

# **THE STATUS OF AND OPPORTUNITIES FOR BUSINESS CLUSTERING WITHIN THE FOREST PRODUCTS SECTOR IN THE U.S.**

## **Executive Summary**

**2009**

**Prepared for the U.S. Endowment for Forestry and Communities, Inc.**

### **Individual Contributors:**

**Francisco X. Aguilar<sup>1</sup>, Stephen M. Bratkovich<sup>2</sup>, Kathryn Fernholz<sup>2</sup>, Amy Garrard<sup>3</sup>,  
Robert K. Grala<sup>3</sup>, Liam Leightley<sup>3</sup>, William Martin<sup>3</sup>, and Ian A. Munn<sup>3</sup>**

<sup>1</sup> Department of Forestry, University of Missouri

<sup>2</sup> Dovetail Partners, Inc.

<sup>3</sup> Forest and Wildlife Research Center, Mississippi State University

# EXECUTIVE SUMMARY

## Contents

Introduction.....	3
Concept of an Industry Cluster .....	3
Potential Benefits to Firms Located in Industry Clusters and Local Economies .....	3
Types of Industry Clusters.....	4
Successful Industry Cluster Development.....	4
Targeting Successful Cluster Development .....	4
Experience from Successful Forest Business Clusters.....	4
What U.S. Forest Sector Stakeholders Think About Forest Business Clusters.....	5
Factors Leading to the Successful Development of Forest Business Clusters	
Perceived Advantages of Forest Business Clusters	
Perceived Disadvantages of Forest Business Clusters	
Should Additional Collaboration Within the Cluster be Encouraged?	
Factors Affecting Clustering Within the Wood Products Industry in the U.S. South .....	6
Recommendations.....	6
Online Registry of Forest Business Clusters .....	8
Literature Review on Business Clustering Within the U.S. Forest Sector .....	8
References .....	8

## Introduction

This project examined the status of and opportunities for business clustering within U.S. forest products and closely-related natural resource-based sectors. The project identified business cluster models adopted in the forest sector, explored partnerships among cluster entities, and examined policies, strategies and support mechanisms that could facilitate successful business clustering. Information collected during the summer and fall of 2008 was also used to develop a template for a national registry of forest business clusters. The project constituted a comprehensive research effort comprised of the following components:

- **A Literature Review:** to examine adopted business cluster models, determine benefits and challenges associated with business clustering, and identify forest business clusters within the U.S. forest sector reported in the literature. The project reviewed over 100 scientific articles, industry reports, and assessment reports (available at [www.fwrc.msstate.edu/cluster/bibliography.asp](http://www.fwrc.msstate.edu/cluster/bibliography.asp)).
- **A Nation-wide Online Survey:** to seek opinion from U.S. forest sector stakeholders on major drivers, advantages, and disadvantages of business clustering in the forest sector, and determine needed support. The survey was also used to identify existing forest business clusters for inclusion in the cluster registry.
- **Geospatial and Econometric Analyses:** to examine socio-economic conditions and resources affecting clustering among wood-using mills in the U.S. South. This study analyzed the reasons behind clustering that can be used to guide regional economic development in the industry.
- **Phone Interviews with Stakeholders Knowledgeable of Forest Business Clusters in the Public and Private Sectors:** to develop case studies illustrating clustering approaches in various regions of the U.S. This component helped identify conditions specific to a given cluster that could not be captured in the econometric analysis.
- **A website featuring a registry of forest business clusters in the U.S.** was created and launched in 2009 (available at [www.fwrc.msstate.edu/cluster/cluster\\_search.asp](http://www.fwrc.msstate.edu/cluster/cluster_search.asp)). The registry allows entry of new clusters.

