Assessing Geographic Information Systems (GIS) Use in Marketing Applications: A Case of Study in the Wood Products Industry

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ABSTRACT

Geographical Information Systems (GIS) is a worldwide growing technology, however it is not yet completely accepted. Of all of the business processes in an organization, marketing is perhaps one of the natural fitting-processes to apply GIS. Even though there is recent research regarding applications of GIS in the wood products industry, those applications are mostly related to biomass mapping and logistics issues. Little research has been conducted on the utilization of GIS as part of the marketing strategic plan in this industry. Thus, the main goal of this project is to understand GIS uses on marketing application in the wood products industry, specifically in the marketing mix strategic plan.

The approach of this project consisted of the collection and analysis of data from secondary wood products industries in the state of Virginia. In addition, a case of study on current users of GIS applications was conducted. Once the data from the survey and the case study were collected, validated, and analyzed; applications and guidelines for the use of GIS in marketing activities were developed. The first application was the creation of a relational database to organize the information and to create an industry directory for secondary wood products industries. Secondly, clustering techniques were used to test if wood products companies cluster around certain geographical regions. Confirmation of the clustering led to the construction of an online map. Finally, guidelines were developed to describe how to use GIS in the marketing process of wood products firms.

By increasing the knowledge and developing guidelines on GIS uses on marketing mix applications this study will help the wood products industry, other practitioners and the academic community, by providing insight of the industry, possible uses to simplify the strategic process and gain understanding of the environment among other.

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1 Introduction

1.1 Research Motivation

In a world in which technology is moving rapidly toward the future, companies face new challenges and adaptations in order to retain their brand and costumers. Since the creation of the internet in the 1960s, companies have adapted to and taken advantage of the beginning of the World Wide Web (Clarke and Flaherty 2005). Increasingly, firms are searching for new and practical ways to adapt technology into their day-to-day process in order to obtain faster responses from the environment and costumers.

As with many other disciplines, marketers remain exploring possibilities of the Internet and information systems, most recently focusing on social media venues, to better assist electronic marketing, channels of communication, selling skills, and the distribution of products and services among others. Utilizing Geographic Information Systems (GIS) is one of the new technologies that companies can utilize to better understand customers and improve their marketing strategies. Spatial analysis knowledge can be provided by GIS, which is a basic and crucial analysis needed to be successful in marketing (Longley and Clarke 1995).

The basis of planning surrounding the decision-making in any situation, ultimately strategy is about finding the union between the organization and the environment (Hoffman, Czinkota et al. 2005). A good method to adapt when trying to accommodate for the ever-changing surroundings of the firm is utilizing a marketing mix (product, place, promotion, price); which refers to the main areas of decision making for the marketers, knows as 4P's (Hoffman, Czinkota et al. 2005).

Today's studies suggest that, the significance of GIS in marketing applications can be validated by the use of marketing mix variables (Hess, Rubin & West, (2004), Clarke & Flaherty, (2005)). Examples refereeing to the 4P's such as; place; locating the retail store, determining costumer potential and physiographic factors, promotion; demographic of

networks, locations and direct mailing, product; ethnicity, socioeconomic status, traffic and shelf space and price; distribution cost, product delivery, demand and competition, to mention some examples for the GIS utilization in marketing mix (Clarke & Flaherty 2005).

Because GIS is proven to be helpful in assisting the creation of marketing mix and marketing strategies, this research sought to understand the basic knowledge of marketing mix variables in the context of GIS applications and the future utilization for the Wood Products Industry. Developing a guideline for wood products industries that focus on GIS uses of marketing and an online map application that represents some utilization will help the wood products industry. An application like this will increase the knowledge on this industry sector, as well as enlarge the range of action for the wood products companies regarding the GIS uses on marketing applications. Researchers consider that increasing the knowledge on this topic in the wood products industry will benefit the companies in topics such as planning, developing, implementation, cost, time spent, ideas of utilizations, resources needed in the GIS uses on marketing application.

Findings will allow researchers to recognize the importance of GIS in the marketing department and to present new ideas and practices to develop a good implementation of GIS in the firms. The development of this research creates three different outputs: (1) an industry directory of wood product firms, (2) an applications of GIS for marketing strategies (online map), and (3) a best practices manual for GIS marketing strategies. These strategies will help the wood products industry on GIS uses on marketing application and the utilization of information systems to better assist the decision making in the company.

Current knowledge regarding GIS applications in marketing focused on aspects such as marketing mix implementation, examples of GIS in marketing applications identify areas where GIS is utilized for product, place, promotion and price (Hess, Rubin & West, 2004). Several investigations regarding applications of GIS in marketing have demonstrated the relationship of the two parts -GIS and marketing- (Wu & Rathswohl

(2010), ESRI (2010), USC – University of Southern California (2011), ESRI (2003), Johnson (2010), LISC (2002), Toppen & Wapennar (1994), Musyoka, et al. (2007), SCGIS (2008), Miller (2007), GIS Marketing (2009), Pick (2005), Department of Economic and Social Affairs (2000).

Little information was found on specific GIS applications on marketing in the Wood Products Industry. Therefore, a big opportunity to investigate on GIS applications on marketing mix for the wood products companies was discovered. If application are already used in other industries, it would only make sense to research and develop new knowledge on this field, in which the little experience will eventually achieve the full potential of this technology and bring benefits to the wood companies and the industry in general.

1.2 Thesis organization

This research contributes to the creation of knowledge on GIS uses in marketing application among the Wood Products Industry. Because of the information deficiency in understanding the application of GIS into the marketing mix strategy in the wood products industry; the researchers design a project in which the level of knowledge will increase form the actual comprehension.

The main goal of the research corresponds to the development of guidelines for GIS uses in marketing applications in the wood products industry, when working with GIS, data becomes a crucial part of the process. The data for this research will be obtained through a survey of the Virginia secondary wood products to create a relational database. The data from the survey will be used to test if this industry is grouped in clusters, hypothesis develop by the researcher. Also, interviews to GIS experts and companies in other sectors were conducted to understand current applications of GIS. The data from the survey and the case study will be used to create a manual of GIS marketing best practices. The data from the survey of the VA secondary wood products will be used to create an online map (GIS application). The GIS application was created as a tool to utilize the data collected for GIS uses on marketing application for the wood products industry, this GIS mapping

tool will be helpful to for the industry by creating a new instrument that help them visualize geographical information about the secondary wood industry, also it will help practitioners from the best practice manual and other investigators. By identifying the best practices for GIS in marketing mix, wood products companies can adopt application and action that fit and improve the marketing mix strategy process.

This thesis is ordered as follows: Chapter 2. Literature Review; provides the literature review and basic procedures to obtain the VA secondary wood industry directory, the online map and the GIS application in marketing. Chapter 3. Research purpose, objectives and hypothesis; explains the main purpose of the research as well as the objective and hypothesis proposed by the researcher. Chapter 4. Methodology; provides the methodology used to implement the industry directory research, the online map and the GIS uses on the marketing applications. Chapter 5. Results; describes the results obtain from this particular study; the directory, the case study, hypothesis, among others. Chapter 6. Discussion, Contributions and Conclusions; provides the discussion and conclusion obtained from this research, as well as some contributions, limitations and future research suggestions arising from the study.

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2 Literature Review

2.1 Relational database models

Computers have been use for many purposes with one of the most important purposes being storing and managing information. The manner in which data is organized has a big connection to how easy it is to access, manage and organize data in tables in the simplest and most versatile way (Aho & Ullman, 1992). Utilizing relational databases also minimizes data duplication, ensuring the integrity of the same and also reduces the requirements of storage (Kroenke, 2005).

A database is defined by Sciore (2009) as "a collection of data stored on a computer" (p. 1), it is also mentioned that typically a database is ordered into records for a better management of data. The relational model is focused in the idea of data organized in two-dimensional tables (relations). These relational data models were developed for databases, which store information over long periods of time in a computer system. The software of this type of relational models allows people to store, access and modify the data within the system (Aho & Ullman, 1992). A relational model is also defined by Kroenke (2005) as a "set-theoretic model for describing data constructs common in the business environment" (p. 89).

According to Aho & Ullman (1992) there are basic needs to design information structures using relational models, which are (1) tables of information called "relations," (2) the selection of "attributes" or properties of the described objects, (3) each column in the table is derivate from an attribute, a "key" correspond to a unique value that is determine by the values of a whole rows in the table, and (4) indexes are data structures in which information can be retrieve or change quickly.

2.1.1 Relations

According to Aho & Ullman (1992) relation is a set of tuples; a list of components and each relation has fixed number of components. The relational model stores information in

tables with each column of the table being an attribute, and each row in the table is called tuple (Aho & Ullman, 1992). According to Aho & Ullman (1992) a table has two aspects, (1) set of columns names and (2) rows that contains the information. The specific relation refers to the set of rows and it is important to clarify that no two rows of the same table will have identical values.

2.1.2 Databases

A database is formed when a collection of relations are made. The first step in designing a database is to decide how the information will be stored (tables), which can be decided by a matter of business needs and judgment. By selecting the appropriate data structure, a simple and unproblematic navigation of the database can be achieved (Aho & Ullman, 1992). The various relations in a database are called the "scheme of the database," but there is a difference between the scheme database and the actual database. The scheme tells how the information is organized in the database, while the database is a set of tuples in each relation (Aho & Ullman, 1992).

2.1.3 Queries

Within the database, a group of functions such as insert, delete and lookup can be performed with help from queries (Aho & Ullman, 1992). Also it is mentioned by Aho & Ullman (1992) that a great variety of operations can be performed with the combination of two or more relations in the database.

2.1.4 Advantages and Limitations of relational models and databases

When utilizing relational models and databases some advantages and limitations can be found, according to Graves (2010) and Sciore (2009) this are:

Benefits:

- It is easy to use and customized
- Provides separation from the physical and conceptual schema
- Provides optimization in the query
- Provides security among the data

- Provides connection with tables, which enforce data integrity
- Saves researchers time and money if the data is available (already collected)
- Allows to manage large samples of data without problems

Limitations:

- The process of data collection and updating data may take a lot of time
- Some knowledge on the software and hardware are necessary
- If data already exist the date, and general focus of the data might be different form your purpose

2.1.5 Microsoft Access

Microsoft Access corresponds to a relational database model, which will be used in this study. According to Tremblay (2011), Microsoft Access creates a relationship between databases, in which the data display is organized and related on tables. On the table, one or more fields are linked to each other and another tables, this linkage ensures that special details from fields are not included in other tables. In other words, it helps preventing the ambiguity of information or repetition of the data (Tremblay, 2011). The most important aspect of Microsoft Access is that it contains multiple tables that comprise various entities, helps store data in an orderly manner and display which makes the data present information in an efficient and structured way (Tremblay, 2011).

This research is emphasized in the development of a best practice manual for Geographic Information Systems (GIS) application in marketing. The results obtained will correspond to a best practice manual that will help companies, academia and other researchers who are interested in this topic. Marketing and GIS is combined in this research in order to understand the benefits that may arise from this combination, not only for the industry but also the benefit of contributing to academic knowledge.

2.2 Marketing

Marketing is easily misunderstood as a process of telling and selling products (Armstrong & Kotler, 2005). Marketing must be understood as a new sense of “satisfying customer

needs." In other words, as Armstrong & Kotler (2005) mention, marketing is a process by which consumers (individuals and groups) obtain what they want and need by creating value in the product and exchanging value with others. Moore & Pareek (2006) mention that marketing has two goals: (1) First, attract new customers by emphasizing the value of the product or service offer by the company and (2) Second, retain the customer attracted and keep satisfying the customer with old and new products and services. Armstrong & Kotler (2005) define the marketing process in a simple way; as those who companies understand consumers, create consumer value build relationships and capture the value from customers.

According to Howe & Bratkovich (2005) companies should have a focus on customer (marketing orientation) regarding the definition of marketing that they have and the activities they develop as company. A marketing orientation is defined by Howe & Bratkovich (2005), as orientating all your company activities on the customer needs, exceptional companies incorporate marketing orientation into their corporate culture. Marketing focuses on 4 principal pillars: Price, Product, Promotion and Place. These "4P's" help the organization target a market and strongly win portion of the segment market (Hoffman, et al., 2005).

The marketing literature expanded along with the growth of Western Europe, which created the basics of marketing for the early writers, with an emphasis on the relationship between economic development and the role of marketing (Tadajewski & Jones, 2008). Since the past, writers recognized three elements of transaction: (1) cost were explicitly noted, (2) cost are implicit in negotiations and (3) concern on improving the structure of the nations communication (Tadajewski & Jones, 2008).

Even with the improvements on marketing in the early days, Tadajewski & Jones (2008) recognized a major weakness in the development of the concept of marketing, which was that the significance of market efficiency was missed. This may have been due to the focus on expanding national policies and forgetting about the output per capita. Despite the lack of analytical tools, early writers made impressive steps for marketing, marketing

management, macromarketing and marketing behavior, which became the bases of the modern marketing (Tadajewski & Jones, 2008).

Marketing application corresponds to a wide range of processes, products and services. It can be used for any company in need of communicating directly or indirectly with the customers. Two basic and most popular types of e-commerce:

1. Business to Business (B2B): The Business Dictionary (2012) defines Business to Business (B2B) as the exchange between firms characterized by large volumes, competitive prices, fast delivery time. In general firms characterize with wholesaling is B2B and firms characterize with retailing is Business to Customers (B2C). The process by which organizations employ strategies with the purpose of converting target business into customers, with web communications, email, media campaigns and relationship managements is called Business-to-Business Marketing (Business Dictionary, 2012).
2. Business-to-Consumer (B2C): Business to consumer is when a transaction occurs between a consumer and a company. In other words, it is a process that describes the relationship and dealings with a company's goods or services to suite the needs of the consumer (Business Dictionary, 2012).

In order to provide many applications and benefits among different industries and companies, marketing needs to develop a good strategic plan. Since the 1960s, there have been a lot of terms to describe Strategic Planning, such as, comprehensive corporate planning, comprehensive managerial planning, comprehensive integrated planning, corporate planning, formal strategic planning and other combinations. According to Steiner (1997), formal strategic planning has to be defined from four points of view; (1)Futurity of current decisions, (2) Process, (3) Philosophy and (4) Structure.

1. Futurity of current decisions: It means to look at the cause and effect consequences of an actual or future decision that the manager is going to make. If the manager does not like the consequences ahead, the decision can change (Steiner, 1997).

2. Process: Steiner (1997) mentions that it begins with setting organization aims, defining strategies and policies to accomplish them as well as detailed plans to implement the strategy correctly, in more cases the plans are set for a certain amount of time, not to change every day, but it has to be appropriate for unexpected changes and actions.

3. Philosophy: This point refers to an attitude; a lifestyle. It refers to the fact that the organization has to believe in the strategic plan. The manager and the coworkers need to believe that it is worth doing, and they must want to do the strategic planning in the company (Steiner, 1997).

4. Structure: The fourth point Steiner (1997) mentions is referring to the integration of strategic plans, medium-rage programs and short-rage budgets and operating plans. It is focused on the linkages of those plans into a management strategies that will translate to current decisions.

Developing a strategic marketing plan is not an easy process, but Pophal (2009) describes a step-by-step approach to developing a strategic marketing plan:

1. Situation analysis
    a. Industry analysis
    b. Market analysis
    c. Competitive analysis
    d. Internal analysis
2. SWOT analysis
3. Quantifiable objectives/goals
4. Strategies and tactics to meet objectives/goals
5. Responsibility/ accountability
6. Develop a budget
7. Ongoing monitoring and adjustment

Creating a strategic plan is one of the components in marketing, but analyzing the competition is another crucial element. A competitive analysis involves observing your competition, as well as analyzing how your organization compares to the competitors. This includes analyzing a number of factors such as sales, products, customers, service, market position, as well as looking for strengths and weaknesses (Pophal, 2009). According to Day (1990), the development of an effective competitive strategy starts with truly understanding the advantages and deficiencies of a business, as well as the vulnerability of the actual position to copying by competitors.

There are two different approaches to assessing advantages: " The first sustaining edge of excellence; Take exceptional care of customers via superior service and superior quality" (Peters & Austin, 1986, p. 125-160) and "the true nature of marketing is not serving the customer--it is outwitting, outflanking and outfighting your competition" (Ries & Trout, 1986, p. 126-160). These two diverse views on how to compete shape how managers decide to distinguish business advantages and how those are gains (Day, 1990).

Recognizing characteristics of clients such as where they live, their behavior and their preferences on stores, has become a necessity for companies nowadays (Badea, Bagu, Badea, & Moises, 2009). Knowing that characteristics of the customers are so significant for the business, it is important to accelerate the process such as customer profiling, profile behavior, which will give the corporation a competitive advantage.

For this particular research, the focus on marketing will refer to the strategic marketing mix plan (4P's). According to Moore & Pareek (2006), one of the main and critical functions of a company is marketing, because without consumers there is no revenue, and without that the company cannot work. Marketing is a business process that can fit into the overall firm's strategy, decision-making, mission statement, and corporate strategy (Moore & Pareek, 2006).

Marketing not only fits the company strategy, but organizations can also create their own marketing mix (strategy) to fit their consumer preferences and behavior as well as the

goods or services provided by the company. Moore & Pareek (2006) mention the elements of the marketing mix, which consist in the four P's (product, place, price, promotion).

- **Product:** In marketing, a product is more than a physical object; it is a union of physical, experimental, psychological benefits that a consumer receive to satisfy their needs (Moore & Pareek, 2006).
- **Place:** Manufacturing companies do not sell their good directly to the consumer instead they sell the product through a marketing channel (which represents a network of institutions linked to accomplish marketing task and deliver the products to the consumers) (Moore &Pareek, 2006).
- **Price:** Determining the correct price is not a perfect science. The price must cover the cost of the product and return a profit to the producers. The amount of profit collected by the producer, and the company and the market potential buying status will determine the marketing channel (Moore & Pareek, 2006).
- **Promotion:** Promotion includes spreading information about the company or the product using five different elements: (1) advertising, (2) sales promotion, (3) public relations, (4) personal selling and (5) direct marketing (Moore &Pareek, 2006).

According to Kitchen (2003), over the past several years marketing has evolved from a highly product-centered to competitive forces centered and now is moving to a customer centered orientation. For many decades the primary focus of marketing was promoting and packages products, companies focus on differentiation as an advantage especially in B2B contexts (Kitchen, 2003). After that differentiation phase, Kitchen (2003) mentions that marketing became more competition, in order to combat that the tendency of companies to adopt low cost strategies, differentiation and positioning to competitors. Now companies realize that too much competition could destroy them, and they are looking forward to using the consumer as the basis for strategy and positioning instead of competition (Kitchen, 2003).

2.2.1 Marketing on the wood products industry

Even though this research will help different industry types, the main researcher's interest focuses on the wood products industry. Taking this into account it is important to understand the role that marketing has in this wood products industry.

On the marketing perspective, according to Dasmohapatra (2009), the North America Forest Product Industry is losing its domestic markets, the slow economy and low manufacturing cost cause the close of many mills and many workers lose their jobs in recent years. Dasmohaprata (2009) also argues that the new marketing drives or new era of the forest products industry relies in opening the minds to global markets, targeting products to changing demographic structure and customers taste, products with environmental taste, innovation, efficient management, trade practices and policies. Some of the most important finding of Dasmohapatra (2009) for marketing in the Forest Products Industry was:

- Today economics shows that manufacturing will continue to move to efficient and lower-cost centers.
- Why marketing? How can it help? Because the firm primary objective is to make profit, and it can only be accomplished by offering and targeting the correct **products** to the **customers** at the precise **time** at the exact **place** .

There have been some changes in the Forest Product Industry market which are; globalization and access to free markets, changing demographic structure across the world, environmentally friendly material, demand of small environmental footprint, innovative products, creating value in the supply chains and trade policies and tax practices.

Referring to the consumer behavior in wood products, Anderson, et al. (2005) developed a study about current consumer behavior in forest products, in which they research how forest firms can satisfy consumer's wants and needs, only if they really understand their consumer. Regarding the method used (mail survey or mall intercept methods) researchers need to cautious control the bias in the data typical use in forest products

business/marketing field (Anderson, et al., 2005). The two most important results found by Anderson, et al. (2005) were: "Researches will need to adapt their efforts to incorporate the networking aspects," and "surveys have been and will continue to be, a mainstay in forest products marketing research" (p. 21-27).

According to the marketing strategic plan in wood products industry, Cohen & Smith (1991) researched two different marketing strategies for the Forest Products Industry: (1) International marketing and (2) Global marketing. The first marketing plan consists in selling different products of the same resource to international markets using different method to each market. The second marketing plan refers to selling the same standardized product to many markets using the same method.

The International and Global marketing represent completely different points to approach a strategic marketing plan, even though Cohen & Smith (1991) conclude that the appropriate strategy combination have an substantial impact in the success of wood products exports. They also mention that choosing the correct strategy is not a simple process (it is linked to tactical decisions, product mix, promotional efforts, specific export targets, etc.) and finally they explained that: "Understanding the strategic options available to an exporting company or region is the first step towards developing appropriate exports strategies" (Cohen & Smith, 1991, p. 131).

One important aspect of the strategic marketing plan is the marketing mix in which the company analyze the four P's and develop a plan of action for each one of them. In one way or another research conducted in recent years may be associated with the marketing mix made by companies, for example research such as Surveying and mapping wood residues (De Hoop et all, 1997) can be associate with the product, Planning the use of information technology in marketing (Toivonen, 1999) can be related with promotion, Consumer behavior in forest products (Anderson et all, 2005) with price, Green advertising in forest sectors (Grillo, Tokarcsyk & Hansen, 2008) related with promotion, Availability of biomass residues for bioenergy production (Parhizkar & Smith, 2008) can

be associated with product and Forest cover changes (Kumar, 2011) with price or product to mention some.

In terms on competitive advantage in the wood products industry, competing with an increasingly complex environment, a competitive business atmosphere and pressures such as foreign competition or substitute products are some factors the forest products firms have to deal each day (Tokarczyk & Hansen, 2006).

According Tokarczyk & Hansen (2006) one way to minimize the effects of these factors is by improving and targeting marketing through branding activities. Product or service branding is becoming common in the marketplace; this is beneficial because wood products take a positive connotation in the minds of consumers (Tokarczyk & Hansen, 2006). After analyzing; what does our brand stand for…(quality, price, service, innovation)? And How can these be improved, maintained and communicated?, the value of brands can be improved; creating relationship with the customer is the main goal of branching, this help to build and maintain the growth of the firm (Tokarczyk & Hansen, 2006).

Many other articles were found regarding the wood products industry and marketing applications such as strategies changing in mature industries (Bush & Sinclair, 1992), hardwood lumber export barriers and incentives (Ifju & Bush, 1993), timber bridge industry marketing practices (Smith & Bush, 1994), product and supplier attributes on hardwood lumber fir furniture industry (Forbes, Sinclair, Bush & Araman, 1994), productivity features of the US wood cabinetry (Punches, Hansen & Bush, 1995), customer quality requirements for marketing management (Hansen & Bush, 1999), marketing aspects selection of character-marked furniture (Bumgardner, Bush & West, 2000), marketing in wood products companies (Smith, Olah & Virginia Cooperative Extension, 2000), customer behavior in forest products (Anderson, Fell, Smith, Hansen & Gomon, 2005), competitive strategies of furniture manufacturers (Gazo & Quesada, 2005), US hardwood broad market (Bowe, Smith & LaBissoniere, 2005) and marketing

opportunities for appalachian forest products in central America (Lyon, Quesada-Pineda, Smith & Kline, 2013) among other.

2.3 Geographic Information Systems

Demers (2009) defined Geographic Information Systems (GIS) as "a system designed to input, store, edit, retrieved, analyze, and output geographic data and information" (p 19). As with all systems, GIS is composed of integrated parts that allow it to perform correctly. These parts include (1) computer hardware and software, (2) space and organization, (3) personnel and (4) data and information (Demers, 2009).

According to Demers (2009), analyzing spatial data and information is the primary task of GIS, but performing meaningful analysis requires software that achieves many other tasks such as editing, retrieval, and output. With GIS Business Analysis users can better understand their organization environment information, the competition and also improve the decisions in customer behavior. In addition, business analysis can build models that fit into organization analysis workflow for site evaluation, market penetration and conduct customer prospecting (Raduj, 2009).

Over 25 hundred years of geographic research and investigation, resulting in a geographic information systems evolution, the first stages of GIS were focused on exploration unknown lands, their inhabitants and phenomena's, in other words the primary focus was discovering (Demers, 2009). Demers (2009) explains that the need of explain phenomena's lead researcher to create an outcome of pattern explanations for different distributions, in the early 1960's the Department of Forestry and Rural development of Canada pursue a project to manage the territory of Canada, this was the first big scale project. With this project the first operational system ever built was created –Canada Geographic Information Systems-, this creation led to more research and exploring which conduce to the actual GIS, as we know now a days (Demers, 2009).

Grimshaw (1993) describes GIS for business purposes as an application or tool that support management decisions. According to Toppen & Wapenaar (1994) mention that

every activity and process requires a different kind of GIS within each level of the organization, this correspond to: (1) Operational GIS applications; use GIS to monitor functionalities of goods for the retail, (2) Tactical application; provide information for decision making and (3) Combination of spatial data; information on market potential and competitors location.

Marketing of all the business sectors is perhaps one of the most obvious to which to apply GIS. In general, marketing emphasis on demand (customers) and supply (outlets, retail, shopping centers), are easy to analyze and see in the geographic information systems (Toppen & Wapenaar, 1994). There are research articles, news and investigations about GIS application in every industry, in marketing is generally found in topics such as; Customer Marketing Analysis, (Toppen & Wapenaar, 1994) Penetration & Winning Strategies (Simon Thompson, 2010), Customer Profiling & Costumer Behavior (Badea, Bagu, Gap, Badea, & Moises, 2009), Business Analysis (Raduj, 2009), Market segmentation (Musyoka, Mutyauvyu, Kiema, Karanja, & Diriba, 2007) among others.

Combining conventional marketing techniques with geospatial methods enables users to picture the spatial distribution of data in maps -such as the distribution process, the market diverse- also complementing it with statistical graphs and diagrams will link marketing and GIS (Musyoka, Mutyauvy, Kiema, Karanja, & Diriba, 2007).

The main focus of this research is on GIS application for the marketing mix (4 P's), which refers to the main element on a marketing strategic plan. Hess, Rubin & West (2004) research and present some ways in which GIS can support the activities of the four elements of the marketing mix.

- On the product component Hess, Rubin & West (2004) mention that, this element involves the link between the product attributes and the consumer characteristics, the consumer characteristics are geographic distributed, which suggest that the design and market of the product will be based on geographic data. Hess, Rubin & West (2004) also mention one application of GIS for a product is "to discover where products are selling well and what characteristics of consumers in these

areas drive the demand" (p 208). Using the same analysis, it can be found what product characteristics make then unattractive in low sales areas, this type of information can be used for marketing product decision such as line-stretching, line-fitting, line-modernization and features (Hess, Rubin & West, 2004).

- In regards to price Hess, Rubin & West (2004) mention that geography can influence the price of a product. For example, you expect to pay more for gasoline next to a interstate that in a small town. The influence of proximity to other similar products, discount complementary availability, competing with products or services and other merchants, wholesalers, retailers can affect the price of a specific product.
- Place (distribution) is according to Hess, Rubin & West (2004) one of the first areas where GIS is used for marketing mix application, examples such as address retail location, distribution centers, fixed delivery routing and flexible delivery routing can be found on GIS applications for place.
- For promotion according to Hess, Rubin & West (2004) the most important issue is to successfully intergrade internal and external information using GIS. The internal and external information of promotion refers to the approach the company will use for the specific product or service, such as personal selling, international selling, local selling, sale promotions, telemarketing, direct mail, spam, product placement, among others (Gillespie & Hennessey, 2007).

Some research articles founded about the GIS application on the marketing mix are; Geographic Information System (GIS) market in retail sector (M2 Presswire, 2010), DSS implementation in the UK retail organizations: A GIS perspective (Nasirin & Birks, 2003), Methods for evaluating agricultural enterprises in the framework of uncertainty facing tobacco producing regions of Virginia (Halili, 1999), Put your firm on the map (Talsky, 1996) among others.

