well-educated workers. Migration also plays an important role in shaping educational attainment rates. Rural communities may experience a net out-migration of well-educated workers (brain drain) or can attract well-educated workers from other locations.

Data Sources: County level data on educational attainment of the adult population (persons aged 25 years old and older) is reported by the in the decennial census. Data on educational attainment between decennial Census years is difficult to obtain; some data are available by using pooled data estimates from the American Community Survey.

Analytical Approach/Descriptive Statistics: Census data report the number of persons having completed various amounts of schooling, ranging from a few years of elementary schooling, high school completion, some college or an associate degree, 4 years of college and graduate and professional degrees. For simplicity, we focus on the widely used benchmark of the fraction of the adult population 25 years old and older that has completed a four-year degree or higher level of education.

Metro/Non-Metro Results, National Trends Analysis: Nationally, educational attainment is systematically higher in metropolitan areas than in non-metropolitan areas. The fraction of the population aged 25 years and older with a four-year degree is almost double in the nation’s metropolitan area the level found in non-metropolitan areas. The rate of college completion in metropolitan areas rose from 25 percent in 1990 to almost 30 percent in 2000.

Educational Attainment: Percent of Adults (Aged 25 and older) with 4 years of college or more. (United States 1990 and 2000)

Geography	1990	2000	Change
Metropolitan	25.1%	29.9%	4.8%
Non-Metropolitan	12.9%	15.9%	3.0%

Source: U.S. Census Bureau, Census 2000 Summary File 3, Matrices P19, P36, P37, P38, PCT24, and PCT25 (Note: These data are un-adjusted for changes in metropolitan area boundaries between 1990 and 2000; some areas that were classified as non-metro in 1990 were reclassified as part of metropolitan areas in Census 2000 tabulations).

We can use educational attainment data to identify counties that might have a strong knowledge concentration. In Oregon for example, five of the state’s 26 rural counties have more than 20 percent of their population with a four-year degree or higher level of education—Deschutes, Hood River, Sherman, Union and Wheeler. These counties would be immediate candidates for having strong knowledge concentrations.

The following table outlines the metro/non-metro concentration of adults aged 25 years and older in Northwest Minnesota. In the case of both metro and non-metro areas, the change in the fraction of the adult population aged 25 and over holding at least a four-year degree is somewhat higher compared with the national average.

Educational Attainment: Percent of Adults (Aged 25 and older) with 4 years of college or more. (Northwest Minnesota 1990 and 2000)

Geography	1990	2000	Change
Metropolitan	25.9 %	32.1%	6.2%
Non-Metropolitan	13.2%	16.9%	3.7%

Source: U.S. Census Bureau, Census 2000 Summary File 3, P37 (Note: These data are un-adjusted for changes in metropolitan area boundaries between 1990 and 2000; some areas that were classified as non-metro in 1990 were reclassified as part of metropolitan areas in Census 2000 tabulations).

Net In-Migration of Young Adults

Why this is important: Young adults, aged 25 to 34 are the most mobile segment of the population. They are also the most likely to be in the workforce (measured by the employment ratio), have the most recent education, and the smallest wage premium for experience (Peri, 2001). There are nearly four million fewer 25 to 34 year olds in the US in 2000 that there were in 1990.

Data Sources: County level data on population by age group are available on-line from the 1990 and 2000 censuses through American Fact Finder for Census 2000, as well as through a data lookup function for the 1990 Census.

Analytical Approach/Descriptive Statistics: Census data report the number of persons by age residing in each county in both 1990 and 2000. We obtain these data for each county and compute the change in the number of persons in the 25 to 34 age group, between the two decennial censuses.

Metro/Non-Metro Results, National Trends Analysis: The population aged 25 to 34 has become increasingly concentrated in the nation’s metropolitan areas in the past decade. Due to the aging of the Baby Boom generation, the number of persons in the 25-34 demographic group has declined by nearly 3.9 million. The decline has been most pronounced in non-metropolitan areas, which have seen a 21 percent decline in this age group, compared to a 6 percent decline in metropolitan areas.

Total Population 25 to 34				
	1990	2000	Change	Percent Change
US	43,467,034	39,577,357	-3,889,677	-9%
Metro	34,940,825	32,864,383	-2,076,442	-6%
Non-Metro	8,526,209	6,712,974	-1,813,235	-21%

Source: U.S. Census Bureau, Census 2000 Summary File 3, Matrices P19, P36, P37, P38, PCT24, and PCT25 (Note: These data are un-adjusted for changes in metropolitan area boundaries between 1990 and 2000; some areas that were classified as non-metro in 1990 were reclassified as part of metropolitan areas in Census 2000 tabulations).

A growth, or even a less than average decline in the number of 25 to 34 year olds may be a useful flag for identifying candidate metro economies with a knowledge concentration. Between 1990 and 2000, just four of Oregon’s 26 rural counties recorded an increase in the population aged 25 to 34: Morrow, Crook, Deschutes and Jefferson.

Second Homes

Why this is important: Second homes are a potentially useful indicator for two reasons. First, they may be a way of measuring the presence of amenities and second, they may be an indicator of longer term trends in attracting population. Amenities have been understood to be an important factor in flows of population. Communities with a significant number of second homes are in many cases also places with high amenity values. Second homes are typically owned by well-educated, high income individuals who may ultimately relocate to their second home and serve as entrepreneurs in rural communities.

Data Sources: The housing portion of the decennial census has produced some statistics on the number of second homes in each county in the United States. Although the exact definition has varied from year to year, reasonably comparable data from the 1940 through 1990 Decennial Censuses, by state is available from: www.census.gov/hhes/www/housing/census/historic/vacation.html

Analytical Approach/Descriptive Statistics: The simplest test statistic is to compute the portion of an area’s housing stock that was composed of second homes. Counties that have more than the national average of about 3 percent of the housing stock in second homes are likely to be candidates for further investigation.

Metro/Non-Metro Results, National Trends Analysis: Second homes are much more likely to be found in some states than in others. Second homes are particularly common in the Northeast (Maine, Vermont and New Hampshire lead the list, and in sunnier climates (Florida and Arizona have the highest proportion of second homes among states with a million or more housing units).