In the following paragraphs we review some key findings of this project. Complete details are presented in a full report available at [www.usendowment.org](http://www.usendowment.org) and [www.fwrc.msstate.edu/cluster](http://www.fwrc.msstate.edu/cluster). Our findings are summarized as: Concept of an industry cluster; Potential benefits to firms located in industry clusters and local economies; Types of industry clusters; Successful industry cluster development; Targeting successful cluster development; What U.S. forest sector stakeholders think about forest business clusters; Factors affecting clustering within the wood products industry

in the U.S. South; Experience from successful forest business clusters; Recommendations; Online registry of forest business clusters; Literature review on business clustering within the U.S. forest sector; and References.

## Concept of an Industry Cluster

An industry cluster is a group of firms and institutions located in close proximity whose businesses are interlinked through value and supply chains, labor, and use of similar inputs, technology, and complementary products. Companies locate close to each other because they have similar production interests and needs, and consequently depend on each other in achieving success as a group. Industry clusters are attractive to related companies because they create new business opportunities that would not be available if the companies operated in isolation.

## Potential Benefits to Firms Located in Industry Clusters and Local Economies

By locating their production and services in the cluster, companies gain ready access to trained workers, infrastructure and specialized suppliers. The result is that companies participating in a cluster can lower their costs compared to non-clustered ones. Some of the specific benefits to industry and local and regional economies include:

### Easier and Less Costly Recruitment of Workers:

clusters create a pool of workers that often are trained and specialized to work for specific companies in the cluster. Consequently, this reduces the risk of not being able to recruit qualified workers and reduces recruitment costs. It also reduces the cost and time of training such workers.

### Easier and Less Costly Access to Production Inputs:

by locating production in an industry cluster, companies gain access to specialized inputs and their suppliers. This reduces costs associated with transportation, inventory, and potential delays. Close proximity to suppliers improves both communication and access to support services provided by these suppliers, and allows for faster product modifications.

### Better Understanding of Suppliers and Consumers:

companies participating in clusters acquire knowledge and experience that is crucial to individual company success. Interactions among companies facilitate exchange of expertise and help solve production problems. Closer interaction with suppliers and consumers permits greater efficiency in the production of goods and services that better meet the needs of consumers.

### Companies Provide Complementary Products and

**Services:** many companies produce products that are complementary and, thus, do not compete directly with each other. However, collective success of cluster companies and their productivity depends on the performance of each individual firm.

### Improved Access to Public Institutions and Goods:

collectively, cluster companies are better able to attract government investments in infrastructure and various

educational and training programs. They also can compete more effectively for funding.

**Better Motivation for Continuous Improvement:**

by participating in clusters, companies continuously compare their achievements with others in the cluster, which stimulates positive competition, innovativeness, and increased productivity.

**Higher Wages:** industry clusters decrease costs and lead to increased productivity and employment. Cluster employers, competing for skilled workers, are willing to pay higher wages than non-cluster employers.

**Improved Employment Opportunities:** cluster workers tend to specialize in specific jobs, improve their skills, and be more productive. They are more likely to find jobs matching their skills in the industry cluster than in areas without a cluster.

**Improved Communication and Company Interaction:** clusters can enjoy improved communication and interaction among firms. Firms benefit from closer cooperation, improved logistics, innovation, and positive competition leading to increased productivity.

**Increased Economic Growth:** successful industry clusters attract establishment of new businesses that results in increased economic activity and employment in the region. This provides a larger tax base and generates greater tax revenues.

## Types of Industry Clusters

Industry clusters differ in the way they develop and operate. Some industry clusters manufacture specific products or provide unique services (automotive, financial, and forest products). Others are characterized for locating production in areas with some desired characteristics (abundant natural resources or proximity to markets). For example, sawmills locate close to forests, whereas furniture manufacturers often choose to locate near consumer markets. In other cases, clusters develop because of available trained workforce, suitable infrastructure, and favorable business environment.