Demers (2009) affirm that Geographic Information Systems is an exiting and glamorous field, which is expanding rapidly in opportunities for those who know the concepts and the technology. For the purpose of this research, the authors analyzed future of GIS on

the Business College and development. According to Lawrence (2007), the faculty and leaders of colleges of business apparently are not aware of GIS and its capability in helping make solid immediate business decisions, regarding site analysis and spatial management of business activities. Only 5 out of 140 colleges of business have GIS courses in their curricula and just 23 of these have courses that include spatial analysis (Lawrence, 2007). In 2007, only few curricula include GIS analysis as effective business decision-making. There is much work to be done not only in the academic collaborations of colleagues of business and geographic departments, but also in helping companies to embrace the GIS as a effective way of making decisions, develop marketing strategies and gaining a competitive advantage in their industry sector.

2.3.1 GIS on the wood products industry

As mention the main interest of this research focus on the wood products industry. Taking that into account it is important to understand the role that GIS has in the wood products industry.

On the GIS perspective, The Wood Product or Forest Product Industry has used GIS application to different proposes such as; Surveying and mapping wood residues (De Hoop et all, 1997), Planning the use of information technology in marketing (Toivonen, 1999), Consumer behavior in forest products (Anderson et all, 2005), Green advertising in forest sectors (Grillo, Tokarcsyk & Hansen, 2008), Availability of biomass residues for bioenergy production (Parhizkar & Smith, 2008), Forest cover changes (Kumar, 2011) to mention some.

Some research articles founded about the GIS application on the marketing mix in the industry; Geographic Information System (GIS) market in retail sector (M2 Presswire, 2010), DSS implementation in the UK retail organizations: A GIS perspective (Nasirin & Birks, 2003), Methods for evaluating agricultural enterprises in the framework of uncertainty facing tobacco producing regions of Virginia (Halili, 1999), Put your firm on the map (Talsky, 1996) among others.

Even though there is past and recent research regarding the application of GIS in the wood products industry, those applications are related to other purposes than marketing strategic planning. It was found little researches on the utilization of GIS as a part of the marketing mix strategic process on this industry (wood products industry).

Main findings from the literature review helped the researchers proceed in the development of guidelines of GIS uses on marketing application in the wood products industry. Topics such as relational database model, Microsoft access, marketing and GIS were combine in this research to gain a better understanding and create guidelines for GIS on marketing. A relational database model is important when storage and managing data for future analysis or review, this technology will be used by the researches to preserve the integrity of the data, manage the data and assist the Virginia Department of Forestry in their needs, among others.

The relational database model used in this research corresponds to Microsoft access, which helped the researchers store and present data in an efficient and structured way, literature review help the investigators understand that to use this system is necessary to understand and know how to manage the interface and software.

Marketing and Geographic Information Systems are crucial definitions and aspects to understand in this study. Marketing is generally understand as satisfying the customer needs, any applications on marketing can be found in different industries, including the marketing mix strategy (4P's). It was also found many information and important information regarding the marketing application and researches on the wood products industry. On the other hand GIS correspond to a system with integrated parts that help visualize data in a spatial dimension in other words in a geographic distribution. Different application of GIS in many company processes can be found in the wood products industry as well as in other industries, and also application of GIS in marketing aspects can be found on wood products industry and other sectors.

The conclusion and main aspects found by the researchers in this literature represent the main point in the creation of the research purpose, objectives, hypothesis, benefits and limitations in developing in this study.

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3 Research Question and Objectives

3.1 Problem Statement

Even though GIS is a growing technology among organizations, it is not yet a mature technology. This explains why the diffusion of GIS technology is rather fragmented, and it is expected to find differences in which GIS is applied between organizations and even within organizations (Toppen and Wapenaar 1994). Grimshaw (1993) describes GIS for business purposes as an application or tool that support management decisions. Toppen & Wapenaar (1994) mention that every activity and process requires a different kind of GIS within each level of the organization, this corresponds to: (1) Operational GIS applications; use of GIS to monitor functionalities of goods for the retail, (2) Tactical application; provide information for decision making and (3) Combination of spatial data; information on market potential and competitors location.

Some research articles, news and investigations about GIS application within in the industry are generally found in topics such as; Customer Marketing Analysis (Toppen & Wapenaar 1994), Penetration & Winning Strategies (Thompson 2010), Customer Profiling & Costumer Behavior (Badea, Bagu at al, 2009), Business Analysis (Raduj 2009), Market segmentation (Musyoka, Mutyauvyu et al, 2007), among others. In the Wood Forest/Product Industry articles can be found about; Forest coverage (Krumar 2011), National forest planning and wood resources distribution (Brown & Reed 2009), Segmenting forest industry and Marketing planning strategies (Toivonen 1999), Estimate availability of biomass residues (Parhizkar & Smith 2008) to mention a few.

Even though some research exists regarding the application of GIS in the companies, those applications are related to other purposes rather than marketing mix strategic planning specifically. Little research was found on the utilization of GIS as a part of the marketing strategic process specifically from the perspective of the wood products companies that utilizes GIS. Marketing mix is generally defined as “set of marketing tools that firm uses to pursue its marketing objectives in the target market” (p. 71)

(Kotler, 1988) but the most acceptable definition correspond to "comprises four key areas of decision –product, place, promotion and price- also known as the four Ps" (p. 17) (Hoffman et al., 2005). Researchers discovered a gap in the utilization of GIS in Marketing mix strategy development --that specific gap is the main goal for this research- even though during the past years there has been different research and investigations regarding the application of GIS application on marketing mix strategy in different industries.

3.2 Research Question, Goal and Objectives

The main research question for this study correspond to:

What potential GIS use on marketing mix applications can be develop for the wood products industry?

To answer the question researchers aims to conducts (1) a case study for a general overview of the utilization of GIS in supply chain management in different companies and (2) a survey of the VA secondary wood products industry. Both of the methodologies will be helpful to understand the advantages of using GIS in marketing applications. The following hypothesis was developed based on the proposal framework and the literature review.

Hypothesis 1. Wood products companies are located in clusters through the state of Virginia.

The primary goal of this study is to advance the understanding of GIS application for marketing strategies for the wood products industry. This study aims to combine different methods in order to understand the GIS uses on marketing applications in the wood products industry. The expected results of this study are (1) an industry directory of wood product firms, (2) an applications of GIS for marketing strategies (online map), and (3) a best practices manual for GIS marketing strategies.

The specific objectives are:

- *Objective 1: To develop industry directory using relational database model to capture, store, and generate report on the wood industry companies spread through the state of Virginia, U.S.*
  The outputs of this objective aims to help the VA Department of Forestry to update their records and to include new data on secondary wood products industries in VA. Data for the directory will be collected through a survey of secondary wood products in VA.

- *Objective 2: To develop an online GIS mapping tool for primary and secondary wood products industry companies in Virginia, U.S.*
  This research objective was influenced by the GIS importance on marketing mix strategy. The online map will be a public domain on the Internet, which will be helpful for the VA Secondary Wood Industry. The information was obtain from Infogroup Academic and corroborated by a questionnaire apply to the entire population.

- *Objective 3: To create a GIS marketing manual of best practices on for the benefits of wood products companies.*
  This objective involves the developing of a case study to better understand the development process and the perceptions of current GIS users and potential of GIS application. The results of the case study will be used to develop guidelines in order to use GIS in the marketing process.

3.3 Proposed Research Framework

In order to conduct the study, a review of literature was developed to determine the main aspects and best methodology to approach the overall goal of this research, which refers to define the possible utilization of GIS on marketing application in the wood products industry. Figure 1 shows the framework of this research.

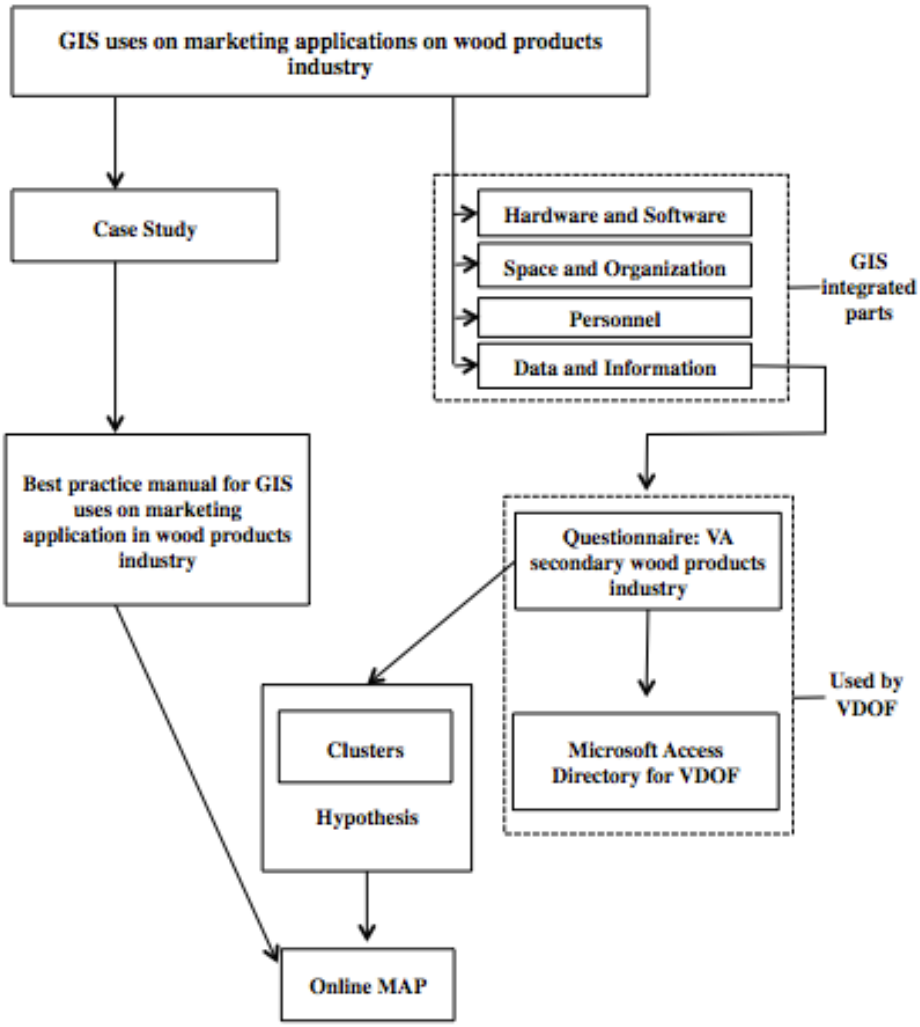

Figure 1. Research Framework

Phase 1 aims toward a literature review of strategic marketing plan and GIS in organizations within the wood products industry and in other industry sectors. The objective of this preliminary research is to identify practices, clarify terms, recognize industry applications and analyze current researches in these areas.

The second phase has the objective to collect the data necessary to develop the directory. To collect data a survey was designed for all the VA secondary wood products industry in an on-line and physical format. The data from the survey will be used to develop the digital directory using a relational database model (MS Access).

For the third phase, the data in the directory will be tested using clustering techniques to verify the firms in industry sectors such as the wood products industry tend to form industry clusters. Once the data has been validated and the hypothesis successfully tested, a GIS online directory will be created.

Finally, a best practice manual for GIS application in the wood products industry will be created using the preliminary results and also from a case study. The case study will be conducted on 2 companies that currently utilize GIS and in addition an academic expert on GIS applications will be interviewed to explore other possibilities.

3.4 Benefits and Limitations

The secondary wood products industry directory was created for the VDOF internal use, but it will also be available for third parties who are interested in the information provided by the directory. The benefits derivate from the directory either for VDOF and third parties correspond to:

- A better understanding of the secondary wood companies located on VA and their wood species, products, residues and exports among others.
- Update the status, physical and mailing address, phone number and other information of the companies on VA.
- It will be helpful to understand the location and proximity of the companies to crucial point of interest by the individual concerned.
- Understanding the environment, find competitors or suppliers for their business can be obtain form the directory and the online map.
- The development of the directory not only benefit the VDOF or the companies but also help future researches ands future studies focusing on the VA secondary wood products industry.

Even though the directory brings benefits it also bring a limitations to the study and to the users such as:

- The biggest limitation lies to the response rate of the questionnaire, which is expected to be low in this industry.
- The questionnaire was self-administered consequently is assumed to be true from the company, no corroboration of physical address or other information was made.
- The research was limited to secondary wood products industry and the area of Virginia because of the time and budget limitation.
- Using an existing industry database provided by InfoGroup (database provider) will limited our research to companies under their database, which could provide inaccurate and updated information.

The GIS use in marketing applications best practice manual was created for companies utilizing and planning to utilize this systems, to the academia and to future investigators in this area. The benefits derivate from the best practice manual either for companies and third parties correspond to:

- It will work as a guide for companies using or planning to use GIS in marketing applications.
- A better understanding of GIS used in marketing application in different company sectors.
- It will be helpful to understand the different utilization of GIS in the marketing applications by individual company experiences.
- Understanding the environment, utilization, applications, processes, techniques for their business can be obtain from the best practice manual.
- The development of the best practice manual not only benefit the companies but also help future researches ands future studies focusing on GIS use in marketing applications.

Even though the best practice manual brings benefits it also bring a limitations to the study and to the users such as:

- The biggest limitation lies on the amount of companies' participating in the case study. The amount of companies corresponds to 2 and one academic expert, which makes the research impossible to generalize to the entire population, but it will be a good point of reference.
- The questionnaire was self-administered and interview consequently is assumed to be true from the company GIS applications, no corroboration of other information or other personnel from the company was made.
- The research was limited to two companies and an academic expert because of the time and budget limitation.

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4 Methodology

To answer the research question and to fill the gap found by the researchers on GIS and the development of marketing mix strategic on Wood Products Industry, the researchers decide to divide the methodology in two sections: 1) a survey and 2) a case of study.

The data from the survey on the secondary wood products industry of VA will be used to develop the industry directory tool and the online map. A similar procedure is currently conducted by the Virginia Department of Forestry (VDOF) to collect data from primary industry called the timber products output (TPO) survey.

Second, in order to emphasize on the development of a best practice manual conformed by guidelines on application of GIS marketing mix and the of GIS, it was necessary to select a methodology, which allows analyzing a real-life context on companies that utilized GIS as part of their strategic development process (Yin, 1994). A case of study was selected as the appropriate methodology to analyze this part of the research.

4.1 Objective 1: Industry Directory

4.1.1 Research Methodology

In this part of the research, investigators analyzed the methodology for the creation of an industry directory for the secondary wood products industry in Virginia; this analysis aims to obtain basic information related to this sector in particular. In order to develop the industry directory and the online map, a survey method was selected as the appropriate methodology, after reviewing similar researches such as the one developed by the VDOF, which has recollected and kept industry records from years in a hardcopy and electronic format about the primary wood sector. The records are updated by the VDOF through a survey called the Timber Products Output (TPO), the researches decided that the best way to approach this objective is by a questionnaire development. The order, the number of items and the length of the survey were modified in order to maximize the data collection, as well to focus the new survey on secondary wood products industry. The

data collected from the questionnaire was encoded and tabulated on an Excel sheet for further analysis and a better data handling.

4.1.2 Company Selection

This research combines requirements from the VDOF and the particular interest of the authors. The four mayor NAICS codes for this research were selected by the VDOF and this corresponds to 337, 325, 321 and 322, which detail as follow:

NAICS 337- Furniture and Related Product Manufacturing
Companies under this NAICS code made furniture and related articles (mattresses, window blinds, cabinets and fixtures), with different manufacture processes (cutting, bending, molding, laminating and assembly) in materials such as wood, metal, glass, plastics and rattan, also designing and following fashion trends is also relevant to the production of furniture (Census; NAICS 337, 2014). Mixing and matching materials is commonly use in the production of furniture, that's why the NAICS classify based on the type of furniture (application/use) rather than the material used (Census; NAICS 337, 2014). Even though NAICS classify industries there are exceptions within each subsector, for furniture manufacturing (1) seating for transportation equipment and (2) laboratory and hospital furniture represent the two exceptions within NAICS code 337 (Census; NAICS 337, 2014).

NAICS 325- Chemical Manufacturing
The subsector related to chemical manufacturing is associated with the transformation of organic and inorganic materials by chemical processes and formulation of products, also relates to the production of basic chemicals from the production of intermediate and end products (Census; NAICS 325, 2014). The exception for this NAICS code is that this do not include all industries that transform raw materials by chemical processes, its common for some chemicals processing to occur during mining operation (Census; NAICS 325, 2014).

NAICS 321- Wood Product Manufacturing

This subsector corresponds directly to the primary wood products industry. Industries under NAICS 321 manufacture wood products includes lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes and prefabricated wood buildings, with production processes (sawing, planing, shaping, laminating and assembling) the wood products starts from logs then cut into bolts or lumber, for further cuts and shapes to assemble and transform into finished products (Census; NAICS 321, 2014). The exceptions to this subsector correspond to sawmill and wood preservation establishments, which are grouped into industries with specific products manufactured (Census; NAICS 321, 2014).

NAICS 322- Paper Manufacturing

In this code industries make pulp, paper or converted paper products, they are group together because of they connectivity in processes usually conducted in a single establishment (Census; NAICS 322, 2014). Under this manufacturing process three essential activities are defined: (1) separate cellulose fibers from impurities in wood or recycled paper for the manufacturing of the pulp, (2) matting the fibers into sheets correspond to the manufacturing of paper and (3) technics such cutting, shaping, coating and laminating activities are part of creating paper products and other materials (Census; NAICS 322, 2014). Photosensitive papers are excluded from this sector, because of their chemically treat those are classified under NAICS 32599 (Census; NAICS 322, 2014).

The company selection was given by the VDOF, which specifically corresponds to companies under the NAICS codes of 337129, 337110, 325191, 321113, 321920, 337212, 321213, 337215, 337122, 337127, 337211, 337121, 321918, 321912, 321991, 321219, 3221, 321992, 321214, 321211, 321212, 321911, 321114 and 321999 all corresponding to secondary wood products industry and related services. The company selection corresponds to secondary wood products and related services which is detailed as follow:

337 Furniture and Related Product Manufacturing

3371 Household and Institutional Furniture and Kitchen Cabinet Manufacturing

33711 Wood Kitchen Cabinet and Countertop Manufacturing

337110 Wood Kitchen Cabinet and Countertop Manufacturing

33712 Household and Institutional Furniture Manufacturing

337121 Upholstered Household Furniture Manufacturing

337122 Nonupholstered Wood Household Furniture Manufacturing

337127 Institutional Furniture Manufacturing

337129 Wood television, radio, and sewing machine cabinet manufacturing

3372 Office Furniture (including Fixtures) Manufacturing

33721 Office Furniture (including Fixtures) Manufacturing

337211 Wood Office Furniture Manufacturing

337212 Custom Architectural Woodwork and Millwork Manufacturing

337215 Showcase, Partition, Shelving, and Locker Manufacturing

325 Chemical Manufacturing

3251 Basic Chemical Manufacturing

325191 Gum and Wood Chemical Manufacturing

321 Wood Product Manufacturing

3211 Sawmills and wood preservation

321113 Sawmills

321114 Wood Preservation

3212 Veneer, plywood, and engineered wood product manufacturing

321211 Hardwood Veneer and Plywood Manufacturing

321212 Softwood veneer and plywood manufacturing

321213 Engineered Wood Member (except Truss) Manufacturing

321214 Truss manufacturing

321219 Reconstituted wood product manufacturing

3219 Other wood product manufacturing

321911 Wood window and door manufacturing

321912 Cut Stock, Resawing Lumber, and Planing

321918 Other Millwork (including Flooring)

321920 Wood Container and Pallet Manufacturing

321991 Manufactured Home (Mobile Home) Manufacturing

321992 Prefabricated Wood Building Manufacturing

321999 All Other Miscellaneous Wood Product Manufacturing

322 Paper manufacturing

3221 Paperboard container manufacturing

4.1.3 Database

Infogroup Academic proportionated the initial database used for the collection of data. Identified as powerful data solutions for academic institutions, Infogroup Academic focuses on delivering solutions to colleges and universities across the nation (Infogroup, 2013). This institution three mayor points of interest which relates to: (1) Data, they have access to 24 million U.S. businesses and over 265 millions U.S. costumers, with records verified and updated daily, (2) Survey, one of their services targets to offer survey services such as telephone, email and direct mail, in which experts dedicated their time to compiling question, obtaining responses and analyze results and finally (3) Marketing, which refers to their database of postal and email addresses that can operate in marketing mail center and also their TargetReady Models™ - ready-made models that help refine target markets- (Infogroup, 2013).

For the development of this directory and for the given specification of industry (NAICS codes) an amount of 1001 companies' information were bought as database from Infogroup Academic. The fields on the database that were use for this study corresponds to: company name, primary address, mailing address, primary city, primary state and primary zip code.

After cleaning the database and erased all the imperfections and blank spaces from the document bought from Infogroup Academic the total of companies available for usage correspond to 972 companies.

4.1.4 Questionnaire development

The methodology selected for the data collection of the secondary wood products industry directory was a survey. The base for the questionnaire was provided by the VDOF, which has been used for the last years and include basic and relevant information of primary wood product industry. The researcher in order to minimize the length and maximize the data collection modified the questionnaire and focused on the secondary sector of the wood product industry.

The survey was divided in five different sections; (1) Industry Information, (2) Raw Material Purchased, (3) Other Purchased Materials, (4) Production Residues and (5) Export Information. The questionnaire was divided into these five sections based on the survey used by the VDOF for the primary wood products industry, but for this particular study researchers focus on minimizing the length, maximizing the data collection and emphasis on the secondary wood products industry. The sections and items selected for the tool are explain below:

Section 1. Industry Information

This section consists in basic information about the company, such as date, company name, physical and mailing address, coordinated location, number of employees, plant type and production facilities. This section was formulated to obtain and corroborate information held by the researches.

Section 2. Raw Material Purchased

Section 2 contains raw material information such as type of wood specie (hardwood/softwood), the thickness, green rough, kiln dried dressed or kiln dried rough, use in board feet, states were purchased, certification wood products and used of composite wood products. This part of the questionnaire aims to understand the wood specie utilization in VA and the origin.

Section 3. Other Purchased Materials

Other purchased material section focuses in find out other materials that can be used for the company day a day basis, such as boiler fuel, hardwoods chips, softwoods chips, dimension wood products-blanks, glue, panels, machined parts, mill residues for manufacturing value added products, bark, sawdust, shavings and pellets among other wood materials purchased.

Section 4. Production Residues

This part of the questionnaire consists on learning about the residues production of the company, specificity understanding the amount produce, percentage of total residues and the market for residues, such as chips, saw dust, shavings and other type of restudies produce in wood manufacturing facilities.

Section 5. Export Information

The last section of the questionnaire corresponded to exports, this section has to be fill only if applies to the company participating, it consist in knowing if the company export and which is the major markets (Canada, Mexico, Central America, South America, Europe, Asia, Africa, Australia among others).

See Appendix A. Industry Directory Survey Tool, for the complete questionnaire implemented on this part of the research.

4.1.5 Implementation Process

The implementation process have many different direction, on this study the implementation process will follow the direction from Fowler Jr. (2002) which mention that according to Dillman (2000) a reasonable sequence of events that should happen after sending the first questionnaire are: (1) Ten days after the initial mailing, send all respondents a reminder card, emphasizing on importance of the study and high rate of response, (2) Ten days after the postcard, mail the non-respondents a letter emphasizing the importance of a high rate and including another questionnaire and (3) If the response

rate is still not satisfactory the next step is to call non-respondents on the telephone (p 48).

The researchers utilize Virginia Tech Printing Services to print and send the questionnaires, the main envelope and response envelope, the postcards and the remainder letter for the 972 companies selected for this study. The steps of the implementation process of the questionnaires are detailed bellow:

4.1.5.1 First mailing

In order to present the companies participating in the research with more response options the questionnaire was distributed in two formats:

- Written: with help from Virginia Tech Printing Services, the questionnaire will be mail to the companies selected for the research. It had an enveloped attached in order to return the questionnaire without paying postage.

- Digital: with help from Qualtrics, available at: http://virginiatech.qualtrics.com/, which is included on the list of approved online sources of Virginia Tech. All digital information generated by this study will be kept in the researchers' computer hard drive in encrypted form.

4.1.5.2 Reminder Card

The remainder card or postcard was mailed 10 days after the first questionnaire. The purpose of the remainder card is to remind companies about the survey as well as to incite the participation of the study. The post card size was 5.5 inches (14cm) long with 4.25 inches (10.8 cm) wide. Figure 2 shows the conformation of the postcard.

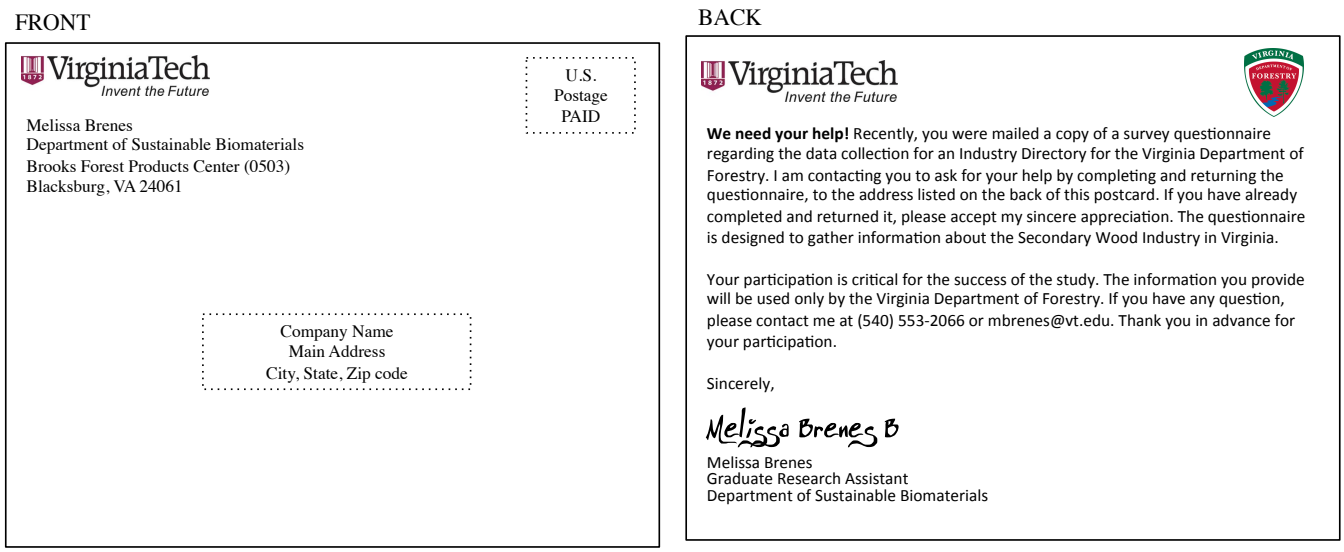

Figure 2. Postcard

4.1.5.3 Mail letter to companies that did not respond

The letter directed to the companies that did not respond was send 10 days after the postcard. The letter was developed in order to refresh and motivate the companies to participate in the study. Attached to the letter another copy of the questionnaire was mailed, to increase the response and also anticipating that the company lost the old questionnaire sent previously. The letter reads as follow:

Dear Participant:

We need your help! Recently, you were mailed a copy of a survey questionnaire regarding the data collection for an Industry Directory for the Virginia Department of Forestry. I am contacting you to ask for your help by completing and returning the questionnaire, postage free, to the address listed at the end of this letter. If you have already completed and returned it, please accept my sincere appreciation. The questionnaire is designed to gather information about the Secondary Wood Industry in Virginia.

The questionnaire will require approximately 10 minutes to complete. Also the questionnaire can be access online if you desire, just go to: https://virginiatech.qualtrics.com/SE/?SID=SV_7ZChiVfoW76Wxed

Your participation is critical for the success of the study. The information you provide will be used only by the Virginia Department of Forestry. If you have any question, please contact me at (540) 553-2066 or mbrenes@vt.edu. Thank you in advance for your participation.

Sincerely,
Melissa Brenes
Graduate Research Assistant
Department of Sustainable Biomaterials
Virginia Tech
Phone: (540) 553-2066
Email: mbrenes@vt.edu

4.1.5.4 Call companies that did not respond

After developing and implementing of a questionnaire to 972 companies of the secondary wood products industry in Virginia, aiming to collect information to develop an industry directory for the Virginia Department of Forestry. A total 10% response rate is expected from the companies, the main purpose of the phone calls is to understand what happen to the remaining companies that didn't answer to the questionnaire. For this particular goal the remaining companies and their status will be verified by phone call or secondary sources.

The objective for the call non-respondents is to investigate the status of the companies that did not respond to the survey conducted by the investigators earlier this year. The key features for the phone calls corresponds to the real status of the companies located into the secondary wood product industry of Virginia. Specifically understanding the why they didn't answer the questionnaire, the status of the company and if they utilize wood product as a raw material.