Ten States With the Highest Percentage of Seasonal, Recreational, or Occasional Use Homes: 2000

Area	Total Housing Units	For seasonal, recreational or occasional use	Percent
United States	115,904,641	3,578,718	3.1
Maine	651,901	101,470	15.6
Vermont	294,382	43,060	14.6
New-Hampshire	547,024	56,413	10.3
Alaska	260,978	21,474	8.2
Delaware	343,072	25,977	7.6
Florida	7,302,947	482,944	6.6
Arizona	2,189,189	141,965	6.5
Wisconsin	2,321,144	142,313	6.1
Montana	412,633	24,213	5.9
Hawaii	460,542	25,584	5.6

Source: U.S. Census Bureau, Census 2000 Summary File 1.

Knowledge Creation

Why this is important: Ideally, we search for direct measures of innovation, such as companies that produce new products, develop more efficient processes, or find new ways of satisfying customer needs. We have few direct measures of the creation of new knowledge. Innovation processes are not reported in the same fashion as the number of jobs, or tabulations of different types of establishments.

Data Sources: Patent data provide a number of interesting insights into the process of invention and innovation. They have begun to be widely used by economists in the study of industrial and regional economic dynamics. Patent data come in two forms. The patent office produces aggregate statistics on patent activity by county and year. Additionally, the National Bureau of Economic Research has taken raw patent data and geocoded it and cross-referenced patent citations, making it possible to study the linkages between patents across time and space. Unlike public sector employment data, the identifying information in patents is a public record, making it possible to identify by name particular firms. Data are available at: <http://www.nber.org/patents/>

Analytical Approach/Descriptive Statistics: There are two distinct levels to the analysis of patent data. First, the analyst can use patent statistics, either from the USPTO or NBER databases to compute the number of patents in a county (or the number of patents per capita). Rankings of these variables can identify which counties are more or less innovative than others. The second step is for the analyst to use patents to determine whether there are any particular knowledge specializations implied by the patent activity. The analyst can pursue either a quantitative approach (by counting the number of patents in each of the different patent classifications) or, in counties with relatively few patents, by inspecting patent records to determine the identity of the patent holder and the character of the technology in question.

The US Patent and Trademark Office classifies patents into one of several hundred technology classifications, and it is possible to determine in which technologies a region is most specialized by examining tabulations of data according to patent classification.

(The technology classifications can be found at:
<http://www.uspto.gov/web/offices/ac/ido/oeip/taf/tecstc/classes.htm>

Metro/Non-Metro Results, National Trends Analysis: Patenting tends to be highly concentrated in metropolitan areas. In the past decade about 92 to 93 percent of all US patents have been issued to inventors in metropolitan areas. In 1999, nearly 6,000 patents were issued to inventors in non-metropolitan areas of the US.

Total US Origin Utility Patents, Selected Years, 1990-1999

Geography	1990	1995	1999
Metropolitan	43,693	51,413	78,128
Non-Metropolitan	3,804	4,423	5,901
Percent Metropolitan	92.0%	92.1%	93.0%
Total US	47,497	55,836	84,029

Data for individual states is summarized at the county level (see Appendix). The patent rate, expressed as the number of patents issued over the past decade per 10,000 population, is a useful measure of the overall level of innovative activity. In Oregon, three counties (Clatsop, Deschutes and Jefferson) stand out as having the highest rural patent rates.

Data for Oregon (see Appendix) show that two companies located in Clatsop County, Ag-Bag International and Versa Corporation, each have five or more patents in the past five years. Each of these companies specializes in manufacturing equipment and supplies for storing silage. In addition, a third Clatsop County company, Carruthers Equipment, manages food processing machinery. The large number of patents in these related fields may indicate the possible presence of a knowledge-based industry cluster.

Other Indicators

There are a number of other promising indicators of knowledge related economic activity in rural areas. Not all of these potential indicators met our criteria for inclusion in this memo because data were lacking at the appropriate level of geography or because data are reflective of knowledge only in a particular industry.

Exports

Data on exports, particularly of value-added products, would be one potentially useful indicator of rural knowledge creation. However, data for rural areas are difficult to obtain. Export data at the state and metropolitan level are generated by the US Department of Commerce from Shipper's Export Declarations. While much of the original data for this purpose are coded by ZIP code, tabulations of data at less than a statewide level are difficult to obtain. Data are not available at the County level. See Miser export data at <http://www1.miser.umass.edu/trade/statex.html>

Research & Development Expenditures

Private sector research and development expenditures are another useful indicator of knowledge-creation. Again, while state level data are available, county level data generally are not. The National Science Foundation surveys private businesses about their research and development expenditures, but these data are generally only reported at the state level. In a research project for the U.S. Economic Development Administration on the dynamics of technology development and transfer, Dr. Andrew Reamer developed a database of about 1,900 public R&D organizations (universities, federal laboratories, and nonprofit research institutes). For each institution, the database provides zipcode, metro area (if appropriate), and known R&D expenditures by year, as available. For more information contact Dr. Reamer directly at: reamer@thecia.net.

Industry Specific Indicators

Industry Associations

Why this is important: A key element of the cluster concept is that there is some kind of connection among firms. They either serve a common market, use similar technology or worker skills, or are one another's customers and suppliers. Often when there are groups of such firms, they self-organize into trade or industry associations to provide a venue for networking and joint action on issues of common interest. The boundaries of trade association membership, and the lists of association members can be useful tools in describing and measuring industry clusters.

Data Sources: By their very nature, industry association data are idiosyncratic. Some associations regard their membership lists as proprietary or confidential, while others publish them freely on the web. The quality and detail on membership data varies substantially among industries. In some cases, the data can include valuable information about segmentation within the industry—which firms produce what kind of products, who the principal suppliers are, and so on.

