Opportunities for an Online GIS-Based Wood Supply Management System

Brandon Todd Martin

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Master of Science
Forestry

Steve Prisley
Earl Kline
Chad Bolding

February 13, 2009
Blacksburg, Virginia

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ABSTRACT

The forest industry has become more complex due in part to increasing global competition. The highly fragmented nature of the forest industry supply chain and lack of interaction between industry segments can cause major supply/demand inequalities. This fragmented nature can lead to unnecessary lead time and costly inefficiencies for business transactions. The objective of this research project is to develop the concept of using an Internet-based, Geographic Information System (GIS)-supported, optimized wood supply chain management system to overcome some of the current inefficiency problems. Currently many different forms of relevant supply chain management information can be found on the World Wide Web. Through review of Internet-related material, this project identified three classes of existing web resources relevant to the development of a forest industry supply chain management system: resource, market, and e-commerce sites. Internet information provides many of the basic data attributes needed in a supply chain management system. This project demonstrated that linking this data with geographic/spatial location (georeferencing) could add an extra dimension in the planning and decision making processes and will be a key development to push the boundaries of supply chain optimization. Within the forest industry, georeferencing of supply chain business entities can easily be done with GIS. Using GIS, members of the forest industry supply chain can be visually and spatially allocated to form a grand forest industry supply chain overview and specific business opportunities using this geo-referenced data platform can be developed. Although the technology exists to produce a high quality Internet-based supply chain network system, there are challenges in producing a system that is truly integrated among all industry partners. Technology obstacles, anti-trust regulation, reluctance to use the online platforms, and inaccurate information input and dispersal are some of the major issues facing a supply chain management tool that are discussed in this report. To demonstrate how a GIS-based supply chain management system could be implemented, three case studies have been presented to show how the proposed system would benefit the current industry in

realistic situations. These include (1) a simple location-based search of consulting foresters, (2) a trucking logistic optimization, and (3) a quantitative resource assessment within a manufacturing facility procurement area. Case 1 demonstrates how geocoded landowner and consulting forester information can add efficiency in communication and services provided. Case 2 demonstrates that GIS paired with geocoded information gives a logger increased decision-making power by choosing the most profitable option in a choice between sawmills that includes transportation costs. Lastly, case 3 shows that by analyzing geocoded resource information, a manufacturer can make the proper decision of whether to expand or contract operations. In each case, added value was given to market players that were able to have analysis power through geocoded information. This information is not readily used at the present time and could potentially add value along many steps of the forest industry supply chain.

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1.0 Introduction

Traditionally, the availability, quality, and sustainability of U.S. forest resources have been major drivers behind the nation's wealth. The value added by U.S. forest industries was $300 billion in 2005 (U.S Department of Commerce 2006). However, to produce added value within the current forest industry supply chain, many non-value added efforts are required. Kline and Cumbo (2005) suggested that the forest industry supply chain is fragmented as depicted in Figure 1.1. The total lead time needed from the forest to marketable consumer goods can be many months. Cumbo et al. (2006) noted that the average forest products facility requires at least 22 business days of lead time to produce a product.
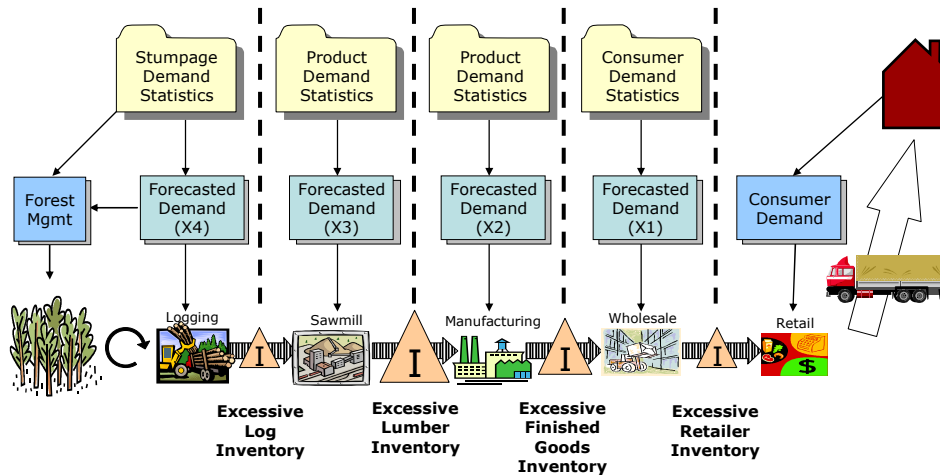
Figure 1.1: Current state of the extended forest to consumer value stream
(Kline and Cumbo 2005)

As shown in Figure 1.1, each step along the supply chain takes current demand information (folders) and generates some forecasting estimate (boxes) with some inventory and or safety factor applied to address the variability of demand. Inventory

refers to the stock of goods that a particular segment of the supply chain maintains at a given time. A safety factor is generally a percentage above the anticipated demand to account for actual demand fluctuations and supply uncertainties. It is this safety factor, along with fragmentation among forest industry segments that leads to overproduction and translates to excessive inventories at each stage in the supply chain.

In the fragmented supply chain shown in Figure 1.1, a lack of interaction (represented by dashed lines placed between each industry segment) is the result of many years of standardized or "commodity" products. This fragmentation causes additional time, effort, and money to be tied up in excessive inventories and stockpiles. Research has identified that companies desire more information about their customers, vendors, and consumer market trends to help them customize or distinguish their products and services (Bumgardner et al. 2004, Vlosky and Smith 2003). However, under the current system of trade where the major information emphasis between industry segments is treated as proprietary and mainly driven by the lowest price, it is difficult to collect and transmit information about true customer needs and translate this information effectively into production.

Advanced web-based computing and computer visualization tools such as Geographic Information Systems (GIS), Global Data Synchronization (GDS), databases, and inventory tracking and control systems have been emerging and some are being adapted for forest industry applications. The capabilities and increasingly easy-to-use interfaces could potentially address the information needs of the forest industries and lead to innovations that can bridge the information gaps between the various industry segments from the forest to the final consumer. A competitive and

vibrant marketplace allows for the best economic conditions and is essential to a healthy forest economy. Using technology to ensure that a fair and competitive marketplace within the forest industry persists is the main goal of this project. The following study objective and methodology were used to form a foundation for what types of forest industry information commonly exist on the Internet and how georeferenced information about forest industry players can provide analysis capabilities that have not been used to their full potential.

2.0 Study Objective and Methodology:

The objective of this paper was to develop the concept of using a GIS-supported, optimized wood supply chain management system. The following methodology was used to analyze the components of such a system:

1. Review of literature pertaining to supply chain management and optimization to answer the questions:

   - What is supply chain management?

   - How has supply chain management been used in forestry?

   - What are the opportunities for improved supply chain management in forestry?

2. Review of existing information as it pertains to current web-interface/GIS programs that may be useful in the development of a prototype:

   - Diagram the woods-to-goods supply chain to depict where current programs operate

   - Describe and summarize programs of interest

   - Identify parameters determining the information that is made available by such programs

3. Review of Anti-Trust regulation:

   - Define anti-trust law

   - Determine how anti-trust law effects the forest industry

   - Identify implications of anti-trust law on GIS management system development

4. Development of an optimum "woods to goods" GIS-online platform:

- Define the potential scope of the prototype platform

- Identify key players (possible participants in a wood supply system)

- Determine prototype parameters as dictated by player involvement

5. Develop case studies:

- Find and georeference real life forest industry supply chain data for case study demonstration

- Demonstrate the usefulness of GIS and geocoded information in forest industry supply chain management

3.0 Background:

The forest industry supply chain is composed of a multitude of market players from the forest landowner to the final consumer of wood products. The fragmented nature of the forest industry supply chain leads to unnecessary lead times and costly inefficiencies for business transactions (Cumbo et al. 2006). A significant amount of non-value-added time, money and human effort are required to overcome long lead times justified by the current wood products supply chain (Kline 2006). Non-value-added simply means any process that does not lead to adding value as defined by customer needs.

Due to new economic challenges and recent trends regarding international trade and globalization, many forest products companies have reached a point where profits cannot be improved without the involvement of their entire organization, which includes distributed facilities and offices spread around the world as well as their customers (Frayret et al 2005). Frayret et al. (2005) indicated that "companies are now facing the need to re-engineer their organizational processes and business practices with their partners and adopt new technologies to support the planning and control of their manufacturing and logistic activities in a customer-centered environment."

Common problems currently facing the forest industry supply chain include long lead times, inventory production contrary to demand production, and a focus towards the current product instead of the final product required by the consumer. These problems cause inefficiencies which lead to lost production, thus leading to decreased yield and profits. Kuglin (1998) states that "a company's performance within the supply chain as a whole will be only as good as its slowest-moving, least effective task, activity, function, or company". With this in mind, companies are carefully managing their supply

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chains to replace poor performers and upgrade performance. Many industries have already started operating under a "virtual" corporation; which is the process by which many entities join forces through the supply chain to produce a common product or service (Kuglin 1998). Poirier and Reiter (1996) state that "constituents in a virtual supply chain share resources and benefits, absent in competing networks, relationships are established and an advantage is created in particular industries and markets." Virtual corporations can operate within many markets and have shorter production schedules, while accommodating consumers with high quality expectations. To be successful a company must provide a product or service quickly, at low cost, and with high quality. Internet technology can help a company achieve the high demands of consumers while remaining competitive in a global marketplace. Poirier and Reiter (1996) claim that "the e-supply chain linked with virtual corporations can create the necessary links among data, communications, and network effectiveness." The e-supply chain uses the Internet as a tool to streamline business processes by providing a common communication medium that is instantaneous and provides information in real time (Poirier and Reiter 1996).

This project considers an online GIS linked with real-time forest business information for application within the forest industry. The goal of this system is to improve the efficiency of the wood supply system by capturing the benefits of new and innovative technologies.

3.1 Defining a Supply Chain

A supply chain is defined as an "integrated process wherein a number of various business entities (i.e. suppliers, manufacturers, distributors, retailers) work together in an effort to (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to retailers" (Beamon 1998). This definition can be interpreted to describe the typical forest industry supply chain, from the forest (raw material) to the final consumer (finished wood product). The participants in a typical forest industry supply chain include landowners, loggers, sawmills, manufacturers, and retailers. The value added by the manufacturing of forest products to the U.S. economy is over $300 billion annually (United States Department of Commerce 2006). In order for the forest industry supply chain to work efficiently and effectively (at its optimum level) it must be managed appropriately.

3.2 Defining Supply Chain Management

For many years the philosophy behind successful companies has been the concept of mass production, whereby a company produces as many units as quickly and cheaply as possible. In such a system, "the company is built around the plant and all internal transactions that make up the order-to-cash cycle- [order entry, purchasing, transportation, and distribution] all revolve around the manufacturing function" (Kuglin 1998). In such a system, manufacturers are the dominant force, pushing products through a supply chain where there may not be an immediate need for products produced. The market for timber products has changed from a sellers' market (push system) into a buyers' market (pull system). Gunter et al. (2006) states that "it is not possible anymore to produce timber for an anonymous market". Timber production has

to take market requirements into account (Heinimann 2000). Companies have to be able to react quickly and flexibly to customer's demands. In response to these changes and needs, supply networks and supply chain management systems (SCMS) have been introduced in forestry and many other industries (Heinimann 1999).

Within the last twenty years the term 'supply chain management' (SCM) has been established. During this time, SCM has been used to combat some of the problems associated with mass production philosophy. SCM can be defined as: "The manufacturer and its suppliers, vendors, and customers- that is, all links in the extended enterprise- working together to provide a common product and service to the marketplace that the customer is willing to pay for. This multi-company group, functioning as one extended enterprise, makes optimum use of shared resources (people, processes, technology, and performance measurements) to achieve operating synergy. The result is a product and service that are high-quality, low cost, and delivered quickly to the marketplace" (Kuglin 1998). Schonsleben (2004) defines supply chain management as coordination of strategic and long-term cooperation in logistics networks.

In order to better monitor and manage the flow of goods and information, and to work towards efficient use of enterprise resources in the supply network, managers have started to introduce supply chain management systems (SCMS) (Davenport and Brooks 2004). Schonsleben (2004) notes that "SCMS– just like logistic software in general – portrays products, actors, and processes of orders, and supports administration activities and accounting". Shared databases are integral parts of SCMS as they provide network members with detailed and timely information (Symon 2000).

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3.3 Supply Chain Management within the Forest Industry

In a study done by The Wood Supply Research Institute and Virginia Tech titled 'Planning and Communication: State of the Forest Industry and Opportunities for Improvement in the Wood Supply Chain', three major findings were presented (Rodgers et al. 2002): (1) suppliers, and consumers to a lesser degree, are currently operating with an excessively short planning horizon; (2) improvements in planning and communications can result in substantial gains in efficiency and reduced costs in the wood supply process; and (3) these gains will not likely occur without an increased level of cooperation between all parties involved in the wood supply planning process. Since that report, little in the way of improvements has been documented within the forest industry supply chain. Rauch (2005) noted that within the forest-based industries only a few experiences with process management are evident (Skutin 1996, Rauch 2003). Several authors recognize process management or business process re-engineering as a promising method for forestry and the forest industry (Warkotsch and Ziesak 1998, Heinimann 2000) or apply a process management approach to a single business (Erni et al. 2002, Oswald et al. 2004, Rauch 2005).

Rauch (2005) used a four-step business process re-engineering approach in the context of the timber supply chain. The process involved (1) identify the process to be re-engineered, (2) map (model) the processes, (3) measure performance, and (4) improve the process using a project approach (Barber et al. 2003). This approach is a basis for re-engineering facilitates finding possibilities for process automation, redundancies and process locks and loops (McKay and Radnor 1998).