Phone Call Plan

The phone call plan consists of the following sections:

A. Overview of the research
B. Procedures and protocol
C. Guide for the caller and
D. Caller report

A. Overview of the research

For this particular research, the main goal is to develop an industry directory for the Virginia Department of Forestry. This directory will contain contact information of the secondary wood products industry of Virginia. The phone calls will be made to 864 companies that didn't answer the questionnaire and later a secondary source investigation will be made to those companies that didn't answer the calls.

B. Procedures and protocol

For this part of the research, the following protocol and procedures should be followed in order to achieve the best results possible:

a. Call company

   The main researcher will provide the list of the 864 companies to be called. The information was obtained from a third party which ensure the veracity of the information in order to obtain the best results from the phone calls.

b. Introduce yourself

   Once the researcher calls the company, a brief introduction of themselves should be made. This introduction basically consist in:

   I am (First name, Last name) and I am calling from Virginia Tech.

c. Introduction of the call

   After the introduction is made, the researcher should explain briefly the goal and the reason of the call. Basically the researchers should say:

We are in the process of updating our industry directory and we would like to confirm the type of business your company is in and if you use any wood products as raw material.

d. Ask questions

Once the introduction is made, two questions should be asked to ensure the success of the calls. The questions are:

- What type of business is your company is?
- Do your company se any wood products as raw materials? What type?

e. Annotate findings

All the information obtained from the companies should be annotate in the document provide by the main researcher. This document would be provided electronically and physically format. Every single data and extra information should be documented in order to ensure a good result from the phone calls.

f. No responders companies

If a company doesn't respond to the call, the researcher should leave it and call other day. Three times is the maximum amount of calls that will be made to a company. If after the third call the company still doesn't answer, a note should be made and the company should be investigated by secondary source.

g. Google search

For the companies that do not answer the phone call, their status will be verified by secondary sources, meaning this, a research on the Internet, in sites such as Google, Yellow pages among others.

C. Guide for the caller

The caller should respect the following outline to ensure a successful investigation:

a. Call company

b. Introduce yourself

I am (First name, Last name) and I am calling from Virginia Tech.

c. Introduction of the call

   We are in the process of updating our industry directory and we would like to confirm the type of business your company is in and if you use any wood products as raw material.

d. Ask questions

   - What type of business is your company is?
   - Do your company se any wood products as raw materials? What type?

e. Annotate findings

f. No responders companies

g. Google search

D. Caller reports

A report of the process and results will be developed at the end of the phones calls and the secondary source investigation. This report will be created in order to understand what happen to the companies that didn't respond the questionnaire. This report will be of help for the researcher group as well as the VDOF.

4.1.5.5 Non-respondents analysis

According to Fowler (2002) the effect that a nonresponse has over a survey will depend on the percentage of non-respondent and the extent in which those are biased or significantly different form the population. Depending on the results obtained from the survey if the resulting non-respondents samples are very similar to the population the study can be used to generalized without problem (Fowler, 2002). In other words, if the final group that responded to the survey is small it will become a self-selected sample, in this case is very difficult to prove statistically or generalized to the entire population selected (Fowler, 2002).

The National Center for Education Statistics (2013) mentions that nonresponse corresponds to “the failure to obtain responses or measurements for all sample elements”. It is mentioned by Bose (2001) that bias corresponds to the different between a survey evaluation and the actual population, for example in a survey it can be the different

between the results and all the possible samples. According to Bose (2001) the nonresponse bias is confirmed by two factors (1) amount of nonresponse and (2) different between respondents and non-respondents.

For this particular study, an analysis for non-respondents bias was developed and because of the type of data collected by the survey (companies information for a directory), only the NAICS Code information will be used as analysis for the non-respondents bias. Also, it is important to mention that since the beginning of the study, the researcher had all the basic information of the companies participating in the study, which means that investigators have all the basic information of the non-respondents (NAICS Codes). The non-respondent information previously purchased will be used as source of valid material that makes the non-respondent analysis.

4.2 Objective 2: GIS application in marketing

4.2.1 Hypothesis testing

The hypothesis can be tested once the list of companies has been revised and verify. To prove or denied the hypothesis which refers to understand if the wood products companies are located in clusters through the state of Virginia a statistical method was applied.

Different statistical methods exist regarding clustering analysis. In general basic clustering refers to a technic of grouping rows together that share similar values among the variables (SAS Institute, 2014). For this particular research JMP 11 is the software use to perform the statistical analysis. JMP 11 provides three different clustering methods:

- Hierarchical clustering (small groups, several thousands)
- K-means (large tables, several hundreds of thousands)
- Normal mixtures (data come from multivariate normal distributions)

To prove or reject the hypothesis the K mean clustering was selected because of the data conformation and the simpler analysis required. The K-means method clusters the data by first entering the number of clusters, K required for the investigation, then a search algorithm finds the number of K points all ready specified and then each other point is assign to the closest cluster, for each cluster the new center is formed as centroid (mean) of the point currently in the cluster (SAS Institute, 2014).

Because of the nature of the data (addresses) and the main purpose of the analysis (find clusters) a biplot is going to be used to prove or denied the hypothesis. The biplot shows the two principal components of the data: the point (rows) and the clusters (SAS Institute, 2014). The circle size of the cluster is proportional to the count inside; a shaded area around the mean represents the 90%, in other words the 90% of the observations will fall in the shaded area of the cluster. (SAS Institute, 2014). Also the hypothesis will be tested with help of a scatterplot and visual aids (map).

4.2.2 Google Maps application

Google Maps is an application, which layer business data on a map in order to see information in a more effective and insightful way, by importing data from spreadsheet or database into a map and providing an easy way of sharing information with others (Google maps for business, 2014). For this specific outcome, the researcher will have help from IT specialist in the development of the map with the information collected from the industry survey. This map can be access from a website under the domain of Virginia Tech- Sustainable Biomaterials Department (SBIO), the information and the map is going to be public domain in order to help companies make better decisions on their marketing strategies and other processes as well.

- Data mine information from the relational database

The information utilized for the Google map tool will be obtained form the questionnaire applied to the VA secondary wood products industry. Not all the information collected can be display as public domain because of the sensitivity of the information. But basic

information such as, company name, telephone, fax, web page and company physical address will be added to the online map tool.

- Develop Google map application

The development of a Google map basically involves the creation of codes and programing, in which latitude and longitude was added to the map as a point. Once the coding was done and the map link under the VT SBIO (Department of Sustainable Biomaterials) domain, the basic data collected from the secondary wood products industry was added to the map. The creation of the Google maps application was in charge of a specialist from the College of Natural Resources and Environment of Virginia Tech.

- Test application

The researchers test the application by adding previous information from the primary wood products industry in VA, collected by the VDOF in the past. The information given by the VDOF covers the basic information from the companies. The information utilize in the test wasn't corroborated by the researchers, but it fulfill the purposes of testing the application.

4.3 Objective 3: Best practice manual for GIS applications in Marketing

4.3.1 Research methodology

In this part of the research, investigators utilized a case study as methodology for the creation of the best practice manual for companies, academia, and future researchers that use GIS in marketing applications; this analysis aims to create a guidelines for GIS application in marketing in all type of companies sectors. In order to develop the best practice manual, a case study (questionnaire and interview) was developed and implemented as the methodology. As part of the case study a questionnaire with an interview will be implemented to 2 companies and 1 academic expert in the field. The questionnaire was design to maximize the data collection; as well to be used as an interview tool for the participant companies. The data collected from the case study

questionnaire was used to develop a best practice manual. This best practice manual will contain information related to the utilization of GIS in marketing application, the main user of the manual correspond to companies currently utilizing or planning to utilize this system, but the manual will also be helpful for the academia or future researches in this field.

According to Yin (1994) a case study is one way of doing social science research, and it includes experiments, surveys, histories and analysis of archival information. Yin (1994) mentions that each of the strategies has advantages and disadvantages depending of three conditions: (1) type of research question, (2) the control of the investigator over the actual behavior events and (3) focus on contemporary information opposed to the historical phenomena.

In general the case studies are preferred when; the strategy try to answer "how" and "why" questions, when the investigator has little control over events and when the focus of the phenomenon in within some real-life events. (Yin, 1994) It is mention by Yin (1994) that for case studies, there are five components that are specially important; (1) study's question, (2) its proposition, if any, (3) its unit(s) of analysis, (4) the logic linking the data to the proposition and (5) the criteria for interpreting the findings. Because of the scope presented by the case study, the researchers consider that as the best method to approach the GIS marketing mix utilization on the wood products industry, since it is a real context phenomenon.

4.3.2 Selection of business

In order to develop the case study, two companies and an expert were selected to obtain data for the development of the best practice manual. This research combines the utilization of GIS and the application in marketing.
The two companies and the expert selected for the case study will remain ammoniums because of the nature of the investigation, but a small description of them will be given below.

- Company A: Machinery Manufacturer

With years of experience, company A, gather real time data using advance manufacturing and Internet to improve the equality of every machinery they produce. As result, they are increasing the range between fueling, performances and streamlining operations at the same time they lower cost and operates +20,000 machineries around the world.

- Company B: Wood Products

For more than a century company B, have been inspired by trees. Using the tree strength, vitality and potential, they create sustainable solution to the world's challenges. The ingenuity of their employees, customers, suppliers and communities is the fueled of innovation in this company. They make the most of one of the planet's most valuable renewable resource.

- Expert: GIS expert

The GIS expert is an assistant professor at Virginia Polytechnic institute and State University (Virginia Tech). Has a Ph.D. from UNC-Chapel Hill 2007, but has work in Virginia Tech since 2011. The research interest and experience focus on remote sensing, GIS, land use and land cover change, and watershed assessment and modeling.

4.3.3 Plan for conducting case study

4.3.3.1 Purpose

With the combination of conventional marketing techniques with Geographic Information Systems (GIS) methods allows the users to picture spatial data in maps - distribution process, market diverse- and also permits statistical graphs and diagrams which links marketing and GIS (Musyoka, et al., 2007).

The main purpose of this case study is to understand the utilization on GIS applications on the supply chain management, in other words, the applications in all the company

process. More specificly the GIS applications used in suppliers management applications, internal applications and customer management applications (marketing mix -4Ps-).

Recent researches explain possible utilization of GIS in Marketing, but it was found little research on the actual utilization of GIS on marketing mix. Thus, the main goal for this case study is to determine how GIS is used in the organization and if the companies utilize GIS for marketing mix application as a good source of information.

4.3.3.2 Key Features of the Case Study Method

For this case study the key features corresponds to the real situation on the industry related to GIS applications in the supply chain management, meaning the actual condition of the GIS for the supplier, internal and customer management applications.

4.3.3.3 Organization of This Plan

This plan is organized following the instructions for a table of contents from an illustrative protocol developed by R. Yin (1989), which also mention that a protocol is a tactic in adding the reliability to a case study research, and also is used as guidance for the investigators of the study.

According to Yin (1989) the protocol consist in these following sections:

Overview of the case study project

A. Field procedures

B. Case study questions and,

C. Guide for the case study report

A. Procedures

a. Initial Scheduling

Case study is utilized when the investigator has little or no control over events and when the phenomenon is within some real-life events (Yin, 1994). Taking that into account the

scheduling of this entire case study will be provided by the interviewee's agenda and accessibility, not that of the researcher.

b. Determination of Persons/Company to be interviewed and Other Sources of Information

For the determination of the Person/Company to be interviewed for the case study few criteria have to be fulfill:

i. Person

1. It has to work in the company under investigation.
2. It has to have knowledge of marketing or GIS.
3. It must have worked on a project that involves marketing and GIS.

ii. Company

1. Should use GIS applications on their supply chain management process.
2. Should be willing to participate in the research.

c. Training the Case Study Team

For this particular case study, there are no team members, the study will be developed and conducted by Melissa Brenes, the only member and researcher of the investigation.

The training will not be necessary because the person is the one with the knowledge of the investigation and the protocol of the case study.

B. Case Study Protocol and Questions

a. Geographic Information Systems (GIS) as defined by Demers (2009) is "a system designed to input, store, edit, retrieved, analyze and output geographic data and information" (p. 19). As any system, GIS is composed by parts that allows it to perform correctly, these parts includes

(1) computer hardware and software, (2) space and organization, (3) personnel and (4) data and information (Demers, 2009).

i. Topics GIS

- Basic functionality: Integrated parts 1) computer, 2) hardware and software, 3) personnel and 4) data and information (Demers, 2009).
- Mayor parts of GIS: population data source, geodemographics, proprietary and customized GIS for business and service planning and Geography in business (Longley & Graham, 1995).
- Data sources and software: TIGER, NavTech, Dun and Bradstreet, Nielsen, ESRI, Geolytics, GDT, ArcGIS, MapInfo, Autodesk and Mappoints-Microsoft (Clarke & Flaherty, 2005)
- Specialize Human Resources: there are evidence that mutual benefits to both the marketing industry and the geography from closer collaboration will help in a better development, application and results of the system (Longley & Graham, 1995).

ii. Summary of Questions for Section a

1. Knowledge of basic GIS functionality and parts?
2. Data and Software Sources available and used by the company?
3. Utilization of specialize workers of specialize team groups for GIS application?
4. GIS process of thinking and development in the projects?

iii. Topics Supply Chain Management

- Supply chain management: "This chain is characterized by a forward flow of materials and a backward flow of information. Traditionally, supply chain is illustrated as a framework for the conversion and movement of raw materials into final product

through the four basic echelons, namely suppliers, manufacturers, wholesalers and retailers. Customers initialize all the processes within supply chain by ordering goods from retailers, which move the orders toward the whole supply chain. Therefore, such supply chains are usually called demand driven supply chains" (p. 116) (Soshko, 2011).

- Supplier Management applications: "The Production Planning and Inventory Control Process encompasses the manufacturing and storage sub-processes, and their interface(s). More specifically, production planning describes the design and management of the entire manufacturing process (including raw material scheduling and acquisition, manufacturing process design and scheduling, and material handling design and control). Inventory control describes the design and management of the storage policies and procedures for raw materials, work-in-process inventories, and usually, final products." (p. 2) (Beamon, 1998).
- Internal Applications: "The Distribution and Logistics Process determine how products are retrieved and transported from the warehouse to retailers. These products may be transported to retailers directly, or may first be moved to distribution facilities, which, in turn, transport products to retailers. This process includes the management of inventory retrieval, transportation, and final product delivery. These processes interact with one another to produce an integrated supply chain. The design and management of these processes determine the extent to which the supply chain works as a unit to meet required performance objectives" (p. 2-3) (Beamon, 1998).
- Customer management application: "A supply chain is the set of value-adding activities that connects a firm's suppliers to the firm's customers. The basic unit of a supply chain activity is Receive input form supplier – add value – deliver to customers.

> Here a supplier may be an external vendor or an upstream process within the firm similarly, a customer may be the final customer of the finished product or service, or a downstream operation that uses the output of one process at the input to another. Three types of flows occur throughout the supply chain: (1) product, (2) information, and (3) funds. These flows travel both three kinds of flows is the overarching goal of supply chain management." (p. 4) (Harrison, Lee, & Neale, 2003).

C. Analysis Plan and Case Study Reports

a. Individual Case Study

For the analysis on the individual case study (individual company) a descriptive analysis will be done, in order to better understand the process and application of GIS in the supply chain management, specifically focus on marketing (customer management applications).

A report will be made to explain all the findings of the individual analysis of the companies.

b. Cross-Case Analysis

For cross-case analysis of the case study (one analysis with the companies) a descriptive analysis will be done, in order to better understand the process and application of GIS in the supply chain management in the total amount of companies interviewed, specifically a general perception in each part (supplier, internal, customer).

A report will be made to explain all the findings of the cross-case analysis of all the companies researched.

4.3.4 Questionnaire development

The methodology selected for the data collection of case study was a questionnaire. The questionnaire was design to obtain the basic information necessary for the case study. In order to minimize the length and maximize the data collection the researcher design a questionnaire simple and easy to complete, by dividing the questionnaire into sections.

The questionnaire was divided in five different sections; (1) General Information, (2) Supplier Management Applications, (3) Internal Applications, (4) Customer Management Applications and (5) General Perception of GIS Applications. The sections and items selected for the tool are explain below:

Section 1. General Information

This section consists in basic information about the respondent, such role in the organization, role description, range of personal experience with GIS application and time range of GIS applications has been utilized in the firm. This section was formulated to obtain information about the company and the interviewed with relation on GIS applications.

Section 2. Supplier Management Applications

Section 2 contains information related to supplier management applications such as if they use GIS for any purpose related to supplier management applications, description of the GIS in supplier applications, type of software company use to support the supplier management activities and advantages and disadvantages about the use of GIS in supplier management activities. This part of the questionnaire aims to understand the utilization of GIS in the supplier management applications.

Section 3. Internal Applications

Internal applications section focuses on finding if they use GIS for any purpose related to internal applications, description of the GIS in internal applications, type of software company use to support the internal activities and advantages and disadvantages about the use of GIS in internal activities. This part of the questionnaire aims to understand the utilization of GIS in the internal applications of the company.

Section 4. Customer Management Applications

This part of the questionnaire consists of learning about the GIS utilization in customer management applications, specificity understanding if they use GIS for any purpose

related to customer applications, description of the GIS in customer applications, type of software company use to support the customer activities and advantages and disadvantages about the use of GIS in customer management activities. This part of the questionnaire aims to understand the utilization of GIS in the customer management applications of the company.

Section 5. General Perception of GIS Applications

The last section of the questionnaire corresponded to general perception of GIS applications, this section describes the general perception of the entire supply chain management, it consist in describing the general perception of the utilization of GIS in your firm, if they recommend other firms to use GIS in supplier, internal o customer applications and why, if the capital investment, implementation cost and maintenance cost of GIS applications worth for the return of investment (ROI) and what industry sector do you consider that more heavily use GIS application.

See Appendix B. GIS Questionnaire Tool, for the complete questionnaire implemented on this part of the research.

For the development of the case study a protocol approval from the Virginia Tech Institutional Review Board for Research Involving Human Subjects was created. The IRB mission is to: "committed to protecting the rights of and ensuring the safety of human subjects participating in research conducted by faculty, staff and students of the University and for research in which Virginia Tech is engaged. This commitment is vested in the Institutional Review Board for Research Involving Human Subjects (the IRB), and is guided by the ethical principles described in the "Belmont Report" and in applicable federal regulations" (VT IRB, 2014)

The protocol assigned was 13-113 and it was approved for implementation in the GIS uses of marketing application. See Appendix C for the approval letter from the VT IRB for the protocol 13-113.

4.3.5 Development of a best practice manual

According to Katzin (1985) to write a good user's manual this should have: 1) needs and description of the user, 2) good documentation and writing techniques, 3) good data quality and format, 4) table of content, 5) introduction, 6) information flow, 7) basic concepts, terminology and glossary, 8) functional sections according to the topic.

Simpson & Casey (1988) mention that to develop an effective user documentation taking into account the human factors, the main aspects to take into account are: 1) type of users (goals, attitudes and time constraints), 2) documentation development process, 3) manual tools (computer base tools), 4) production tools (hardware and software), 5) documentation design, 6) documentation architecture, 7) graphics, 8)documentation models and 9) test and evaluation.

Crandall (1987) explain that to write a good tutorial documentation 4 main steps should be take into account:

- Goals of instruction: Intended audience, Task analysis and Tasks to be taught
- Getting started: Preface and Introduction
- Teaching objectives: Objectives, Chapter overview and Lesson for the objectives
- Supportive documents: Abstract, Table of content, Glossary, Index and References

On the other hand, Kelly (1983) mention that when writing for computer application systems the manual or document should have 1) people roles and computing industry, 2) start with the product/result, 3) goal of the product, 4) design the products, 5) standards and conventions, 6) test the document, 7) manage the documentation project (tasks, collection data, write the document), and 8) conclusions.

After reviewing different methodology regarding the creation of the manual of best practices, the researcher will create a separate document in which important information

about GIS basics and GIS uses in marketing application will be covered. The best practice manual will cover topics such as before needs, strategic plan, implementation plan, design phrase, implantation phrase, pilot project, application development, maintenance and update, tanning and evaluation and best practices for GIS marketing. All the information recollected in the manual will aim to explain basic information, utilization and general application of GIS uses on marketing applications in the wood products industry. The basis of the information was obtained form GIS literature review and the data to conclude the best practices were obtained form the case study.

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5 Results

This chapter aims to present the results collected through the methodologies applied in the research. The main result aim to develop guidelines for GIS uses on marketing applications specifically marketing mix. To obtain the main result other activities where perform in order to ensure a good final result. The other activities correspond to the industry directory (VA secondary wood products industry questionnaire) and the online map (data from VA secondary wood products questionnaire and the hypothesis testing).

Information in this chapter is presented based on the two main parts of this research (1) Industry Directory and (2) Best Practice Manual; the findings are also presented by objective and by hypothesis in order to better explain the results obtain from this research.

5.1 Objective 1: Industry Directory

5.1.1 Current VDOF database

While researching, understanding and analyzing the environment of the wood products industry, it was discovered that the Virginia Department of Forestry of Virginia (VDOF) obtains information about the wood industry with a Timber Products Output (TPO) questionnaire applied to the primary industry.

The data collected from the questionnaire is inputted into a directory for future reports and to help the industry in general. After reviewing the VDOF directory several flaws were discover related to the data management specifically: the duplication of data, incorrect creation of reports, slow data processing and the lack of experience when the directory was created. The data obtained from the VDOF questionnaire and the data requirement for the GIS became a starting point for this research. The problem in the VDOF directory database and the investigators interest combined created this investigation, which ultimately aims to develop new knowledge on GIS uses in marketing application in the wood products industry.

An analysis of the current VDOF industry directory was performed to help and improve the VDOF database. Since its creation in 1914, The Virginia Department of Forestry focuses in the prevention and suppression of forest fires and reforestation of lands, but they had grown and evolved in other protection and management duties such as: Protecting VA's Forests from Wildfire, Managing the Forest Resource, Protecting VA's Waters, Conservation of VA's Forests, Manage the State Lands and Nurseries and Regulated Incentive programs for Forest Landowners (Virginia Department of Forestry, 2014).

An important area of interest for the VDOF relates to the wood products industry, because of they close relationship with their day a day duties as a department. The Wood Products Industry has become a multinational business with plantations and mills around the U.S and the world. By 2007, there were 332,536 manufacturing firms in the United States, which 38.614 represent wood products firms, the industry shipments valued at 186,761,096 ($1000) and the industry employs 1,037,806 people in all regions of the country, becoming this as a strong contributors to the economy of the nation (United States Census Bureau, 2007).

Virginia State has 1048 firms according to the U.S Census Bureau by 2007, this has 6,343881 ($1000) in shipments it represents 6.72% of the national value shipments. This particular research emphasis in the secondary sector of the Wood Product Industry which relates specifically to Furniture and Related product manufacturing composed of 21,746 firms thought the US, particularly in Virginia it is composed with 517 firms, value shipments of 2,481,141 ($1000) which represent 2.92% of the national value shipments. Considering these numbers, this research will be developed to help the VDOF better understand the VA wood products industry and the current status of the industry during the 2014.

NAICS codes were used to classify and identify the companies that participated in the study. NAICS stands for North American Industry Classification System, according to

US. Department of Commerce (2012) is a standard codification in classifying business establishments used by the Federal Statistic Agencies for purposes of collecting, analyzing and publishing statistical data related to the U.S. business economy. The NAICS is a new American Industry Classification System that replaces the U.S Standard Industrial Classification (SIC) system, the new system allow the business to classify the industry type, by customers and prospects (New Industry Classification, 1998). The NAICS were adopted in 1997 to replace the SIC systems, and it was developed for North American countries (Canada, United States and Mexico) to allow comparability in business (United States Census Bureau, 2007).

The Virginia Department of Forestry (VDOF) provides the researcher the actual database relationship of the primary sector of the wood product industry, this model is going to be use and improved by the researcher in order to fit the secondary sector and the objectives of this particular study. The relational database provide by the VDOF is composed by nine queries; which are Addresses, Contacts, Location, City-Country-Region, Operations, Products, Logs-Received, Equipment, and Events. All this queries are link by the KeyID, which link the tables by common fields. The researcher group plans to utilize the data relational model and modified in order to present all the information required by the VDOF and this particular study.

Figure 3 shows the relational database provided by the Virginia Department of Forestry, which was modified by the research group.

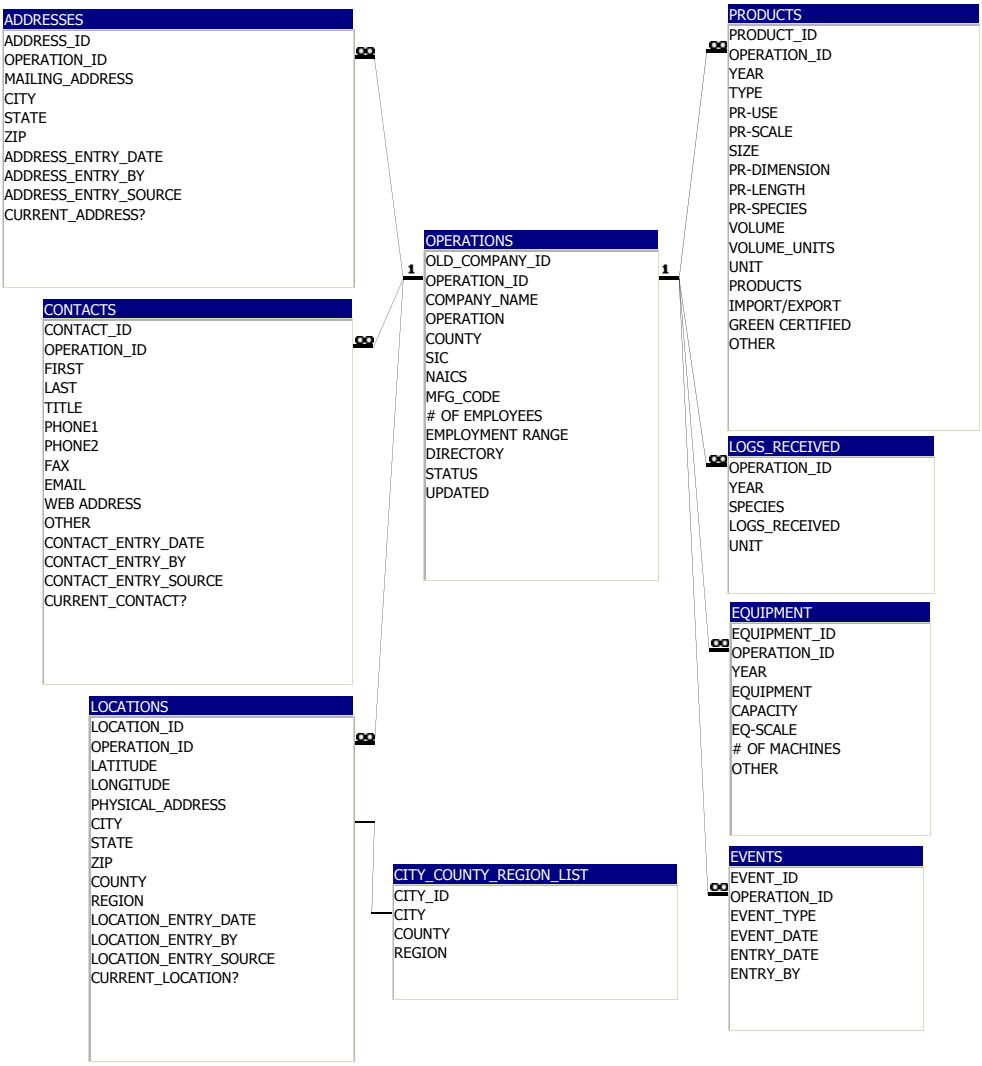


Figure 3. VDOF relational database provided.

Beside the gap found in literature an interest from the VDOF in fixing the problems with the directory was raised. The problems from the VDOF do not relate with the data collection but with the manipulation of the data. In this particular case a Microsoft Access directory was created several year ago to manipulate the data and to create specific report necessary for the functioning of the department. The main problem with the directory corresponds to the duplication of data, slow data processing, the inability to create reports with correct information, the lack of missing spaces to add new information, the wrong relationship database table and missing security feature as well as the data and time of actualization within the new information.

5.1.2 New industry Directory results

5.1.2.1 Survey results and demographics

In this section the researchers had the opportunity to apply a questionnaire in the secondary wood products industry firms through the state of Virginia. The amount of companies available for does NAICS codes selected for this research corresponds to 1001, Infogroup Academic provided the company database selection for this particular part of the research.