More often clusters are defined by interactions among cluster participants and their development. Cluster categories may include Marshallian, hub and spoke, satellite platform, and state anchored clusters. Marshallian clusters typically consist of local small and medium-sized companies that trade their products and services with cluster members. Secondary wood products manufacturers are most likely to follow this type of business cluster. Hub and spoke clusters include one or several large companies serving as anchor companies interacting with numerous small suppliers. A combination of primary and secondary wood products manufacturers can make this type of business model successful. Satellite platform clusters consist of large companies with multiple branch plants that act independently. State-anchored industry clusters are based on an anchoring institution such as a university, government agency, or military installation. Research

parks developed by universities or state governments can serve as examples.

## Successful Industry Cluster Development

Cluster success is based on advantages of location such as availability of raw materials and qualified workers, positive business environment, research expertise, education, infrastructure, and innovativeness. Often, clusters develop as the result of local entrepreneurship. For example, the Marine trade cluster in Washington and log home manufacturing cluster in Montana started with several small firms established by local entrepreneurs. Over time, numerous spinoff businesses emerged and contributed to cluster development.

Some clusters were created by “chance events” such as establishment of a government institution. Such an institution typically needs appropriate infrastructure and external services to function efficiently. This creates the need for suppliers, service providers, financial institutions, and other cooperating businesses. For example, the establishment of land-grant universities resulted in substantial economic development in surrounding areas.

## Targeting Successful Cluster Development

Targeting development of particular industry clusters requires a detailed knowledge of cluster characteristics, stage of development, competitiveness of the industry, and strengths of the region. Regions with well-established clusters should focus on strategies identifying companies’ overlapping interests, new market opportunities, and a shared vision for the cluster. Regions with small industry clusters may benefit from promoting clusters by offering financial incentives for new firms, developing adequate infrastructure, and developing cost-share training programs.

Regions that intend to develop new clusters or reinvigorate declining clusters need to be aware that their efforts might have limited success. Declining industries present additional challenges for developing successful clusters. Such regions should focus on improved recruitment efforts, development of small companies, improved public infrastructure, and training programs.

Federal, state, and local governments can provide a stimulus for successful cluster development. They can provide infrastructure (roads, buildings, power lines, etc.), organize development and training workshops, assist companies with collaborative innovation, conduct market assessments, and promote the cluster. Governments should promote more than one cluster or industry to decrease a region’s vulnerability to economy fluctuations.

## Experience from Successful Forest Business Clusters

Phone interviews and review of reports and scientific papers were conducted to determine business models and

strategies adopted by forest clusters in six regions of the U.S. (Pacific Northwest, Southwest, Midwest, Lakes States, Northeast, and South) and internationally (Finland and Sweden). Each cluster was thoroughly examined with respect to cluster history and development, business structure, partnership with governmental and non-governmental institutions, investment strategies, and policies that led to the cluster success. Adopted business models and strategies varied between clusters. Differences were influenced by available input of capital resources, economic situation in the region, and involvement of external institutions. However, several factors appeared to be particularly important across clusters:

Feasibility analysis needs to serve as a starting point in activities leading to the development of new or expansion of existing forest business clusters. To capture market potential, such analysis needs to examine a region's economic conditions, existing infrastructure and labor resources, and identify development opportunities—including types of new industries that would complement existing firms.

Stakeholder cooperation and commitment are crucial for the success of forest business clusters. Stakeholders, representing industry, government, and supporting organizations need to work together to create a long-term vision for the cluster and apply strategies and policies supporting cluster development.

Leadership by a third party organization is often needed to coordinate activities of stakeholders involved in developing the cluster. An 'umbrella' organization can help cluster businesses identify market niches, assist with workforce training and development, seek financial resources, improve networking among cluster members, educate businesses about the benefits of clustering, and gain political support for the cluster.

Funding plays a major role in the development of many business clusters. Local, state and federal governments can improve the economic climate for business clustering in the forest sector. Important actions created by additional funding (such as grants, loans, and tax incentives) include start up assistance to new businesses, incorporating new technologies, providing workforce training and education, and encouraging capital investment.

Entrepreneurial thinking by the leadership of cluster businesses, governments and supporting organizations is crucial to success. Stakeholders need to focus on educational programs that help businesses develop entrepreneurial capacity in the cluster.