Nationally, there are more than 35,000 associations, according to one proprietary listing (<http://www.associationscentral.com>). Associations include a wide variety of organizations, such as chambers of commerce, interest groups, artists, hobbyists, certain professions, and various industries. Often the easiest way to find specific associations is to do a web search. One excellent resource is the searchable directory of the American Society of Association Executives, <http://info.asaenet.org/gateway/OnlineAssocSlist.html>, which provides links to the websites of more than 6,500 associations.

A typical example is the National Sporting Goods Association (NSGA) which consists of manufacturers, distributors and retailers of sporting goods. Their website (www.nsga.org) lists more than 8,000 manufacturers of sporting goods products. Company listings are divided into more than 70 major categories and also contain listings of sales agents, wholesalers, industry buying groups and retail business services.

Analytical Approach/Descriptive Statistics: Our approach here varies depending on the number of firms or establishments in the industry. Where there are large numbers of firms, it makes sense to use statistical measures like location quotients to describe the concentration or dispersion of economic activity. In the case of finely described industry segments, it may be more appropriate to identify the actual count of firms in different locations.

Trade Directories

Why this is important: Trade directories are much like industry association data and can be used in similar ways.

Data Sources: There are a wide variety of published industry directories, ranging from yellow page listings that encompass all (or nearly all) of the businesses in a particular geographic area, to much more focused industry directories that include only firms in a particular industry.

National yellow page style business directories are available from a variety of sources, and data can be extracted from them by tabulating the number of listings in a particular geographic area (zip codes or combinations of zip codes are convenient for data with mailing addresses). The challenge with these general directories is to select subject headings or industry classification codes that coincide with the industry cluster one is interested in. One of the easiest to use business directories is the Superpages,

published by Verizon at www.superpages.com. You can search by category (through a drill-down list of business categories) and by geography, including town names and by geographic radius.

More focused directories that target a particular industry or industry segment solve part of the analysts problem. Because they are targeted at a particular audience, they automatically include only those firms that see themselves as part of a single industry. As with industry associations, this kind of third-party selection, in this case by the editors and advertisers in such directories, automatically filters data into an economically relevant grouping.

Analytical Approach/Descriptive Statistics: Trade directory data typically comes in the form of listings of individual firms. Counts of numbers of establishments and lists of firms are the best approach to the use of this data.

VI. Industry Clusters & 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

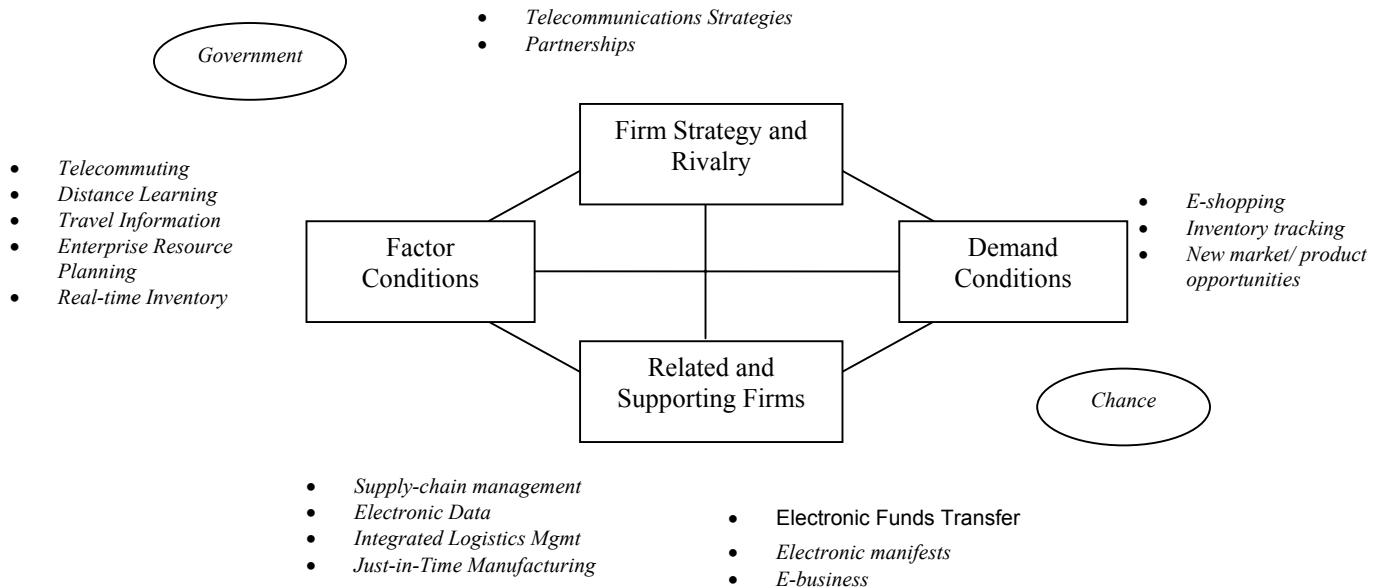
To better understand the role that ITS technologies play in rural industry clusters, this paper presents a summary of ITS use and its affect on the recreational transportation equipment cluster and the wood products cluster in rural northwestern Minnesota. These clusters were identified in previous State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

Industry Cluster Framework

The most compelling and lucid explanation of the cluster effect is from *The Competitive Advantage of Nations* by Michael Porter⁷. 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):

⁷ Porter, M. (1990). *The Competitive Advantage of Nations*. New York: The Free Press.