After cleaning the database and erasing all imperfections and blank spaces, the total amount of companies available for usage correspond to 972 companies. The company's database was sent to Virginia Tech Printing Services to prevent the errorless process of sending the surveys. Table 1 shows a summary of the response rate obtain from the questionnaire applied to the secondary wood products industry in Virginia.

Company response status	Total
No usable (mailed)	36
Undeliverable	19
No company name written	9
Double response	8
Usable (mailed)	86
No manufacturer	8
No longer in operation	1
Refuse to participate	14
No wood user	13
Retailer	2
Sawmill	1
Complete with no problem	46
Usable (Online)	3
Complete with no problem	1
Just basic information	2
Total	**125**

Table 1. Company Response Status

From the 125 responses obtain only 108 (undeliverable-19- and usable-89-) can be use as a response, the other 17 (no company name -9- and double response -8-) will not be

counted as a valid response. The response rate for this study corresponds to 11.11% of the total population selected.

The information collected from the questionnaire corresponds to basic information regarding the company's information, material, and residues among others. Table 2 shows a summary of the information-collected form the participants firms.

Information collected	Number of items	Number responses	Average response per item
Industry Information			
Company Name	1	108	108
Company Contact Information	6	302	50.33
Company Physical Address	4	344	86
Company Mailing Address	4	60	15
Latitude / Longitude	1	16	16
Number of employees	1	52	52
Plant type	5	321	64.2
Purchased Raw Materials			
Solid Wood- Softwood	42	227	5.40
Solid Wood- Hardwood	72	1055	14.65
Solid Wood- Imported Species	7	58	8.28
Percentage of certify wood	2	7	3.2
Purchased Composite Wood Products	24	284	11.83
Other Purchased Materials			
Other Purchased Material	3	27	9
Production of Residues			
Residues	4	168	42
Export Information			
Export	1	2	2
Major Export Markets	1	5	5

Table 2. Information collected

Phone calls were made to the 846 companies that did not respond to the questionnaire, in order to know their business type, if they use wood as raw material and the type of wood products they produce. For now the information provided by a third party will be use to analyze and conclude, researchers consider that the information should not stray too far from reality.

Once all the data collected form the questionnaires and the remaining information is tabulated and input onto an excel spreadsheet, the next steps target the development of results for the objectives and hypothesis of industry directory part of the research.

The survey collects more information such as certificate wood, composite wood products, other materials purchased, residues and export information, all the additional information (datasets) collected with the survey will help potential the VDOF process and activities. For this particular research, the basic information about the companies will be the only used because of the type of research, but it is important to mention that the other information collected has great potential for the VDOF, specially understanding the wood products industry.

See Appendix D. Companies Profiling (Secondary Wood Products Industry VA), for complete details and all of the additional information from companies that respond to the questionnaire.

5.1.2.1 Survey non-respondent analysis

This descriptive analysis will focus on the non-respondents of the survey, this in order to understand the group that decides not to participate in the study. The main focus of the non-responded bias analysis is to understand the NAICS code represented in the results.

It is important to mention that the analysis of non-respondent does not modify the main objective which is to create an industry directory for the VDOF, but it is important to understand more about the companies that decide not to participate in the investigation. Table 3 shows the distribution between companies that respond, companies that do not apply and non-respondents by the NAICS code.

Main NAICS Codes	NAICS description	Companies that respond	% Resp.	Non-respondents	% Resp.	Total	% Total Resp.
337	**Furniture & Related Products Manufacturing**						
3371	Household & Institutional Furniture and Kitchen Cabinet Manufacturing	26	2.67%	538	55.34%	564	58.02%
3372	Office furniture (including fixtures manufacturing)	4	0.4%	22	2.26%	26	2.67%
325	**Chemical Manufacturing**						
3251	Basic Chemical manufacturing	0	0%	0	0%	0	0%
321	**Wood Products Manufacturing**						
3211	Sawmills and Good Manufacturing	4	0.41%	45	4.62%	49	5.04%
3212	Veneer, Plywood and Engineered Wood Products Manufacturing	1	0.10%	11	1.13%	12	1.23%
3219	Other Wood Products Manufacturing	11	1.13%	221	22.73%	232	23.87%
322	**Paper Manufacturing**						
3221	Paperboard Container Manufacturing	0	0%	27	2.78%	27	2.78%
OTH	**Other**	4	0.41%	0	0%	4	0.41%
BLK	**Blank**	36	3.70%	0	0%	58	5.97%
N/A	**Co. do not apply**	0	0%	0	0%	22	2.26%
	Total	86	8.84%	864	88%	972	100 %

Table 3. Non-respondents by NAICS code

Table 3 shows that 22 companies form the total were undeliverable or was filled wrong (no company name) which can not be use in the final results, it also shows that the majority of respondents correspond to 3371 NAICS code and non response was obtain from 3251 and 3221. From the non-respondents the majority corresponds to the NAICS codes 3371 with 538 companies and 3219 with 221 companies. It is also important to mention that from the companies that answered the survey 4 considered that they do not belong to any NAICS code form the research.

5.1.2.2 Database design

Objective 1 corresponds to the development of an industry directory tool on Microsoft Access of the secondary wood products industry companies participating in the research spread through the state of Virginia. The Access directory will be used by the VDOF, the basic information can be made public but a part of the information within the directory cannot be public, even though the relational model and the main view of the directory can be show.

The main changes done to the Microsoft Access database for the VDOF corresponds to:

- Security Feature:

The security feature corresponds to the main pop menu that appears when entering the directory. A menu asks for your name to log in, this record is saved in a table in which the name is kept for future references if needed.

- Main activity menu:

This corresponds to the second menu that appears after entering your name (security feature). This menu asks you what action you want to perform in the directory; browser the main menu, ask for reports or log out. This function was created to help the user find what they want without any incidence.

- Relational model:

The relational model for the database was completely transformed from the old version. The new relational model is composed of 28 of tables, 9 tables composed the old relational model and a total of 23 tables were added to improve the functioning of the database.

- General layout:

The general layout of the directory was changed and improved in order to increase the general appearance of the directory, this aim for a more friendly and visible pleasing directory.

- Buttons and gadgets:

Different buttons and gadgets such as drop down menus and easy access to add information were added to the directory, this to create a more friendly and easy to use directory by the user.

- Tables and relations:

Many of the existing tables were broken down into other and new relationships were created, so as to preserve the integrity of existing data and the new data.

- Reports:

This section was specifically added by a special order by the VDOF. One of the main uses from the directory is the generation of report for internal use and for requests from companies. The report created corresponds to knowing the species used by NAICS code and city.

Figure 6 shows the new access relational model created for the VDOF directory.

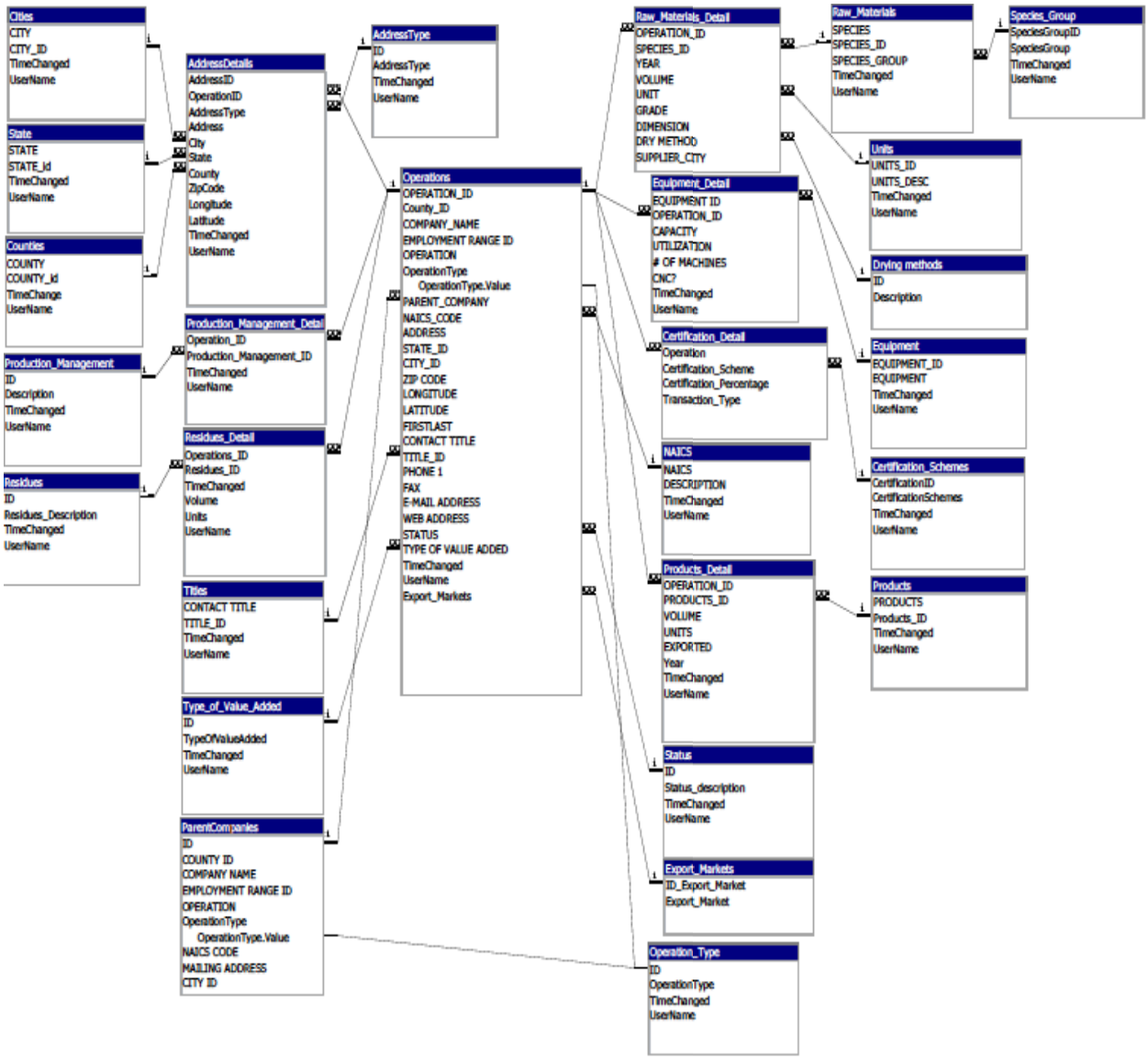


Figure 4. New access relational model.

Once the relational model was created, the design of the main browser was created. Figure 5 shows the log in menu in the directory. Figure 6 shows the security feature in which the user has to entry their name to access the main menu. Figure 7 shows the main operation menu form the directory. Figure 8 shows the operation browser, this corresponds to the main page to find, add and delete records. Figure 9 shows the report menu available for the directory and Figure 10 shows an example of the results obtain from a report.

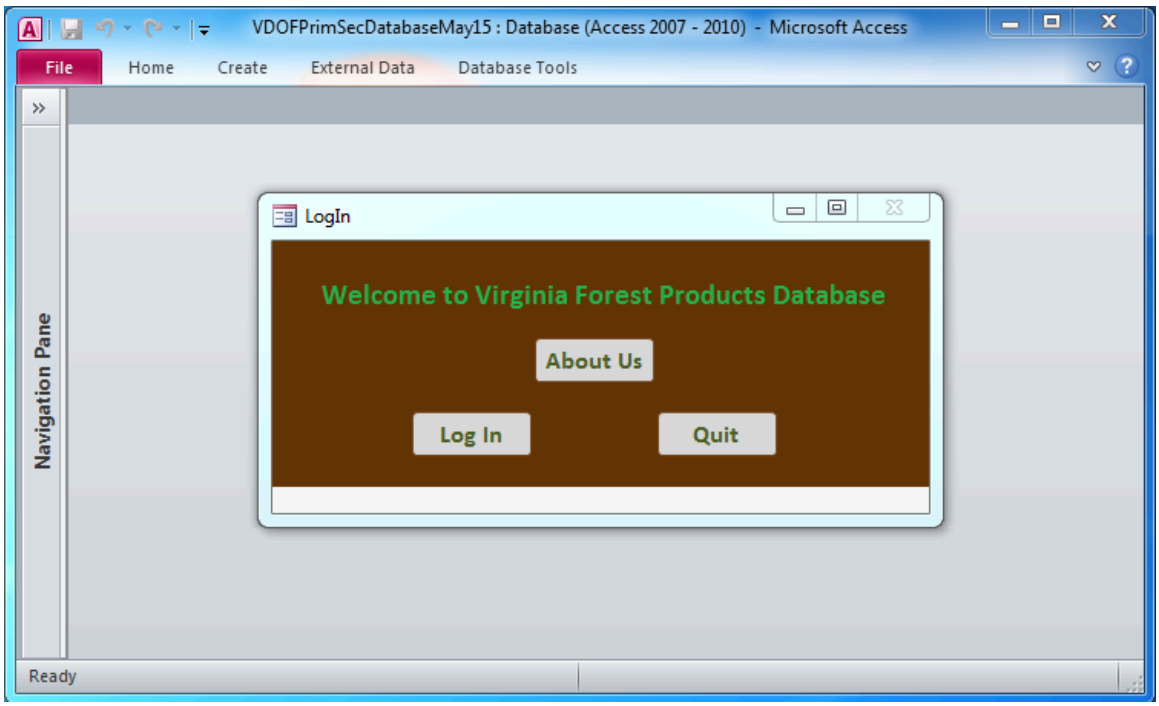


Figure 5. Directory log in menu.

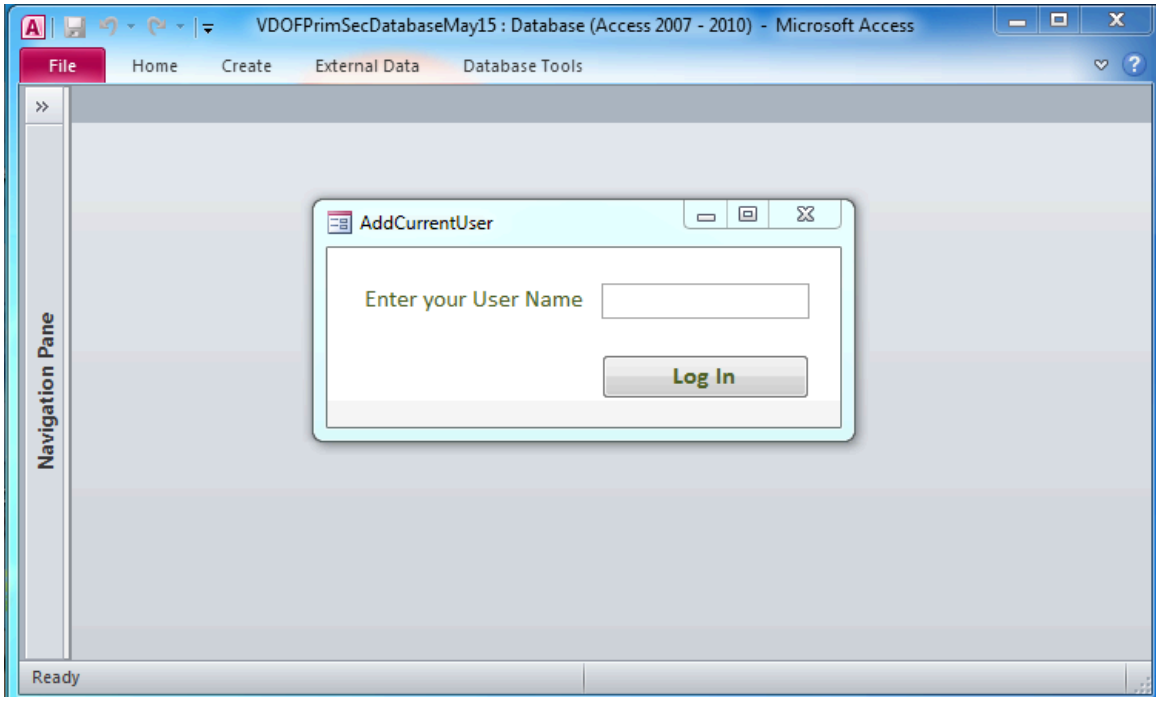


Figure 6. Directory security feature.

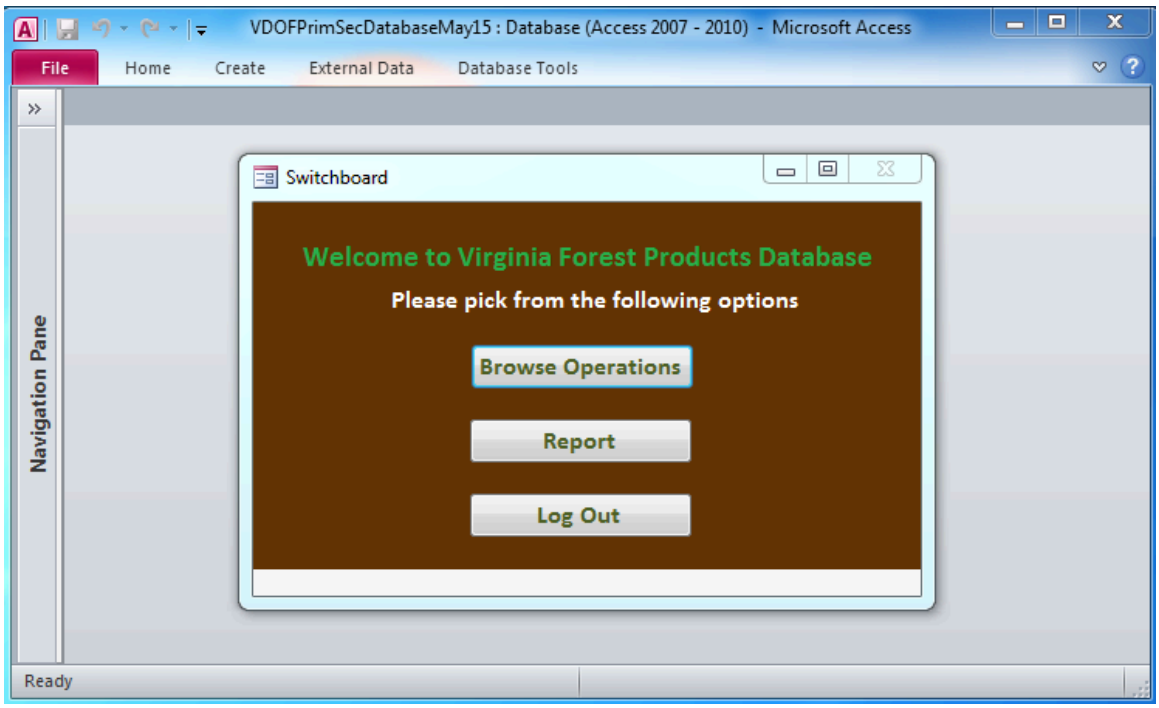


Figure 7. Directory operation menu.

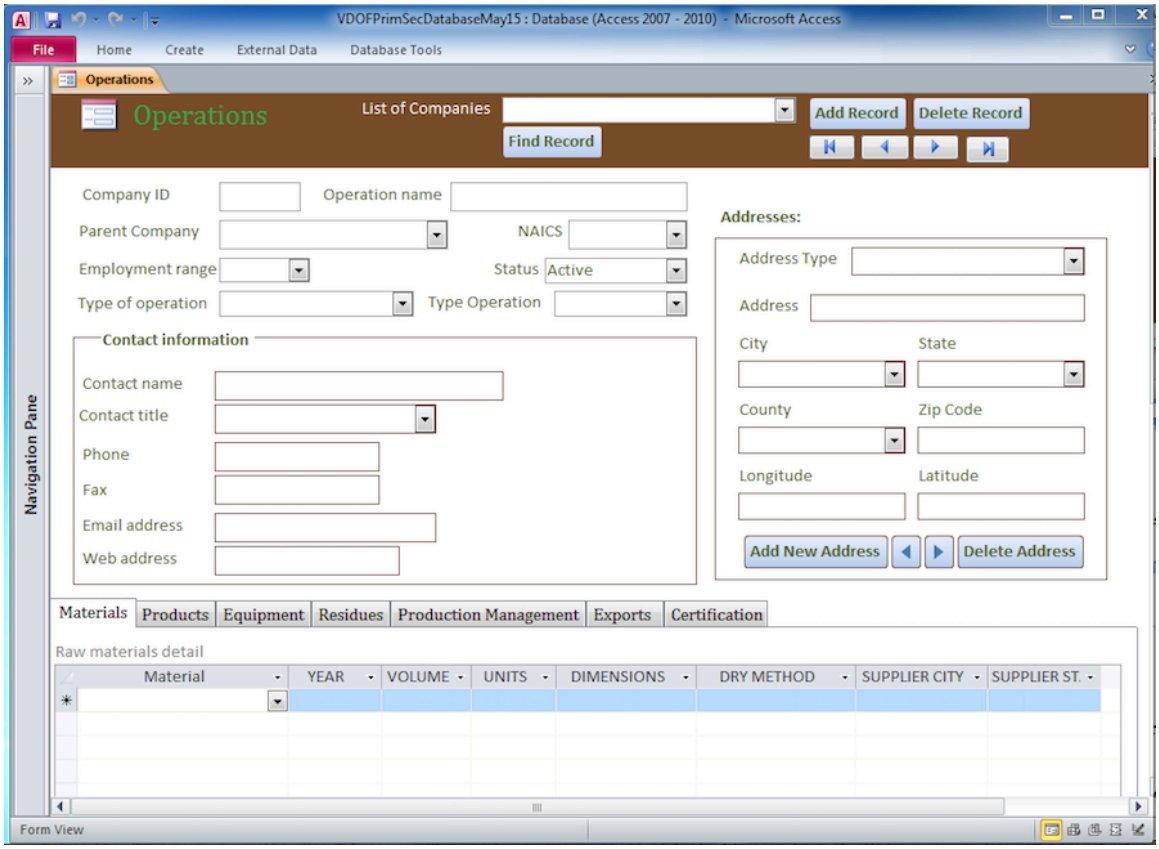


Figure 8. Directory operation browser.

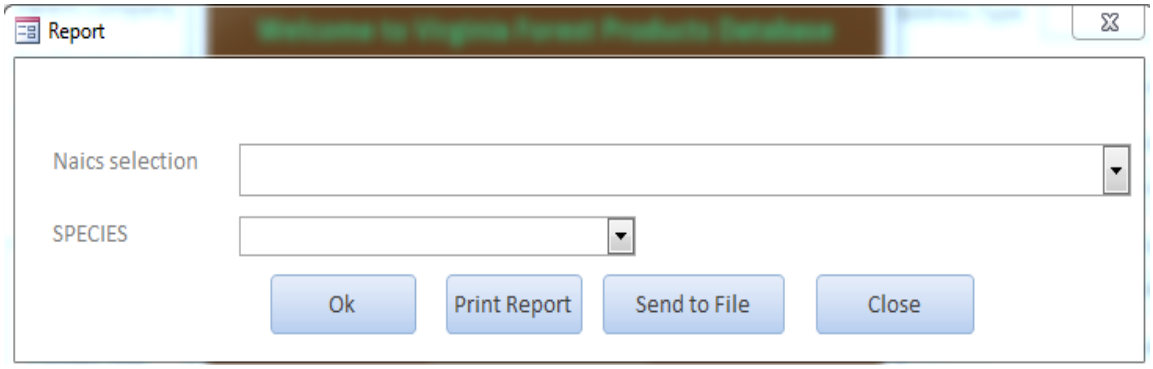


Figure 9. Directory report menu.

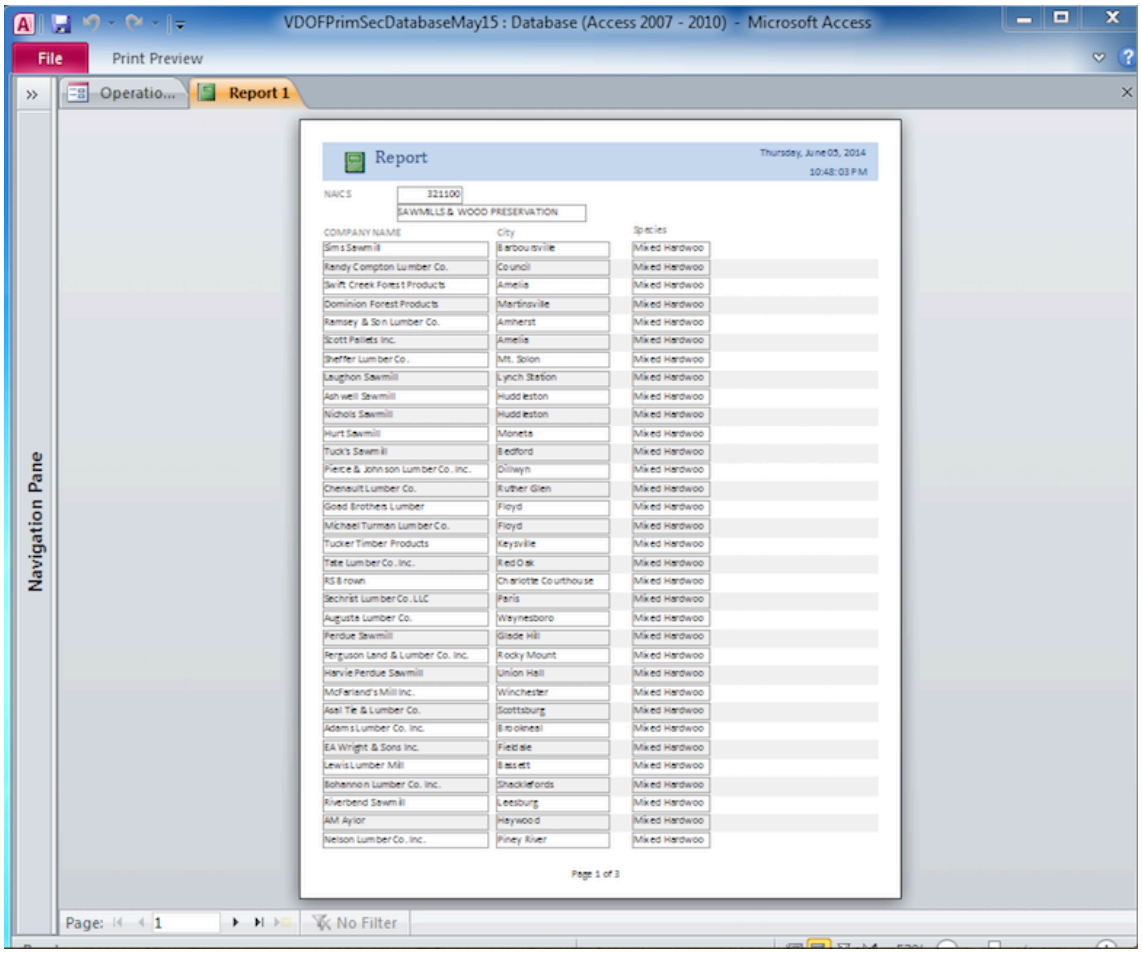


Figure 10. Directory report example.

5.2 Objective 2. Online Map Tool

5.2.1 Hypothesis 1. Wood products companies are located in clusters through the state of Virginia.

The creation of a database helped manage and store the data collected by the researchers. It will especially help the VDOF in their day a day activities and to help the secondary wood products industry. Once the relational database model was created analyzing the hypothesis became the next step for the researchers. By testing the hypothesis researchers gain more understanding of the real context of the secondary wood products industry in VA, this knowledge will be beneficial for the researchers, the VDOF, the industry and future studies, because of the geographical perspective it created of the secondary wood products industry.

Visualizing the data in a spatial dimension help the practitioners better understand the environment and the location of the dataset, this to make better decisions, strategies and to comprehend the entire situation that they are in or they plan to venture. The result of the hypothesis becomes a step to understand the secondary wood products industry environment.

Everitt (2011) mentions that according to Milligan (1996) typical steps must be followed in order to develop a cluster analysis, the following description of each step combine ideas from Everitt (2011) and Milligan (1996):

1. Objects to cluster: because cluster analysis is a inferential technique a representative sample is not required as long as generalization is not necessary.
2. Variables to be used: variables should be used only is there's a reason to believe they define the cluster, variables such as irrelevant or masking variables should be excluded from the data.
3. Missing values: if the missing values are low it is acceptable, if the missing data is big a re-clustering or other analysis should be perform to test the missing values.