Access to inputs and markets is crucial to cluster development and long-term viability. A dependable flow of raw materials and stable markets for products and services are key to sustainable clusters. Stakeholders need to focus efforts on ensuring continued access to production inputs and expanding the customer base.

## **What U.S. Forest Sector Stakeholders Think About Forest Business Clusters**

An online survey was used to obtain feedback from

forestry stakeholders on the status of and opportunities for business clustering in the U.S. forest sector. A total of 158 respondents across the U.S. evaluated the importance of various factors driving the development of forest business clusters, indicated their advantages and disadvantages, and provided information on existing forest business clusters. Below are main findings:

### **Factors Leading to the Successful Development of Forest Business Clusters**

According to stakeholders, the most important driving factors to the successful development of a forest business cluster included availability of raw materials, access to product markets and transportation network, labor availability, public non-financial support, and private financial and non-financial support. Other factors, that can potentially lead to cluster development, included forest health concerns, public financial support, university and college extension, training and research, environmental certification, stewardship contracts, and existence of industrial parks.

### **Perceived Advantages of Forest Business Clusters**

Stakeholders agreed that the most prominent advantages of business clustering included better utilization of raw materials and/or manufacturing, improved cooperation among cluster members, and more effective product marketing. Other advantages included cluster ability to attract more suppliers, greater opportunity to add value by vertical integration of cluster members, and improved manufacturing innovativeness and competitiveness.

### **Perceived Disadvantages of Forest Business Clusters**

Stakeholders were concerned with increased competition for available labor, undesired competition between cluster members, increased cost of raw materials, increased congestion on roads, and increased labor cost. Increased energy costs was not viewed as a potential disadvantage. However, statistical analysis indicated that none of the mentioned potential disadvantages was statistically significant.

### **Should Additional Collaboration Within the Cluster be Encouraged?**

Collaboration among cluster businesses and external institutions is important for development of successful business clusters. Forest sector stakeholders were asked to indicate whether additional collaboration among cluster entities should be encouraged and what was needed to support such collaboration. A majority believed that collaboration should be encouraged; however, stakeholders differed in what was needed to facilitate such collaboration. Many stakeholders indicated that such collaboration should be facilitated through improved communication between cluster members, engagement, and effective leadership (government or private). Ensuring financial and non-financial support, providing outreach, and educating businesses on benefits of clustering were also needed to encourage collaboration.

A few respondents believed collaboration should not be encouraged because it potentially can result in negative

impacts. For some, encouraging collaboration did not present any tangible benefits, whereas for others clusters divert needed resources and create confusion if it is unclear who is responsible for cluster development. Antitrust concerns were also mentioned for not encouraging additional collaboration.

## Factors Affecting Clustering Within the Wood Products Industry in the U.S. South

Information on the location of 1,964 wood-using mills<sup>1</sup> was used to study factors affecting clustering in the U.S. South<sup>2</sup>. The number of sawmills per county was used as evidence of industry clustering. Examined clustering factors included access to labor pool, cost of logs, linkage with supply chain industries, transportation infrastructure, energy cost, complementarity with industries using similar inputs, and land value. A statistical model was developed to explore how the number of sawmills per county would change as a result of changes in aforementioned clustering factors. Findings suggest that the primary clustering factors are:

### **Infrastructure Facilitating Low Transportation**

**Costs:** Transportation is an important cost element in all wood procurement systems in the forest industry. The model suggests that a county with access to an adequate transportation infrastructure is more likely to attract a new mill. The probability of attracting an additional mill is 38% higher for counties with access to such infrastructure than counties without such access. Infrastructure is one of the most critical clustering factors in the primary wood products industry.

### **Complementarity with Other Industries Using**

**Similar Production Inputs:** The model looked at the geographic concentration of sawmills and other mills including pulp mills, composite manufacturing facilities, post pole, plywood, and veneer mills. Results showed a strong relationship in the coincidence of all mentioned wood-using mills. All these manufacturers share similar inputs, related technology, and human resources. Counties that already have a core of established wood manufacturers can benefit from the presence of other related firms. The model suggests that counties with an already established industry can be 26% more successful in attracting other sawmills.