In a case study performed by Gunter et al. (2006) the company LENCA AG, a logistics coordinator in forestry, was hired to perform supply chain management operations from forest landowner to sawmill. "The core of this SCMS is a database, which processes and stores order information, stock information, technical information about processes and products, and financial information" (Gunter et al. 2006). It was found that after implementing a SCMS: (1) agreements on objectives between management and subcontractors are well defined and subcontractors supported these agreements more often, and (2) subcontractors seemed to recognize available alternatives more often. Within the context of this paper, subcontractors are responsible for coordinating the processes of all other network members including: transportation contractors, forest owners, and customers from the paper, timber, and sawmill industry.

Daxner (2002) reported on a project to promote information interchange in mechanized timber harvesting systems by implementing GEOMAIL. GEOMAIL is a software tool to enhance data flow in timber production. It is based on a GIS and therefore it allows information relevant for forest logistics to be displayed on a basic map. This study found that GEOMAIL is designed strictly as an information management system and does not include any optimization or control structures that would lend it to optimizing the forest products supply chain (Daxner 2002).

3.4 Supply Chain Management: Implementation and Opportunities

Coordination and cooperation are necessary for a supply chain management system to be successful. Social factors determine the degree to which interorganizational information systems – like SCMS – are used (Andriessen 2003). Factors within the company may dictate whether or not supply chain management

systems are accepted and thus used by members of a supply chain management program. As documented by Clegg and Walsh (2004), users are empowered to get involved in the decision-making processes related to the change initiative. If users become a part of the change process, acceptance of change will increase. The forest industry supply chain is a non-hierarchical structure, meaning that there is no formal authority that leads a change process. In a non-hierarchical structure, technology becomes a key ingredient to stimulate change among industry participants. Technology replaces the hierarchy present in many other industries and leads to more collaborative planning among industry and organizational participants. Gunter et al. (2006) suggests that "collaborative planning consists of two sub-processes, creating and executing plans". Gunter et al. (2006) also lists key points that have been identified as crucial to the collaborative planning process which leads to successful supply chain management: Creation:

1) It is important to know about the planning environment of other companies that are part of the supply network.

2) It is necessary not only to communicate information that is highly reliable but also information that is not yet finally confirmed. This makes it possible to predict likely disturbances in the production process of the supply network more accurately and to initiate counteractive measures earlier.

3) Laterally agree on common goals.

4) Plan alternatives in case the master plan fails.

5) Planners have to examine their common plan to see how much of the individuals' possibilities to handle disturbances locally are restricted by the common plan.

Execution:

1) It is necessary to monitor planned actions to diagnose errors in the common

    planning.

2) If errors are diagnosed, it is necessary to revise and possibly replace plans.

3) In collaborative planning processes actors must communicate modifications in their

    planning to make sure everyone in the network has the same information.

4) Measurement of performance to know if targets have been reached.

Gunter et al. (2006) states that "to decrease costs and lead time as well as to increase quality and flexibility in the supply network, it is imperative to improve coordination of the flow of goods and information across intra- and inter-organizational boundaries." The quality of coordination processes in supply networks highly depends on the visibility and transparency of all information needed. In their study of the methods of Business Process Re-engineering, Vakola and Rezugi (2000) state: "It is even more important to understand existing processes before designing new ones." Process analysis can be seen as the possibility to gain knowledge about intra- and inter- organizational processes (Gunter et al. 2006). Full and complete information flow is a critical component of a functional supply chain management system.

In order for SCMS to be successful, supply chain management technology must be accepted by the users of the system (in the context of this project- the forest products supply chain). A major opportunity within the forest industry supply chain is the creation of a user-friendly supply chain management tool that will not only allow users to better manage information as with GEOMAIL, but also the capability to

optimize the supply chain by allowing users to make more informed decisions in

transactions and communications, inherently improving efficiency and ultimately profit.

4.0 Review of Web Information:

After a review of relevant websites and the information that they provide to users, it is clear that many of the associated data attributes that should be included with an online GIS integrated supply chain management system are already posted on the web in some form. Implementing industry data with GIS technology through an easily accessible platform could bring a spatial context that is not used within the forest industry supply chain at this time.

The forest industry uses a variety of programs and systems for managing information. These programs and systems vary in format, usability, and content but stretch from the forest to the final consumer in the forest industry supply chain. Three classes of programs were defined to present websites and their data by like characteristics. The following groupings best represent the websites that were analyzed:

1. Resource Sites- State and federal natural resource agencies have publicly available mapping tools and informational pages. Many of these sites pertain directly to resources such as timber, water, roads, and infrastructure.

2. Market Sites- These sites are devoted to relaying accurate information on market supply and demand. These systems provide some information free of charge but may have a fee to access to all the services provided by these companies.

3. E-Commerce Sites- These websites provide services that make trading platforms for timber, lumber and a variety of other forest products. These sites facilitate the buying, selling, and trading of wood products around the world. Many e-

commerce related sites require membership to enjoy most of the benefits and

services offered by these companies

The above classifications broadly define the types of information easily available via the

Internet from a forest industry stakeholder perspective. This information allows the

forest industry supply chain to make essential contacts, business transactions, and

basic daily business operations successfully (Kuglin 1998). Table 4.1 lists information

needs categorized by members of the forest and wood products industry (Martin et. al

2007). The information in this table is based on what forest industry participants

conveyed as being important to everyday business transactions.

Table 4.1: Informational needs defined by forest industry stakeholder

Information Needs	Land-owners	Forestry Consultants	Wood Dealers	Loggers	Mills	Manufacturers	Whole-salers & Retailers
Forest management advice	x						
Stumpage Prices	x	x	x	x	x		
Logger availability	x	x	x		x		
Identification of landowners with timber		x	x	x	x		
Bare land values	x	x	x	x			
Quantity of timber in potential sale areas	x	x	x	x	x		
Site conditions of potential sale areas	x	x	x	x			
Roundwood demand	x	x	x	x			
Prices for delivered roundwood	x	x	x	x	x	x	
Roundwood product specifications	x	x	x	x	x	x	
Demand projections for various products	x	x	x	x	x	x	x
Time needed for wood harvesting/delivery	x	x	x	x	x	x	x
Trends in wood consumption	x	x	x	x	x	x	x
Preferences of final consumers						x	x
Cost of other raw materials		x	x	x	x	x	x

The business information needs in Table 4.1 have conventionally been met through traditional business practices of contact networks and business partners. This business practice can be time-consuming and costly and does not generally work as the most efficient means for maximizing company profit. Furthermore, when the industry is fragmented, information can be delayed or simply be wrong due to artificial supply and demand variations. The Internet is allowing new networking opportunities to be developed through easily-accessible information. This information drives the business of forest industry and facilitates the buying and selling of wood products around the world. Web capabilities have the potential to link members of the supply chain to establish more efficient wood supply chain networks. With the help of readily-available updated information on the Internet, a more informed, well-educated supply chain network is developing that is operating more efficiently and effectively. Figure 4.1

depicts a forest industry supply chain characteristic of the southeastern U.S. (Martin et. al 2007). It illustrates the information that individuals desire at each segment (boxes), provide to the system (arrows), and the relevant websites that offer assistance (grey ovals). Boxes represent information wanted by stakeholders and ovals indicate current websites that offer some of this information.

State Department
of Forestry (e.g. VDOF)

Procurement Forester

Wood Dealer

Management expertise and regulation of forestry practices

VDOF IFRIS and ForestRIM systems

Management Plan, Species %, Volume, value, maps

CFM or FMAP

Timber pricing, Logging rates, Product specs, Forest markets $

Forest2Market Timber Mart South

Supply, Demand, Advertising, On-line auction, Directory, sourcing

Landowner

Harvesting services, quality, business practices

Logger

Sawmill

Lumber Yard

State forestry Personnel & Databases VDOF

TIMBERWeb Global Wood

Forest2Market Timber Mart South

Advice and management expertise and Value of resources ($)

Consultant Foresters

Supply, Demand, Advertising, On-line auction, Directory, sourcing

Sales, Advertising, Shipping, Distributors, Products

Sales, Service, Products

Lumber Yard

Manufacturer

Wholesaler

Customer

E-commerce Global Wood TIMBERWeb

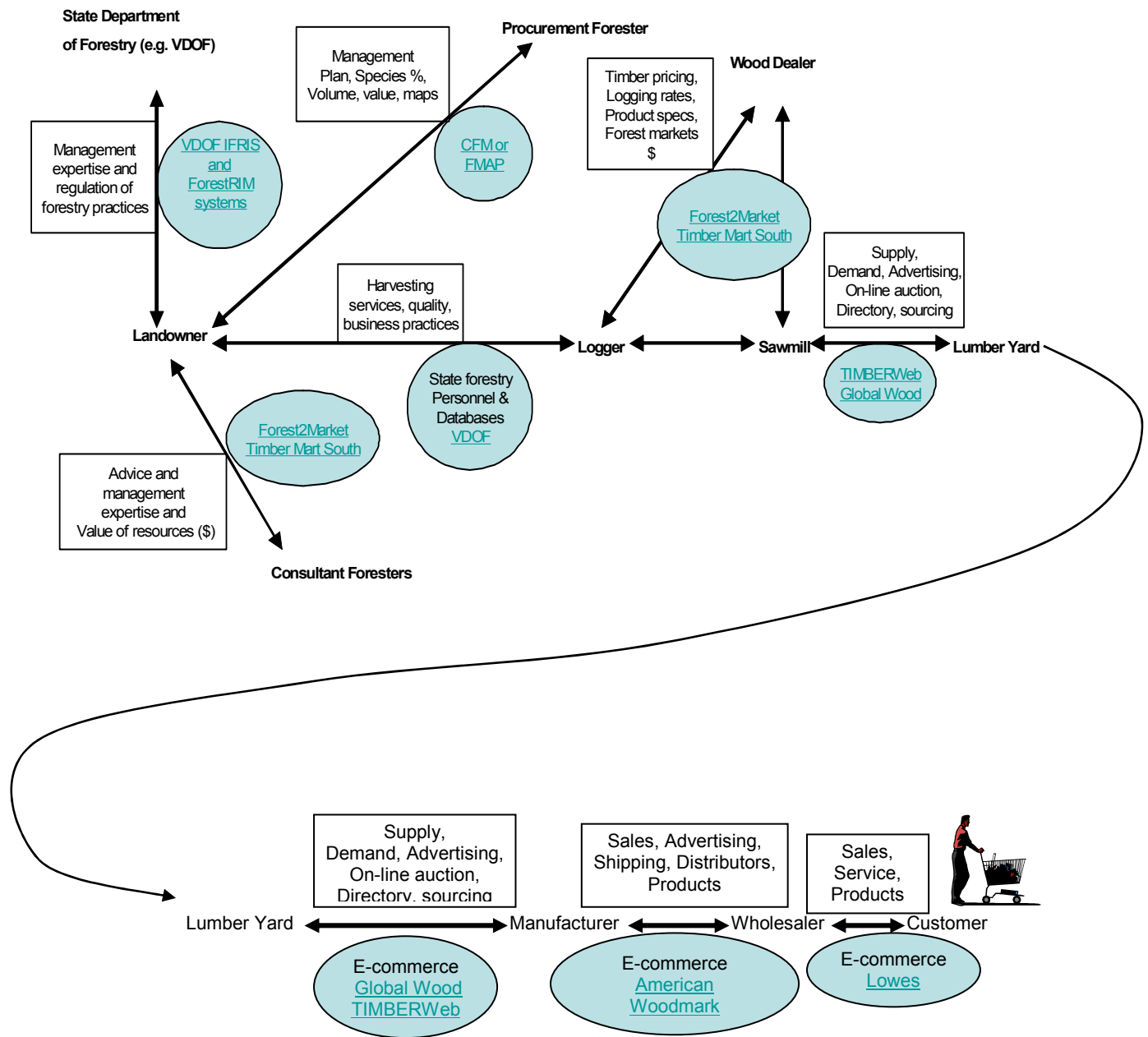E-commerce American Woodmark

E-commerce Lowes

Figure 4.1: Forest-to-consumer supply chain with required information by stakeholder.

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The following websites were reviewed to identify the types of information relative to wood supply chains that are available on the web. Two websites were chosen in each category to represent the types of information available.

Resource Sites Analyzed:

- Virginia Department of Forestry: (www.dof.virginia.gov)

- United States Forest Service: (www.fs.fed.us)

Market Sites Analyzed:

- Timber Mart-South: (www.tmart-south.com)

- Forest2Market: (www.forest2market.com)

E-Commerce Sites Analyzed:

- Global Wood: (www.globalwood.org)

- TIMBERWeb: (www.timberweb.com)

4.1 Virginia Department of Forestry

The Virginia Department of Forestry (VDOF) provides a wealth of information through their websites. The department is responsible for the protection and management of some 15.8 million acres of forestland in the state of Virginia and assists some 300,000 non-industrial private forest landowners that control 77 percent of the state's land. The VDOF's website (www.dof.virginia.gov) provides information about forestry in Virginia as well as all other state forestry websites for the entire United States. In addition, links are available to access both federal and state partner agencies of the VDOF such as the Natural Resource Conservation Service (NRCS) and the Virginia Department of Environmental Quality (VDEQ). The department provides public access to an online mapping interface called Forest Resource Information Mapper

(ForestRIM; www.forestrim.org). This program allows users to view digital map layers for Virginia and construct simple maps. Data layers include: aerial photography, infrastructure, hydrology, topographic maps, digital elevation models and others. This information allows non-industrial private forest landowners as well as small consulting and logging firms to use mapping technologies to plan management applications. A wealth of literature pertaining to forest management is readily available for landowners who are interested in learning more about management options for their landholdings. Information on financial assistance and incentive programs is available for landowners to view and online applications are available for some programs. Business and bid information on both private and public timber sales is posted as it is received by VDOF. Timberland tax information as well as links to help landowners with tax planning and filing are also readily accessible. Contact information for professional private consulting foresters is available as well as the contact information for local county foresters. State forestry agency websites are a good place to look first for contact information and basic forestry information for a given state.