Figure 1
Diamond of Advantage - Potential Applications of ITS to Industry Clusters



- *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 Minnesota⁸. In

⁸ State and Local Policy Program and Metropolitan Council. (1995). *Twin Cities Industry Clusters Study*. St. Paul: Metropolitan Council. <http://www.hhh.umn.edu/centers/slp/edweb/tcclust.htm>

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

Rural Minnesota Industry Clusters studies by SLPP

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

The Initiative Fund of Southeastern and South Central Minnesota and the State and Local Policy Program. (1996) *Southeast Minnesota Industry Clusters Study*. Owatonna: Southeastern and South Central Initiative Fund. <http://www.hhh.umn.edu/centers/slp/edweb/seminn.htm>

State and Local Policy Program and the University of Minnesota Extension Service. (1998). *Northwest Minnesota Industry Clusters Study*. Minneapolis: Humphrey Institute, University of Minnesota. <http://www.hhh.umn.edu/centers/slp/edweb/nwclust.htm>

State and Local Policy Program and the University of Minnesota Extension Service (1998). *Southwest Minnesota Industry Clusters Study*. Minneapolis: Humphrey Institute, University of Minnesota. <http://www.hhh.umn.edu/centers/slp/edweb/swclust.htm>

State and Local Policy Program and the Bureau of Business and Economic Research at the University of Minnesota Duluth (2001). *Northeast Minnesota Industry Clusters Study*. Minneapolis: Humphrey Institute, University of Minnesota. <http://www.hhh.umn.edu/centers/slp/edweb/neclust.htm>

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 functional⁹. 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 as 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

⁹ State and Local Policy Program and the University of Minnesota Extension Service. (1998). *Northwest Minnesota Industry Clusters Study*. Minneapolis: Humphrey Institute, University of Minnesota.
<http://www.hhh.umn.edu/centers/slp/edweb/nwclust.htm>

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 2001¹⁰. 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 of 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:

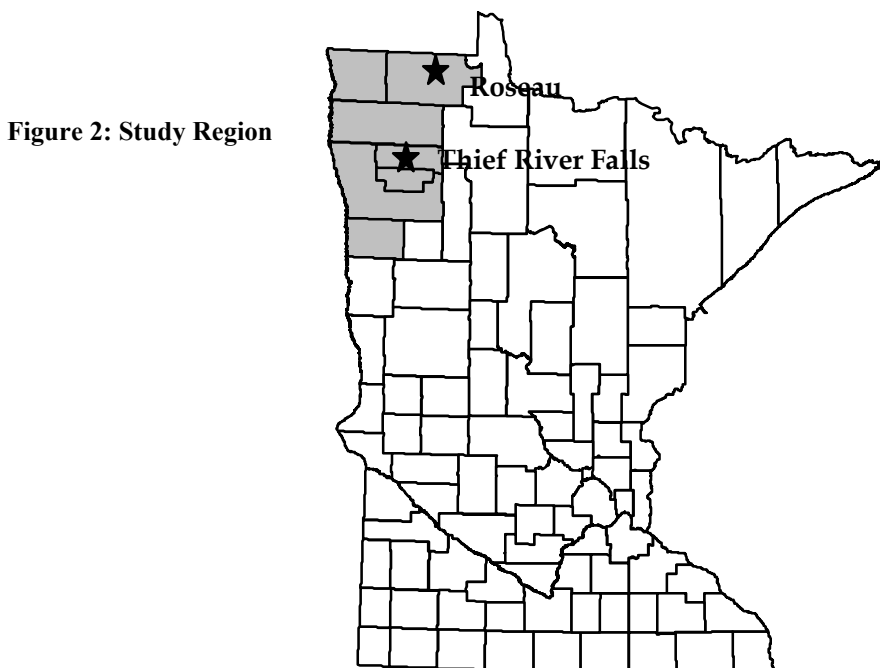
- How did transportation and communication costs affect your firm’s location?
- How do you communicate with suppliers and consumers?
- How do you transport your products? What kinds of transportation and information networks are used to link firms to suppliers and customers?
- Are you involved in any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

¹⁰ Policy Program at the University of Minnesota Twin Cities Humphrey Institute. Information available upon request.

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 88,472¹¹ 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.



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

¹¹ United States Census Bureau. (2000) Decennial Census. <http://www.census.gov>. October 2002.

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 & 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.

3A recent report from Minnesota Technology¹² 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.

¹² Center for Rural Policy and Development & Minnesota Technology, Inc. (2002). 2002 Rural Minnesota Internet Study.

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.

In 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 manufacturers¹³. 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.

¹³ Minnesota Department of Trade and Economic Development. Minnesota's Forest Products Sector. <http://www.dted.state.mn.us/PDFs/forest.pdf>

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.

VI. Looking Forward to Year 3

The following section is a brief narrative outline for plans to be undertaken in the third and final year of the project.

Globalization and local institutions

For the coming year, the globalization and local institutions project will be undertaken in two complimentary parts.

- Quantitative analysis section
- Qualitative analysis section

The Quantitative analysis section which is a spillover from year two will involve the synthesis of all the research findings that have been collected to date. The main objective will be to prepare a trend analysis report of the institutional changes that have occurred at the state and local level since the end of World War II.

The Qualitative analysis section will involve an analysis of local institutions to identify the main institutional changes that have taken place in the recent past. The targeted area of study will be Northwest Minnesota - one of the regions under study in the Rural Knowledge Cluster project - the other component of the globalization and knowledge clusters study.

The focus of the qualitative analysis will be to identify whether the globalization process has induced any significant institutional changes at the local level and the institutional innovations that have occurred as a result of these changes. The study will focus on the following local institutions in this region.

- The University of Minnesota extension service
- The Northwest initiative foundation
- USDA rural development groups
- The rural development councils
- MNSCU institutions
- The University of Minnesota Crookston
- State agencies e.g. DEED, DNR
- Small Business development center
- K – 12 education institutions

The analysis of the two sections mentioned above will lead to the production of a comprehensive project report that will be used in the preparation of user friendly publications for distribution and consumption at the state and local level. The aim will be to enhance the capacities of these institutions to effectively deal with the challenges resulting from the globalization process.

Cluster Case Studies

In order to show the applicability of our model to other rural areas, we began cataloging examples of rural knowledge clusters across the United States in April, 2003. Besides collating examples from existing research, the project has also partnered with researchers in other regions to obtain local profiles. SLPP will utilize the catalog of examples both in paper and electronic form to advance the idea of knowledge clusters as a viable and universal economic development model in rural areas. Also, in bringing these examples together in one clearinghouse on our website, SLPP can act as a resource center for economic developers and government officials looking at the cluster model for local applications. The collection work will continue throughout the third year of the project with the findings reported and published thereafter.