**Energy Costs:** Increases in electricity prices will have a negative effect on the ability of counties to develop forest business clusters. A one cent increase in the cost of electricity per kilowatt hour would reduce the probability of an additional sawmill locating in that county by 22%. States and counties with lower electricity costs will be the most likely to host a forest business cluster.

**Cost of Logs:** Logs are relatively immobile input factors and their cost must be analyzed when examining viability of forest business cluster. The model suggests that price increase would significantly impact the ability of a county to attract a

cluster of sawmills. A \$1 increase in the average price per ton of logs would reduce the probability of an additional sawmill in a county by 4%.

### **Other Factors Include:**

**Land Values:** Areas with high land costs are less likely to host a cluster of firms. Wood manufacturers require land for the manufacturing process and storage of logs and manufactured products. However, compared to other factors, land value is not as important. A \$1,000 increase in land value would decrease a county's probability of attracting an additional mill by 0.6%.

**Access to Labor Pool:** The development of a successful forest business cluster requires synchronizing location with existing knowledge on forest management, forest products manufacturing, sales, and marketing. Nevertheless, compared to other manufacturing inputs, such as logs, labor is mobile and is not as critical as fixed conditions such as availability of logs, infrastructure, and energy cost. If county labor availability increased by 1,000 people, the probability of attracting a sawmill would increase by less than 0.1%.

**Linkage with Supply-chain Industries:** Close integration can add value to wood products and reduce transportation and transaction costs along the supply chain. It also can lead to better utilization of wood and residues and improved quality of final products. The existence of a well-integrated supply chain allows for development of new value-added products and creates business opportunities such as the development of integrated biorefineries. Nevertheless, at the county level, this linkage is not as strong as other factors (the probability of attracting a sawmill would increase by less than 0.1%).

## Recommendations

A major finding of this project is the uniqueness of development strategies adopted by successful forest business clusters. The ultimate objective of a business cluster is to develop competitive advantages that make products manufactured by the cluster of special value to customers based on price, quality, service or other attributes. The business model adopted is dependent on the nature of the cluster, access to input materials, types of products manufactured, and proximity to markets. Certainly, there is no universal model that will fit all business structures and ensure their success. We determined that the clusters shared several common features that seemed essential to their success. Below, we summarize our recommendations related to forest business clusters.

### **Collaboration Helps Gain Competitive Advantages and Builds Business Resilience:**

- The forest sector has experienced significant changes over the last few decades, and changes can only be expected to continue. A forest business cluster can better adapt to such changes and create opportunities

<sup>1</sup> Wood using mills included sawmills, pulp mills, composite manufacturing facilities, post pole, plywood, veneer and others.

<sup>2</sup> Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

to overcome possible future challenges. Close collaboration between members allows for better understanding of processes, cost structures, and opportunities for efficiency improvements.

- One of the main objectives of business clusters is the creation of competitive advantages. Competitive advantage is not static, but rather it has to change continuously to adapt to evolving consumers' preferences, technologies, and prices. The close collaboration between firms can provide resiliency needed to address adverse market conditions and allow for adopting value added technologies. Competitiveness can be enhanced in a cluster by purchase of inputs from other members at lower costs, increased ability to improve processes and products due to closer cooperation and innovation.
- Coordination among cluster members is fundamental to success. Raw materials must flow from forest to factory in a reliable manner. Close working relationships between logging contractors, wood manufacturers, and supply-chain companies should be exercised. Industry sub-sectors must be linked to strengthen competitiveness of all cluster members to ensure supply and quality of raw materials. Closer business collaboration also can facilitate development of viable markets for wood residues. Collaboration should be complemented with strong local support from the private and public sectors. Coordination of business interactions must work to ensure quality control and provision of products that meet customer expectations. Full circle (self-sustaining) clusters are not as dependent on raw materials and include numerous supporting businesses and organizations. Clusters relying solely on private ownership or partnership of private and public businesses and institutions were successful. However, a third party leader institution was crucial to the successful development of many clusters.
- Forest business clusters should build upon existing communication networks to outreach to potential cluster participants and customers. Building public awareness about the role of the forest industry in local, regional and national economies can be fundamental to promoting locally manufactured products.