Integrated Forest Resource Information System:

The Integrated Forest Resource Information System (IFRIS) is an Internet based communication system that tracks field accomplishments and management plans from Virginia Department of Forestry foresters and field technicians. The basic spatial reporting unit is a forest stand, which has both stand conditions and management activities attached. Management activities are reported and details such as trees per acre/ planting density or total acreage involved are also recorded. Field personnel can describe the basic stand conditions with criteria such as species composition or

stocking levels. Foresters and VDOF personnel do not conduct timber appraisals, thus details such as basal area or volume estimates can not be maintained by the IFRIS system.

On-screen digitizing through an employee-only web interface is the way that field foresters create stand maps with the IFRIS. The data are written directly to a geodatabase on the VDOF server and there is no need to synchronize the data since it is a direct link to the server (Scrivani pers. com. 2007).

Holistically the IFRIS system is made up of a multitude of technological pieces that interact collectively to produce the integrated product of IFRIS. Each component gives IFRIS a new dimension and increases functionality. The IFRIS system in many ways parallels the idea of an online GIS-based wood supply chain management system.

4.2 United States Forest Service

The United States Forest Service is a federal agency housed in the United States Department of Agriculture. The mission of the Forest Service is to "sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations". The U.S. Forest Service maintains a diverse website (www.fs.fed.us) that allows the many different users of national forests and grasslands the ability to obtain relevant information on lands administered by the USFS. The 193 million acres that make up the National Forest and Grassland landbase are managed for recreation, wildlife, water quality, grazing, minerals, and timber resources. The agency manages all of its resources with a multiple use-sustained yield philosophy. Volumes of research documents are available to answer almost any forestry or natural resource issue and financial and technical assistance is granted to state and private

forestry agencies. The website also offers information on current forestry issues such as disease or insect outbreaks as well as economic conditions within the forest industry.

4.3 Timber Mart-South

Timber Mart-South, produced by the Center of Forest Business, Daniel B. Warnell School of Forestry and Natural Resources, University of Georgia, is a quarterly market price survey and report of the major timber products markets in 11 Southern States. Timber Mart-South's website (www.tmart-south.com) allows viewers to see quarterly Southeastern average stumpage prices in $/ton. The site also allows viewers to see reports from Timber Mart-South's quarterly market archive. The Timber Mart-South quarterly report (which must be purchased through Timber Mart-South) gives a detailed look into current market conditions. The complete report includes logging and load rates, hardwood and softwood stumpage prices, whole tree and fuelwood prices and pine straw prices and markets.

Two basic surveys are used to gather the information that generates the price reports; the logging rate survey and timber price survey. Within the logging rate survey, a logging rate reporter form and instructions and definitions for the logging rate form are provided. The logging rate survey consists of the following data: state, county, date of logging rate, and occupation of the surveyor. Additionally, cut and load rates by physiographic province and by logging method are recorded including the high, low, and average ($/ton) for final harvest, plantation thin, natural thin, and swamp logging. Data on hauling rates ($/ton per mile) are also collected. A minimum haul distance in miles and associated rate ($/ton per mile) as well as the incremental rate above the minimum haul distance ($/ton per mile) are collected to give accurate estimates of hauling rates.

Low and high values of off-road and highway grade fuel are also collected and reported to show how fuel prices impact hauling rates.

In order to provide clarity and to avoid miscommunication between all reporting parties, definitions associated with the logging rate survey are provided by Timber Mart-South and can be found in Appendix A.

The second main survey that is conducted by Timber Mart-South is the Timber Price Survey. Within this survey, data within four areas of interest are reported: 1) Market Summary Reporter Form- Stumpage and Delivered prices, 2) Timber Sale Reporter Form, 3) Other Products Reporter Form and 4) Chip Price Reporter Form.

To provide consistency, the definitions listed in Appendix B are used within the Timber Price Survey.

The Market Summary Report collects price data and reports on the basic forest products from the Southern United States. Basic geographic data including the state and corresponding zone, and the date/quarter in which the prices are applicable is recorded. Products that are included within this section include pine sawtimber, pine ply logs, oak sawtimber, mixed hardwood sawtimber, pine poles, pine chip-n-saw, pine pulpwood, hardwood pulpwood, and "super-pulp" pine pulpwood. Stumpage and delivered prices for each of these products is recorded on a per-ton or cord basis and the respective log scale (Scribner, Doyle or International ¼") is given. An overall opinion of the market conditions (good, fair, or poor) is recorded and the low end as well as the high end of the price scale is given for both stumpage and delivered wood.

The Timber Sale Report reports data on sales of stumpage. Parameters for this report include the following: Timber Mart-South Region (1 or 2), state, county, date of

sale, type of sale, size of sale (acres), total volume, haul district (miles), length of cutting contract, total purchase price, number of bids, highest bid, lowest bid, type harvest (clearcut, partial clearcut, marked, salvage, other), grade of timber (above average, average, below average), market conditions at the time of sale (excellent, good, fair, poor), logging conditions (excellent, good, fair, poor), and other conditions of the sale that may have an impact on the sale. Furthermore, the products sold within the sale are given by a price per cord or ton metric and the log rule in which they were calculated (Scribner, Doyle, and International ¼"). Lastly, the type of sale in which the stumpage was sold is marked as auction, sealed bid, negotiated, or other. (Center for Forest Business 2006)

The third section of the Timber Price Survey is the Other Products, Price, and Scale reporting form. This form gives reporters a chance to give prices for specialty wood products such as: pine straw, hunting leases, or grade hardwood sawtimber. There is also a place where bare land values can be listed in a $/acre rate. This section of the survey serves as a catch-all, where reporters can list values and specifications for certain products that normally would otherwise not be reported or recognized.

The final section of the survey is a Chip Price reporting form. Within this form the location and date of the prices is given and a complete breakdown by chip type is given including: Freight on Board (FOB) sawmill pine, FOB sawmill hardwood, FOB chip mill pine, FOB chip mill hardwood, In-woods whole tree pine, In-woods whole tree hardwood, Fuel Chips pine, and Fuel Chips hardwood. Additional attributes including active market designation (yes/no), price/ton (high/low), specifications (screened,

unscreened, and other), export price (high/low), and a section for comments and definitions are available for comment.

Timber sale reports come from both buyers and sellers within the forest industry. Industry, consulting, and procurement foresters are most knowledgeable about current markets and local stumpage prices, which makes them a good choice for obtaining this data. Data obtained from Timber Mart-South surveys are combined based on the region in which the data was collected. Simple averages are computed for each region in the data procurement area and posted in the quarterly report (Center for Forest Business 2006).

4.4 Forest2Market

Forest2Market is a company that helps forest products companies and businesses meet their supply and demand of wood products more efficiently. Their website, (www.forest2market.com) is used primarily as a price reporting medium and portal where members of Forest2Market can access current timber prices. One can also find registered forestry service providers by location and an average south-wide timber index for pine pulpwood, pine chip-and-saw, pine sawtimber, hardwood pulpwood and hardwood sawtimber. Membership is segmented between landowners, small businesses, regional businesses, and south-wide businesses.

Forest2Market's role as a leading data provider to the forest industry is compatible with the information that is obtained and analyzed by the company. The main drivers of the Forest2Market system are its database management systems. Microsoft Excel, Statistical Analysis Software (SAS), and Microsoft Access databases are all used by the Forest2Market analysts. These systems hold and manage the

nearly 1.8 million mill transactions that Forest2Market collects every month in addition to the data collected from timber dealers and forest products plant managers (parameter inputs). Forest2Market collects tract-by-tract information for nearly 60-70% of all timber sold in the southeast United States. A fifteen-point market analysis is done for each tract and extensive time is spent corresponding with wood dealers, loggers, and forest industry personnel to obtain the data used within their analyses. Information that they collect within their stumpage database includes specifics such as: location (county), zip code, quality of timber (excellent, good, fair, poor), timber type, road access, loggability (months/year), percent of stream side management zones within the sale, hydrology information, miles of road building, acres, type of seller, type of buyer, consultant used (yes/no), type of sale, type of harvest, method of inventory, date of sale, rainfall prior to sale, weather conditions day of sale, total bid price, and species/specification/product breakdown. From this data market averages by DBH size, premium price lines, average price lines, and discount price lines can be produced to add detail to the market analysis (Twillmann pers. com. 2007).

Subsequently, Forest2Market's delivered price database adds data such as: delivered value ($), volume, products, logging rates, chip prices, bare land values ($/acre), alternative forest values ($/acre), hauling distances, and hauling rates. These data give Forest2Market the power to make accurate price and market reports for its clients. The level of data that Forest2Market is able to provide, in addition to its 3rd party position within the forest industry, adds transparency to a group of stakeholders that have traditionally operated under opaque conditions.

4.5 Global Wood

Globalwood.org (www.globalwood.org) is a business-to-business Internet-based marketplace for wood related products. The website provides a variety of information for the forest industry, such as current events in the lumber and wood products markets. This site also provides U.S. and Canadian timber prices, international log and sawnwood prices, international plywood and veneer prices, and New Zealand pine log prices. An online timber inquiry service is available to answer questions pertaining to the timber, furniture and wood products sectors. Global Wood also maintains a trade center in which businesses can offer to buy or sell, post their contact information, and post an offer for a particular resource. This service enables buyers and sellers to conduct efficient transactions, which results in lower material cost. A products page lists manufactured and non-manufactured wood products and their representative producers. Global Wood also maintains a multitude of useful links on a variety of subjects within the forest and wood products fields to help educate their customers.

Global Wood is devoted to serving the needs of the lumber and wood products industry. To serve this industry, ten different core information areas direct users and organize the material appropriately within the site. The following is a description of each section of the website.

- Industry News Section

The industry news section gives the latest updates within the industry on wood markets around the world. Breaking news stories, trade agreements, buyouts and any other major issues that impact the forest industry are listed within this section.

- Market Information

The market information section of Global Wood is split into two sections. The first section is the Market and Prices section; which gives a breakdown of the following products and corresponding prices: International log and sawnwood, International plywood and veneer, North American Lumber market, wood market prices in Japan, China, and Europe, and tropical timber product price trends. The second half of the Market Information section is the Research and Marketing section. Information such as market reports for cabinets, furniture, and dimension lumber are given. Current supply and demand as well as forecasted statistics for the vast majority of the wood industry is given. Also volume and value numbers are given for production segments of the industry.

- Showroom Link

The Showroom is a place where new trends, products, and styles are advertised. Companies have a chance through this link to broadcast to the Global Wood audience what new products they are offering and how interested parties and contact them.

- Classified Ads

The classifieds section of the Global Wood site has two sections, current popular offers and a features-and-highlights section. The current popular offers section lists by country offers that are new or have been popular. The features and highlights section lists classified ads by timber and wood product type including: hardwood, softwood, milled lumber for construction, Tropical timber, logs, and standing timber, plywood, veneer, panels, flooring, doors, windows, cabinets, furniture and furnishing, wood components, garden and outdoor products, pallet and packing, and other wood

products. Within both the popular offers and features and highlights classified ad sections the subject, details of ad, name of contact, position (import/export), company, e-mail, telephone, fax, web address, city, province, country, and certification are listed.

- Global Wood Trade Center

The Global Wood Trade Center allows companies to buy, sell, trade, or post an offer for any type of wood product worldwide. A forum structure is implemented and buyers, sellers, and traders can communicate with each other until an agreement is reached. The online trade center also has a shopping directory indexed with 40 wood product categories. The online forum structure is used to navigate through the different categories to find products and services for sale.

- Products Catalog

The products catalog simply lists lumber and wood products by type. The information that is provided within this directory includes product information as well as contact information. Product information consists of: product type, product name, specification, quantity, product origin, business type, target market, delivery lead time, and minimum order size. Contact information includes: e-mail, company, address, state, country, phone, fax, and web-address.

- Company Directory

The Company Directory is an information bank categorized by products within the forest industry and the businesses that deal within those areas. Company name, profile, address, city, state, country, postal mail code, number of employees, establishment date, assets, type of business, contact person, position, telephone, fax, e-mail, and homepage are all given within this directory.

- Timber Technology and Knowledge Center

This section of the Global Wood site is responsible for supplying users with important literature that is practical within the forest and wood products sectors. Important information on timber/lumber measurement, timber grading & quality, timber sale & marketing, timber glossary & terms, woodworking tips, timber species & photos, world distribution of forests, and a miscellaneous section are available.

- Exhibitions

This section provides information for upcoming trade and product shows around the world. Information on the place, date, exhibits, space rent, discounts, registration fee for exhibitors, registration dead-line, entrance fee, visitor fee, opening hours, and contact information for the show is listed.

- Useful Links

The useful links section of Global Wood provides a place where companies can advertise and provide direct access through an Internet hyperlink. Also within this section web links to the most well recognized professional organizations within countries around the world are listed. Within the United States for example, listings for The Engineered Wood Association, The American Hardwood Export Council, American Softwoods, Softwood Export Council, and the Western Wood Products Association are available.

4.6 TimberWeb

TimberWeb (www.timberweb.com) is a global business-to-business (B2B) timber and lumber e-market. This site provides a networking environment for buyers and sellers of timber and lumber. The website is segmented into three distinct sections

including: e-trading center, global timber directory, and an information center.