Conference on Regional Cluster Initiatives in Minnesota

The Humphrey Institute's State and Local Policy Program and Freeman Center will host a conference on regional cluster initiatives in Minnesota in late spring or summer 2004. This conference will feature national speakers on cluster strategies for rural regions as well as case studies of regional initiatives in Minnesota. The Humphrey Institute will work with the Minnesota regional initiative foundations in organizing the conference and developing the case study presentations. Other partners in organizing the conference will include University of Minnesota Extension and Minnesota State Colleges and Universities (MNSCU).

Cluster Initiatives outside Minnesota

The Humphrey Institute team will conduct an inventory of rural cluster initiatives outside of Minnesota and include a summary of these initiatives in its final report. This inventory will include a brief description and contact information for each cluster initiative.

SLPP Website as Information Clearinghouse

During the coming year, the Humphrey Institute's State and Local Policy Program (SLPP) will redesign and update its economic development website to incorporate the rural knowledge cluster research and toolkit for practitioners. While the current website <http://www.hhh.umn.edu/centers/slp/projects/rkcweb/index.htm> includes work on rural knowledge clusters to date, the revised website will be much easier to use by practitioners and will include useful tools, information and links.

Conferences/Presentations

We anticipate presenting the rural knowledge cluster research results and tools to a number of groups in Minnesota and nationally during the coming year. During the past year, Lee Munnich made presentation on rural clusters in Wisconsin, Vermont, Pennsylvania, Oregon, in addition to Minnesota. Given the interest in rural clusters to date, we anticipate a number of presentations during the coming year.

Working Papers

The Humphrey Institute research team will produce several working papers on globalization and rural knowledge clusters during the coming year. These papers will be available through the SLPP website and may be submitted to economic development journals or other publications.

Quality Report

A high quality report on the findings of the project on “Globalization and Knowledge Clusters for Rural America” will be produced at the conclusion of the three-year project. This report will be designed to be used by professionals and practitioners and will complement the toolkit on the SLPP website. The report will be available on the website as a PDF file.

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VIII. Appendix

The following tables contain sample data related to the section of this report entitled “Developing Knowledge Indicators.”

Economic Indicators

Location Quotients for Sporting Goods Manufacturing, Wholesaling & Retailing,
Hood River County, Oregon

NAICS	Description	Number of		Share of		Location Quotient
		Hood River	United States	Hood River	United States	
33992	Sporting & Athletic Goods Mfg.					
	Employers					
	Establishments	7	2,486	0.90%	0.04%	25.5
	Employees	259	68,072	3.37%	0.41%	8.2

42191	Sporting Goods Wholesaling					
	Employers					
	Establishments	4	6,221	0.51%	0.09%	5.8
	Employees	75	57,625	0.98%	0.35%	2.8
	Non-Employers					
	Establishments	12	11,948	0.90%	0.07%	12.5
	Receipts	618	766,000	1.45%	0.11%	13.3

45111	Sporting Goods Retailing					
	Employers					
	Establishments	13	22,611	1.66%	0.32%	5.2

	Employees	64	184,964	0.83%	1.12%	0.7
	Non-Employers					
	Establishments	15	96,373	1.13%	0.58%	1.9
	Receipts	419	3,761,000	0.98%	0.53%	1.8

Demographic Indicators

Demographic Indicators for Oregon Counties

County	College Attainment	Creative Class		Change in 25-34s
		Super Creative	Creative Professionals	
	2000	2000	2000	1990-2000
Baker	16.4	10%	19%	-27%
Benton	47.4	26%	19%	-11%
Clackamas	28.4	12%	22%	-2%
Clatsop	19.1	9%	16%	-24%
Columbia	14	10%	15%	-7%
Coos	15	11%	16%	-28%
Crook	12.6	9%	14%	13%
Curry	16.4	10%	15%	-31%
Deschutes	25	10%	19%	29%
Douglas	13.3	9%	14%	-24%
Gilliam	13.4	6%	20%	-28%
Grant	15.7	13%	18%	-34%
Harney	11.9	10%	21%	-24%
Hood River	23.1	12%	19%	-3%
Jackson	22.3	12%	17%	0%
Jefferson	13.7	9%	15%	14%
Josephine	14.1	10%	15%	-6%
Klamath	15.9	10%	16%	-12%
Lake	15.5	11%	18%	-28%
Lane	25.5	13%	17%	-5%
Lincoln	20.8	10%	16%	-16%
Linn	13.4	10%	14%	-7%
Malheur	11.1	8%	16%	22%
Marion	19.8	10%	17%	8%
Morrow	11	8%	16%	23%
Multnomah	30.7	14%	19%	7%
Polk	25.3	13%	18%	4%
Sherman	19	10%	23%	-46%
Tillamook	17.6	9%	17%	-15%
Umatilla	16	9%	14%	0%
Union	21.8	13%	17%	-20%
Wallowa	20.3	12%	19%	-39%
Wasco	15.7	9%	16%	-14%
Washington	34.5	17%	21%	30%
Wheeler	14.3	13%	19%	-11%
Yamhill	20.6	10%	16%	10%

Source: Census 2000, 1990 Census, Impresa Calculations

Knowledge Indicators

Utility Patent Grants By State, County, And County Equivalents, United States And U.S. Possessions, 1990-1999