4. Variable standardization: it is not necessarily always necessary to perform standardization; sometimes it can lead to false results. A solution represent choosing the correct unit to measure and that will work for scaling.
5. Proximity measure: some procedures are necessary when understanding the proximity among the data, but understanding the context and type of data suggest a proper choice or none.
6. Clustering method: the methods chosen should be suitable for recovering the types of clusters, insensitive to error, and availability of software.
7. Number of clusters: perhaps the number of clusters to use is the most difficult decision, stopping rules suggest different numbers usually the highest should be consider for safety. Alterably you might consider the possibility that there are no clusters.
8. Replication and testing: in this part a cross-validation techniques can be implemented to identify subsample among the cluster data.
9. Interpretation: this requires graphical illustrations and descriptive statistics to be able to correctly interpreter the data. Standard analyses such as analysis of variance are inappropriate for comparing clusters.

Taking into account the steps mentioned by Everitt (2011) and Milligan (1996) researchers develop a cluster analysis regarding the hypothesis 'Wood products companies are located in clusters through the state of VA'. For this particular study no inferential technique (sample) was necessary on the clustering analysis, because the entire population was taken into account for the analysis, even though the study focus on the entire population the study can not verify that the 100% of the secondary wood products in VA were used for the research, specially because of the constant status changes occurring in companies.

Because of the type of data utilized for the cluster analysis (company address) there's no reason to believe that the variable will define the clusters, in other words no data was removed because of the irrelevancy or masking variables. For the set of data utilized in this analysis some missing data can be found on the database, but the missing data

correspond to 19 of 972 addresses, in this case researchers consider that the small amount of data missing will not affect the clustering analysis. As well because of the variable utilized in this analysis (companies address) no standardization or proximity measure was necessary to preform the cluster analysis.

Because of the amount of data (972 company address) and the type (continue data) the clustering methodology selected was K-means from the software JMP 11. The system (JMP 11) assigned a set of point as temporary clusters and then when more points are added the cluster center point become the mean. For this particular method the k-mean approach used the EM algorithm (Expectation-Maximization algorithm), which basically assign the data to the closer cluster in the study (SAS Institute 2014).

For the number of cluster selected for this study, the researchers decide to cluster the data in a small group (3 clusters), then in a medium group (5 clusters) and finally in a big group (10 clusters) to se how the data behaves. For replication and testing a validation with a scatterplot and real map context was developed to identify is the data really behaves in clusters. For the interpretation the utilization of graphic illustrations (JMP results {Clustering analysis and scatterplot} and Map visualization) and also the utilization of descriptive statistic was used to determine if the hypothesis was prove or denied.

To test the hypothesis the statistical software JMP 11 was used, the data input in the statistical software correspond to the Latitude and Longitude from the companies participating in the study; these variables will be presented in the biplot and a scatterplot.

The biplot will show the clusters found in the data, pin 1 and pin 2 correspond to the latitude and longitude with the new values transformed by the software, in the other hand the scatterplot will show the latitude and longitude with their real numbers. The utilization of the map with the address is a second test in with the researches want to prove if the results actually resemble the reality of the data.

The hypothesis “Wood products companies are located in clusters through the state of Virginia” will be proven or denied with the data obtain from the VA secondary wood products industry questionnaire and the information bought from a third party form the companies that decide to not participate in the study.

Figure 11. Data in 3 main clusters, Figure 12. Data in 5 main clusters and Figure 13. Data in 10 main clusters, represent the results obtain from the clustering analysis performed in JMP 11, which helped better understand the data and finally will help the researchers prove or denied the hypothesis created at this research.

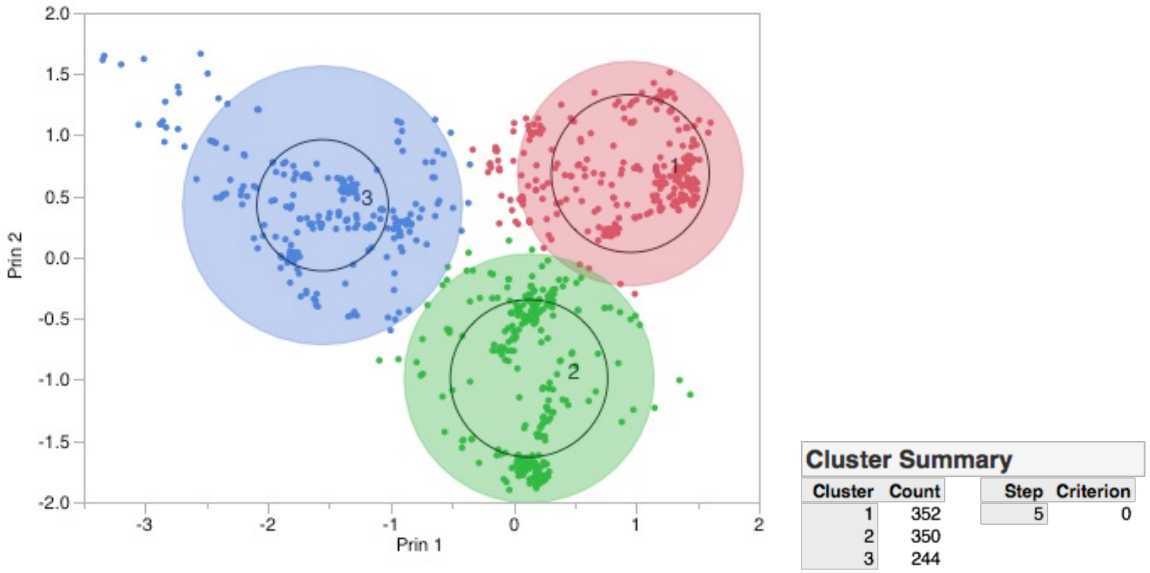
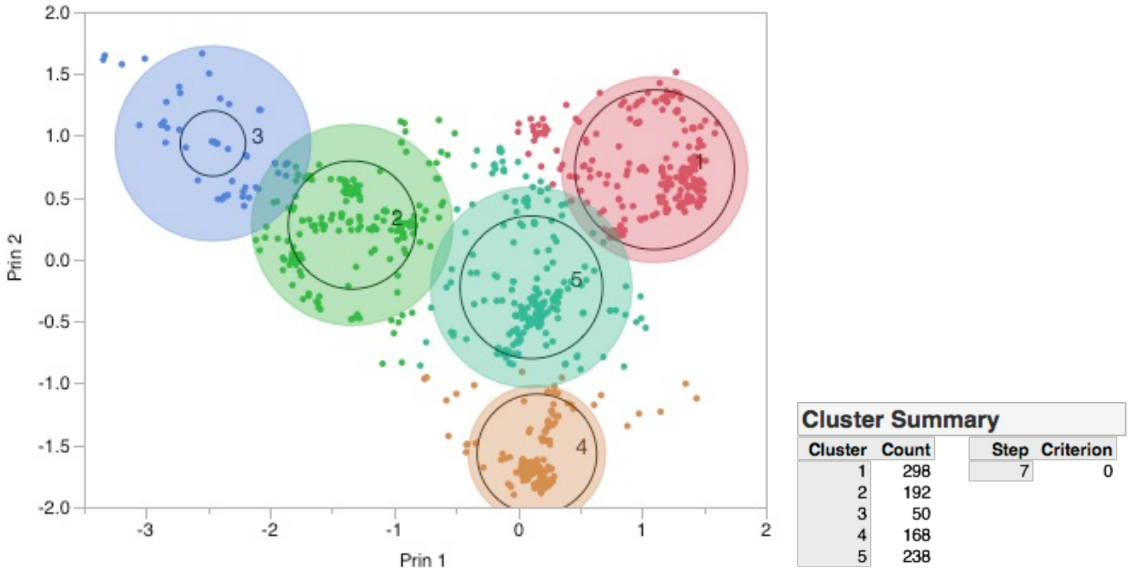


Figure 11. Hypothesis; Data in 3 main clusters

As shown in Figure 13 the data can be mainly cluster in 3, this can be show in the count inside each cluster (1=352, 2=350 and 3=244). But even with 3 big clusters, small groups are seen inside the three main clusters. For example on cluster 2, clearly two more clusters can be made, that’s why a new analysis with 5 clusters were perform to appreciate if the analysis throws more specific information.



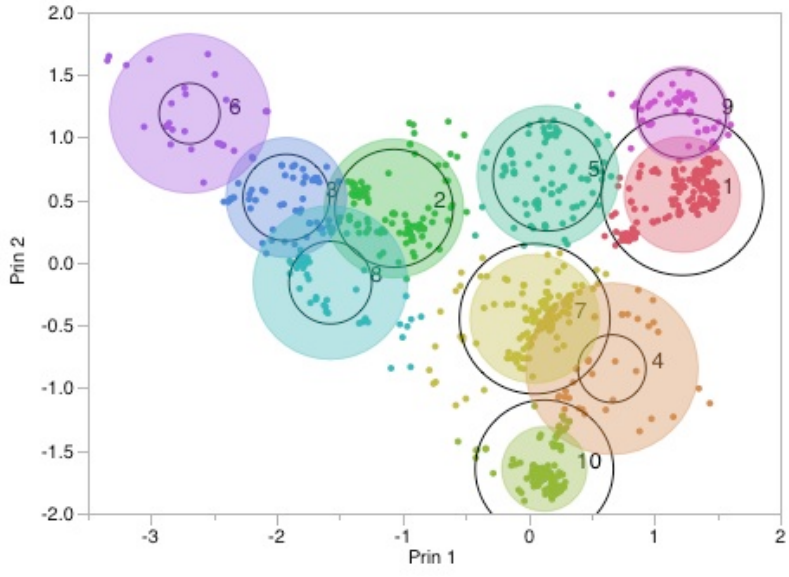
Cluster Summary

Cluster	Count
1	298
2	192
3	50
4	168
5	238

Step	Criterion
7	0

Figure 12. Hypothesis; Data in 5 main clusters

When the data is clustered in 5, four out of the five clusters shows a significant group of companies (1=298, 2=192, 4= 168, 5=238 vs. 3=50). A bigger analysis with 10 clusters was performed to identify the main clusters in a larger group. The idea of this analysis is to see were the main concentration of data is located to help prove or denied that the information collected (companies) are located in clusters around VA.



Cluster Summary

Cluster	Count
1	199
2	106
3	57
4	35
5	92
6	28
7	172
8	52
9	60
10	145

Step	Criterion
8	0

Figure 13. Hypothesis; Data in 10 main clusters

From the last analysis with 10 clusters, the researcher proves that the data is clustered in 4 groups mainly (1=199, 2=106, 7=172 and 10= 145). This analysis proves that the data (companies) are located in clusters on VA, when a clustering analysis such as K-mean is applied.

Another way of proving that the data is located in clusters on VA is by looking at the scatterplot matrix from the analysis, which represents each interval (latitude, longitude) of each point. Figure 14 shows the scatterplot matrix for this study.

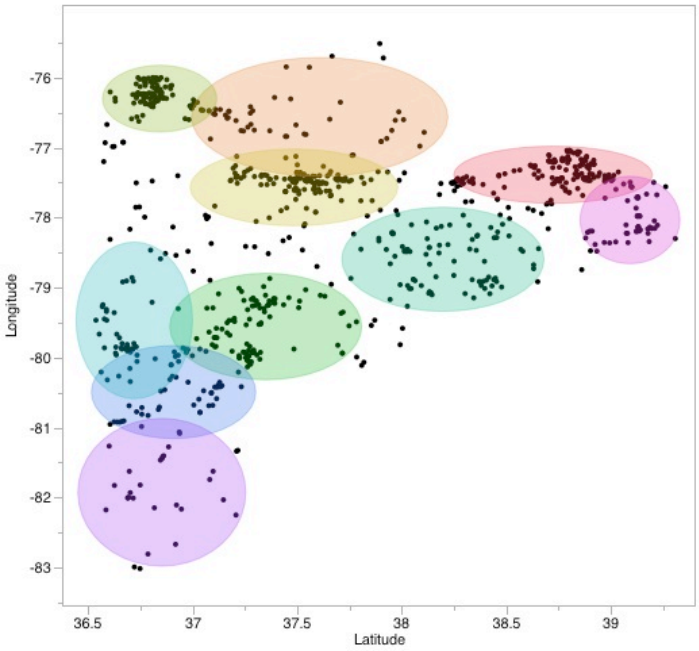


Figure 14. Hypothesis; Scatterplot matrix

As shown in Figure 14, clusters can be identified form the data. By locating the latitude and longitude of each observation in a scale, several clusters can be located in the data this help identify and prove the hypothesis, which imply that the companies in Virginia are located in clusters. The final test utilize to prove the hypothesis relates to the mapping of each company address in a map of Virginia, Figure 15 shows the location of the companies address (data) on VA.

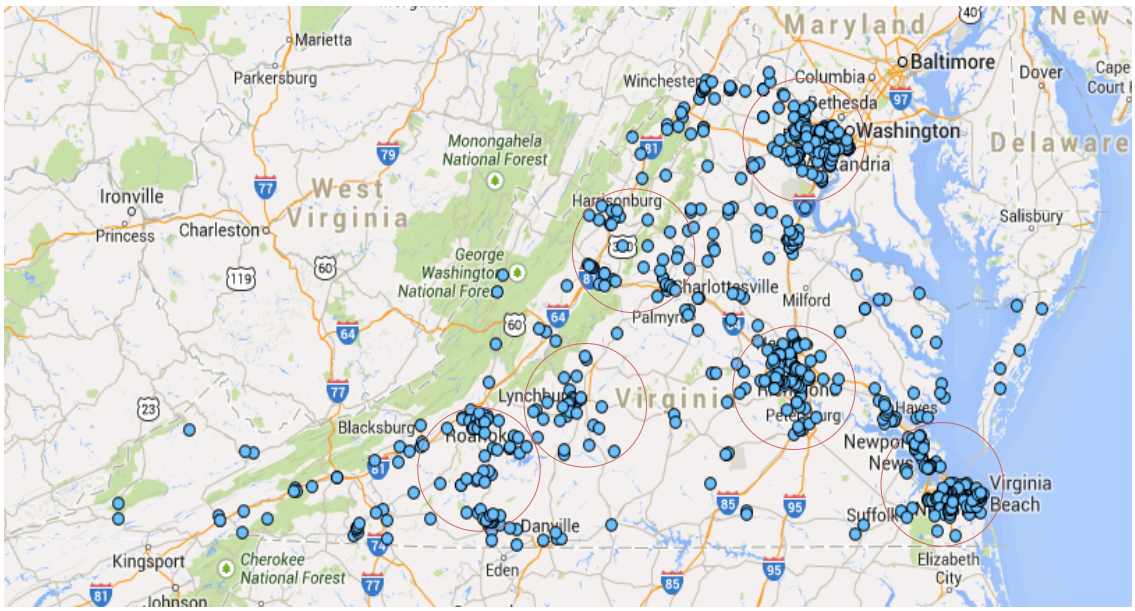


Figure 15. Hypothesis; VA Map

The last hypothesis testing represents a geographical analysis, in which the data (companies location) is show in a map with help of a Google map. This last test help the researchers prove that the hypothesis "Wood products companies are located in clusters through the state of Virginia" is true. All the testing realized to the hypothesis help the researchers to have sufficient evidence to prove the hypothesis proposed in this study.

Clustering Analysis

An analysis of 4 main clusters and non-clustered companies was developed, in order to better understand the conformation of the clusters and the differences with companies not located in clusters. For this particular analysis the clusters selected corresponds to: cluster 1 next to Washington DC, cluster 2 Richmond area, cluster 3 Virginia Beach area and cluster 4 Richmond and Roanoke area. All the clusters selected were analyzed and compared with the companies not located in clusters, this in order to understand and have an inside of the type of companies located into clusters unlikely to the one not in clusters.

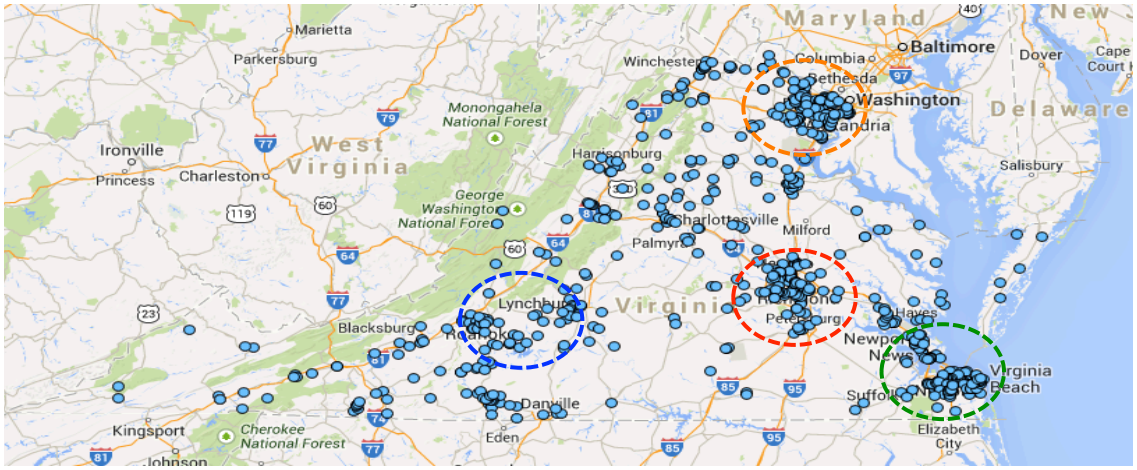


Figure 16. Cluster analysis selection.

The companies utilized for the cluster analysis correspond to companies that answered the questionnaire and phone call companies, in other words all the companies were used for the clustering analysis. Specifically the clustering analysis consisted of a description of the NAICS codes thought the clusters and companies not located in clusters, the NAICS were selected because is the basic information that was collected from all the companies selected in the study.

Table 4 shows the clustering analysis by the NAICS code, focusing on 4 main clusters founded on the hypothesis testing and the companies not located in clusters.

NAICS CODE AND DESCRIPTION		CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4	NON-CLUSTER COMPANIES	TOTAL
NAICS 322- Paper Manufacturing	322110	1	1	0	0	3	5
	322121	3	6	0	0	4	13
	322130	0	4	3	0	2	9
	Total by Cluster	**4**	**11**	**3**	**0**	**9**	**27**
NAICS 321- Wood Product Manufacturing	321113	2	2	0	5	29	38
	321114	0	0	3	1	6	10
	321213	0	0	1	0	4	5
	321214	1	1	0	0	5	7
	321911	1	0	1	0	1	3
	321912	1	1	1	0	9	12
	321918	21	14	4	6	39	84
	321920	1	8	1	1	5	16
	321991	3	4	1	2	12	22
	321992	7	8	3	11	37	66
	321999	7	3	7	2	9	28
	Total by Cluster	**44**	**41**	**22**	**28**	**156**	**291**
NAICS 337- Furniture and Related Product Manufacturing	337110	114	76	79	42	131	442
	337122	6	0	5	6	24	41
	337127	13	6	10	8	28	65
	337211	1	0	0	0	1	2
	337212	0	3	0	0	2	5
	337215	5	1	3	2	5	16
	Total by Cluster	**139**	**86**	**97**	**58**	**191**	**571**
NAICS 325- Chemical Manufacturing	325	0	0	0	0	0	0
	Mix NAICS (337 & 321)	3	2	2	3	10	20
	Other	0	1	0	1	2	4
	Blank	8	10	5	4	32	59
	TOTAL	**385**	**289**	**251**	**180**	**756**	**972**

Table 4. Clustering analysis by NAICS code.

For a better analysis the data was divided in two main groups (1) companies located in clusters and (2) companies not located in clusters, to better understand the real distribution and profile of the companies in a cluster and out of a cluster. Table 5 shows the two groups utilized for the clustering analysis.

NAICS CODE AND DESCRIPTION		SUM OF CLUSTERS	NOT IN CLUSTERS
NAICS 322- Paper Manufacturing	322110	2	3
	322121	9	4
	322130	7	2
	Total by Cluster	**18**	**9**
NAICS 321- Wood Product Manufacturing	321113	9	29
	321114	4	6
	321213	1	4
	321214	2	5
	321911	2	1
	321912	3	9
	321918	45	39
	321920	11	5
	321991	10	12
	321992	29	37
	321999	19	9
	Total by Cluster	**135**	**156**
NAICS 337- Furniture and Related Product Manufacturing	337110	311	131
	337122	17	24
	337127	37	28
	337211	1	1
	337212	3	2
	337215	11	5
	Total by Cluster	**380**	**191**
NAICS 325- Chemical Manufacturing	325	0	0
	Mix NAICS (337 & 321)	10	10
	Other	2	2
	Blank	27	32
	TOTAL	**1105**	**756**

Table 5. Cluster companies vs. Non-cluster companies by NAICS codes.

Table 4 and 5 shows the distribution of NAICS codes among the cluster groups and non-cluster companies. For this particular clusters analysis table 4 and 5 helped derived conclusions such as:

- The majority of companies from NAICS 322 Paper Manufacturing are located in the Clusters 2.

- Cluster 1 has the majority of the companies form NAICS 321 Wood Products Manufacturing.
- From the NAICS 337 Furniture and Related Products Manufacturing the majority of companies are located in Cluster 1.
- NAICS 321 Wood Products Manufacturing has the majority of companies that are no located in clusters.
- In general matters Cluster 1 has the majority of companies and Cluster 3 has the minority of companies.

Even though many aspects can be concluded from the tables probably the most important aspect to conclude corresponds to:

- From NAICS 322 Paper Manufacturing the majority of the companies are located in cluster.
- From NAICS 321 Wood Products Manufacturing the majority of companies are not located in clusters but the difference with the cluster companies is small.
- From 337 Furniture and Related Product Manufacturing the majority of companies with a big difference are located in clusters.

With the data results, the tables and conclusions above some assumptions can be made in order to understand why the companies are located in clusters and why some locations are more popular that others. Some of the assumptions created by the study are:

1. The majority of the companies in NAICS 337 and NAICS 322 are located in clusters because of the proximity to the consumers and to potential buyers in other words to the easy access to the customers. In this particular case clustered in main cities such as Washington, Richmond, Virginia Beach, Roanoke and Lynchburg.
2. Those that do not belong to a cluster are located majority in NAICS 321, this might be because of the easy access to raw material, more space for production manufacturing line, in other words they do not need to be as close to the customers as other companies.

5.2.2 Industry Directory tool

By understanding the importance of GIS uses in marketing application such as in marketing mix strategies (price, product, place, promotion) has on companies, and the way secondary wood products companies are located in VA, encourage the development of a tool that support the utilization of both; new knowledge on GIS marketing and clustering location of the secondary wood products industry. Integrating the knowledge of GIS marketing and the secondary wood products location information became a main result of this study, in which an online map was created to show the wood industry the combination of the two results mention above.

Also the creation of the GIS application (online map) will provide the wood industry with insights into the secondary wood industry, by locating the companies geographically and help them visualize better the entire secondary industry. The desire to create a map tool (GIS application) emerge from the results of the hypothesis testing, specially because the hypothesis prove that the companies are located in clusters and the necessity to visualize the data geographically.

Some uses of the GIS tool for marketing mix applications correspond to: match you company or competitors locations with mayor sales, associate ethnic population in the map, associate the product depending of the geographic location, search for new products markers, find channels or locations for future locations, find competitor or possible partners, understand why some stores are more rentable than others, see distances to price the product or service, maximize promotion by recognizing the mayor routes, located and pin it t the map the customers, target the biggest clusters of companies for promotion strategies, among others

As part objective 2, which aims to create an online map tool that presents all the secondary wood products industry companies that participate in the research, spread through the state of Virginia, a total of 953 from 972 companies were added to the online

map, because of the removal of the 19 companies that were impossible to deliver or are no longer in operation.

The development of the online map basically involves the creation of codes and programing of Google map, which was de venue chosen for the map. Once the coding is done and the map link under the VT SBIO (Department of Sustainable Biomaterials) domain, the basic data collected was added to the map.

The final online map version will be available to the public. Figure 17 shows the outlook of the online map tool.

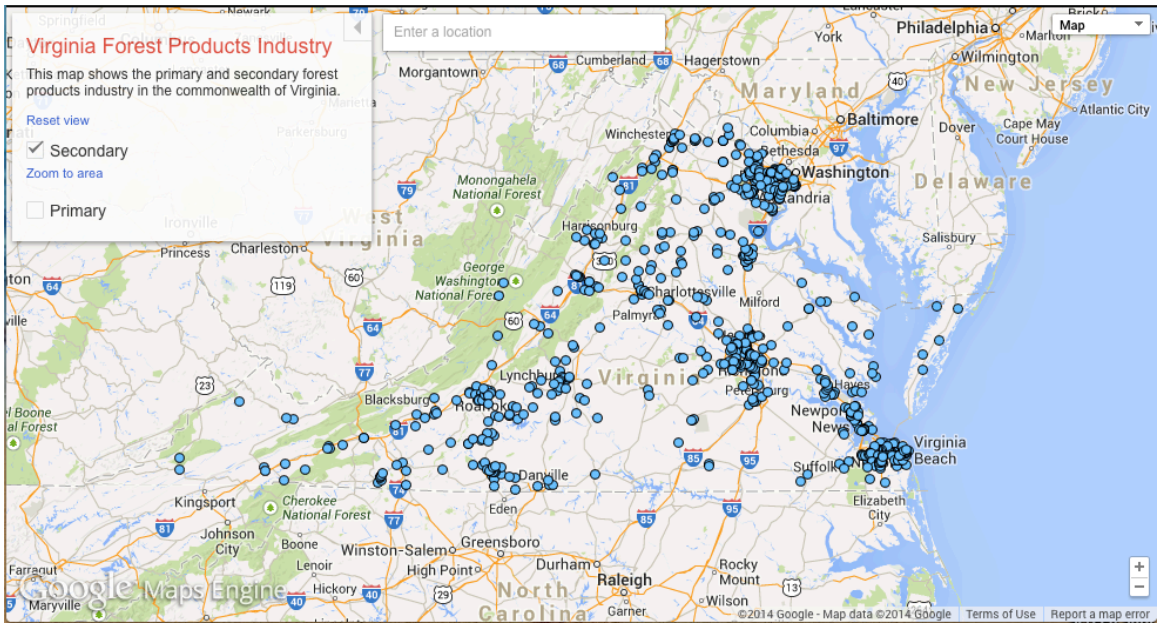


Figure 17. GIS tool outlook.

The GIS tool when zoom the name of the company and other important information about the company pop. Figure 18 shows how the GIS tool shows the specific information about the company when this is zoomed.

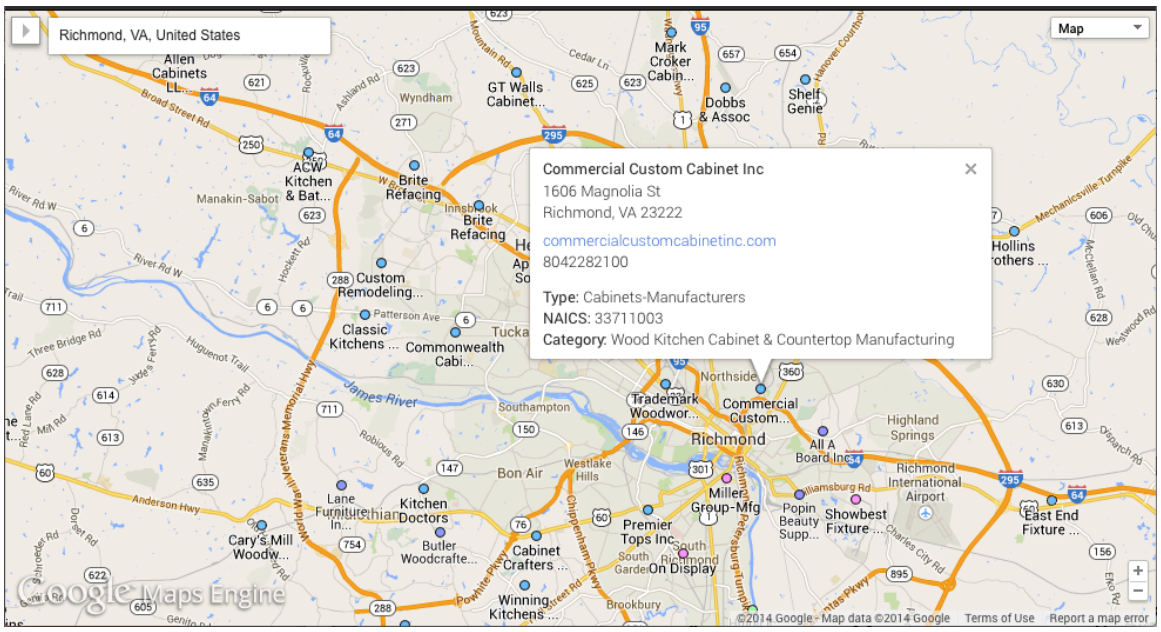


Figure 18. GIS tool; company information

5.3 Objective 3: GIS applications in marketing on Wood Products

The creation and utilization of GIS in marketing application has proven to be beneficial for marketers and companies. The development and implementation of the GIS application in the marketing department is not an easy task but with the correct guidelines it turns in to a successful and powerful tool that can be used when developing marketing mix strategies. The third objective of this research is to focus on the creation of guidelines (best practice manual) for GIS uses in marketing application, specifically marketing mix in the wood products industry. This manual of best practices will compress the basic information regarding the development and implementation of a GIS application in marketing. This manual will work as guidelines for practitioners, academia and future research on the topic.