TimberWeb's e-trading center is a trading platform that enables buyers and sellers to

trade publicly as well as conclude deals privately. The global timber directory that

TimberWeb maintains is comprised of over 90,000 businesses that advertise their

products and services. Lastly, the information center portal keeps members informed

on current news, events, jobs, and other market information. Four types of membership

are available for interested parties to access the benefits of the TimberWeb network.

Trading membership is designed for members that are buyers or sellers of timber,

lumber, roundwood, veneer, logs or other wood products. Logistics membership is

specific to industries that are part of the shipping, transport, or movement of wood

around the world. Services membership is designed for businesses that provide

financial services, machinery, equipment, computer technology, etc to the forest

industry. Lastly an associate membership is available for parties such as universities,

associations, commerce departments, and other business or educational groups.

Nearly all activities on TimberWeb are reserved for members.

To summarize the different informational needs provided by current web

information systems, Table 4.2 lists key forest industry information needs that are

provided by the different Internet sites analyzed in this work. By analyzing Table 4.1

and Table 4.2 one can draw conclusions where current information needs still exist and

how those needs might be satisfied by the information provided by the Internet sites

analyzed. An example of an information need not filled is time needed for wood

harvesting/delivery. This information is hard to obtain due to many independent

variables that are hard to address and are constantly changing (i.e. terrain, weather,

timber type, production days, etc.) This need is not addressed in any of the websites that were analyzed. With a more extensive list of informational needs we would likely find more informational needs that are not addressed for forest industry stakeholders within the limited scope of this project and the Internet sites that were analyzed. However, one goal of this work is to show that a wealth of information needed by forest industry supply chain stakeholders can be found on the Internet. This information could lead to better, well-informed decisions being made by supply chain participants if it is easily available to all members of the supply chain. The main struggle that seems to have been identified through this research at this time is that a common website (platform) that provides all information to all industry participants does not exist. Many companies have their own proprietary intra-web resources but they are limited because they are isolated and do not exchange information in real-time.

Table 4.2: Informational needs provided by web resources

Information Provided	Virginia Department of Forestry	USFS	Timber Mart-South	Forest2Market	GlobalWood	TIMBERWeb
Forest management advice	x	x				
Stumpage Prices			x	x		
Logger availability	x					
Identification of landowners with timber	x					
Bare land values			x	x		
Quantity of timber in potential sale areas	x	x	x	x		
Site conditions of potential sale areas	x	x				
Roundwood demand			x	x	x	x
Prices for delivered roundwood			x	x	x	x
Roundwood product specifications			x	x	x	x
Demand projections for various products				x	x	x
Time needed for wood harvesting/delivery						
Trends in wood consumption					x	x
Preferences of final consumers					x	x
Cost of other raw materials					x	x

5.0 Legal Considerations- Anti-trust Law:

Within the U.S. legal system, anti-trust regulation sets standards for the way business is conducted. Since we are proposing to develop a business management tool that will share important business information about companies, it is imperative that the current anti-trust legal system be analyzed for compatibility. The following is a synopsis of current anti-trust regulation and how it pertains to the forest industry and its operations.

5.1 Definition of Anti-trust

Anti-trust regulation has its origins in medieval England. Three very important underlying principles of present day anti-trust regulation were spelled out during these times. The first principle of anti-trust regulation was the principle of equality among businessmen. The second principle was that businessmen should charge no more than a "just price" for their goods. The last principle of anti-trust regulation was that a tradesman should not, in any other manner, take advantage of his neighbor's necessity (Cise 1982, Cise and Lifland 1980). These elementary philosophies became the foundation of anti-trust regulation once European settlers inhabited North America. Settlers to the new world combated the early monopolies enacted by the British kings and Parliament. Rejecting the British monopoly of the tea trade in the North American colonies ultimately led to the American Revolution; leading to the drafting of the Declaration of Independence (1776) followed by the writing of the United States Constitution (1787), which set forth the right of "equality of opportunity" (Cise and Lifland 1980). Following the United States Civil War, western farmers complained of excessive rates from railroad monopolies that were delivering products from eastern trusts and

combinations. State governments struggled to use local laws, due to their intrastate

jurisdiction, to control the railroad and trust combinations that were threatening the

fundamental "equality of opportunity" value in American life (Cise and Lifland 1980,

Gellhorn 1976). With the need for laws to control interstate affairs, the current anti-trust

laws were born beginning with the Sherman Act.

5.2 Objectives of the Anti-trust Laws

Two fundamental principles embody The Federal Anti-trust Laws. Cise (1975)

wrote that "The first and basic principle of these laws is that their general objective is to

prohibit private restraints that may operate to deny our nation a competitive economy.

The second principle is that the generality of their statutory language has necessitated

the delegation to the Department of Justice, The Federal Trade Commission, and the

courts a wide discretion in the interpretation and application of their competitive

commands in specific cases". In general anti-trust laws contain provisions against

private restraints which may threaten a free trade economy. Congress has restrained

from narrowing the language of the anti-trust laws on the grounds that it would be nearly

impossible to list all forms of anti-competitive conduct (Cise 1975, Cise 1982).

5.3 Interstate Commerce Commission 1887

The Interstate Commerce Commission was formed in 1887 to assure just and

reasonable rates and to prohibit undue discrimination for railroads. This federal agency

enabled government regulation to temper the competitive market of railroad firms and

large trusts so that a fair and competitive marketplace could be established (Gellhorn

1976). Shortly after the Interstate Commerce Commission was formed, additional

clarification and legislation was needed to "bar excesses such as combinations in

restraint of trade and monopolizing activity, while at the same time permitting fair competition and healthy combinations" (Gellhorn 1976). This new statute was known as The Sherman Act.

5.4 Sherman Anti-Trust Act

In 1890 Senator John Sherman asked Congress to provide federal enforcement upon monopoly enterprises. The Sherman Anti-trust Act was enacted in 1890 and was the first legislation embodying the competitive objective and comprehensive delegation of our anti-trust laws. The sections of the Sherman Anti-Trust Act of 1890 prohibit unreasonable restraints and monopolization of trade (Cise and Lifland 1980). The sections of the Sherman Act are detailed below:

Sherman Act:

Section 1. "Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is hereby declared to be illegal."

Section 2. "Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize, any part of the trade or commerce among the several states, or with foreign nations, shall be deemed guilty of a felony" (Gifford and Raskind 1983, Neale and Goyder 1980).

5.5 Clayton Act

The Clayton Act of 1914 was established in an attempt to clarify and list the specific practices that would have anticompetitive effects on markets which the Sherman Act failed to record. Sections 2, 3, 7, and 8 of the Clayton Act lists four restrictive or monopolistic acts that are illegal:

Section 2. Price discrimination- Sales of products at different prices to similarly situated buyers.

Section 3. Exclusive dealing contracts- Sales on the condition that buyers stop dealing with the sellers competitors.

Section 7. Corporate mergers- Acquisitions of competing companies

Section 8. Interlocking directorates- Common board members among competing companies (Gellhorn 1976, Shenefield and Stelzer 1993, Thompson and Brady 1974). The Clayton Act of 1914 was amended in 1936 by the Robinson-Patman Act, which was directed against price discrimination and amended Section 2 of the Clayton Act to make it more detailed and descriptive pertaining to price discrimination (Thompson and Brady 1974).

5.6 Federal Trade Commission Act

The Federal Trade Commission Act of 1914 added to the aforementioned Clayton Act the ability to enforce anti-trust regulation. The Federal Trade Commission Act allowed legal enforcement of sections 2, 3, 7, and 8 of the Clayton Act and restrained any anti-competitive methods or measures affecting commerce (Gellhorn 1976, Thompson and Brady 1974).

5.7 Miller-Tydings Act

The Miller-Tydings Act Amendment of 1937 amended Section 1 of the Sherman Act and pertains to federal support of the fair trade movement between states. The Miller-Tydings Act exempts from the operation of the Sherman Act "contracts or agreements prescribing minimum prices for the resale" of specified commodities when "contracts or agreements of that description are lawful as applied to intrastate

transactions" under local law (Becker 2004). Under this amendment resale price

agreements could be validated by state law with respect to trademarked articles "in free

and open competition with commodities of the same general class produced or

distributed by others," as long as the agreements were not between persons on the

same level of distribution or "in competition with each other" (Becker 2004).

5.8 Celler-Kefauver Act

The last major anti-trust act was the Celler-Kafauver Act of 1950. Section 7 of

the Clayton Act was amended to include the barring of mergers accomplished through

corporate acquisition of another corporation's assets. While the original Clayton Act

managed to include a statute applied to mergers accomplished through corporate

acquisition of another corporation's stock it failed to mention assets. The Celler-

Kefauver Act also reworded section 7 of the Clayton Act to make it applicable to

corporate purchases of the assets of other corporations, and deleted the clause on

"competition between the acquiring and acquired corporations" (Thompson and Brady

1974).

5.9 Anti-trust Regulation and the Forest Industry

Anti-trust cases have been brought against forest industry companies throughout

their existence. Two recent cases that have come through the judiciary involving the

forest industry are reviewed here to demonstrate the interaction of anti-trust legislation

within the forest industry.

<u>United States of America vs. Georgia-Pacific Corporation and Fort James Corporation[1]</u>:

On November 21, 2000, the United States filed a complaint alleging that the acquisition of Fort James Corporation by Georgia Pacific would substantially lessen competition in violation of Section 7 of the Clayton Act, as amended 15 U.S.C. § 18. This case was spurred by Georgia Pacific purchasing Fort James Corporation and in doing so, gave Georgia Pacific monopolistic powers in the Away From Home (AFH) tissue and bathroom products business. In the acquisition of Fort James Corporation, a large producer of AFH products, Georgia Pacific Corporation would control 66% of the dollar sales of AFH products in the United States and 36% of the North American bath tissue productive capacity. In doing so, the United States found that by acquiring the assets of Fort James Corporation; competition would be substantially reduced thereby harming consumers of AFH products. In the final judgment of this case, recorded May 9, 2001, in the United States District Court for the District of Columbia, Georgia Pacific's AFH tissue business was ordered to "divest as a viable ongoing business to one or more purchasers acceptable to the United States in its sole discretion, provided that at least one of these purchasers, in the sole judgment of the United States, becomes, as a result of the acquisition and any preexisting AFH business, capable of competing effectively in supplying AFH Tissue Products to national accounts".

<u>Weyerhaeuser Company v. Ross-Simmons Hardwood Lumber Company, Inc[2]</u>:

In 2001, Ross-Simmons, a sawmill, filed suit under §2 of the Sherman Act, alleging that petitioner Weyerhaeuser drove it out of business by bidding up the price of

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[1] United States v. Georgia-Pacific Corp. and Fort James Corp. The United States District Court for the District of Columbia

[2] Weyerhaeuser Co. v. Ross-Simmons Hardwood Lumber Company, Inc. Supreme Court of the United States.

red alder sawlogs to a level that prevented Ross-Simmons from being profitable. Ross-Simmons asserted that Weyerhaeuser overpaid for alder sawlogs (predatory bidding) to cause sawlog prices to rise to artificially high levels as part of a plan to drive Ross-Simmons out of business. Ultimately, the District Court instructed the jury that Ross-Simmons could prove that Weyerhaeuser's bidding practices were anticompetitive acts if the jury concluded that Weyerhaeuser "purchased more logs than it needed, or paid a higher price for logs than necessary, in order to prevent [Ross-Simmons] from obtaining the logs they needed at a fair price. Finding that Ross-Simmons had proved its claim for monopolization, the jury returned a $26 million verdict against Weyerhaeuser. The verdict was trebled to approximately $79 million". On February 20, 2007 The U.S. Supreme Court threw out the $79 million judgment in a 9-0 ruling. The court justified its verdict requiring that Ross-Simmons must meet a stricter legal standard than the trial court originally allowed, specifically, they must be required to prove that Weyerhaeuser had a dangerous probability of recouping the losses in incurred in the predatory bidding process.

5.10 Anti-trust rules and regulations within professional forestry organizations

The Society of American Foresters (SAF) is a professional society of foresters and adopts policy positions relevant to forestry in the United States. The SAF is concerned mainly with anti-trust issues at its meetings, social gatherings, and from the context of its members from a professional forester perspective. The following anti-trust policies were adopted by the Society of American Foresters:

a) "No activity or communication shall include any discussion that might be construed as an agreement or understanding written or oral, formal or informal,

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expressed or implied, among competitors with regard to prices or professional fees, terms or conditions of sale, distribution, timing, or volume of production, territories, or customers.

b) No exchange or collection of information among competitors regarding prices, pricing methods or costs of production, sales, or distribution.

c) No activity or communication shall include any discussion that might be construed as an attempt to prevent any person or business entity from gaining access to any market or customer for goods or services, or to prevent any business entity from obtaining a supply of goods or otherwise purchasing goods or services freely in the market.

d) No activity or communication shall include discussion that might be construed as an agreement or understanding, written or oral, formal or informal, expressed or implied, to refrain from purchasing or selling any raw materials, equipment, services, or other supplies from any supplier, or to any customer.

e) No activity or communication shall involve any discussion of costs, or any exchange of cost information, for the purpose or with the probable effort of: (1) increasing, maintaining, or stabilizing prices; or (2) reducing competition in the market place with respect to the range or quality of products or services offered (SAF 1980, 2007)."

The Forest Resources Association Inc. (FRA) is an organization that "promotes the interests of forest products industry members in the economical, efficient, and sustainable use of forest resources to meet the needs of the wood fiber supply chain through private enterprise" (FRA 2007). The FRA has instituted the following set of

specific recommendations for FRA members to follow regarding anti-trust law regulations. These regulations pertain to FRA meetings, business to business transactions, and all other industry activities (FRA 2007).

a) Do not discuss prices or the terms of sale or purchase of any product.

b) Do not participate in any conversation at which fixing price is discussed, either directly or indirectly.

c) Do not discuss any information relating to current or future prices to be charged or paid for products or to be bid on purchase contracts.

d) Do not attend or participate in collateral meetings ("rump sessions"), prior to, during, or after scheduled Association meetings.

e) Do not enter into sensitive areas such as price or cost in any meeting, personal communication, telephone conversation or writing, where other competitors are involved.

f) Do not make any agreement, either written, oral, or implied, concerning cost or prices, procurement areas or territories, etc.

g) Do not make threats or any implication of boycott against a competitor, supplier, or other member of the industry.

h) Do become aware of and abide by any consent judgments that affect your company.