MINNESOTA

Code	Name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
001	Aitkin	1	2	1	0	0	1	1	1	3	0
003	Anoka	61	68	64	84	112	85	84	104	118	138
005	Becker	3	0	2	2	2	1	1	0	1	2
007	Beltrami	2	3	1	3	3	1	0	0	3	6
009	Benton	2	4	3	5	5	4	3	3	9	4
011	Big Stone	0	0	0	0	0	0	0	0	0	0
013	Blue Earth	3	6	4	6	7	8	10	4	13	5
015	Brown	0	2	1	1	0	1	2	2	1	0
017	Carlton	3	2	1	2	2	1	3	1	2	0
019	Carver	15	12	13	25	26	18	21	26	41	41
021	Cass	1	1	2	0	1	4	2	3	3	9
023	Chippewa	0	2	2	0	0	1	3	3	1	3
025	Chisago	5	7	6	5	10	7	7	7	16	15
027	Clay	2	4	6	5	1	9	7	5	6	4
029	Clearwater	1	0	0	0	0	0	1	0	0	0
031	Cook	0	1	0	0	0	0	0	0	0	0
033	Cottonwood	0	0	0	0	1	2	1	0	0	1
035	Crow Wing	7	7	2	4	7	10	5	10	10	13
037	Dakota	99	93	83	124	117	139	141	111	180	170
039	Dodge	4	5	10	3	1	5	5	2	12	11
041	Douglas	6	4	5	8	5	9	3	5	5	8
043	Faribault	2	2	0	1	4	2	0	1	2	2
045	Fillmore	2	1	2	5	4	2	2	4	3	4
047	Freeborn	4	3	2	2	3	1	3	3	2	0
049	Goodhue	10	2	13	13	8	8	10	19	9	15
051	Grant	0	1	1	1	0	0	2	0	2	0
053	Hennepin	492	471	494	526	569	487	570	594	771	863
055	Houston	3	6	1	4	3	2	3	5	7	6
057	Hubbard	0	1	0	2	1	0	0	0	0	0
059	Isanti	6	5	6	3	2	3	3	2	3	3
061	Itasca	1	7	6	6	2	2	1	3	3	1
063	Jackson	1	0	0	1	0	0	0	1	2	4
065	Kanabec	3	4	1	2	0	0	2	2	2	3
067	Kandiyohi	7	2	5	1	5	9	6	4	4	10
069	Kittson	0	0	1	0	0	0	1	0	0	0
071	Koochiching	1	2	1	0	0	0	0	0	1	1
073	Lac qui Parle	0	0	0	1	0	0	0	1	0	1
075	Lake	3	3	2	1	1	2	1	1	1	0
077	Lake of the Woods	1	0	0	1	0	1	0	0	0	0
079	Le Sueur	6	4	5	5	7	4	9	9	11	10
081	Lincoln	1	1	2	0	0	0	0	0	0	0
083	Lyon	2	0	0	1	0	0	1	3	1	0
085	McLeod	0	4	8	4	4	14	4	9	15	31
087	Mahnomen	0	0	0	0	0	0	2	0	0	0
089	Marshall	2	2	1	3	0	1	1	0	0	1
091	Martin	1	0	4	5	2	3	2	2	2	3
093	Meeke	2	2	1	2	3	5	3	3	5	7
095	Mille Lacs	1	2	0	3	3	1	3	0	1	6
097	Morrison	1	0	2	2	0	1	0	0	0	2
099	Mower	3	2	0	1	3	2	2	6	6	6
101	Murray	0	0	0	0	0	1	0	0	0	0
103	Nicollet	4	3	1	5	5	4	5	4	7	3
105	Nobles	1	1	2	4	3	4	1	5	3	2
107	Norman	0	1	0	0	0	0	0	0	0	0
109	Olmsted	51	37	38	64	85	77	102	116	209	229
111	Otter Tail	3	0	1	4	4	1	4	7	2	3
113	Pennington	1	6	3	2	0	3	3	3	2	0
115	Pine	0	0	0	0	1	0	1	0	0	1
117	Pipestone	0	0	0	0	0	0	1	0	0	1
119	Polk	3	3	3	2	2	2	3	2	3	1
121	Pope	1	4	1	3	0	2	0	2	3	2
123	Ramsey	288	304	312	298	331	326	319	310	446	426
125	Red Lake	0	0	3	0	0	0	0	0	0	0
127	Redwood	0	1	0	0	0	1	2	4	3	8
129	Renville	1	1	0	1	0	0	0	0	1	9
131	Rice	2	4	6	4	5	8	12	7	13	9
133	Rock	0	1	0	0	0	0	0	0	0	0
135	Roseau	0	2	4	2	4	2	2	5	2	5
137	St. Louis	10	15	13	15	20	15	17	13	18	26
139	Scott	16	28	31	21	27	30	31	30	35	56
141	Sherburne	5	7	16	15	7	12	12	6	27	20
143	Sibley	0	0	1	0	2	1	1	2	1	2
145	Stearns	5	7	5	5	7	5	9	9	12	9
147	Steele	13	12	16	13	11	16	13	8	26	18
149	Stevens	0	0	1	1	2	0	1	1	2	1
151	Swift	1	0	2	1	3	0	2	0	2	2
153	Todd	2	2	1	0	1	1	2	0	0	0
155	Traverse	0	1	0	2	0	0	3	0	1	0
157	Wabasha	1	1	0	2	2	2	4	7	9	10

159	Wadena	1	2	0	0	1	1	0	1	0	0
161	Waseca	3	7	4	4	2	4	4	8	5	5
163	Washington	117	121	144	183	241	272	275	306	332	362
165	Watowan	0	0	0	0	1	0	1	0	0	0
167	Wilkin	1	1	0	1	1	0	0	0	2	0
169	Winona	7	6	5	6	9	4	5	5	5	7
171	Wright	15	22	19	21	22	11	9	15	30	28
173	Yellow Medicine	0	1	1	0	1	1	0	1	0	0
999	UNKNOWN	0	0	0	0	1	0	0	0	1	0
	TOTAL	1322	1351	1397	1552	1725	1662	1775	1836	2479	2654

Source: US Patent & Trademark Office (<http://www.uspto.gov/web/offices/ac/ido/oeip/tafi/county.pdf>)

Utility Patent Grants By State, County, And County Equivalents, United States And U.S. Possessions, 1990-1999