In this section the researchers applied a survey and interview two different companies currently utilizing GIS on their processes and also an academic expert in GIS.

5.3.1 Case study Results

The results obtained from the questionnaire applied to the 2 companies and the interview to an academic expert on GIS is:

- **Company A:**
  - Organization role: Marketing Officer
  - Role description: promotion and establish portfolios / Develop and evoke the strategy for the next generation portfolio
  - Personal experience GIS: 5 years or more
  - Company experience on GIS: more than 5 years less than 10 years
  - Supplier management applications
    - They use it but not for competitors specifically more on the actual supplier of the machinery
    - On the supplier, they teach how to use the systems
  - Internal applications:
    - On internal applications they used it for inventory management, asset management, financial management, manufacturing
    - No use on marketing strategic is perform by the company
  - Customer applications:
    - The collection of data for the customers
    - Location and problem solving
    - Distribution of assets for the customers
  - General Perception:
    - Positive general perception, essential to their business and many others
    - Yes, to recommended to other firms because of it advantage in location and problem solving
    - The capital invest is worth to the benefits and ROI return from the utilization from the system.
    - Logistics/distribution is the industry he consider to use more GIS applications

        - Advantage: tracking of assets
        - Disadvantage: equipment- addition control- certify equipment every two years = version control by vendor (CISCO) change the equipment software every to years and they have to certify all the process again.
    - Software use:
        - They develop their own application system (Oracle), but use Google maps to visualize it geographically

- **Company B**:
    - Organization role: Regional Forest Manager and Southern Inventory Functional Team Leader
    - Role description: working with a team to oversee the history activities and inventory for about 970,000 acres in Mississippi and Alabama. Further duties working with peers to do the some on a little more then 3 million additional acres.
    - Personal experience GIS: 5 years or more
    - Company experience on GIS: 10 years or more
    - Supplier management applications
        - No use on supplier management applications is perform by the company
    - Internal applications:
        - They use GIS applications in internal applications for inventory management of forest resources, land title, minerals resources, trucking logistics, timberlands acquisition analysis.
        - According to the company some disadvantages correspond to the high cost of ESRI software and performance issues.
        - Some advantages are spatial decision tool and history tracking planning.
    - Customer applications:
        - No use on customer applications is perform by the company

- General Perception:
    - In a general perception, they consider most helpful in answering questions about where, how much, what happened, communication to other team members.
    - They recommend using GIS; because it helps to manage land, remember treatments, knowing where to plan activities, which is very helpful in managing recourse with a 25-year plus rotation.
    - They consider that the capital invest is worth to the benefits and ROI return from the utilization from the system.
    - Marketing and sales is the industry sector they consider to use more GIS applications
- Software use:
    - Some software corresponds to: Esri ArcGIS 10.1 Desktop, ArcSDE 10.1, ArcGIS Server 10.1, Image Server 10.1, ArcLogistics, various ArcGIS Desktop and ArcGIS server extensions, ArcPad, ERDAS, Cengea's Resources application, Silvacom online

- **Academic Expert:**
    - It is more fro GIS to be use in Supplier and Firm applications
    - Benefits from supplier: know and understand more about
        - Transportation
        - Locations
        - GIS tools
        - Competitors locations
    - Benefits from Firm applications: the two more beneficial factors
        - GIS shipping
        - Routing
    - On the customer use for GIS:
        - Identification of customer (costumers research, marketing research)

        - Potential buyers
        - Existing customer on the market
        - Demographics and customer databases
        - Patterns target, clusters from customers and suppliers
    - Software and systems:
        - ArcGIS map = Bigger companies/ large budget
        - Open Source = Smaller companies/ limited budget
            - Map window
            - Google maps
    - Recommend a specialist on company:
        - Depend on how the size of the company
        - Also depend on the need of GIS in the company
        - If GIS in crucial and the company used big data a specialist might be needed.
        - Open source is a good option for smaller companies
    - Advantages of using GIS:
        - Spatial analysis and map display
        - Traditional location
        - Targeting customers/ suppliers
    - Disadvantage of using GIS:
        - Not very commonly use in different sectors (applications)
        - Not know the potential of the system
        - Budget is a big factor on the utilization on the system
    - Data Source:
        - First: existing data from the company
            - Geographic positioning of data using their own information for station location
            - Link your information first before looking for other information.
        - Second: government information and open source information
    - ROI more than the Capital Investment

- Yes, with the open source/downside from open sources is that not always has good information and not always the system is stable it might crash.
- With pay source the budget is bigger but the advantages with the system are better and the system is more stable.

5.3.2 Objective 3. Best Practice Manual

The objective 3 corresponds to the development of a manual of best practices for GIS uses in marketing application, specifically the marketing mix. The manual was created to help the practitioners, academia and future research on this field. The best practice manual will be open for public and will contain all the basic information needed to develop GIS uses in marketing mix strategies.

The two companies and the experts that participated in the case study completed all the questions on the questionnaire and were beyond explanations explaining the GIS applications. Unfortunately, none of the companies applied GIS in their marketing department but they have great suggestions and opportunities on that application. In this manner the GIS marketing application part of the manual was taken form literature review, case studies and other successful applications of GIS in marketing in other industries found.

The main features presented in the manual of best practices correspond to:

- Needs and requirements
- Strategic plan & Implemented plan
- Design phrase and Implementation phrase
- Pilot project
- Application development
- Maintenance and update plan
- Training & Evaluation
- GIS marketing uses and applications

See Appendix E. Best Practice Manual, for the complete version of the best practice manual on this part of the research.

5.4 References

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6 Discussion, Conclusions and Contributions

6.1 Discussion of results

This segment aims to explain and discuss the results obtain from the study, this research was divided in 3 main objectives; 1) industry directory, 2) GIS map tool and 3) manual of best practices, the discussion of results was also divided in those three main parts.

6.1.1 Industry directory

When researching about the VA wood products industry it was found that in the US and in the world this industry has become a multinational business with plantations and mills worldwide. In US this industry contributes to the economy of the nation as well as to the employment, specifically in Virginia it represent 6.72% of the national value shipments and 2.92% of the value shipments when it refers to the furniture and related product manufacturing (United States Census Bureau, 2007).

Also when researching about the wood products industry it was found that the Virginia Department of Forestry (VDOF) was created in 1914 with the purpose of preventing and suppressing the forest fires and reforestation of lands, but over time it evolved to cover other protection and management duties, the creation of the VDOF help the wood products industry in Virginia specially all the companies within the state, creating new knowledge and updating companies information is one of tasks of the VDOF that help the industry keep moving forward.

One of the tasks of the VDOF corresponds to assist the wood products industry by surveying the primary wood products with a survey called Timber Products Outputs (TPO), which collects basic information about the primary industry to help them understand and the better assist the companies. All the information collected from the TPO survey is input into a database that help them manage the data, after reviewing the database it was found several flaws such as duplication of data, incorrect creation of reports, slow data processing and the lack of experience when the directory was created.

In order to help the VDOF, researchers decide to develop a survey in which secondary wood products were investigated and later a new database was developed to cover all the flaws found on the old database. The main results found on the survey implemented to the secondary wood products in VA is that from the 972 companies surveyed only 125 companies respond to the survey and form that only 108 companies are usable to the research, this corresponds to a 11.11% of respond rate, this result help the researchers create a new directory for the VDOF.

With the information collected from the secondary wood products industry survey and information brought from the third party of the non respondents, the researchers improved the database from the VDOF as result the new Microsoft access database contains new features such as: security aspect, a new and more friendly main activity menu, a completely new relational database model, a new general layout, addition of buttons and gadgets, creation of tables and relations and the creation of report. The new database will primarily help the VDOF but it will also help the industry and the academia.

The new database created by the researchers will help the VDOF understand more about the secondary wood products companies, it will also help them in the management of the data, preserving the integrity of the same and in the creation of reports to help the companies and have updated information to better assist the decision making in the department. Regarding the industry this directory will he helpful for them, because they will be able to ask for updated and accurate information to the VDOF regarding the status, information of other companies (competition), species, export and other basic information regarding the wood products industry. From the academia prospective, the new database will be helpful in future research's specially those related to the secondary wood products industry and it will also help in the data gathering for different research's.

6.1.2 GIS map tool

Before discussing the results from the GIS map tool, it is important to discuss results obtained from the hypothesis. The hypothesis tested correspond to understand if the wood

products companies are located in clusters through the state of Virginia, to test this hypothesis a clustering analysis was performed. To test the hypothesis a K-mean clustering analysis was performed with the Latitude and Longitude data from the companies participating (those who respond and the information from the third party of the companies that do not participate in the study).

After analyzing the hypothesis with K-mean clustering analysis (3, 5 and 10 clusters), a scatterplot and with help form the GIS map tool the researchers have sufficient evidence to conclude that the secondary wood products industry is located in clusters through Virginia. This result will help: 1) the VDOF by helping them understand how the secondary wood products are distributed in Virginia, 2) other companies in this industry by locating their competitors, suppliers or other locations for future retailers and 3) the academics by understanding more the distribution of the companies and the localization of them through VA will help academics plan new research taking into account the information developed in this research.

The creation of the map tool correspond to a GIS application of secondary wood industry information collected form the survey. The tool was created on Google Maps engine with help from a third party, basic information from each company was added to the map in order to be presented geographically. The GIS application (online map) will help in general manner in the understanding of the geographical distribution of the companies in VA, this will mainly help the VDOF, industry and academia to better visualize, understand and create strategies and plans for the secondary wood products industry.

6.1.3 Best Practice Manual

The third set of results discussion corresponds to the best practice manual for the GIS uses in marketing applications. To develop this last objective a case study was developed, a survey and a interview was conducted to two companies that currently use GIS in their processes and a academic expert were interview to obtain the information necessary to develop the manual of best practices.

The main results obtained from the questionnaire applied to the companies selected for the case study are 1) the companies utilize GIS for supplier and customer applications none utilize GIS for marketing purposes, 2) the companies consider that the capital investments is worthy because of the benefits and ROI from the utilization of the system and finally 3) the companies participating on the study had a general positive perception of GIS application and recommend other firms to use GIS because of the advantages they gain using it.

According to the academic expert the most remarkable results correspond to 1) probably suppliers is the most used application for GIS, marketing can be utilized with GIS application but companies do not use it because they lack of information and procedures, 2) many benefits, advantages and disadvantages can be raised from GIS application in the companies such as competitors locations, transportation information, spatial analysis, map display, targeting markets, not commonly used, do not know the potential of the system and budget is a big factor among others and 3) understanding about the software and systems and data sources available will help the companies obtain ROI form the capital they invest in the system.

With the responses from the companies and the expert that participated in the case study and additional literature review, the researchers created a manual of best practices for GIS uses in marketing application. The manual is informed by the needs and requirements, strategic plan and implementation plan, design phrase and Implementation phrase, pilot project, application development, maintenance and update plan, training & Evaluation and GIS marketing uses and applications

The best practice manual of GIS uses in marketing application will help the 1) VDOF by providing a tool to be shared with the wood products industry and that can also be utilize by the department, it will additionally help 2) the industry by providing guidelines for the implementation and development of GIS uses in marketing application and possible application in marketing and finally it will help 3) the academia by creating new

knowledge regarding the GIS uses in marketing application in the wood products industry.

6.2 Conclusions

From the previous discussion of results, the researcher was able to summarize the main conclusions below.

- Wood products industry is a worldwide multinational business; in US this industry contributes to the economy of the nation as well as to the employment.
- Virginia Department of Forestry (VDOF) was created in 1914 with the purpose of preventing and suppressing the forest fires and reforestation of lands, but over time it evolved to cover other duties. The VDOF have help the wood products industry in Virginia in many different ways that help the industry keep moving forward.
- The VDOF develop a primary wood products survey called Timber Products Outputs (TPO), which collects basic information about the primary industry. All the information collected is input into a database that help them manage the data, after reviewing the database it was found several flaws and imperfection that jeopardize their functioning.
- The results from the survey implemented to the secondary wood products in VA correspond to a 11.11% of respond rate, this result help the researchers create a new directory for the VDOF that correct the flaws and imperfections found in the directory.
- The researchers improved the database from the VDOF as result the new Microsoft access database contains new features such as: security aspect, a new and more friendly main activity menu, a completely new relational database model, a new general layout, addition of buttons and gadgets, creation of tables and relations and the creation of report.
- The new database will help the VDOF understand more about the secondary wood products companies, it will also help them in the

management of the data, regarding the industry will be helpful to updated and obtain accurate information to the VDOF regarding the secondary wood products industry and from the academia it will be helpful in future research's and to data gathering for different research's.

- After analyzing the hypothesis with K-mean clustering analysis (3, 5 and 10 clusters), a scatterplot and with help form the GIS map tool the researchers have sufficient evidence to conclude that the secondary wood products industry is located in clusters through Virginia.
- The main results from the companies from the case study questionnaire are 1) GIS is utilized for supplier and customer applications none utilize GIS for marketing purposes, 2) the capital investments is worthy because of the benefits and ROI from the utilization of the system and 3) companies have a general positive perception of GIS application and recommend other firms to use it.
- The results from the academic expert on the case study corresponds to 1) suppliers is the most used application for GIS, marketing is utilized but in a smaller level, 2) many benefits, advantages and disadvantages can be raised from GIS application in the companies and 3) knowing about the software, the systems and data sources available will help the companies obtain ROI.
- The best practice manual of GIS uses in marketing application will help the 1) VDOF by providing a tool to be shared with the wood products industry, 2) the industry by providing guidelines for the implementation and development of GIS uses in marketing application and 3) the academia by creating new knowledge regarding the GIS uses in marketing application in the wood products industry.

6.3 Contributions, Limitations and opportunities for future research

This study contributes to a research framework that includes all the elements previously identified in the literature. This study complements the research framework with (1) a questionnaire for the industry directory and (2) a questionnaire and interviews for the

case study, which allows future researchers to follow up this research. The tools implemented in this research are already created, which would involve less time and cost in future applications since this is already designed. Finally, the framework proposed in this research is not tied to any particular company; therefore, this can be applied to many different industries.

A summary, contributions and recommendations for industry practitioners, academia and future researchers, especially for the wood products industry, are describe in this section.

6.3.1 Contributions to secondary wood industry sector

In order to help the wood products industry improve in their strategies, competitors and environment, this research focuses on understanding how the secondary wood products industry is distributed and work in Virginia. This research conducted a questionnaire to establish its basis and to better understand the secondary wood products industry in the state of Virginia. The contribution of this study revealed that the wood products industry in Virginia:

- First, the VDOF now has an industry directory with updated information which will enable the department to better assist this industry sector and also will help companies understand and request for current information about the industry.

- Second, understanding the distribution of the companies in Virginia and being able to localize the industries in a free online map, will definitely help the wood products industry in general.

6.3.2 Contribution to GIS marketing application

As with many other industries, the wood products industry needs to find ways to improve their processes and activities. In order to help the wood products industry to improve in their GIS application in the marketing department, the research focuses on understanding how GIS can be used in marketing applications in the wood products industry. This research conducted two questionnaires and interviews to establish the basis and to better

understand the GIS uses in marketing application. The finding of this study revealed that the biggest contribution on GIS uses in marketing application in wood products industry is:

- The main contribution for the GIS use on marketing application refers to the creation of the manual of best practices for the wood products industry. Even though this manual focuses on wood products industry it helps a base for different industry sectors interest in this topic.
- Another contribution refers to the creation of new knowledge develop by this study. By creating new data and understanding the field, researchers help a little in the filling of the gap found form the literature review.

Some contributions or uses of the GIS tool for each of the marketing mix correspond to:

- **Product**
    - Match your company location or competitors locations with major sales, favoritism.
    - Research about ethnic populations and associate them in the map.
    - Associate the product portfolio depending of the geographic location.
    - Search for new products markers depending of the geographic location and competitors.
- **Place**
    - Find channels close to your current location or for future locations.
    - Find competitor locations or possible partners.
    - Search for locations for new stores.
    - Understand by location why some stores are more rentable than others, the same with the competitors.
- **Price**
    - Look for distance from the customers to price the product or service.
    - Understand the distance from the suppliers or main ports to price the product or service.
    - See competitors around you to price correctly the product or service.

- **Promotion**
    - Maximize promotion by recognizing the mayor routes.
    - Understand were the customers are located and pin it t the map.
    - Target the biggest clusters of companies to have an effective promotion strategy.
    - Design a promotion strategy based on the location of the companies.

6.3.3 Contribution to Academia

The contribution to academia corresponds to the expanding knowledge on GIS uses in marketing application. This research demonstrates that a gap in GIS uses on marketing for the wood product industry exists, and that multiple applications can be develop to improve the marketing application strategies utilizing GIS. The results also reveal that even though marketing is a department in which GIS can be applied, companies do not invest resources in the development of GIS in this area, even though they uses the system for other purposes.

The second contribution is made to future researchers. While developing the study a clear gap was found, which opened doors for future investigators in this field. Other researchers might be willing to increase the knowledge over the guidelines of this study.

6.3.4 Limitations and recommendations for future research

Although the research contributed to important findings to the knowledge of the GIS uses of marketing applications and understanding of the wood products industry, this research still has some limitations, which are listed below.

- The results obtained from the case study developed in this study can not be generalized to the entire population, which makes the results important for a better understanding of the topic but does not make it generalizable to the entire population.

- The study focused on the secondary wood products industry because of the time frame and the budget limitation. But the same study can be conducted in the future with more time and budget to gain a deeper understanding of the industry

- Because of the type of information obtained from the secondary wood products industry, not all can be displayed in a free online map, but the information can be accessed though the VDOF.

- The last limitation relates to the diffusion of results. Based on the time restriction of Master's research work, findings have not been published at this time, but among the next steps is the publishing of this study's results.

The researchers in this study recommend other practitioners or investigators explore deeper the utilization of GIS in marketing to understand more the utilization of the same in this industry sector. Because of the response rate obtained from this study, the researchers recommend to utilize case study interviews to obtain information regarding the GIS marketing utilizations in companies.

Also utilizing information from this study or information from VDOF will be helpful for researches in this industry sector. A study related to the specific utilization is recommended for future research in this area by the investigators. Understanding more about the uses of GIS in marketing will help the industry, future practitioners, and the academia.

6.4 References

United States Census Bureau. (2007). Retrieved from U.S. Census Bureau website: http://www.census.go

Appendix

Appendix A. Industry Directory Questionnaire

Dear Participant:

My name is Melissa Brenes, a graduate research assistant at Virginia Tech. Currently I am assisting the Virginia Department of Forestry (VDOF) to develop an Industry Directory of Secondary Wood Products in Virginia. Because your company's NAICS is considered as Secondary Wood Products, I am inviting you to participate in this project by completing the attached questionnaire. The data collected will provide useful information to the VDOF in order to assist not only the secondary but also the primary wood products industry of Virginia regarding potential suppliers, local and export markets, and other technical assistance that is critical for the competitiveness of the overall wood products industry.

The questionnaire will require approximately 10 minutes to complete. There is no compensation for responding or any known risk. In order to ensure that all information will remain confidential, copies of the questionnaires will be provided only to Charles Becker III, Utilization & Marketing Manager of VDOF. If you choose to participate in this project, please answer all questions and return the completed questionnaire promptly in the provided pre-paid envelope. Participation is strictly voluntary and you may refuse to participate at any time.

Alternatively, this questionnaire can be accessed online at the web site www……

Thank you for taking the time to participate. If you would like a summary of this study please complete the Request for Information section below and return it to me with the questionnaire. If you require additional information or have questions, please contact me at the number listed below.

Sincerely,

Melissa Brenes
Graduate Research Assistant
Department of Sustainable Biomaterials
Virginia Tech
Phone: (540) 553-2066
Email: mbrenes@vt.edu

****

Request for Information

Please send a copy of the study results to the address listed below.

Name: _____
Address: _____

Please return this form with your survey.

Secondary Industry Directory Survey Form

Date: _____

Section 1 **Industry Information**

Company Name: _____

1.1 Company Contact Information	
Contact Name:	
Contact Title:	Owner - President - Vice-president - General Manager - Sales Manager - Other:_____
Telephone:	
Fax:	
Email:	
Web:	

1.2 Company Physical Address	
Street Address:	
City:	
State:	
Zip Code:	

1.4 Latitude / Longitude (Decimal degrees) (If known)	
Latitude:	
Longitude:	

1.3 Company Mailing Address (If different from physical address)	
Street Address:	
City:	
State:	
Zip Code:	

1.5 Number of employees	
A: 1-5	
B: 6-20	
C: 21-50	
D: 51-100	
E: 101-500	
F: 501-1,000	
G: >1,000	

	1.6 Plant Type (Check all that apply)	NAICS code	Number of Production Facilities	Main Products Produce by Facility		
				Product 1	Product 2	Product 3
	Cabinets-TV, Radio, Sewing	337129				
	Cabinets-Residential-Kitchen, Bathroom, Garage	337110				
	Chemical Products-Naval Stores	325191				
	Chips-Hardwoods, Softwood	321113				
	Pallets, Containers, Mats	321920				
	Custom Architectural Woodwork and Millwork	337212				
	Engineered Wood Products Not Trusses	321213				
	Furniture-Fixtures, Showcases, Partitions, Furn Dimension	337215				
	Furniture-Household, Casegoods, Not Upholstery	337122				
	Furniture-Institutional, Schools, Libraries, Public Bldgs.	337127				
	Furniture-Office, Casegoods, Upholstery	337211				
	Furniture-Residential, Upholstery	337121				
	General Millwork, Flooring, Mouldings, Shutters	321918				
	Lumber Cut Stock, Resawn, Planed Lumber	321912				
	Manufacturing Homes	321991				
	Panel Products, Reconstituted W Products-OSB, MDF, HB, PB	321219				
	Paper Manufacturing Mills	3221				
	Prefabricated Wooden Buildings	321992				
	Trusses	321214				
	Veneer and Plywood-Hardwoods	321211				
	Veneer and Plywood-Softwoods	321212				
	Windows and Doors, Garage Doors, Cabinet Doors	321911				
	Wood Preservation, Treating	321114				
	Other W P Mfg., Firewood, Lumber Drying, Pellets	321999				
	Other:					

Section 2 **Purchased Raw Materials**

Solid Wood							
Species	**Check all that apply**	**Thickness** (Circle all that apply)	**Green Rough** (Check if apply)	**Kiln Dried Dressed (D) or Kiln Dried Rough (R)** (Circle if apply)	**Annual Consumption**		**States where purchased** (VA, NC or other)
					Lumber (bf)	**Veneer** (sqf)	
2.1 Softwoods							
2.1.1 Red Cedar		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.1.2 White Cedar		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.1.3 Cypress		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.1.4 Pine SYP		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.1.5 Pine White		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.1.6 Spruce/Fir		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
2.1.7 Other(s):							
1.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
3.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
2.2 Hardwoods							
2.2.1 Ash		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.2 Basswood		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.3 Cherry		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.4 Walnut		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
2.2.5 Gum		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.6 Soft Maple		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.7 Hard Maple		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
2.2.8 Mix Hardwoods		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.9 Red Oak		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.10 White Oak		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.11 Yellow Poplar		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.2.12 Other(s):							
1.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
3.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
2.3 Imported species							
1.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			
2.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other:		D or R			
3.		4/4 - 5/4 - 6/4 - 8/4 –Veneer– Other: ____		D or R			

2.4 Percentage of certified wood products (If apply)	
Purchased Materials	
FSC	
PEFC	
SFI	
ATFS	
Other:	
Sold Products	
FSC	
PEFC	
SFI	
ATFS	
Other:	

2.5 Purchased Composite Wood Products				
Composite	**Check all that apply**	**Annual Consumption**	**Units** (tons, sheets, sqf, $, etc)	**States where purchased** (VA, NC or other)
2.5.1 Plywood Softwoods				
2.5.2 Plywood Hardwoods				
2.5.3 Medium or High Density Fiberboard (MDF / HDF)				
2.5.4 Oriented Stand Board (OSB)				
2.5.5 Lightweight panels				
2.5.6 Particleboard				
2.5.7 Recycled paper stock				
2.5.8 Other(s):				
1.				
2.				
3.				

Section 3 **Other Purchased Materials**

Other Purchased Materials	Check if apply	Annual Consumption	Units (tons, sqf, $, etc)
3.1 Boiler Fuel			
3.2 Hardwood chips			
3.3 Softwood chips			
3.4 Dimension Wood Products-Blanks, Glue Panels, Machined Parts			
3.5 Mill Residues for Manufacturing Value Added Products, Bark, Sawdust, Shavings			
3.6 Pellets			
3.7 Other Wood Materials Purchased			
1.			
2.			
3.			

Section 4 **Production of Residues**

Residues	Annual Production	Units (tons or other)	Percentage of Total Residues	Market For Residues (Internal use or for sale)
4.1 Chips				
4.2 Saw Dust				
4.3 Shavings				
4.4 Bark				
4.5 Other(s):				
1.				
2.				
3.				

Section 5 **Export Information** (only if apply)

5.1 Do you export? (Check if apply)
☐ Yes
☐ No

5.2 Major Export Markets (Check if apply)
☐ Canada
☐ Mexico
☐ Central America (South border of Mexico to Panama)
☐ South America
☐ Europe
☐ Asia
☐ Africa
☐ Australia
☐ Other: _____

Appendix B. Case Study Questionnaire

Dear participant,

The following questionnaire is part of a project led Virginia Tech about GIS applications in your firm. You have been selected for this research because of your known expertise and experience on GIS applications. The questions are designed for you to be open and explain how your company uses GIS as a source of information for better decision-making. All answers will be kept confidential and will be used only in combination with those of other participants in this study.

If you participate and would like to receive a free electronic version on the findings of this research, just contact the researcher (Melissa Brenes) and tell her your preferred email for response. We will be glad to send you a complementary report when ready.

Thank you for your help in this project. Should you have any questions or comments, please do not hesitate in contacting me on your earliest convenience.

Sincerely,

Melissa Brenes
Graduate Research Assistance
Virginia Tech
mbrenes@vt.edu
540-553-2066

GIS Applications

This questionnaire asks for your opinion on several topics related to GIS applications in different value-added processes in your organization. The questionnaire is divided into 5 sections: (1) General Information, (2) Supplier Management Applications, (3) Internal Applications, (4) Customers Management Applications and (5) General Perception of GIS Applications. Please response the following questions as clearly and openly as possible.

1. GENERAL INFORMATION

1.1. Name and describe your current role inside the organization:

Role in your organization:

_____

Role description:

_____

_____

_____

_____

1.2. Your personal experience with GIS applications falls within the following range:

- ☐ Less than 2 years
- ☐ More than 2 less than 5 years
- ☐ 5 years or more

1.3. The time GIS applications has been utilized in the firm falls within the following range:

- ☐ Less than 5 years
- ☐ More than 5 less than 10 years
- ☐ 10 years or more

2. SUPPLIER MANAGEMENT APPLICATIONS

2.1 Do you utilize GIS for any purpose related to supplier's management applications?

- ☐ Yes (continue to question 2.2)
- ☐ No (continue to the following section)

2.2 Describe how your company uses GIS applications for any of the following:

- Relationships with suppliers:

- Suppliers' performance:

- Suppliers' logistics
- SCM planning:

2.3 What GIS software does your company use to support supplier's management activities?

-

2.4 What advantages and disadvantages can you indicate about the use of GIS in supplier's management activities?

-

3. INTERNAL APPLICATIONS

3.1. Do you utilizes GIS for any purpose related to your firm's internal applications?

- ☐ Yes (continue to question 3.2)
- ☐ No (continue to the following section)

3.2. Describe how your company uses GIS application in your internal processes (marketing, manufacturing, inventory management, asset management, financial management, etc.)?