As development of an online forest industry supply chain tool is conceived, the context and range of such a system must be considered. In doing so, one will find that some of the anti-trust recommendations set forth by organizations such as the SAF and FRA will not be enforced. A key component of an online supply chain

management system for the forest industry is the sharing of information through a web based platform. Certain information including but not limited exclusively to inventories, availability, distribution, price, and services must be shared for effective and necessary business transactions.

5.11 Anti-trust conclusions

After reviewing several court cases, the major laws pertaining to anti-trust as defined above in the SAF and FRA positions on anti-trust; several important implications must be kept in mind as development of a prototype online forest products supply chain management system is pursued:

1) Inputs into the "Woods to Goods" system must not discriminate against certain market players. A fair and competitive marketplace must be present in order to adhere to the guidelines of the Interstate Commerce Commission.

2) Free trade must be promoted and represented by such a system as detailed in the Sherman Anti-trust Act of 1890. It cannot restrict trade or those that could enter the system.

3) Monopoly or monopolistic powers must be prohibited from such a system.

4) Price discrimination- (Sales of products at different prices to similarly situated buyers) as defined by Section 2 of the Clayton Act of 1914 and as amended by the Robinson-Patman act of 1936 must be prohibited. Prices must be fair for all members of the "Woods to Goods" information network.

5) Exclusive dealings contracts as they are defined in Section 3 of the Clayton Act (sales on the condition that buyers stop dealing with the seller's competitors,

boycott) shall be prohibited. Private dealings by companies among themselves should not be offered through such a system.

6) Corporate mergers or acquisitions of competing companies through purchase of stock or assets (as defined specifically in Section 7 of the Clayton Act as amended by the Celler-Kefauver Act of 1950) should not be fostered by such a system.

7) Interlocking directorates of forest industry companies should be prohibited in the development of a supply chain management system as defined in Section 8 of the Clayton Act. This statute would suggest that a supply chain management system should be set up and managed independently from individual companies. Example: CEO of Georgia Pacific should not be on the board of directors for an independent forest products supply chain management company.

8) Any unfair or deceptive acts or practices in or affecting commerce should be avoided as spelled out in the Federal Trade Commission Act of 1914. All transactions should be forthright and easily viewed by all parties involved.

6.0 GIS Optimized Forest Industry Supply Chain Concept:

The focus of this project is the development of a more efficient and optimized forest industry supply chain through the use of e-commerce (Internet) and GIS technologies. Thus far we have just looked at information components and implications of interest for such a system. Currently much information available on existing systems is proprietary and used as a form of competitive advantage within single companies. However, through study of e-commerce one finds that by sharing information effectively, a system or process can be optimized thus reducing costs and increasing revenues beyond current levels across the supply chain. The key to such success is an efficient and low cost communication medium- the Internet and the World Wide Web. To clearly define: "The Internet is a global network of networks defined by a set of open standards for communicating data and information between computers. It rests on top of the global data communication network- The World Wide Web" (Davis and Benamati 2003). A global communication network linked with the Internet and sequentially linked with the World Wide Web gives basis for a strong information sharing- E-commerce system that can be implemented within the forest industry supply chain.

In the diagram of the forest industry supply chain (Figure 4.1), arrows connecting adjacent entities represent product flows and data flows. By its very nature, e-commerce is concerned with the exchange of digital data and information. Each logical data flow represents a potential e-commerce application. Sharing information among internal processes helps to coordinate those processes, leading to productivity gains. E-commerce makes it possible to coordinate all entities of a supply chain and reap the productivity gains resulting from improved efficiency (Davis and Benamati 2003).

To add clarity and fully understand e-commerce within the forest industry it is important to realize that there are three major categories of e-commerce: business-to-business, intra-business, and business-to-consumer. All three forms of e-commerce have potential within the forest industry but the most potential lies in the business-to-business and intra-business sectors. Research has identified that the most potential to gain productivity and value lies within business-to-business and intra-business transactions. Business-to-business e-commerce is primarily concerned with business communications and the relay of information more efficiently and effectively. Intra-business e-commerce is concerned with integrating processes across the value chain (Davis and Benamati 2003). Through the implementation of these types of e-commerce, efficiency can be gained through supply chain transactions which lead directly to significant competitive advantages. These advantages can be seen within the forest industry with collaboration between industry segments and cleaner more efficient and accurate transactions.
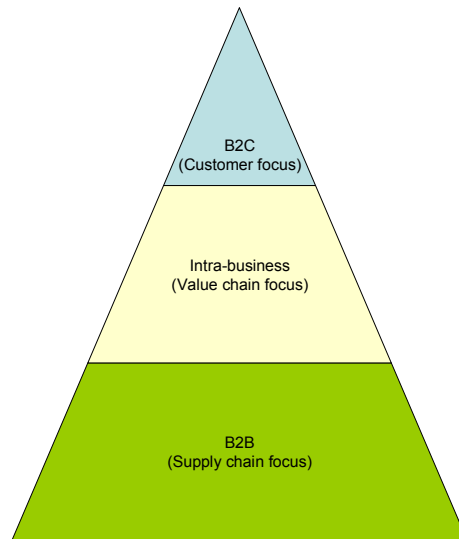
Figure 6.1: Three categories of e-commerce as part of a larger information flow from customer to raw material (Davis and Benamati 2003)

Business-to-consumer e-commerce represents a relatively small piece of the e-commerce pie as depicted in Figure 6.1. Business-to-consumer e-commerce is the front end of both the value chain and the supply chain so it is important to the overall goal of efficient businesses to have a business-to-consumer e-commerce platform. With that said however, business-to-consumer e-commerce adds little in the way of value production with most commodity systems. Within the forest industry supply chain where many large physical products are produced and sold, the majority of the profit comes in controlling costs. The forest industry normally produces commodity products which have low profit margins and are unwieldy and hard to ship cost-effectively which does not match well with business-to-consumer e-commerce models.

Through research it seems that the proposed wood supply chain management system will gain more value through the intra-business and business-to-business sectors of e-commerce. The proposed system would integrate e-commerce

functionality to streamline business processes and cut costs but would also employ a GIS system to visually and spatially allocate members of the supply chain to draw conclusions about information of interest. Such a system does not exist at the present time within the forest industry.

GIS technology has the potential to add value in the form of valuable information within a supply chain management system. In order to show how GIS technology could be used to improve supply chain management a model GIS supply chain tool was developed. In order to do this, a geographic region was selected so that appropriate data elements could be collected. The state of Virginia was chosen as the geographic area of interest for model development. The collection and tabulation of forest industry and spatial data across the state was the next step in the process of development. Once spatial data were collected, the task of matching spatial location with forest industry supply chain players (georeferencing) was performed by creating a forest industry database for the state of Virginia. Georeferencing brings a new dimension of clarity, power, and perspective to forest industry supply chain management. The ability to integrate spatial location with industry information through georeferencing, combined with the efficiency and transparency the Internet and GIS provide, allows for a new horizon in forest industry supply chain management to be explored.

6.1 Geographic Scope of Prototype GIS Information System:

Geographic scope refers to the actual physical area that will be associated with the project elements and users of this system. There are many ways to define and establish a specific geographic scope and certain advantages and disadvantages accompany each method. It should be noted however that geography is essentially

eliminated as a variable when using an e-commerce approach to business. For this

project, however, a finite geographic scope has been considered for mapping and data

collection concerns. Table 6.1 lists different geographic scope options defined by their

attributes.

Table 6.1: Geographic scope options

	Advantages	Disadvantages
Option 1: Defined by single industry or company	Easily Obtainable Information (supply and demand) One set of consumers Small working area	Small geographic scope Limited data interpretation and interaction between markets
Option 2: Limited to a specific timber resource	Information provided by landowners Constrained geographic area Increased number of consumers/producers Market interactions more defined	Larger region of interest Variable information sources Wide array of markets/players
Option 3: Restricted to certain mills	Limited to certain qualified producers within region of interest Data can be collected easily Market segmentation allowable Obtain specific data attributes	Limited market due to increased standards May cause anti-trust concerns Could have trouble from companies that will not disclose pertinent information
Option 4: Arbitrary distance radius	Ability to have a defined working area Limited number of markets Limit land attributes Data boundaries and access	Limited number of producers/consumers/landowners Limitations due to area Limited markets
Option 5: State, province, or region	Defined data area and sources Limited number of markets Common state regulations and taxes	Market limitations Large geographic area

For this project, a limited geographic scope was used to show the capabilities and functions of an integrated data management system. Coverage of the state of Virginia was the primary area of interest within this project. This geographic range (state of Virginia) follows closely to Option 5 (limit scope to a certain state).

6.2 Georeferencing of market information

Georeferencing is the basic process of relating information to geographic location. Georeferencing includes three basic structures (Hill 2006):

1) Informal- This is the means by which one refers to a location by its placename (ex. Blacksburg, Virginia). This type of referencing is general in nature and refers to a common location rather than a specific point. The relative scale and duplication of placenames brings about problems when georeferencing in such a manner.

2) Formal- Formal representation of geographic location can be done based on longitude and latitude coordinates and other spatial referencing systems. This type of spatial illustration shows the particular spot on the Earth surface where something is located. Alternatively to informal georeferencing, formal referencing does not allow the user of formal referenced information to find an area of coverage by its representative placename.

3) Unified- Unified georeferencing is the combination of both informal and formal referencing attributes and functions. In order to achieve the attributes of both georeferencing structures, a translation between the formal and informal representations is essential. In order to achieve this output, a gazetteer which provides placenames that include geospatial footprints must be used. The

integration of these two datasets allows the full potential of georeferenced information to be released.

In regard to this project, the unified georeferencing approach is critical to the goal of visually identifying members of the forest industry supply chain. Having a database of industry names referenced by a placename as well as formal geographic location will allow for spatial analyses to be performed that ultimately could add clarity to the forest industry supply chain.

The collection of high-quality spatial data for visual model development is a key for any supply chain management system with GIS capabilities. In populating a GIS with spatial forest industry information, members of the forest industry supply chain had to be geo-referenced. Data were divided by category: landowners, consulting foresters, loggers, primary manufacturers, and retail locations. Landowner parcel information was obtained from Chesterfield County, Virginia GIS office. Consulting forester address information was collected from the Virginia Forestry Associations Directory for 2005. Logger and secondary manufacturing facility addresses were obtained from the Virginia Primary Forest Products Directory 2001, produced by the Virginia Department of Forestry. Retail locations for Lowe's stores were obtained from a website (www.renovationexperts.com/lowes-virginia.asp). All address information was used to georeference point locations for consulting foresters, loggers, and primary manufacturing facilities across the state of Virginia. All addresses were typed into an Access database file and were incorporated into ArcGIS as a database file. Spatial road data for this research project was obtained from ESRI's Street Map USA data. The street data is based on TIGER 2000 data with enhancements by ESRI and

TeleAtlas. Aerial photography was provided by the Virginia Base Mapping Program of 2002. Forest cover data was provided by the Virginia Department of Forestry and includes their Virginia Forest Coverage Maps from 2005. Virginia county boundary layers were obtained from ESRI Data provided with ArcGIS. Table 6.2 lists data sources, their scopes, and reference information used in this project.

Table 6.2: Summary data table for model development

Data	Scope	Source
Landowner	County	Chesterfield County
Consulting Forester	State	Virginia Forestry Association 2005
Logger	State	Virginia Department of Forestry
Secondary Manufacturing	State	Virginia Department of Forestry
Lowe's Store Locations	State	www.renovationexperts.com/lowes-virginia.asp
Virginia Road Dataset	State	ESRI Street Map USA Data
Aerial Photography	State	Virginia Base Mapping Program
2005 Virginia Forest Cover	State	Virginia Department of Forestry
County Boundary	State	ESRI Virginia County Boundary

In order to georeference members of the forest industry supply chain, physical address locations as well as zip codes were used to place entities appropriately. Data were divided based on whether a true physical location (address) was used or whether the zip code was the best available information (e.g., when an address only included a post office box). Using the geocoding tools in ESRI's ArcMap version 9.2, interactive matching through personal discretion and available address options was done for all physical address locations that did not have a definitive match. For locations that could not be matched interactively, these players were matched on zip code alone to give an approximate location.

In conclusion, all that is needed to georeference forest industry supply chain players is a true address location. If address location is known, GIS allows for spatial representation on a map by geocoding with an available road dataset. Quality road

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data is essential for accurate georeferencing. Other data attributes are just added into a database system that allows attributes to be referenced by a spatial location- georeferenced point.

All GIS work was performed with ESRI'S ArcGIS version 9.2. For all physical addresses, the U.S. Streets with Zone address locator style was chosen from the ESRI ArcToolbox Geocoding Tools option. Reference data to create this address locator came from the ESRI Street Map Data for the state of Virginia (VaStreets.shp). This reference data serves as the primary table for reference of address locations.

For addresses that were georeferenced based solely on zip code location the "create address locator tool" was used to select the (5-digit-zip) address locator style. The reference data for such addresses was the same as the true address locations (VaStreets.shp).

For clarity, two levels of address accuracy of supply chain members have been identified:

Level A: Addresses that were referenced by true physical location

Level B: Addresses that were matched by zip code location, due to insufficient information.