OREGON

Code	Name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
001	Baker	5	0	1	1	1	0	3	0	1	1
003	Benton	37	55	55	39	36	55	61	65	109	101
005	Clackamas	85	90	77	103	89	104	111	126	197	187
007	Clatsop	2	5	6	6	12	19	5	6	7	8
009	Columbia	3	4	3	7	3	5	4	4	6	6
011	Coos	5	6	4	2	2	3	2	4	4	3
013	Crook	2	1	2	0	0	1	0	1	2	3
015	Curry	2	1	2	1	1	4	6	0	6	0
017	Deschutes	20	24	26	29	18	14	23	18	20	25
019	Douglas	12	6	8	8	9	6	10	6	2	10
021	Gilliam	0	0	0	0	0	0	0	0	0	0
023	Grant	0	1	1	0	0	1	1	0	1	0
025	Harney	0	0	0	0	1	0	2	0	1	1
027	Hood River	0	2	0	1	3	1	1	3	2	3
029	Jackson	11	21	24	21	27	30	17	13	28	14
031	Jefferson	9	5	7	4	12	8	7	6	7	13
033	Josephine	6	5	6	4	1	8	11	13	9	9
035	Klamath	5	5	2	2	2	1	1	3	5	1
037	Lake	0	0	1	1	0	0	0	0	0	2
039	Lane	45	38	28	47	60	57	61	50	76	59
041	Lincoln	2	4	3	3	2	1	5	5	4	4
043	Linn	4	2	8	7	8	8	8	12	17	11
045	Malheur	3	3	2	4	1	0	3	1	2	2
047	Marion	15	16	14	14	13	15	11	9	19	16
049	Morrow	0	1	0	0	1	1	0	2	0	1
051	Multnomah	62	64	53	71	57	73	78	81	118	129
053	Polk	7	11	10	7	7	7	13	9	18	18
055	Sherman	0	0	0	0	0	0	0	0	0	0
057	Tillamook	2	0	4	5	1	0	2	0	1	0
059	Umatilla	1	2	3	0	1	3	2	4	6	1
061	Union	0	1	0	1	2	2	1	0	0	0
063	Wallowa	0	0	2	0	0	0	1	0	1	0
065	Wasco	0	0	3	1	0	0	3	0	3	4
067	Washington	189	169	145	176	170	254	304	325	481	443
071	Wheeler	0	0	0	0	0	0	0	1	0	0
073	Yamhill	6	9	13	25	18	23	13	24	30	20
999	UNKNOWN	0	0	0	0	0	0	0	0	0	0
	TOTAL	540	551	513	590	558	704	770	791	1183	1095

Source: US Patent & Trademark Office (<http://www.uspto.gov/web/offices/ac/ido/oeip/tafi/county.pdf>)

Patent Rate for Oregon Counties, 1990-1999

County	Patents, 1990	Population, 2000	Patents/10,000 Population
Baker	13	16,729	7.8
Benton	613	78,130	78.5
Clackamas	1169	339,472	34.4
Clatsop	76	35,579	21.4
Columbia	45	43,685	10.3
Coos	35	62,660	5.6
Crook	12	19,354	6.2
Curry	23	21,101	10.9
Deschutes	217	116,580	18.6
Douglas	77	100,494	7.7
Gilliam	0	1,913	0.0
Grant	5	7,893	6.3
Harney	5	7,611	6.6
Hood River	16	20,473	7.8
Jackson	206	181,886	11.3

Jefferson	78	19,104	40.8
Josephine	72	75,907	9.5
Klamath	27	63,909	4.2
Lake	4	7,401	5.4
Lane	521	323,271	16.1
Lincoln	33	44,303	7.4
Linn	85	103,029	8.3
Malheur	21	31,541	6.7
Marion	142	285,461	5.0
Morrow	6	11,070	5.4
Multnomah	786	660,767	11.9
Polk	107	62,623	17.1
Sherman	0	1,921	0.0
Tillamook	15	24,218	6.2
Umatilla	23	70,689	3.3
Union	7	24,546	2.9
Wallowa	4	7,222	5.5
Wasco	14	23,826	5.9
Washington	2656	448,120	59.3
Wheeler	1	1,543	6.5
Yamhill	181	85,262	21.2

Source: US Patent & Trademark Office (<http://www.uspto.gov/web/offices/ac/ido/oeip/taf/county.pdf>)

**Patenting in Metro and Non_metro Areas of the United States, Breakout by Organization
Oregon, Non-Metropolitan Areas**

Firm	1995	1996	1997	1998	1999	Total
Bend Research	2	5	3	6	2	18
Versa Corporation	9	1	1	3	3	17
Tektronix	2	3	4	1	2	12
Hewlett Packard	1	0	2	5	4	11
Ag-Bag International	4	2	2	1	1	10
Met One	0	1	4	0	4	9
Caddock Electronics	0	2	2	0	2	6
Carruthers Equipment	3	1	1	1	0	6
Northwest Aluminum	0	2	0	1	3	6
Amtek Research	0	0	2	1	2	5
Teledyne Industries	1	2	1	2	1	5
TFR Technologies	0	0	1	2	2	5

**Patenting in Metro and Non_metro Areas of the United States, Breakout by Organization
Minnesota, Non-Metropolitan Areas**

	1995	1996	1997	1998	1999	Total
Hutchinson Technology Inc.	8	2	9	16	20	55
International Business Machines Corporation	2	7	7	16	15	45
Riverwood International Corporation	8	3	6	7	8	32
Truth Hardware Corporation	6	6	2	7	4	25
Pioneer Hibred International Inc.	1	6	0	5	9	21
Micron Electronics Inc.	0	1	7	4	6	18
Mcneilus Truck & Manufacturing Co. Inc.	5	1	0	6	4	16
Wenger Corporation	3	3	2	4	4	15
Viratec Thin Films Inc.	3	4	3	4	1	14
Hormel Foods Corporation	1	2	2	3	5	13
Bedford Industries Inc.	3	0	4	3	2	12

Minnesota Mining And Manufacturing Company	4	0	4	2	2	11
Dekalb Genetics Corporation	0	0	0	1	8	9
Holden's Foundation Seeds Inc.	1	2	2	0	4	9
Asgrow Seed Company	0	1	2	4	1	8
Douglas Machine Limited Liability Company	1	2	2	2	1	8
E. F. Johnson Company	2	3	2	2	0	8
Wagner Spray Tech Corporation	0	1	2	2	3	8
Ecoair Corporation	1	1	2	3	0	7
Monsanto Corporation	0	0	0	0	7	7
Sheldahl Inc.	0	2	2	4	1	7
Rosemount Inc.	0	2	2	1	1	6
Scimed Life Systems Inc.	4	2	1	1	0	6
SI Montevideo Technology Inc.	1	1	2	0	2	6
Adc Telecommunications Inc.	0	0	2	1	2	5
Arctco Inc.	2	2	1	0	0	5
Christian Brothers Inc.	0	1	4	0	0	5
Hussong Manufacturing Co. Inc.	0	0	0	2	3	5
Maywes Manufacturing Inc.	0	1	0	1	3	5
Walker Stainless Equipment Company	0	0	0	1	4	5