-

3.3. What GIS software does your company to support internal processes?

-

3.4. What advantages and disadvantages can you indicate about the use of GIS in your internal processes?

-

4. CUSTOMER MANAGEMENT APPLICATIONS

4.1. Does your company use GIS for any purpose related to customer management applications?

- ☐ Yes (continue to question 4.2)
- ☐ No (Continue to the following section)

4.2. Describe how your company uses GIS on customer management applications (marketing, selling, customer relationships, customer support, order tracking, distribution, etc.?

-

4.3. What GIS software does your company use to support customer management applications?

-

4.4. What advantages and disadvantages can you indicate about the use of GIS for customer management applications?

-

5. GENERAL PERCEPTION OF GIS APPLICATIONS

5.1. Describes your general perception of the utilization of GIS in your firm (supplier, internal, and customer applications)

-

5.2. Would you recommend other firms to use GIS in supplier management, internal or customer management applications? And Why?

-

5.3. Do you consider the capital investment, implementation costs, and maintenance costs of GIS applications worth for the return of investment (ROI)?

-

5.4. What industry sector do you consider that more heavily use GIS applications?

-

I deeply appreciate your time and effort in responding this questionnaire

For more information contact:

Melissa Brenes
mbrenes@vt.edu
540-553-2066

Appendix C. VT IRB Protocol 13-113

Office of Research Compliance
Institutational Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: April 21, 2014

TO: Henry Jose Quesada Pineda, Melissa Brenes Bastos

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Forest Industry Database

IRB NUMBER: **13-113**

Effective April 18, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 2**
Protocol Approval Date:	**April 18, 2014**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?
02/27/2013	13127012	VA Department of Forestry	Not required (Exempt approval)

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

Appendix D. Companies Profiling (Secondary Wood Products Industry VA)

In this appendix, a complete profiling was developed to the 108 secondary wood products companies that responded to the questionnaire. Specific details of responses will be shown in order to obtain a better understanding of the companies surveyed in this research. Details such as contact title, employees count, plant type, NAICS code, number of facilities, products, wood species, certified wood products, composite wood products, other purchased material, residues and export companies were detailed to profile the companies.

1. Company General Information Profile

1.1 Companies distribution by city location

CITY	COUNT COMPANIES	CITY	COUNT COMPANIES	CITY	COUNT COMPANIES
Amelia	1	Luray	1	Richmond	8
Ashland	2	Lynchburg	1	Ridgeway	1
Bristol	1	Madison	1	Roanoke	1
Chantilly	1	Manassas	1	Rocky Mount	1
Chesapeake	5	Martinsville	4	Rustburg	2
Christiansburg	1	Mechanicsville	2	Saluda	1
Collinsville	1	Meherrin	1	Springfield	1
Cross Junction	1	Midlothian	2	Stephens City	2
Danville	1	Moneta	1	Stuart	3
Franklin	1	Monroe	1	Triangle	1
Fredericksburg	3	Mt. Solon	1	Union Hall	1
Galax	3	N. Chesterfield	1	Vienna	1
Gretna	1	Newport News	1	Virginia Beach	2
Hanover	1	Norfolk	1	Warsaw	1
Herndon	1	North Garden	1	Washington	1
Huddleston	1	Palmyra	1	Winchester	3
Keysville	1	Petersburg	2	Wirtz	1
Locust Dale	1	Portsmouth	1	Wytheville	1
Lottsburg	1	Purcellville	2	Blank/ No applied	22
				Grand Total	**108**

1.2 Contact Title and Employees Profile

The contact title corresponds to the personnel from the companies that respond the secondary wood products questionnaire.

CONTACT TITLE	COUNT COMPANIES
Owner	24
President	5
Vice-president	3
General Manager	4
Sales Manager	1
Owner and President	7
Member	1
Office Manager	1
Operation Manager	1
Part Time Title	1
Plant Manager	1
Purchasing Manager	2
All Titles	1
Total Responses	**52**

EMPLOYEES COUNT	COUNT COMPANIES
A: 1-5	30
B: 6-20	12
C: 21-50	5
D: 51-100	3
E: 101-500	1
F: 501-1,000	0
G: >1,000	1
Total Responses	**53**

2. Companies Plant Type and NAICS Code Profile

2.1 Companies Plant Type and NAICS Code

PLANT TYPE / NAICS CODE	COUNT COMPANIES	NUMBER OF FACILITIES
Cabinets-TV, Radio, Sewing 337129	10	8
Cabinets-Residential-Kitchen, Bathroom, Garage 337110	22	19
Chemical Products-Naval Stores 325191	1	0
Chips-Hardwoods, Softwood 321113	3	10
Pallets, Containers, Mats 321920	4	4
Custom Architectural Woodwork and Millwork 337212	10	7
Engineered Wood Products Not Trusses 321213	1	0
Furniture-Fixtures, Showcases, Partitions, Furn. Dimension 337215	10	7
Furniture-Household, Casegoods, Not Upholstery 337122	11	6
Furniture-Institutional, Schools, Libraries, Public Bldgs. 337127	8	6
Furniture-Office, Casegoods, Upholstery 337211	6	3
Furniture-Residential, Upholstery 337121	5	3
General Millwork, Flooring, Mouldings, Shutters 321918	8	6
Lumber Cut Stock, Resawn, Planed Lumber 321912	11	10
Manufacturing Homes 321991	0	0
Panel Products, Reconstituted W Products-OSB, MDF, HB, PB 321219	1	1
Paper Manufacturing Mills 3221	0	0
Prefabricated Wooden Buildings 321992	1	0
Trusses 321214	1	1
Veneer and Plywood-Hardwoods 321211	0	0
Veneer and Plywood-Softwoods 321212	0	0
Windows and Doors, Garage Doors, Cabinet Doors 321911	4	4
Wood Preservation, Treating 321114	1	3
Other W P Mfg., Firewood, Lumber Drying, Pellets 321999	4	3
Other	4	16

2.2 Companies Products

Product 1, product 2 and product 3 correspond to the main products produce in the companies that respond to the questionnaire.

NAICS CODE	PRODUCT 1	PRODUCT 2	PRODUCT 3
337129	Cabinets Homes, Bookcases, Furniture	Furniture, Tucab	
337110	Kitchens, Cabinets, Solid wood	Baths, Vanities, Drawer Boxes, Countertops, Dimension	Bookcases, Built-Ins, Moulding, Library
325191			
321113	Chips, Lumber	Chips	Boiler Fuel
321920	Skios, Pallets, Wood pallets	Panel sawing, Craters	Crates, Sawdust
337212	Turned wood products, Woodworks		
321213			
337215	Mirror Frames	Tables Bares	Chairs Frames
337122	Dining Room (Tables, Servers & Hutches, and Chairs)		
337127	Desk		
337211			
337121	Chairs	Tables	Chest/Beds
321918	Strip flooring, Full Range of Interior Millwork, General Millwork	Dust, Moulding	Flooring
321912	Chips, Lumber, SYP, Treads, Lumber	Turnings	Handrail
321991			
321219	Particleboards		
3221			
321992			
321214	Trusses		
321211			
321212			
321911	Windows	Doors	Cabinet Doors
321114	Treated Lumber	CCA	Fire Retardant Lumber
321999	Firewood		
Other	Top Fabrication, Sawmill, Grade A, B, C, Custom Boxes / Crates	Lumber	

3. Companies Wood Species Profile

3.1 Wood Species Profile

WOOD SPECIES	COUNT COMPANIES	THICKNESS *	GREEN ROUGH **	KDD OR KDR ***	STATES WHERE PURCHASED
SOFTWOODS	**62**				
Red Cedar	8	All	1	Both	NC, VA
White Cedar	4	All	1	Both	NC, VA
Cypress	8	All	1	Both	VA, MD, PA
Pine	16	All	2	Both	VA, NC, SC, LA, AR, GA, AL, MS, PA
Pine White	18	All	3	Both	VA, PA
Spruce/Fir	8	All	0	Both	VA
Other	0	All	0	Both	
HARDWOODS	**221**				
Ash	12	All	5	Both	VA, NY, PA, MD
Basswood	6	All	0	Both	VA,PA
Cherry	32	All	4	Both	VA, PA, NY, NC, MD, KT, TN,WV, DH
Walnut	24	All	3	Both	VA, PA, MO, NY, MD, NC
Gum	3	All	2	KDR	VA
Soft Maple	33	All	6	Both	VA ,PA, NC, NY, WV, MD
Hard Maple	24	All	3	Both	VA ,PA, NC, MD, MI, WV, OH, KY, TN
Mix Hardwoods	7	All	5	Both	VA, NC
Red Oak	33	All	7	Both	VA, PA, NC, WI, MI, MD, KY, TN, OH
White Oak	23	All	7	Both	VA, PA, NC, NY, MD
Yellow Poplar	24	All	5	Both	VA, NC, PA, MD
Other		All	1	KDR	VA, MD, PA, KY, TN
IMPORTED SPECIES	**12**				
Spanish Cedar	1	All	0	Both	VA, NC
Mahogany	1	All	0	Both	VA, NC
Gatoba	1	All	0	Both	VA, NC
Sapele	4	All	0	Both	VA, PA, NC, NY, Canada, Congo
Brazilian Cherry	1	All	0	Both	
Wenge	1	All	0	Both	Congo
Bubinga	2	All	0	Both	VA, NY, Canada, Congo
Other	1	All	0	Both	

* Thickness corresponds to 4/4 - 5/4 - 6/4 - 8/4 and Veneer

** Green Rough has the count of companies that selected that as an aspect in there wood specie.

*** KDD and KDR corresponds to Kiln Dried Dressed and Kiln Dried Rough respectably.

4. Companies Certified Wood Products Profile

4.1 Certified Wood Products Profile

CERTIFIED WOOD PRODUCTS	COUNT COMPANIES
PURCHASED MATERIALS	
FSC	3
PEFC	
SFI	
ATFS	
Other	AHMI
SOLD PRODUCTS	
FSC	2
PEFC	
SFI	
ATFS	
Other	AHMI

5. Companies Composite Wood Products and Other Purchased Materials Profile

5.1 Composite Wood Products and Other Purchased Materials Profile

COMPOSITE WOOD PRODUCTS	COUNT COMPANIES
Plywood Softwoods	16
Plywood Hardwoods	25
MDF / HDF	21
Oriented Stand Board (OSB)	8
Lightweight panels	1
Particleboard	9
Recycled paper stock	0
Other(s)	1
Total	**81**

OTHER PURCHASED MATERIALS	COUNT COMPANIES
Boiler Fuel	1
Hardwood chips	0
Softwood chips	1
Dimension Wood Products-Blanks, Glue Panels, Machined Parts	2
Mill Residues for Manufacturing	1
Value Added Products, Bark, Sawdust, Shavings	
Pellets	0
Other Wood Materials Purchased	
Other 1	4
Other 2	1
Total	**10**

6. Companies Residues and Exports Profile

6.1 Residues and Exports Profile

RESIDUES	COUNT COMPANIES	MARKET OF RESIDUES
Chips	5	Internal, For sale, Paper mill
Saw Dust	22	Internal, For sale, Paper Mills, Horse Farms, Power plant
Shavings	7	Sale, Horse Farms, Mulch
Bark	5	Sale, Mulch
Other(s)	0	Firewood internal, For sale, Recycler

COMPANIES EXPORT	COUNT COMPANIES
Middle East	1
Caribbean Islands	1
Total	**2**

The purpose of the companies profiling is to better detail and understand the data gathered by the researchers in this study. By detailing aspects such as companies general information, plant type, NAICS code, wood species, certified wood products, composite wood products, other purchased materials, residues and exports, practitioners in this area will gain a better understanding of the type of companies they are dealing and also understand the profile some of the secondary wood products companies located in VA.

It is important to mention that the results from these companies' profiling cannot be generalized to the entire population -secondary wood products industry in Virginia-, but will help to comprehend some of the companies in this industry sector.

Appendix E. Manual of Best Practices

Manual of Best Practices

Geographic Information Systems in marketing application for the wood products industry

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1 Introduction

In a world in which technology is moving rapidly toward the future, companies face new challenges and adaptations in order to retain their brand and costumers. Even though, since the 1960's Internet was created, companies adapt to this change and exploit the advantages until the beginning of the World Wide Web (Clarke & Flaherty 2005). Increasingly, firms are searching for new and practical ways to adapt technology into their day-to-day process in order to obtain faster response of the environment and costumers.

As many other disciplines, marketers remain exploring possibilities into the Internet and information systems, more recent the social media venues, to better assist electronic marketing, channel of communications, selling skills, distribution of products and services among others. Utilizing Geographic Information Systems (GIS) as one of the new technologies companies can utilize to better understand customers and improve their marketing strategies. Spatial analysis knowledge can be provided by GIS, which is a basic and crucial analysis needed be successful in marketing (Longley and Clarke 1995).

The basis of planning surround the decision making in any situation, ultimately strategy is about finding the union between the organization and the environment (Hoffman, Czinkota et al. 2005). A good adapting method to the changing surrounding of the firm is utilizing a marketing mix (product, place, promotion, price); which refers to the main areas of decision making for the marketers, knows as 4P's (Hoffman, Czinkota et al. 2005).

Today's studies suggest that, the significance of GIS in marketing applications can be validated by the use of marketing mix variables. Examples refereeing to the 4P's such as; place; locating the retail store, determining costumer potential and physiographic factors, promotion; demographic of networks, locations and direct mailing, product; ethnicity, socioeconomic status, traffic and shelf space and price; distribution cost, product

delivery, demand and competition, to mention some examples for the GIS utilization in marketing mix (Clarke & Flaherty 2005).

Because GIS is proven to be helpful in assisting the creation of marketing mix and marketing strategies, this research sought to understand the basic knowledge of marketing mix variables into the context of GIS applications and the future utilization for the Wood Products Industry. Findings will allow researchers to recognize the importance of GIS in the marketing department and to present new ideas and practices to develop a good implantation of GIS in the firms. The development of this research creates a manual of best practices to implement and utilize GIS on wood products industry, which relates to the utilization on information systems to better assist the decision making in the company.

1.1 Who should read this book

This manual was written to help practitioners design and implement GIS in marketing applications. It is presumed that your knowledge of GIS in minimal and have some ideas about what you can do with GIS and marketing. It is also assumed that have an interest in applying GIS into your form and plan to utilize it as a resource for your marketing strategy planning. Reviewing information available no manual was found that help practitioners in the design and implementation of GIS in marketing, this manual will help cover that gap and probably help organizations that already have GIS or plan to install GIS in their marketing applications. It is important to mention that this manual will cover basic and essential information necessary to the development of GIS and its application on marketing mix, but it does not cover deep information regarding the development.

1.2 What is a Geographic Information System?

Demers (2009) defined Geographic Information Systems (GIS) as "a system designed to input, store, edit, retrieved, analyze, and output geographic data and information" (p. 19). As with all systems, GIS is composed of integrated parts that allow it to perform correctly. These parts include (1) computer hardware and software, (2) space and

organization, (3) personnel and (4) data and information (Demers, 2009). Others have argued that GIS is composed of (1) people –the system user-, (2) applications –process and programs used-, (3) data –information needed-, (4) software –GIS software- and (5) hardware –physical components- (Harmon & Anderson, 2003).

Although there are different amounts of components by author, all related to the same basic components, which need to be connected and working in harmony in order make the system work in perfect conditions and obtain the expected results. Figure 1, shows the relationship needed from the components.

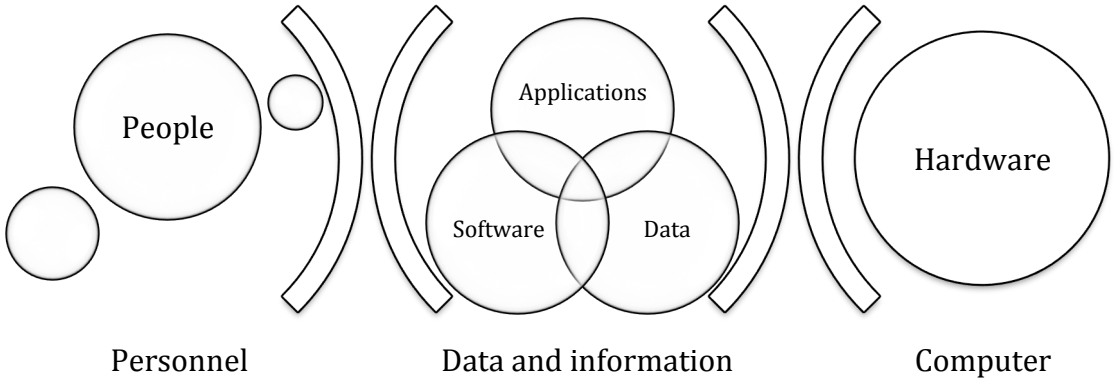


Figure 1. Components if GIS

Once the components of the GIS are collected, Harmon & Anderson (2003) propose a series of 10 steps to design and implement the GIS in the organization with correspond to:

- Step 1: Needs and requirements
- Step 2: Strategic Plan
- Step 3: Implementation Plan
- Step 4: Design Phrase
- Step 5: Implementation Phrase
- Step 6: Pilot Project
- Step 7: Application Development
- Step 8: Maintenance and upgrade plan

- Step 9: Training
- Step 10: Evaluation

Each step will be cover in general basis in this manual to ensure the basic knowledge of GIS and also the insert information regarding the utilization of GIS in marketing applications in the wood products industry. The manual will basically fill the desire of general and basic understanding on GIS and marketing applications in wood products companies.

2 Step 1: Needs and Requirements

Before the development and implementation of GIS, it is important to understand the needs and requirements to succeed in the following steps. According to Harmon & Anderson (2003) some factors are crucial to identify before the next steps, those corresponds to:

- Proper individual are involved in the organization
- Users education
- Management commitment for the implementation
- Realistic expectations
- User needs and requirements
- Evaluation existing data
- Implementation costs and benefits
- Strategic plan for implementation

Each of the following sections contains the consideration mention above:

2.1 Organization involvement

Many organizational structures works against the GIS successful implantation in the organizations, preparations have to be made in order to ensure that corporate data can be access for GIS and the proper data utilization in a corporate approach. (Douglas, 2008)

According to Douglas (2008) a way to ensure the organizational focus and involvement on GIS without having to re-structure the organization, is to follow the aspects bellow:

- System 'owner' or 'custodian': the successful implantation of GIS should not be only appointed to the 'owner' or the 'custodian' of the system, but to the entire unit or department of the organization. (Douglas, 2008)
- GIS coordinating/steering committee: a committee should be created to ensure the good implantation and use of corporate data, the owner of the system should be the chair of this committee and following by stakeholders from different business

groups, unit managers and not technical officers. (Douglas, 2008)

- Data custodians: the data custodians represent a nominated particular to a specific data set, this person will be responsible of the carriage and maintenance of the data, usually that's their primary job function. (Douglas, 2008)
- GIS person/team: the GIS person or team is the responsible of collecting the data under the supervision and direction of the GIS coordinating committee. (Douglas, 2008)

2.2 Users education

As in any other new technology the need of knowing what works, what doesn't work, how to avoid them and what can be expected is a must in the development and implementation of GIS, the education process can take a long time but there are ways to accelerate the learning curve. (Harmon & Anderson, 2003)

1. Visit other companies or agencies that already implanted the system and see the complete process, ask them all the relevant questions regarding the development, implantation and utilization of the GIS, questions such as: what they like? what they don't like?, what problems they had? And what they would do different? (Harmon & Anderson, 2003)
2. Use users conferences as a good venue to learn form the technology, interact with the other participant and listen to their experience and expertise in the system. (Harmon & Anderson, 2003)
3. Invite consulting companies in order to present their planning and implementing approach to the system, usually their experience in different companies and systems will be a good learning experience. (Harmon & Anderson, 2003)

2.3 Management commitment and Realistic expectations

As know implementing a system takes time, between 2-3 years takes a system to mature if this is a well-planned system, that's why it is important to design a plan to manage create realistic expectations. (Harmon & Anderson, 2003)

According to Harmon & Anderson (2003) it is important to plan milestones through the

years, in departments is important to create small achievements, many implementation fail because of the expectations are so high and they are not met during the time and immediately the user lost interest.

2.4 User needs and requirements

The need of categorize users is required in all GIS environments:

- Power users: usually full-time, high skilled focused on data entry, editing, map compilation, map presentation and analysis functions (Douglas, 2008).
- Intermediate users: usually several times a week, for a purpose mapping and analysis (Douglas, 2008).
- View (web) users: stall accessing a read-only data, specialized applications (Douglas, 2008).

Each category of GIS users depend of the organizational size, particular to the training and support, the ration of Power: Intermediate: View should be 1: 5: 100. (Douglas, 2008)

2.5 Evaluation existing data

When evaluating the existing data it is crucial to first understand which layers you need to make your system work, the amount of layers and data collected will depend of the department requirements (Harmon & Anderson, 2003).

According to Harmon & Anderson (2003) the three major ways of handling existing data/ historic data are:

1. Historic documents (e.g. land records) are important and should be include in the system as a layer.
2. Only one period of time is important or crucial for the system users for example 3 to 5 years of historic data.
3. Much historic data needs to be converted, this conversion may be costly for the organization, sometimes it is not worthy to make that cost and move forward to other newer data and less costly.

2.6 Implementation costs and benefits

Harmon & Anderson (2003) mention that when implementing a system like this predicting the costs a relative direct process, they are primary divided in two costs associated with the implementing process:

1. Initial cost: easily recognizable and are composed of initial capital outlays, purchased hardware and software necessary and initial training to users (Harmon & Anderson, 2003)
2. Recurring cost: corresponds to the costs frequently incurred over time, such as maintenance costs, staff salaries, data costs and training cost. (Harmon & Anderson, 2003)

The two major benefits obtain from the implementation the system according to Harmon & Anderson (2003) refers to:

1. Quantitative: represents the benefits in which an organization con extract the exact quantity of time, effort, or cost derived from the analysis, in other words represent benefits that can be measured or quantify, such as reduction in staff time to perform, decrease operating costs, increase revenue, cost avoidances and reductions (Harmon & Anderson, 2003).
2. Qualitative: these benefits are represented to all the allowance for the people to make better decision, decrease uncertainty, improve image or service provided, these benefits are difficult to value because of its nature. (Harmon & Anderson, 2003).

2.7 Strategic plan for implementation

Harmon & Anderson (2003) mention that the final phrase on needs to be assessed to pull the system components together refer to the implementation plan, it can also be consider the wish list or the to do list, this strategic implementation plan include the following components:

- Data development plan
- Application development plan
- Staffing and management plan

- Training plan
- Hardware and software plan
- Final projection plan
- Schedule plan

3 Step 2: Strategic Plan

As many other organizational plans such as goals plans, specifics plans for projects and many others changes the organization has gone through, a GIS strategic plan is just another strategic process with similar anxiety and midlevel management, nothing out of the ordinary (Harmon & Anderson, 2003).

The creation of GIS strategic plan concerns primordially to the top-level management (they needs it to reference in difficult decision making) and outside organizations according to Harmon & Anderson (2003), which also specify that strategic plans for GIS should contain the following components:

- A concrete discussion of how an enterprise GIS fits within the existing mission statement of the organization.
- A tentative and light discussion of how GIS is going to fit inside the organization with a recognition that the design and implantation process may require modification of the plan
- A timetable with checkpoints
- If the implementation is to be phrased
- Initial decision on what existing staff will do in the design and implementation process and what functions the organization will hire consultants to do.
- Some statements of the resources the organization is willing to contribute to the process.

The following sections explain a more about the component within the strategic plan for GIS:

3.1 GIS fit with the mission statement

The mission statement is usually irrelevant to the front-line workers and midlevel management, because they believe their work have little relationship with the company's' mission statement, that's why it is important for the strategic plan developers to make

understand and demonstrate the people participating in GIS that their work on GIS will support the organization mission statement (Harmon & Anderson, 2003).

3.2 GIS fit inside the organization

All the personal involved in working on GIS should have an idea of their fit within the organization, GIS strategic planning committee is the group that decide if a separate group should be created or of existing personal will work on the technology (Harmon & Anderson, 2003).

In many cases during the implementation and design of the plan staff may raised because of their skills, leadership may change, recommendations may emerge and this is something the organization and committee should understand and take unto account with designing and implementing GIS in the company or department (Harmon & Anderson, 2003).

3.3 Timetable with checkpoints

Having a timetable allows the management a way to monitor the process, without timeline the plan becomes a hazardous thing, it is always important to remember that the implementation process may take more than a year, and that's why having checkpoint becomes a must have in order to be able to manage the progress (Harmon & Anderson, 2003).

3.4 Implementation phrase

The first action form the implementation phrase corresponds to the pilot project, this will help the organization develop and understand the phrasing patterns needed by the organization (Harmon & Anderson, 2003).

On the pilot testing one unit should be chosen for the test, this will make many managers develop disputes because they want to be the first or it will make skeptical wait and see how the technology really work and develops (Harmon & Anderson, 2003).

3.5 Staff design and implementation process

Small amounts of company do not need to hire new staff for the GIS project, but these happen only because for the high technical and database expertise within the organization, most will find that a combination of staff work and consultant contracts is the best team for a quick implementation (Harmon & Anderson, 2003).

The plan is not a the place to detail all the responsibilities for the consultants or to choose the consults, but is a place to agree con the mix it will be created to the implementation of the GIS, for this part the GIS implementation committee is going to lay out responsibilities and nature of the GIS technology (Harmon & Anderson, 2003).

3.6 Organization resources

For this part of the plan a complete detailed budget should not be created, but the identification of some cost and how the organization plans to pay should be statement, for big companies utilities in large territories and implantation time should be measured un years and cost in millions of dollars (Harmon & Anderson, 2003).

4 Step 3: Implementation Plan

According to Harmon & Anderson (2003) this specific phrase represent a point in which the combination of information learned from needs assessment and the develop of strategy plan creates the implementation plan, a number of factors should be taking into account in order to create the implementation plan which are:

- System configurations and product architecture plan
- Data development and conversion plan
- Application development plan
- Staffing and management plan
- Implementation phasing plan

4.1 System configurations and product architecture plan

On the system configurations and product plan the fundamental components and base foundation are defined, which make the system work (Harmon & Anderson, 2003). If the tittle is break down, two different plans are created:

1. System configuration plan: this aspect correspond to the core back end which make the system work, in other words refer to the software to be used (Harmon & Anderson, 2003).
2. Product architecture plan: this correspond to the architecture that will be used to distribute the data to the users, basically it can be (1) distributed architecture –in which the data is stored and access form a single central location but the client has the application installed on local computer- or (2) client serve architecture - in which the data is stored and access form a central location but the client has nothing or little applications installed on the client- (Harmon & Anderson, 2003).

4.2 Data development and conversion plan

The majority of this information from this plans has been obtain through the 'needs of assessments' but it need to be more carefully documented, the data development and

conversion plan details a step-by-step of all the data to be developed, the sources to be used, the methods to be used for information, the order set and the quality control procedure and measures to check the data set, the hole idea is to walked you though the data creation and establishes goals (Harmon & Anderson, 2003).

4.3 Application development plan

When developing any technology a strategy should be developed with a focus on the operational, business and constitutional needs of the firm, this to ensure that the results from the strategy are alight with the business and not only focus on the technology needs (Douglas, 2008)

It is also mentioned by Douglas (2008) that there are critical success factors (CDFs), which help managers, and top-level personnel to concentrate in the business issues, the role of the CSFs in the information system analysis consist in:

- To support the decision making a definition of business priorities and management information needs are necessary.
- The goals of the business process should be deported by the operational processing functions.
- Determine if the technology support and enhance the business process effectiveness.

Once the development plan is created and review but the organization, this can be applied to the unit, area or department designated.

4.4 Staffing and management plan

According to Harmon & Anderson (2003) assessing the users is an important component of the system, because of the many types of users that use the system as primary output or as reference; they also mention that there are mainly two types of users:

1. Users that currently use maps in a day a day functions, this users are easy to find because they usually surround with maps.

2. Users who use the system to solve problems but the final result is not a map, this users might be harder to identify.

To identify the users of a system, a review of their processes should be done in order to determine if they use GIS and if GIS can be automate the process (Harmon & Anderson, 2003). Also it is mention by Harmon & Anderson (2003) that the main categorization of users are: 1) director, head or manager, 2) professional –level or technical staff, 3) administrative staff, 4) external professionals (engineers, architects, attorneys, developers) and 5) citizens.

4.5 Implementation phasing plan

One crucial and important aspect of all the planning is the pilot project testing the methods, procedures, processes and final deliverables, this pilot will uncover issues arising from the technology, and problem that have not been thought during the first stages (Harmon & Anderson, 2003). According to Harmon & Anderson (2003) one the pilot is done and all the problems fix, it is ready to go to full scale without any preoccupations.