Within the geocoding interface of ArcMap, geocoding options can be picked to form threshold values for matching addresses based on true address location. The default ESRI settings were used in this exercise to produce the geocoding results. Address candidates that did not meet these ESRI criteria were either matched interactively through personal selection of likely candidates or exported to be geocoded based on zip code. Summary statistics for members of the forest industry supply chain

that were georeferenced in this project can be referenced in Table 6.3. It was clear by

performing this exercise that address accuracy plays a large role in the quality of

georeferenced information. Address accuracy and reference data accuracy play huge

roles in determining the number of addresses geocoded with quality match scores.

Quality road reference data sets can be expensive but do provide a significantly higher

level of address matching accuracy than what was experienced with the road dataset

used in this exercise.

Table 6.3: Number of addresses geocoded by stakeholder

Statistics	"A" Level Accuracy	Unmatched	Matched w/candidates tied	unmatched w/candidates tied	"B" Level Accuracy
Lowes	36	11	3	0	11
Loggers	1419	1524	124	0	1511
Primary Manufacturers	105	159	60	0	153
Consulting Foresters	23	11	1	0	11

Table 6.3 shows the total number of industry stakeholders that were georeferenced

during the course of this work. Address candidates were matched based on the best

available data. Addresses that were not matched by true physical location were

matched by the zip code location alone to give a general location. The result of

georeferencing members of the forest industry into a workable GIS database

demonstrated how forest industry supply chain data can be used to create a

visualization and information tool on an Internet based supply chain management

system.

7.0 Case Studies:

Three hypothetical case studies are presented to demonstrate the uses of geographic information systems and geocoded forest industry supply chain information. Case 1: A landowner in Chesterfield County, Virginia is trying to acquire the services of a consulting forester. Using the Woods to Goods GIS database, consultants can be referenced and contacted.

Case 2: A logger is interested in making some business decisions and would like to broaden the range of mills that he/she delivers to based on current prices of delivered timber. Using the Woods to Goods GIS database and its functionality, demonstrate the opportunities that exist with a linked system- through cost/benefit analysis based on mileage and delivered price.

Case 3: A manufacturer of high-quality hardwood lumber is interested in expanding its operations. In doing so, the manufacturer realizes that a significant increase in the supply of white oak logs will be necessary. In order to make a sound business decision, mill owners would like to have a good idea of the available oak stumpage in the mill resource area to make predictions as to how much wood the mill could potentially procure with an increase in mill capacity.

In order to show the capabilities of GIS within this context, a step by step approach is taken to guide the reader through the different views in mapping software such as ArcGIS to show how depth and clarity can be added within the context of a forest industry supply chain management system.

Case 1: In Case 1 our landowner is defined as Dalroad LLC and they are

located in Chesterfield County, Virginia. A GIS functional tool in this situation can be

used to select Chesterfield County and all associated land ownership parcels within the

county (Figure 7.1). This information gives the user a wealth of useful information such

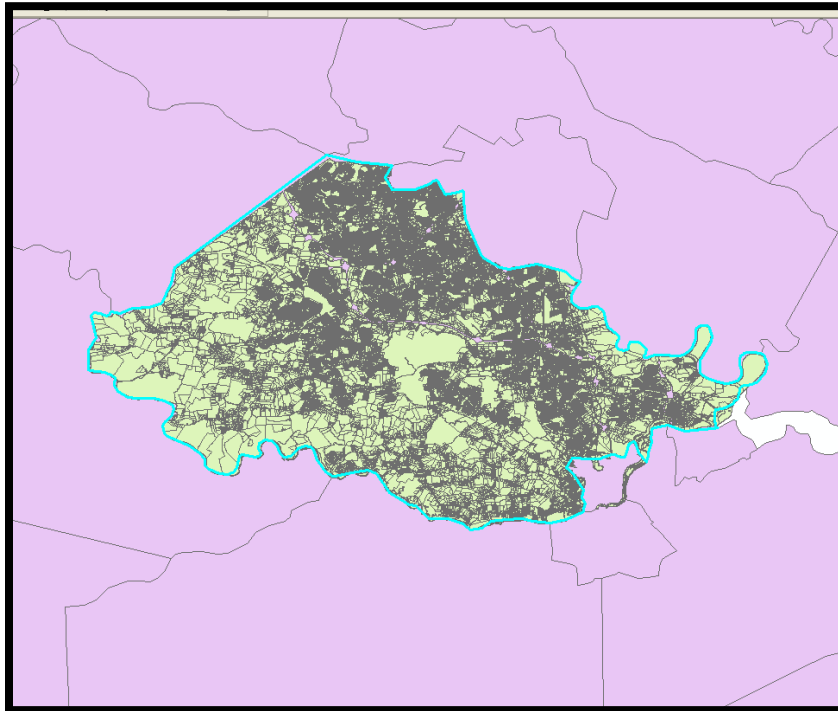as landowner name, acreage, contact information, zoning sector, and appraised value.

Figure 7.1: Chesterfield County and its associated land ownership parcels.

GIS provides the ability to select a parcel of interest by querying any of the attribute

fields (owner name, address, etc.), and then will display parcel of interest (Dalroad LLC;
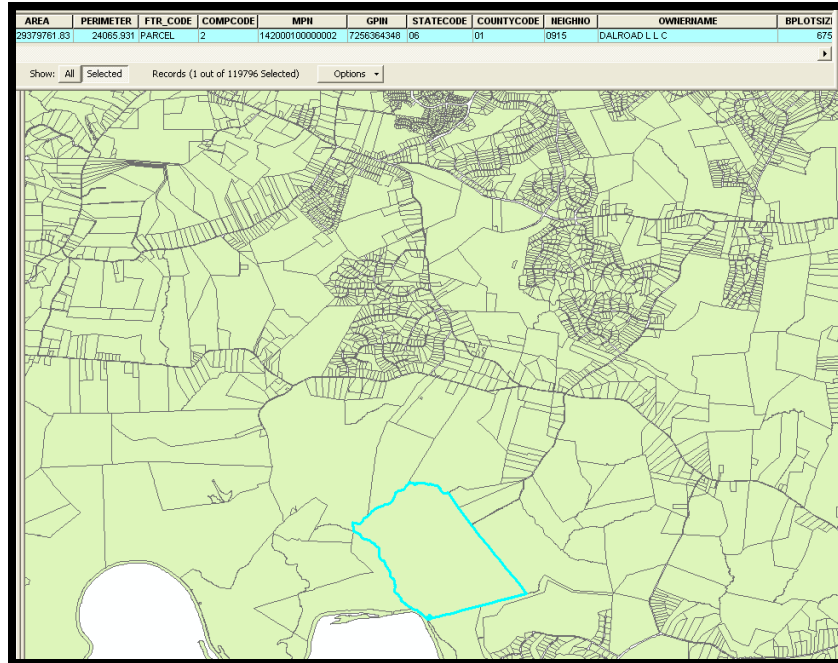
Figure 7.2).

AREA	PERIMETER	FTR_CODE	COMPCODE	MPN	GPIN	STATECODE	COUNTYCODE	NEIGHNO	OWNERNAME	BPLOTSIZ
29379761.83	24065.931	PARCEL	2	142000100000002	7256364348	06	01	0915	DALROAD L L C	675

Show: All Selected   Records (1 out of 119796 Selected)   Options ▾

Figure 7.2: Landowners property (Dalroad LLC) highlighted on parcel map for identification and spatial location. Parcel attributes are noted at the top of figure.

A GIS tool can be used to modify and add layers of interest that may be useful in supplying information for supply chain players. In Figure 7.3, aerial photography can be displayed with our parcels layer to add context and attribute level detail to the landowner's property. Information such as cover type, accessibility, proximity location, and basic ground layout can all be obtained by using aerial photography.

Figure 7.3: Dalroad LLC property highlighted with added information provided by aerial photography.

At this point we have quite a bit of information about the landowner of interest and where this property is located. To find consultants within a 50 mile radius of our landowners property, we can retrieve information on consulting foresters to show their location, name, and contact information (Figure 7.4).
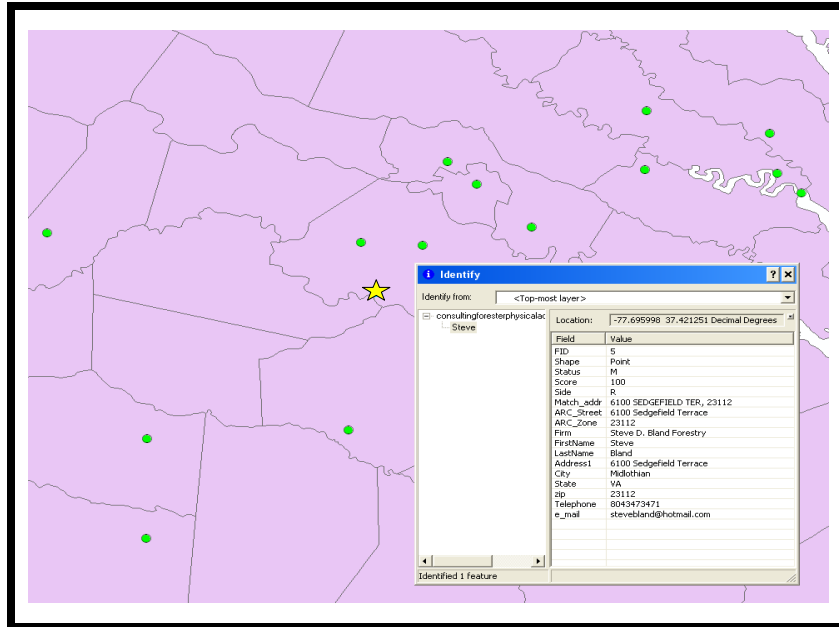
Figure 7.4: Consultant foresters (point locations) within a 50 mile radius of our landowner's location (star). Information about each consultant forester can be displayed.

A useful function in a Woods to Goods system would be a tool that would allow a landowner to send e-mail to all consultants in the selected work area. This would be an efficient means of contacting several consultants at one time with an inquiry about their services. Information shared through such a system would be efficient and timely and help alleviate costs, time, and process management associated with the common task of finding consultant foresters.

Case 2: In Case two, the logger of interest is located in Chesterfield County, Virginia. To orient ourselves initially, the state of Virginia can be viewed showing the locations of all logging businesses (points) and primary manufacturers (stars) across the state (Figure 7.5).
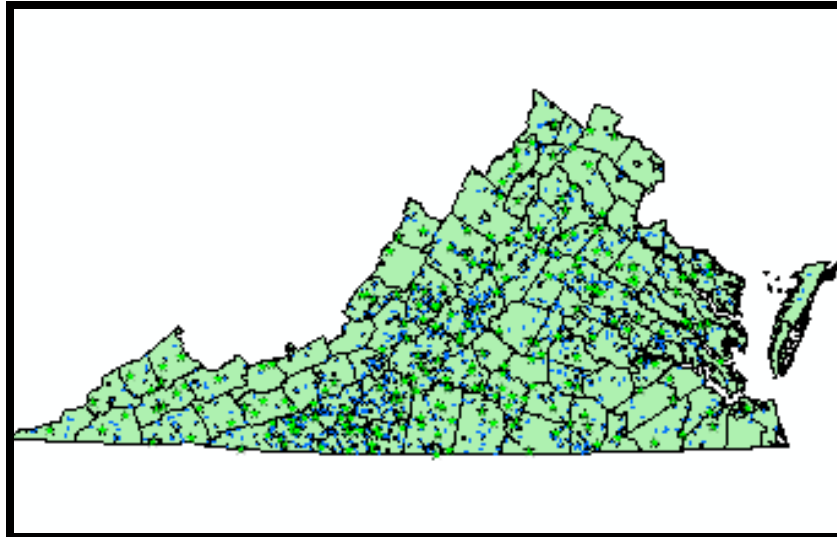

Figure 7.5: State view of Virginia- loggers (points) and primary manufacturers (stars). Information such as this gives a overview of loggers and primary manufacturers across the state of Virginia.

A slightly closer view of our area of interest allows us to select our logger and corresponding mills that we are interested in shipping our products to.
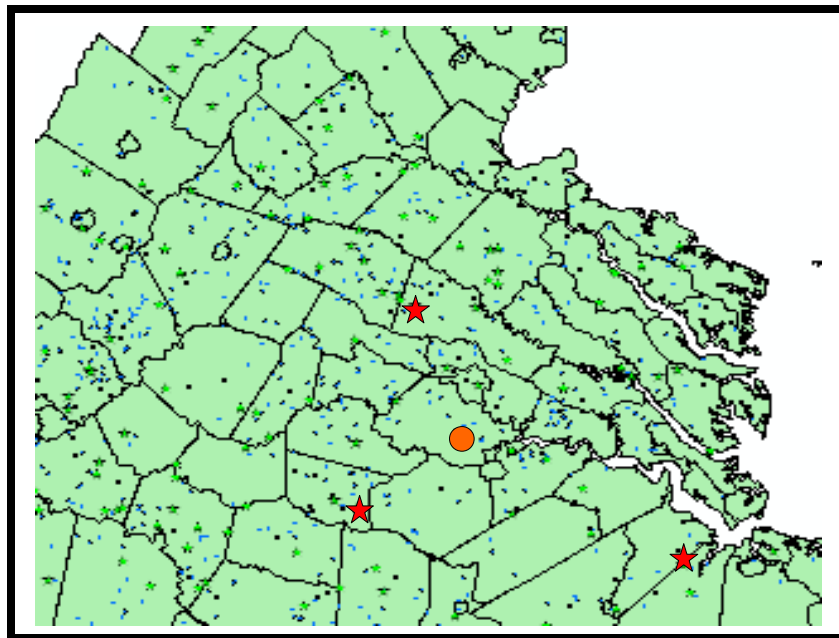

Figure 7.6: Logger (large circle) and sawmills of interest (large stars).