#### **Industry, Private and Public Sectors Stakeholders are Important for Successful Forest Business Clusters:**

- Stakeholders need to be aware that economic development based on only one business cluster is vulnerable to changing economic conditions and consumer preferences. Any negative changes may have an adverse impact on the cluster and economic development in the region. Whenever possible, efforts should focus on identifying and

supporting more than one viable cluster. Full circle clusters offering diversified products and services increase customer base and may help to ease negative economic impacts.

- Key stakeholders must be committed long-term to the cluster. Although leadership styles differ among clusters, it is necessary to have individuals who are committed to the success of the cluster. Commitment to the cluster among business community members and economic developers is fundamental. Cluster building must use the competitive advantages existent in a region (natural resources, technical know-how, transportation systems, etc.). Some regions are endowed with plentiful amounts of softwoods or hardwoods, enjoy a rich network of roads, have a long history of managing and using their forest resources, or possess a unique cultural background expressed through wood products manufactured locally. To be successful, a cluster has to build on the foundation provided by the natural advantages present in a region.
- Individuals, businesses and agencies outside the cluster, particularly those in the public sector, are also important in providing adequate support. A combination of private and public efforts to develop a unified strategy for promoting North American forest products can be an interesting model to follow. North American manufacturers and related forest-based communities face price pressures and competition from wood product companies around the world. A national strategy that facilitates the development of competitive advantages in forest business clusters could be used as a strategy to promote efficiency in the sector and improve economic well-being of rural communities.
- The public sector, at the federal, state and local levels, can also facilitate the development of clusters by investing in human resources. Funding for workforce training and development helps promote efficiency in the forest sector. Lack of adequately trained labor can halt the development of clusters.

#### **External Support and Funding are Needed to Facilitate Cluster Development:**

- Cluster building benefits from a comprehensive economic development strategy supported by government. Business can benefit from easy to access funding opportunities, continuous training, research, and the development of adequate infrastructure facilitating transportation of inputs and final products.
- Successful business clusters enjoy the ability to access information, technology, and external

funding. Capital investments and technology from outside a cluster must be encouraged. They can come from other counties, states, regions or even countries. Access to information and funding for the continuous upgrading of technology and know-how is fundamental to maintain competitive advantage.

- Public and private investment in research and development of new technologies and products and acquisition of equipment is another factor fundamental to successful clustering. Sufficient lines of credit to support training, upgrade equipment, and process improvement and development will be necessary to allow clusters to create competitive advantages.
- Colleges, universities, and public agencies are important in developing clusters. Training in forest management, logging, manufacturing, add-value processes, business management, and transportation can contribute to the improved efficiency of the wood products supply chain. Collaboration between educational institutions and the private and public sectors can facilitate provision of necessary and continuous training.

#### **Integration and Diversification are Important for Improved Competitiveness:**

- Opportunities for clusters include embracing renewable energy production as part of the business cluster. An existing cluster of forest firms can utilize residues to generate energy for local consumption and export. Pulp and paper plants can consider the adoption of a biorefinery model to maximize the use of wood materials for the production of wood products, chemicals, and energy. As federal and state governments prioritize locally produced renewable energy, companies that

are closely integrated could have better access to programs promoting renewable energy production and be poised to diversify their processes and outputs to add an energy component.