Source: US Patent and Trademark Office

7.4 Business Startup Activity

Number of New Firms Started and New Jobs Created, Minnesota, 2001

County	Number of Business Establishments		Number of Jobs	
	Number	Rate	Number	Rate
Aitkin	26	5.9	60	1.6
Anoka	562	9.0	2,008	1.9
Becker	99	11.1	291	2.7
Beltrami	83	8.0	470	2.9
Benton	60	8.2	373	2.9
Bigstone	17	8.3	65	3.8
Blue Earth	131	17.8	803	1.1
Brown	45	5.9	154	1.1
Carlton	42	6.0	277	2.2
Carver	149	9.1	1,044	4.3
Cass	65	8.3	188	2.2
Chippewa	44	10.6	328	6.4
Chisago	86	9.0	505	4.2
Clay	72	6.6	514	3.1
Clearwater	22	9.3	33	1.2
Cook	13	4.9	16	0.7
Cottonwood	16	4.2	9	0.2
Crow wing	153	17.4	804	3.3
Dakota	757	9.1	4,386	3.0
Dodge	41	10.6	80	1.7
Douglas	84	7.6	384	2.6
Faribault	18	3.8	70	1.2
Fillmore	33	5.3	93	1.4
Freeborn	39	4.6	281	2.2
Goodhue	76	6.6	387	1.9
Grant	9	3.9	72	3.5
Hennepin	3,171	8.2	19,565	2.4
Houston	26	6.5	98	2.0
Hubbard	45	8.8	163	2.8
Isanti	46	6.7	265	3.0
Itasca	77	6.7	292	1.9
Jackson	21	6.7	44	1.0
Kanabec	19	6.5	40	1.0
Kandiyohi	71	5.8	285	1.4
Kittson	8	4.0	20	1.4
Koochiching	28	5.8	146	2.6
Lac-Qu--Parle	11	4.7	10	0.4
Lake	24	8.3	136	3.7
Lake_of-the-Woods	D	D	D	D
Le-Sueur	47	7.4	269	3.1
Lincoln	13	6.7	88	5.3

Lyon	39	5.1	206	1.5
Mahnomen	11	8.7	44	2.2
Marshall	19	6.4	29	1.2
Martin	38	5.4	327	3.6
McLeod	59	6.2	439	2.5
Meeker	38	6.9	143	2.2
Mille-Lacs	53	9.3	166	1.8
Morrison	75	9.7	386	3.8
Mower	77	8.9	349	2.3
Murray	14	4.9	60	2.3
Nicollet	28	4.7	267	2.0
Nobles	42	6.6	281	3.1
Norman	10	4.5	21	1.1
Olmsted	272	9.6	2,188	2.8
Ottertail	101	6.5	373	1.8
Pennington	24	6.0	144	1.8
Pine	40	7.0	143	1.9
Pipestone	9	2.6	22	0.6
Polk	70	7.6	349	2.9
Pope	20	6.3	26	0.8
Ramsey	1,002	7.4	5,551	1.7
Red-Lake	D	D	D	D
Redwood	34	6.1	64	0.9
Renville	34	5.8	135	2.2
Rice	83	6.5	390	1.8
Rock	13	4.9	118	4.0
Roseau	28	7.1	89	1.0
Scott	233	11.5	1,256	4.0
Sherburne	185	14.0	875	5.0
Sibley	30	8.1	114	3.0
St.-Louis	359	6.7	2,048	2.2
Stearns	265	7.3	1,505	2.0
Steele	67	7.7	646	3.4
Stevens	13	3.8	82	1.8
Swift	20	5.8	74	1.9
Todd	31	6.0	115	1.9
Traverse	8	6.3	29	2.6
Wabasha	39	7.2	121	1.7
Wadena	38	9.0	179	3.1
Waseca	32	6.7	112	1.4
Washington	406	9.5	2,112	3.3
Watonwan	21	6.3	57	1.2
Wilkin	5	2.6	12	0.6
Winona	75	6.4	350	1.4
Wright	207	9.8	1,213	4.6
Yellow-Medicine	18	5.1	118	2.8

Source: Minnesota Employment Security Department

7.5 Industry Specific Data

Hood River Sporting Goods Retailers/Wholesalers Listed in Business Directory, 2003

Firm	Street Address	City	State	Zip
Bob Kendall		Hood River	OR	97031
Boolacoc	4705 Highway 35	Hood River	OR	97031
Deportes Morelia 2	1205 B Street	Hood River	OR	97031
Hood River Outfitters	1020 Wasco Street	Hood River	OR	97031
Gorge Fly Shop	201 Oak Street	Hood River	OR	97031
Sportsman's Den	201 Oak Street	Hood River	OR	97031
2nd Wind Sports Consignment	210 Oak Street	Hood River	OR	97031
Windy River Archery Center	2680 Dock Road	Hood River	OR	97031
Miller Medical Equipment	151 East Jewett Boulevard	White Salmon	WA	98672

Source: SuperPages.Com

Sample Knowledge Indicators

- Academic/Professional qualifications
- Internal/External appointments
- Honours conferred
- Memberships in professional organizations
- Professional expertise
- General interests
- Bibliography (published and internal material)
- Reviews given
- Research projects (alone and in cooperation)
- Innovation
- Knowledge transfers
- Recognition
- Leadership
- Significant liaisons
- Courses taught
- Individuals taught/mentored
- Special presentations made
- Peer evaluations
- Client service
- Service to individuals/groups
- Committees/Advisory boards
- Departmental service
- Conference service
- Community service
- Continuing education activities