In this case our logger is interested in shipping raw materials to these three key manufacturing sites. One major cost to logging companies is the cost of transporting products from the logging location to the sawmill. Some of the variables that loggers consider when shipping their products to a mill are the drive distance, drive time, fuel costs and price paid for certain products at the sawmill. Through the use of a GIS integrated web system, such information can be analyzed to make the best business decisions. With GIS, addresses of logging location and prospective mill locations can be visualized on a detailed road network map (Figure 7.7).
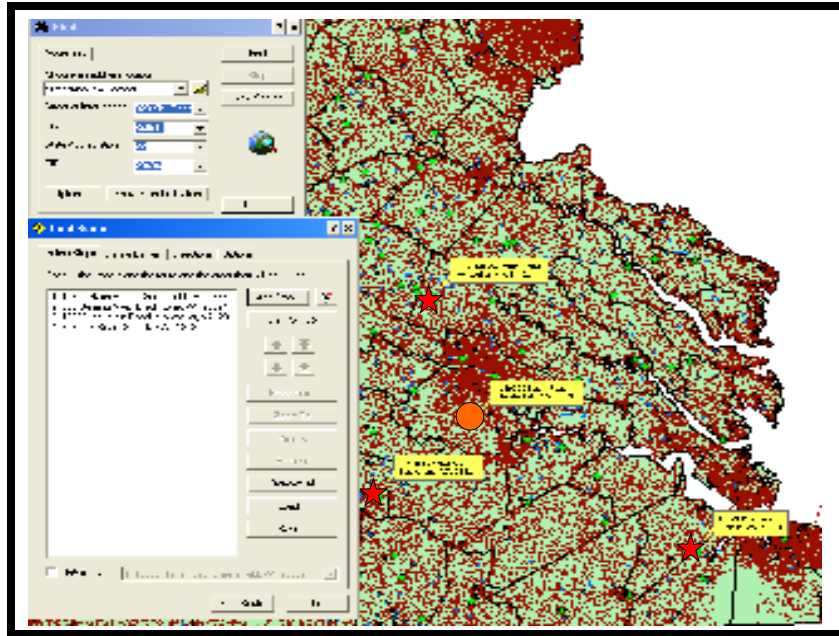
Figure 7.7: Geocoded address locations of our logger and sawmills of interest.

GIS functionality allows routes to be mapped to find the shortest and safest route to each mill (Figure 7.8). The power that GIS matched with geocoded information provides a user is significant.
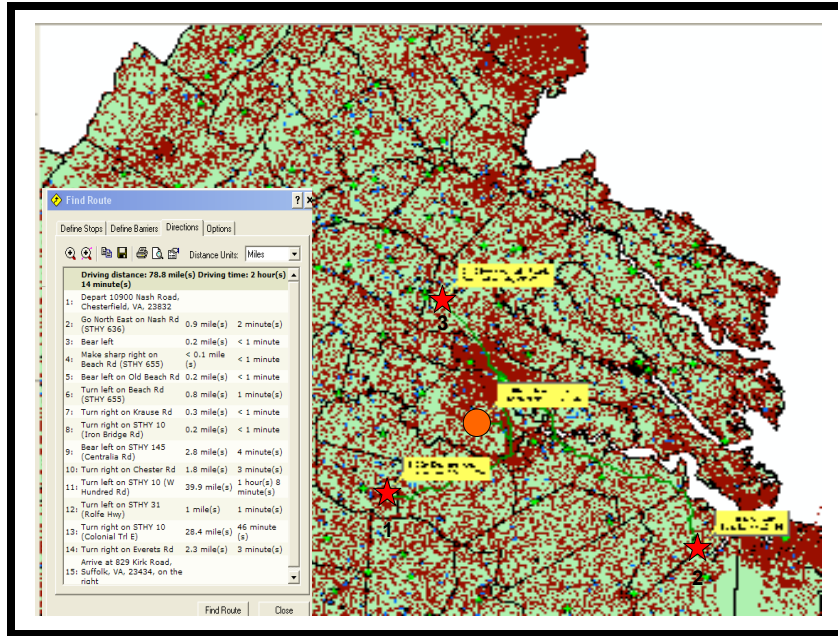
Figure 7.8: GIS-derived routes and mileage to each mill.

To summarize, Table 7.1 lists road distance, estimated drive time, and current prices being paid at each mill. This information, transferred quickly and easily via the Internet, provides key variables to make better informed business decisions.

Table 7.1: Summary table for case 2

Mill	Distance (miles)	Delivered Price per ton	Time in transit (minutes)	Net Income[3]	Payload (tons)	Freight Cost (ton/loaded mile)
1	52.9	$25	85	306.5	25	0.2
2	78.8	$32	134	406	25	0.2
3	40.7	$20	59	296.5	25	0.2

[3] Net income per load = Payload x (delivered price – (freight cost x distance))

To analyze the business decisions outlined in this case study, a cost analysis can be performed to figure out which mill will provide for the best profitability for the logging company. To show how a logger might use the provided information, analyses are provided for each mill. This type of analysis power provided by georeferenced

information, placed within the functionality of a GIS, and linked with the efficiency of the

Internet to transmit information offers efficiency and real time updates as prices or

sawmill location needs change in the forest industry supply chain.

Case 3: In Case 3 the manufacturer of interest is located in Goochland County, Virginia (Figure 7.9). Mill owners have expressed interest in expanding their current hardwood sawmill operations but would like to have an idea of the available hardwood timber resources within the procurement area. GIS-based analysis can provide helpful and informative information to make such decisions.
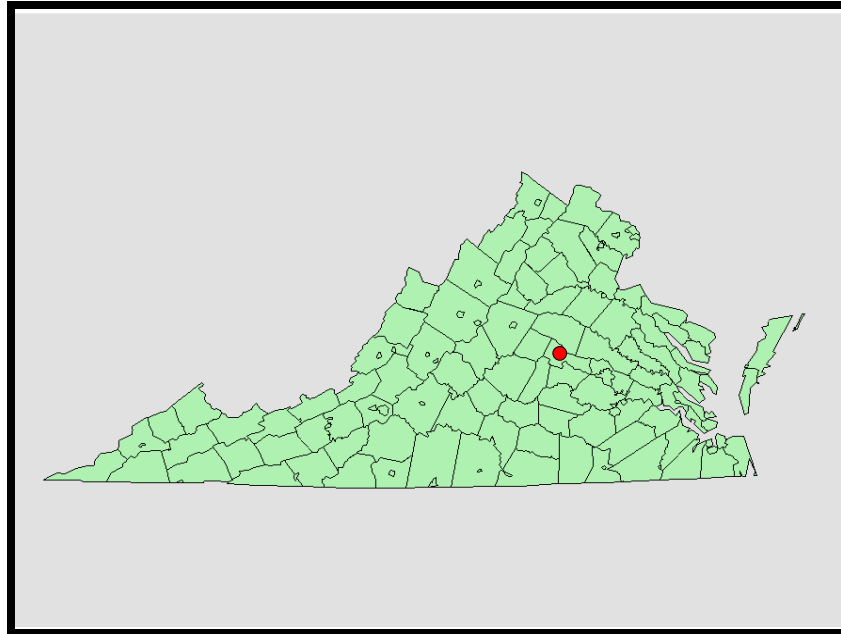

Figure 7.9: Location of manufacturing facility (point).

In order to provide a means for calculating hardwood acres or hectares and quantifying areas of interest, distance zones can be produced in GIS. In this case, 10 miles (16.6 km) was used as the straight-line distance to segment the procurement area of our manufacturing facility. Figure 7.10 displays 10-mile (16.6 km) zones around the mill location.
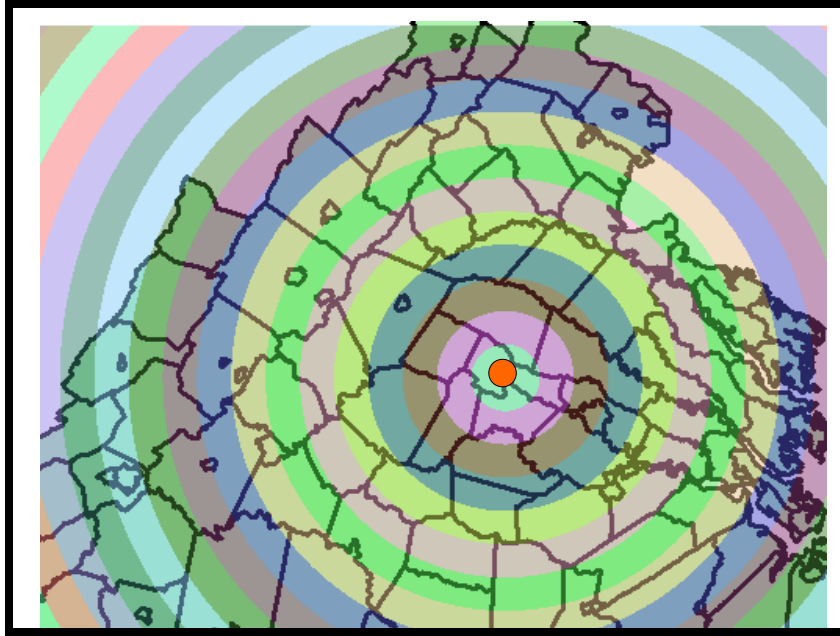
Figure 7.10: 10 mile (16.6 km) zones around manufacturing facility.

In order to quantify hardwood timber resources within the procurement area, hardwood timber resources must be displayed. Figure 7.11 shows hardwood timber denoted as pixels. All timber pixel data were abstracted from the Virginia Department of Forestry forest cover dataset from 2005.
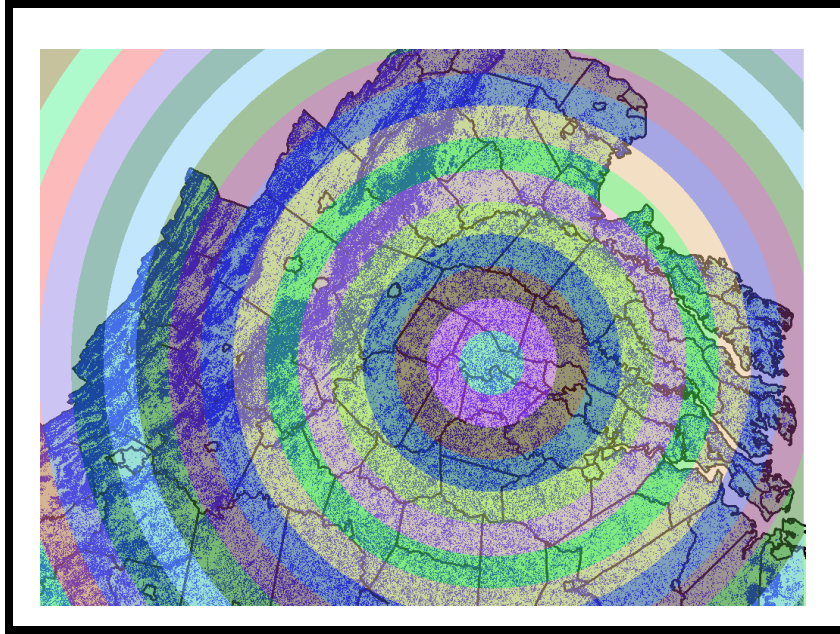
Figure 7.11: 15 x 15 meter hardwood timber pixels within procurement area.

To quantify timber pixels within each 10 mile (16.6 km) area, GIS functionality allows for a count of pixels within each procurement zone. Figure 7.12 displays the number of 15 x 15 meter pixels that were counted within each zone. Raw pixel counts are converted to area estimates by multiplying by a conversion factor: there are 18 pixels per acre (44.4 per hectare).
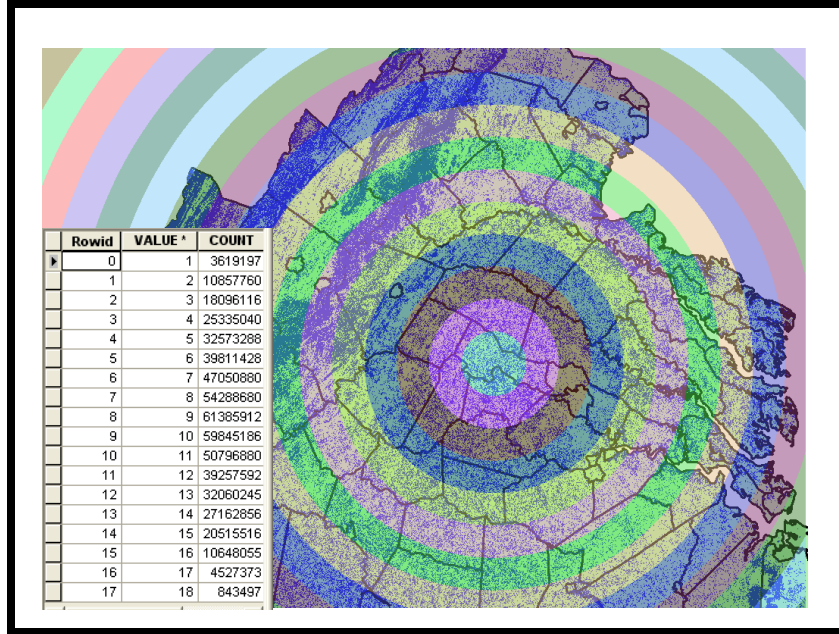
Rowid	VALUE *	COUNT
0	1	3619197
1	2	10857760
2	3	18096116
3	4	25335040
4	5	32573288
5	6	39811428
6	7	47050880
7	8	54288680
8	9	61385912
9	10	59845186
10	11	50796880
11	12	39257592
12	13	32060245
13	14	27162856
14	15	20515516
15	16	10648055
16	17	4527373
17	18	843497

Figure 7.12: Count of 15 meter hardwood pixels that occupy each sequential area around the manufacturing facility.