### **Online Registry of Forest Business Clusters**

An online registry of existing forest sector clusters in the U.S. is available at [www.fwrc.msstate.edu/cluster/cluster\\_search.asp](http://www.fwrc.msstate.edu/cluster/cluster_search.asp). The registry provides information about each cluster including location, contact information, geographic area served, legal status, size (number of firms and employees), duration, and specific strategies the cluster uses to meet its objectives. The registry is not intended to represent all forest sector clusters in the U.S. Instead, it is the “first step” in a process to begin to categorize clusters nationwide and create a structure for monitoring clustering activities in the U.S. forest sector. Visitors to the website can submit information about additional clusters for listing in the online registry. A more detailed description of the online cluster registry is included in Appendix C.

### **Literature Review on Business Clustering Within the U.S. Forest Sector**

An online database of over 100 scientific papers, assessment and industry reports is available at [www.fwrc.msstate.edu/cluster/bibliography.asp](http://www.fwrc.msstate.edu/cluster/bibliography.asp). Each reviewed document is briefly summarized with respect to its key findings. Visitors to the website can view the entire list of document summaries or search the database by keywords and pre-defined terms. Examined papers and reports relate to the U.S. forest industry, adopted business cluster models, benefits and challenges associated with business clustering, and identify forest business clusters within the U.S. forest sector. A more detailed description of the online database is included in Appendix D.

## **References**

- Barkley D.L., Henry, M.S. 2001. Advantages and disadvantages of targeting industry clusters. Regional Economic Development Research Laboratory, Department of Applied Economics and Statistics, Clemson University. Research Report 09-2001-01. Available at [http://cherokee.agecon.clemson.edu/redrl\\_rpt3.pdf](http://cherokee.agecon.clemson.edu/redrl_rpt3.pdf).
- Barkley, D.L., Henry M.S. 2005. Targeting industry clusters for regional economic development: An overview of the REDRL approach. Regional Economic Development Research Laboratory, Department of Applied Economics and Statistics, Clemson University. Report 01-2005-03. Available at [http://cherokee.agecon.clemson.edu/redrl\\_rpt15.pdf](http://cherokee.agecon.clemson.edu/redrl_rpt15.pdf).
- Braden, R., Fossum, H., Eastin I., Dirks, J., Lowell, E. 1998. The role of manufacturing clusters in the Pacific Northwest forest products industry. CINTRAFOR, College of Forest Resources, University of Washington. Report WP-66.
- Gibbs, R.M., Bernat, G.A. 1998. Rural industry clusters raise local earnings. Rural Development Perspectives 12(3): 18-25. Available at [www.ers.usda.gov/Publications/RDP/RDP697/RDP697d.pdf](http://www.ers.usda.gov/Publications/RDP/RDP697/RDP697d.pdf).
- Hovee, E.D., Logue A. 2005. Oregon forest cluster analysis. E.D. Hovee & Company, LLC. Report prepared for the Oregon Forest Resources Institute. Available at [http://www.oregonforests.org/media/pdf/ForestCluster\\_FINAL.pdf](http://www.oregonforests.org/media/pdf/ForestCluster_FINAL.pdf).



- Ketels, C.H.M. 2003. The development of the cluster concept – present experiences and further developments. Harvard Business School. Paper prepared for NRW conference on clusters, December 5, 2003. Duisburg, Germany. Available at [http://www.isc.hbs.edu/pdf/Frontiers\\_of\\_Cluster\\_Research\\_2003.11.23.pdf](http://www.isc.hbs.edu/pdf/Frontiers_of_Cluster_Research_2003.11.23.pdf).
- Porter, M.E. 1998. Clusters and the new economics of competition. *Harvard Business Review* 76 (6): 77-90.
- Porter, M.E. 2000. Location, competition, and economic development: Local clusters in a global economy. *Economic Development Quarterly* 14(1): 15-34.
- Porter, M.E., Ketels C.H.M, Miller, K., Bryden, R.T. 2004. Competitiveness in rural U.S. regions: Learning and research agenda. Institute for Strategy and Competitiveness, Harvard Business School. Available at [http://www.nyecon.cornell.edu/downloads/research/Competitiveness\\_Rural\\_US.pdf](http://www.nyecon.cornell.edu/downloads/research/Competitiveness_Rural_US.pdf).