Mill owners can use information such as this to aid in the decision as to whether the hardwood resource will support mill expansion. Geocoded information and GIS analysis allow for detailed useful information for the forest industry. Resource analysis data is something that is not readily used widely within the aged forest industry owners of sawmills around the commonwealth. Providing this information via the Internet would provide for efficient, timely information that is not easily available to most sawmill owners at this time.

8.0 Discussion and Conclusion:

The objective of this research was to explore opportunities for using geographic information systems, the Internet, and georeferenced forest industry information within the context of a forest industry supply chain management system. To fulfill this objective, informational needs of forest industry stakeholders and current information supplied by forest industry websites were identified (Tables 4.1 and 4.2). By identifying current needs and information on the Internet to fill those needs, the idea of a forest industry supply chain tool was developed. The goal of such a tool would be to make the forest industry function more efficiently by improving data and information flows between industry segments through the Internet and also adding clarity and understanding by visualizing activities through GIS technology. To make such a system possible, georeferencing of forest industry supply chain information must take place.

Spatial representation of features allows the user to visualize location on a map (GIS interface) while the database management structure allows for the transmission of valuable information. To demonstrate how georeferencing of market information can lead to efficiency improvements, data sharing and process improvement; three case studies were presented. Each case study demonstrates the usefulness of georeferenced information and GIS technologies in common forest business activities. This information paired with the Internet allows for easily accessible forest industry information. Within this research, georeferencing is viewed as one of the major fundamental necessities of a forest industry supply chain management system. Georeferencing of supply chain players allows the implementation of a GIS to use as a tool in supply chain management. This tool accessed through the Internet for all supply

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chain members, has the ability to reduce costs associated with current inefficiencies by improving information flow and breaking current barriers that exist between forest industry players. At the very least, hopefully this paper transmits to the reader the importance of timely information flow and that value can be gained by improving information flow in the forest industry.

Many challenges and needs were identified within the course of this research. One major challenge the forest industry faces in implementing a supply chain management system is the use of proprietary information. Proprietary information does not generally work in the best interests of a supply chain management system. Having clear, open information flow is essential for proper decision making and efficient transactions. Proprietary information has long been a part of the forest industry but must be limited if a functional supply chain management system is to become a reality within this industry. Anti-trust regulation brings another challenge for the implementation of a forest industry supply chain management system. Creating a platform whereby all players are treated equally and the promotion of fair trade is established will be a challenge due to the complexity of the forest industry. Fairness among all market players will be a key for successful implementation. Getting the current industry to adopt the use of a supply chain management system presents another hurdle. Traditionally the forest industry has operated its supply chain without the use of major technological devices. Making users aware and comfortable with using supply chain management technology will increase use and efficiency and be a major measure of success. The potential global scope of this system presents challenges in itself. Linking all members of the forest industry across the world using common

formats of language, monetary value, and definition presents many challenges. A system of this extent would need oversight by a designated authority to ensure operation and effective communication. Constant real time updates and system upgrades present another unanswered question that needs future research. In order for a supply chain management system to work within the constantly changing marketplace of the forest industry from day-to-day, real time updates and instantaneous transaction ability must be standard. Who should be involved with oversight, should there be a charge for using a supply chain management system, what liability will this system have for transactions made are questions that need further research.

This work has shown some of the benefits that an online GIS supply chain management system may provide; but such a system will require more research and testing before implementation. By performing this project, key information needed to georeference forest industry supply chain members has been identified. An enhanced understanding of anti-trust law and regulations regarding the forest industry has been presented within this work. Current forest industry information available on the Internet has been presented and analyzed to provide data to increase efficiency and provide a communication medium via Internet. Forest industry supply chain members for the state of Virginia were researched and georeferenced to demonstrate three case studies that mimic real life forestry applications. This research has been an important building block toward the goal of optimizing the forest industry supply chain and has served to enhance the knowledge of forest industry supply chain management.

Literature Cited:

Andriessen, J.H.E. 2003, Working with Groupware: Understanding and Evaluating Collaboration Technology, Springer Verlag, London.

Barber, K., F. Dewhurst, R. Burns and J. Rogers 2003: Business-process modeling and simulation for manufacturing management. Business Process Management Journal. 9 (4): 527-542.

Beamon, B.M. 1998. Supply chain design and analysis: models and methods. International Journal of Production Economics 55(3):281-294.

Becker, A.D. 2004. Miller-Tydings Act. Northfield, Minnesota.

Bumgardner, M., U. Buehlmann, A. Schuler, and R. Christianson. 2004. Domestic competitiveness in secondary wood industries. Journal of Forest Products. 54(10):21-28.

Center for Forest Business, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602-2152. 2006. Timber Mart-South (www.tmart-south.com). The Journal of Southern Timber Market News Vol. 11 No. 1 (1st. Quarter 2006).

Cise, J.G.V. 1975. The Federal Anti-trust Laws. 3rd rev. ed. American Enterprise Institute for Public Policy Research, Washington, D.C.

Cise, J.G.V. 1982. The Federal Anti-trust Laws. 4th rev. ed. American Enterprise Institute for Public Policy Research, Washington, D.C.

Cise, J.G.V. and W.T. Lifland. 1980. Understanding the Anti-trust Laws. Practicing Law Institute, New York.

Clegg, C. and Walsh, S. 2004. European Journal of Work and Organizational Psychology. Vol. 13, Issue 2. pp. 217-239.

Cumbo, D., D.E. Kline, and M. Bumgardner. 2006. Benchmarking Performance Measurement and Lean Manufacturing in the Roughmill. Journal of Forest Products. 56(6):25-30.

Davenport, T.H. and J.D. Brooks. 2004. Journal of Enterprise Information Management. Vol. 17, No. 1, pp. 8-19.

Davis, W.S., and J. Benamati. 2003. E-commerce Basics Technology Foundations and E-Business Applications. Addison Wesley, Boston.

Daxner, P. 2002. Logistics software implementation in Austrian forest and timber industries. Operations Research Conference. Santiago, Chile. 4-7 March.

Erni, V., R. Lemm, F. Fruitig and K. Oswald 2002: Modeling of process chains with component-ware: The example of timber harvesting. Schweizer Z. Forstwessen 153 (12): 462-470

ESRI. Oct. 31 2007. http://support.esri.com/index.cfm?fa=software.gateway.

Forest2Market. 2007. www.forest2market.com.

Forest Resources Association Inc. 2007. Rockville, Maryland. www.forestresources.org/

Frayret, J.-M., D. Amours, A. S. Rousseau, and S. Harvey. 2005. Agent Based Supply Chain Planning in the forest products industry. FOR@C Research Consortium, Universite Laval Departement de genie mecanique, pavillon Pouliot, Quebec, Canada.

Gellhorn, E. 1976. Anti-trust Law and Economics in a Nutshell. West Publishing Co., St. Paul, Minnesota.

Gifford, D.J., and L.J. Raskind. 1983. Cases and Materials on Federal Anti-trust Law. West Publishing Company, St. Paul, Minnesota.

Global Wood. 2007. www.globalwood.org.

Gunter, H., G. Grote, and O. Thees. 2006. Information technology in supply networks Does it lead to better collaborative planning? Journal of Enterprise Information Management 19(5):540-550.

Heinimann, H.R. 1999, "Logistics in timber production – state-of-the-art and perspectives". Forstwissenschaftliches Centralblatt, Vol. 118, pp. 24-38.

Heinimann, H.R. 2000, "Business process re-engineering – a framework for designing logistics systems for wood procurement", Proceedings of the 1st World Symposium on Logistics in the Forest Sector, Supply Chain Management for the Paper and Timber Industries.

Hill, L.L. 2006. Georeferencing The Geographic Associations of Information. The MIT Press, Cambridge

Kline, D.E. 2006. Woods-to-Goods: Creating a web-based forest industry community to promote sustainable and competitive forest-to-consumer value streams. April Progress Report. Wood Education and Resource Center.

Kline, D.E. and D. Cumbo. 2005. Understanding Forest to Consumer Value Streams: RFID tracking and GIS visualization Technologies. RFID Integrated Supply Chains, Alfred P. Sloan Foundation, Baylor University, Waco, TX. October 20-21, 2005.

Kuglin, F.A. 1998. Customer-centered supply chain management: a link-by-link guide. AMACOM, American Management Association, New York.

Martin, B., Kline, E., Prisley, S., and Visser, R. 2007. Online information systems for today's Forest industry. Austro2007/FORMEC´07: Meeting the Needs of Tomorrows´ Forests –New Developments in Forest Engineering, October 7 – 11, 2007, Vienna and Heiligenkreuz –Austria.

McKay, A. and Z. Radnor 1998: A Characterization of a business process. International Journal of Operations and Production Management. 18, 9-10.

Neale, A.D., and D.G. Goyder. 1980. The Anti-trust Laws Of The United States of America. Cambridge University Press, Cambridge.

Oswald, K., D. Riechsteiner, O. Thees and R. Lemm 2004: Reorganization of Wood Production for Improved Performance: a Swiss Forest District Case Study. Small-scale Forest Economics, Management and Policy, 3 (2): 143-160.

Poirier, C.C., and S.E. Reiter. 1996. Supply Chain Optimization Building the Strongest Total Business Network. Berrett-Koehler Publishers San Francisco.

Rauch, P. 2003: Strategies and methods for an efficient management of small scale forests- SWOT analysis, process management, GIS-based analysis of harvesting potential and organizational development. Doctoral thesis at the University of Natural Resources and Applied Life Sciences Vienna, 176 S.

Rauch, V.P. 2005. Business networking in the timber supply chain. Forest Science 122(4).

Rodgers, B., R. Visser, R. Shaffer, and T. Gallagher. 2002. Planning and Communication: State of the Forest Industry and Opportunites for Improvement in the Wood Supply Chain. Wood Supply Research Institute Industrial Forest Operations at Virginia Tech.

Schonsleben, P. 2004, Integral Logistics Management: Planning and Control of Comprehensive Supply Chains, St Lucie Press, Boca Raton, FL.

Scrivani, John. Virginia Department of Forestry. Personal Interview. June 2007.

Shenefield, J.H., and I.M. Stelzer. 1993. The Anti-trust Laws The AEI Press, Washington, D.C.

Skutin, S.-G. 1996: Business Process Improvement: The key to satisfied customers And Cost Reduction. Blinn C. and Thompson M.: Planning and Implementing Forest Operations to Achieve Sustainable Forests. 19th COFE Meeting. 260-268.

Society of American Foresters. 1980. Anti-trust Policy. P.1.

Society of American Foresters. 2007. Bethesda, Maryland. www.safnet.org

Symon, G. 2000, "Information and communication technologies and the network organization: A critical analysis", Journal of Occupational & Organizational Psychology, Vol. 73, 389-414.

Thompson, G.C., and G.P. Brady. 1974. Text, Cases and Materials on Anti-trust Fundamentals. West Publishing Company, St. Paul, Minnesota.

TIMBERWeb. 2007. www.timberweb.com.

Twillmann, Scott. Forest2Market. Phone Interview. October 26, 2007.

United States Department of Commerce. 2006. Value of Product Shipments 2005. http://www.commerce.gov/

United States Forest Service. 2007. www.fs.fed.us.

University of Texas Libraries. 2007. Proprietary Information and Competitive Intelligence. www.lib.utexas.edu/engin/guides/proprietary.html.

Vakola, M. and Y. Rezugi (2000): Critique of current business process re-engineering methodologies. The development and implementation of new methodology. Business Process Management Journal, 6, 3: 238-250.

Virginia Department of Forestry. 2007. www.dof.virginia.gov.

Vlosky, R.P., and T.M. Smith. 2003. eBusiness in the U.S. hardwood lumber industry. Forest Products Journal 53(5):21.

Warkotsch, W., and M. Ziesak 1998: The timber supply chain- problems and solutions. Schriftenreine des Instituts fur Forsttechnik, Band 8: 49-55.

Appendix A: Timber Mart-South Logging Survey Definitions

1. Cut and Load Rate- Rate paid to a logger to harvest trees and load them on a truck. Do not include any hauling rates.

2. Logger- Harvests timber on a contract basis for a mill or wood dealer.

3. Swamp Logging- Cut/Load Rate for harvesting with "Swamp Crews". Harvest equipment consists of a tracked feller and skidders with oversized or dual tires. Also referred to a bottom land logging in some areas.

4. Upland Logging- "Typical" logging conditions on good ground. Harvest equipment consists of four or three wheeled feller-buncher and skidders with normal tires.

5. Final Harvest- Cut/Load Rate for clear-cut, real estate and seed tree cuts.

6. Plantation Thin- Cut/Load Rate for 1st or 2nd thinning in pine plantations

7. Natural Thin- Cut/Load Rate for thinning in natural timber stands.

8. Wood Dealer- Purchases wood for contract loggers and company owned loggers.

Appendix B: Timber Mart-South Timber Price Survey Definitions

1. Pine and Hardwood Pulpwood- 6" and up Diameter at Breast Height (DBH).

2. Chip-n-saw- 8"-11" DBH

3. Pine and Hardwood Sawtimber- 12" and up DBH

4. Pine Ply Logs and Poles- Reflect the standards in the area and may or may not be strictly comparable either from area to area or quarter to quarter.

5. Pine Sawtimber- 7.5 tons/MBF- prices are based on Scribner.

6. Pine Pulpwood- 2.68 tons/standard cord

7. Hardwood Sawtimber- 8.75 tons/MBF- prices are based on Doyle

8. Hardwood Pulpwood- 2.90 tons/standard cord