5 Step 4: Design Phrase

Harmon & Anderson (2003) mention that the design phrase basically enclosure the following parts (1) designing the GIS database schema, (2) designing spatial data and (3) designing issue for attribute data.

5.1 Designing the GIS database schema

The word schema refers to the diagram and documents that explain the structure of the database and relationships, it is easily compare to a blueprint of the database Harmon & Anderson (2003).

Harmon & Anderson (2003) describe the elements of a schema, which consist in the distribution of the tables and relationships among them, because of the different information and work companies do, it is impossible to give a cookbook one schema to be apply to al types of companies. With more information more time and larger is the schema in the organization.

It is recommended by Harmon & Anderson (2003) to create 1) a data dictionary, in which descriptions of each field in the table is explain, 2) primary and foreign keys in which the primary key is well indicated and the relationship type, 3) relational diagram that shows the exact distribution of the table and the relations and 4) the metadata elements that corresponds to the information you need your document to have in order to he understood by and outsider.

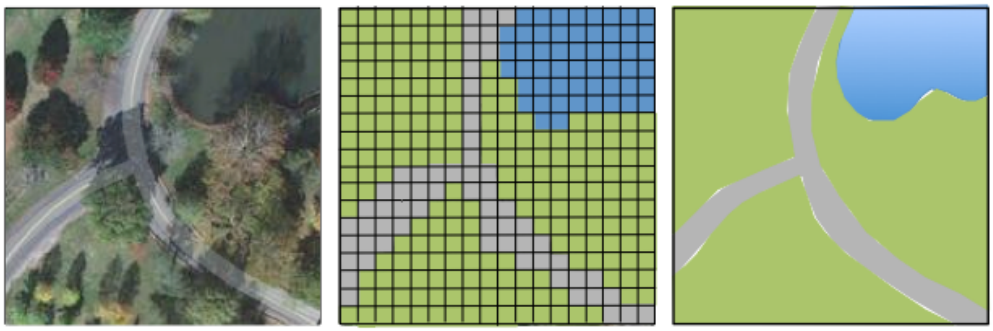
5.2 Designing the spatial data

By understanding the complexity of the world we live in, help practitioners design their GIS models as close to reality as possible Harmon & Anderson (2003). Over the years expert of GIS have divide geographic data into two classes of models:

- Raster data models: this data model is where each grid cell is represented by attribute value in order to create a map. (Demers, 2008)

- Vector data models: this help the representation of the geographic space in a more familiarly visual, usually represent the spatial location of the entities and might store the attributes in another file, the three basic types of data structures in the vector (1) spaghetti models, (2) topological models and (3) vector chain codes.

Maybe the simpler way to explain the difference between raster and vector data models is by a figure. Figure 2 shows the difference between raster and vector data models.



1. Real life landscape 2. Raster Model 3. Vector Model

Figure 2. Different between data models.

Which data model will fit better your data will depend on the data itself, most GIS are able to use raster image and vector information in the same GIS, what is important is to find the proper data model for a particular feature not the proper model for the entire GIS (Harmon & Anderson, 2003).

5.3 Designing issue for attribute data

The attribute data corresponds to the set of data that are joined on a unique ID value, and correspondence between a geographic feature and a row in a table is made (Harmon & Anderson, 2003).

According to Harmon & Anderson (2003) the attribute data is usually stored in basic formats to provide an easy maintenance by the users of the system; the difference from the attribute data and the spatial data is that more people are interest in the attribute data because of the content.

Harmon & Anderson (2003) explain the main principles for the attribute data:

- A unique identifier for each record must be in every table, preferably located in the first field.
- The rows should be related to the objects they model.
- Each field should have a unique name, but same name should be used in different tables.
- Field names should be short and without spaces, to separate use underscore.
- The field name should be descriptive so the users have an idea of what the field characterize.
- Avoid multiple fields on the same general type.

6 Step 5: Implementation Phrase

In the implementation phase several aspects are take into account such as; (1) remotely sensed data as background layers and data sources, (2) implementation data development and conversion and (3) selecting hardware and software.

6.1 Remotely sensed data as background layers and data sources

There are two main parts on GIS:

- System configuration: composed by the design of the core back end that make the system work, basically the software solution of the GIS, usually vendor design the core back end to be open architecture (Harmon & Anderson, 2003)
  Primary approaches:
  - File-structured system: use proprietary file formats to store data (graphic and attribute data), example coverage on ESRI format or MapInfo on MIF format, some advantages related that the user need low-level knowledge because the software manage the data making it simple to interact, use, manage the system and the main weakness relates to the security of the system and the capability to work with large data, usually for very small systems and data. (Harmon & Anderson, 2003)
  - Create centralized data repository: in which all the data is stored and managed in the system. (Harmon & Anderson, 2003)

- Product architecture: this correspond to t the architecture that will be used to distribute data to the users (Harmon & Anderson, 2003)
  Ways to approach:
  - Distributed architecture: in which each client have the application installed in a local computer and the data stored in a storehouse, which means a single central location and centrally maintenance (Harmon & Anderson, 2003)

- Client-server architecture: in which the data is also stored and maintenance form a central location but the user have little or none software installed in a local computer (Harmon & Anderson, 2003)

6.2 Implementation data development and conversion

The development of the data and the conversion of the data detail the data to be developed, the source to be use, the methods to used, the order of the data and the control procedures and measurements of the data used (Harmon & Anderson, 2003)

According to Harmon & Anderson (2003) some steps should be develop in order tone ensure the best data development or the conversion:

- First, detailed inventory of all the source materials (best mapping source)
- Second, organized the source data (by folders, database, document imaging, etc.)
- Third, tag each feature to a unique ID (realize control check t ensure the integrity of the data)
- Finally, place the features created over the map used to project and check the creations and check the features created.

Harmon & Anderson (2003) mention that it is important to take into account the following aspects related to the data development:

1. Capturing digital data
    a. Photogrammetric data capture
    b. Digitizing
        i. Head-down digitalizing
        ii. Heads-up digitizing
        iii. Raster-to-Vector conversion
2. Optical character recognition
3. In-house in out-source data development of conversion
4. Selecting a vendor

6.3 Selecting hardware and software.

When selecting the software to be used, functionality has to be a main component, which was identified from the needs assessment; on the other hand hardware is selected based on the software you selected and the operation system (Harmon & Anderson, 2003).

6.3.1 Software considerations

The software depend on the selection of the operating system and hardware, new technologies create a fast changes on software developments, which leas to a increased confusion and concerns in the user or future users (Harmon & Anderson, 2003)

It is important to understand that not only because a new version is on the market it means that your company need to change the software, and also having a old version do not always is the best action to take, when evaluating the software it is important according to Harmon & Anderson (2003) to take into account: 1) functionality, 2) standards, 3) performance, 4) expandability of products and 5) licensing options.

When selecting the software for the organization it is relevant to create a evaluating team, prepare the specification needed form the software, prepare a formal request, evaluate and review proposals form different vendors, conduct interviews and benchmarking testing all of this to make a good final selection of the software to be used by the organization (Harmon & Anderson, 2003)

6.3.2 Hardware considerations

The operating system, the CPU, the hard drive and memory compose the computer hardware, basically the selection of the software determines the requirements of the hardware (Harmon & Anderson, 2003)

According to Harmon & Anderson (2003) several concepts are important in the selection of the hardware those correspond to:

- Now the operating system itself
- Understand the requirements from the central processing unit (CPU)

- Requirements for the hard drives to store the information
- Obtain the memory necessary for the system development

Also it is mentioned by Harmon & Anderson (2003) that other factors should be of interested for the hardware selection, such as: 1) networking issues, 2) types of networks, 3) basic client/server communication and network performance and 4) the capacity of the network.

6.3.3 The best GIS product is…

According to Douglas (2008) the best GIS product is Google earth this conclusion is raised because of the intuitive and easy to use. Douglas (2008) consider this product can change the way people see geography, this conclusion was made because of:

1. It is natural to the user and friendly to use.
2. With the union of images and location maps, make it able to be understood by everybody even those with no knowledge on GIS.
3. It has developed a new subculture developing Google maps for all purposes.
4. Expose spatial technology to a number of people that wouldn't be exposed otherwise.
5. It provides spatial data to governments and local governments, and turn Google Earth in a free source of GIS.

7 Step 6: Pilot Project

An important part of the development of a GIS project in the organization is to perform a pilot project to test the methods, produces, processes and outcomes from the system (Harmon & Anderson, 2003)

The method should be tested in a small area to make sure that the functioning of the system is correct, that have the level desire in accuracy, precision and completeness, with a pilot project several issues will raise that might be forgotten on the past steps, and that should be address now to ensure the good functioning in the future and in the large scale (Harmon & Anderson, 2003)

Once everything is tested, according to Harmon & Anderson (2003) the system is ready to be applied on a full scale, all the steps develop prior this point are important to ensure the data integrity, and the successful application and utilization of GIS in the firm. All the documentation created until this point will help future measurements and evaluations of the project, also the rule of thumb should be take into account in which 80% of the cost of GIS relates to the development of the data so the implementation planning, documentation and processing are more important than any other step (Harmon & Anderson, 2003)

8 Step 7: Application Development

In the application development several aspects are fundamentals for the success of the technology, which correspond to (1) ownership of geographic information, (2) user roles, (3) staffing the design and implementation process and (3) where to put the GIS.

8.1 Ownership of geographic information

There are two ways to see the ownership of the geographic information it can be:

- Within the organization

  On this ownership the organization controls the data, when it is within the organization aspects such as design process, control and accountability, set of features and tables are developed by your organization (Harmon & Anderson, 2003)
- Outside the organization

  On the outside ownership the data is vied form outside and is it more complex, some technical concerns and database design are left to experts, or hire consults the organization should be directly affected by the power distributed in the organization, so it is important to pay attention in the level of people within the organization (Harmon & Anderson, 2003)

8.2 User roles

Although there are many different users that can rise from the GIS installation process, Harmon & Anderson (2003) mention that there are four basic users roles that are easy to identify:

1. Viewer: the user that only can view certain spatial and attribute information.
2. Modify spatial information: this user can add, delete and edit the points, lines and polygons in the GIS database.
3. Modify attribute information: person that can edit the special information and update the attribute table.

4. Decision- making: correspond to the user that makes decisions based on the database information.

8.3 Staffing the design and implementation process

A good balance should be made on staffing for the planning and design phases, either you want in house staff or consultants, a good group are conformed by both types of staff. (Harmon & Anderson, 2003)

How your group is conform depends on two factors according to Harmon & Anderson (2003) first, the skill and levels of interest in the in-house staff and second the time they have to offer to the process in addition of their own duties. The creation of a GIS coordinating committee is a necessity in this process; Harmon & Anderson (2003) mention that the functions for this committee are:

- Supervising the needs assessments and requirement process.
- Develop and review the request of proposals.
- Reviewing the proposal and make recommendation.
- Oversee the complete staff input in the designing and planning of the GIS.
- Communicate to management the decisions and steps, also communicate downward to the organization the management decisions.

Also it is mention by Harmon & Anderson (2003) that the committee should:

- Be small but not too small.
- Use skeptics in the committee people.
- Use people how have a successful ability to interact with other people, units, departments and organizations.
- Define a champion (person most missionary about spreading the news of GIS)
- Include front-line users of the system
- Develop clean timelines and checkpoints.
- Include regular meeting in their schedule.

8.4 Where to put the GIS

In order to understand where to put the GIS, Kraemer & King (1989) mention that the organization should be first classify into states:

- Skill State: GIS centralized in the information system or technology department; usually users consider GIS to be too technical and unusable for the daily work.

- Strategic State: GIS is centralized in the top-level, other potential users might feel felt out.

- Service State: GIS is utilized in different units, with different types of services to a variety of clients.

- Mixed State: this correspond to the organization that do not fit any of the other states, some parts in service organizations, other at strategic level and other at IT department.

9 Step 8: Maintenance and update plan

An important plan and the last to be develop after the functioning of GIS correspond to the maintenance plan, the main features in this plan correspond, according to Harmon & Anderson (2003) to:

- Applications
    - The maintenance related to the updating of the existing data and the creation of new data, this is accomplish by the feedback from users, in-house staff and contracts (Harmon & Anderson, 2003).
- People
    - Refers to the upgrade skills in users by creating new training for users, this is accomplish by in-house staff and contract trainings and workshops (Harmon & Anderson, 2003).
- Software
    - Indicates the modernization of technical support and licenses for new users, this is accomplish by the interaction with vendors (Harmon & Anderson, 2003).
- Hardware
    - Refers to the replacement of hardware and adding new hardware for new users, this is achieve by the feedback form the users and improvements in hardware (Harmon & Anderson, 2003).
- Data
    - Maintain by replacing large-scale of data, this is accomplished by updating the entire service and updating a selected portion of the data (Harmon & Anderson, 2003).
- Evaluation
    - Understanding the assessment of GIS and the utility and acceptance of the same, this can be achieved by users feedback (Harmon & Anderson, 2003).

10 Step 9: Training

To develop a successful GIS implementation it is necessary to have professional training, the stall must receive sensitive training to undertake the functions and requirements to use GIS and to do it efficient and in a meticulous manner, and also a continual refreshing of concepts and applications in hand with a mentoring to ensure the staff retain their skill level (Douglas, 2008).

According to Douglas (2008) it is important the training to be sensible focused and as effective as possible considering the technical content of GIS, it is usual to have the training in the location required, and at the skill level on the trainees and be relevant to the work and processes o the organization.

Although GIS is usually located in corporate areas of the organizations, Douglas (2008) mention that the "system owner" and the management of the system should be supported by:

- Information technology and GIS staff
- Vendor staff (for uses of GIS and related applications)

For many organization training budgets are consider a luxury and are usually sacrifice in financial rough times, the learning curve can be accelerate by training programs, not only because you have a skill staff that means that the transfer of information to other will be effective, many vendors have programs to certify trainers but also universities with GIS programs are a good source of training for your organization (Harmon & Anderson, 2003).

11 Step 10: Evaluation

Once the users are familiar with the system and bugs are fix or at least identify and worked out it is time to conduct a formal evaluation of the design and implementation process (Harmon & Anderson, 2003).

According to Harmon & Anderson (2003) this evaluation process can be omitted and the organization will not fall apart, but it important to understand the level of satisfaction and how GIS has work out in the organization. The budget of the evaluation was previously distributed but usually managers had to quickly find budget from the strategic plan to the evaluation (Harmon & Anderson, 2003).

The GIS committee is in charge of conducting the evaluation, programs and activities that consume resources are looked closely to understand if they still bring value to the organization (Harmon & Anderson, 2003).

Harmon & Anderson (2003) explain the main components to be evaluated correspond to:

- Investigate the implementation plan and the documentation to determine if the implementation tasks were accomplish on time and budget and why if not.
- Survey the department users and managers for a before and after impressions of the GIS and the applications.
- Develop a summary of time and money estimate of the system payoff.
- Obtain routine and no routine outputs of the system from all users and departments.
- Be honest with the entire finding in the evaluation, the results form the evaluation can get the organization to the planning stages for the next developments.

12 Best practices for Marketing application on GIS

Now that the basics of developing and implementing a GIS project in a business is covered, the best practices of GIS in marketing for the wood products industry will be assessed.

According to Armstrong & Kotler (2005) marketing is easily misunderstood as a process of telling and selling products. Marketing must be understood as a new sense of "satisfying customer needs". In other words, as Armstrong & Kotler (2005) mention, marketing is a process by which individuals and groups (consumers) obtain what they want and need by creating value in the product and exchanging value with others. Moore & Pareek (2006) mention that marketing has two goals: (1) First, attract new customers by emphasizing the value of the product or service offer by the company and (2) Second, retain the customer attracted and keep satisfying the customer with old and new products and services. Marketing focuses on 4 principal pillars: Price, Product, Promotion and Place. These "4P's" help the organization target a market and strongly win portion of the segment market (Hoffman, Czinkota, et al., 2005).

Marketing application corresponds to a wide range of processes, products and services. It can be used for any company in need of communicating directly or indirectly with the customers. According to Moore & Pareek (2006), one of the main and critical functions of a company is marketing, because without consumers there is no revenue, and without that the company cannot work. Marketing is a business process that can fit into the overall firm's strategy, decision-making, mission statement, and corporate strategy (Moore & Pareek, 2006).

For this particular manual, the focus on marketing will refer to the strategic marketing mix plan (4P's). Marketing not only fits the company strategy, but organizations can also create their own marketing mix (strategy) to fit their consumer preferences and behavior as well as the goods or services provided by the company. Moore & Pareek (2006)

mention the elements of the marketing mix, which consist in the four P's (product, place, price, promotion).

- **Product:** In marketing, a product is more than a physical object; it is a union of physical, experimental, psychological benefits that a consumer receive to satisfy their needs (Moore & Pareek, 2006).
- **Place:** Manufacturing companies do not sell their good directly to the consumer instead they sell the product through a marketing channel (which represents a network of institutions linked to accomplish marketing task and deliver the products to the consumers) (Moore &Pareek, 2006).
- **Price:** Determining the correct price is not a perfect science. The price must cover the cost of the product and return a profit to the producers. The amount of profit collected by the producer, and the company and the market potential buying status will determine the marketing channel (Moore & Pareek, 2006).
- **Promotion:** Promotion includes spreading information about the company or the product using five different elements: (1) advertising, (2) sales promotion, (3) public relations, (4) personal selling and (5) direct marketing (Moore &Pareek, 2006).

Even though this research will help different industry types, the main researchers interest focus on the wood products industry. Taking this into account it is important to understand the role that marketing has in this wood products industry. According to Dasmohapatra (2009), the North America Forest Product Industry is losing its domestic markets, the slow economy and low manufacturing cost cause the close of many mills and many workers lose their jobs in recent years. Dasmohaprata (2009) also argues that the new marketing drives or new era of the forest products industry relies in opening the minds to global markets, targeting products to changing demographic structure and customers taste, products with environmental taste, innovation, efficient management, trade practices and policies.

There have been some changes in the Forest Product Industry market which are; globalization and access to free markets, changing demographic structure across the

world, environmentally friendly material, demand of small environmental footprint, innovative products, creating value in the supply chains and trade policies and tax practices. Referring to the consumer behavior in wood products, Anderson, et al. (2005) developed a study about current consumer behavior in forest products, in which they research how forest firms can satisfy consumer's wants and needs, only if they really understand their consumer. Regarding the method used (mail survey or mall intercept methods) researchers need to cautious control the bias in the data typical use in forest products business/marketing field (Anderson, et al., 2005). The two most important results found by Anderson, et al. (2005) were: "Researches will need to adapt their efforts to incorporate the networking aspects," and "surveys have been and will continue to be, a mainstay in forest products marketing research" (p 21-27).

One important aspect of the strategic marketing plan is the marketing mix in which the company analyze the four P's and develop a plan of action for each one of them. In one way or another research conducted in recent years may be associated with the marketing mix made by companies, closer detail in the marketing mix application on GIS will be develop to help the wood product industry develop strategies and integrate them with GIS.

12.1 First P: Products

From the marketing perspective a product is more than just an object, it represent a group of physiological, physical and experiential benefits for customers, understanding why the customers purchases the products is essential in this part of the marketing mix (Moore & Pareek, 2006)

Managers according to Moore & Pareek (2006) should test the performance of the product, some tests correspond to: 1) inventory turnover, 2) return of investment and 3) return on capital. As well the product itself should have a level of strategy, some of the strategies are product filling, line stretching, and product line pruning (Moore & Pareek, 2006)

12.1.1 GIS application for products strategies

On this part of the manual a general description of possible application of GIS in the product strategic of the marketing mix is developed. This part correspond to a recompilation of information obtain from a literature review and the case study.

On the product strategy, GIS can be used for:

- Match the products attributes to the characteristics of customer groups, this by understanding the geographical distribution of the customer and the favoritism in their products by region (Hess, Rubin & West, 2004).

- On a national level or international level, the marketers can match the product to ethnic population distributed geographically (Hess, Rubin & West, 2004).

- The product design and distribution decision can also be better understood with GIS, this to gain a healthier market environment. (Hess, Rubin & West, 2004).

- Discovering if the consumers match with the product characteristics, for example understanding why products are successful in some places and unsuccessful in other, what characteristics on customers varies from place to place (Hess, Rubin & West, 2004).

- By understanding where the customers are located and where new customers can be, the marketers can target new products, to similar interest, desires and need depending of the customers preferences (ESRI, 2010).

12.2 Second P: Place

Placement is important because usually manufacturers do not sell directly to the customers; they need one or more marketing channels. A marketing channel is defined by Moore & Pareek (2006) as “a group of interdependent organizations involved in the process of production and distribution of a good or service” (p 45). The decision of a marketing channel is not an easy task, and once it is made it is not easy to change it

again, but if the decision is well made a competitive advantage can be obtain (Moore & Pareek, 2006).

The are different levels of channels, some products require no intermediaries while other need more than one intermediary, a zero level channel is when companies do nor need a intermediary, they produce, distribute and sell the products, and one-level or more is when one intermediary or more is needed between the producer and de customer (Moore & Pareek, 2006).

To built and manage a marketing channel Moore & Pareek (2006) specify guidelines that need to be take into account:

- Setting channel goals and channel type
- Identify partners (intensive distribution, exclusive distribution or selective distribution)
- Channel management decisions (coercive power, reward power, legitimate power, expert power or referent power)
- Evaluating partners

12.2.1 GIS application for placement strategies

On this part of the manual a general description of possible application of GIS in the placement strategic of the marketing mix is developed. This part correspond to a recompilation of information obtain from a literature review and the case study.

On the placement strategy, GIS can be used for:

- Most commonly use correspond to the utilization of GIS for location selection and delivery routing of the products (Hess, Rubin & West, 2004).

- Locating retail locations, distributions center, competitors locations can also be solve the use of GIS (Hess, Rubin & West, 2004).

- Profile and segments, with GIS marketers can see every transaction and localized it geographically, this used to identify the customer buying habits, recognize patterns and trends that help a better placement of products (ESRI, 2010).

12.3 Third P: Promotion

Creating a good promotion not only benefits the publicity but built the brand equity and brand perception (Moore & Pareek, 2006). It is also mention by Moore & Pareek (2006) that promotion "involves disseminating information about the product or a company using five different key types of promotions: advertising, sales promotion, public relations, personal selling and direct marketing" (p 85).

In the promotion strategy it is important to understand the communication process, in which the communicator, the audience, the channel and the message interact together to create the promotion desired by the organization for the product or service (Moore & Pareek, 2006). When creating the marketing communication strategy Moore & Pareek (2006) consider it is important to:

- Identify the target audience
- Design the message
- Develop the message content
- Determine the message source
- Analyze the message format
- Select the communication channels
- Establish the budget to be use
- Establish the percentage of sales method
- Create objective and task methods

12.3.1 GIS application for promotion strategies

In this part of the manual a general description of possible application of GIS in the promotion strategic of the marketing mix is developed. This part correspond to a recompilation of information obtain from a literature review and the case study.

On the promotion strategy, GIS can be used for:

- On promotion the integration of internal and external data for an accurate and efficient promotion strategy can be address with GIS (Hess, Rubin & West, 2004).

- See the customers, using GIS marketers can become more agile, find new markets and stay ahead of the competition, utilization GIS for mass mailing for example, save money time and resources (ESRI 2010).

- Also by understanding the buying trends of the customers, marketers can use GIS to ensure that the messages will be successful in certain geographical located customers (ESRI, 2010).

- By understanding the needs and behaviors of the customers, knowing different elements that stimulate customers help the marketer to design techniques to respond correctly to the customers (ESRI, 2010).

12.4 Forth P: Price

Once the product and placement is determined, the pricing of the products is necessary to be resolute, pricing is not a perfect science, the price basically need to cover the cost of the product and the return of profits for the manufacturer (Moore & Pareek, 2006).

The declaration of the marketing objective is the first step in defining the price; the marketing objective is defined by Moore & Pareek (2006) as "a started goal a company wishes to accomplish when marketing their product a particulate price" (p 61). Some of the marketing objectives that companies can use are: 1) maximize short-term profit, 2) maximize current market share, 3) market skimming and 4) product-quality leadership.

It is also mention by Moore & Pareek (2006) that the determination of the demand and supply, estimation of costs, analyzing the competitors cost prices and offers of products

and the selection of the price method should be taking into account when selecting the correct price for the product introduce to the customers.

12.4.1 GIS application for pricing strategies

On this part of the manual a general description of possible application of GIS in the pricing strategic of the marketing mix is developed. This part correspond to a recompilation of information obtain from a literature review and the case study.

On the pricing strategy, GIS can be used for:

- Pricing consideration can be made related to the spatial distribution of the consumers (Hess, Rubin & West, 2004).

- Modifying the price of a product or service depending of the location, and the spatial analysis of the consumer (Hess, Rubin & West, 2004).

- Understanding the segmentation of the customers geographic and psychographic help marketers target the real customers, maximizing the marketing dollars in the profitable geographic areas, maximizing the ROI and gaining competitive edge (ESRI, 2010).

12.5 GIS tool applications (online map)

For this particular manual, the researchers previously created a GIS tool applications (online map), which provide information form VA secondary wood products industry companies that participate in the research, spread through the state of Virginia, a total of 953 companies were added to the online map.

The development of the online map basically involves the creation of codes and programing of Google map engine, which was de venue chosen for the map. The final online map version will be available for public at www.cfpb.vt.edu

Researchers understand the many information is require to create marketing mix strategy but the utilization of maps like that one design by the researches will simply part of the process of development and implementation of the strategy. Some uses of the GIS tool for marketing mix applications correspond to:

- **Product**
  - Match you company location or competitors locations with mayor sales, favoritism
  - Research about ethnic population and associate them in the map.
  - Associate the product portfolio depending of the geographic location.
  - Search for new products markers depending of the geographic location and competitors.
  - Among others

Marketing mix product example with the GIS application tool. Figure 3 shows an example referring to the localization of competitors.

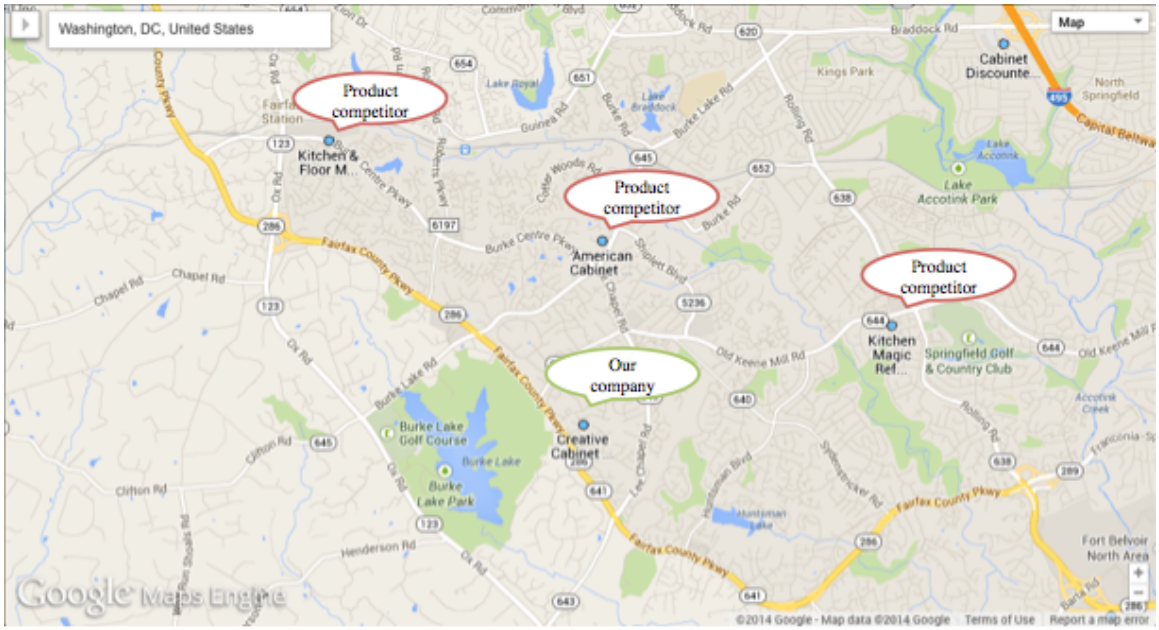


Figure 3. GIS tool application on products.

- **Place**

    - Find channels closed to you current location or for future locations.
    - Find competitor location or possible partners
    - Search for location for new stores
    - Understand by location why some stores are more rentable than others, the same with the competitors.
    - Among others

Marketing mix place example with the GIS application tool. Figure 4 shows an example referring to the localization of competitors.to the localization of potential business partners near the customers.

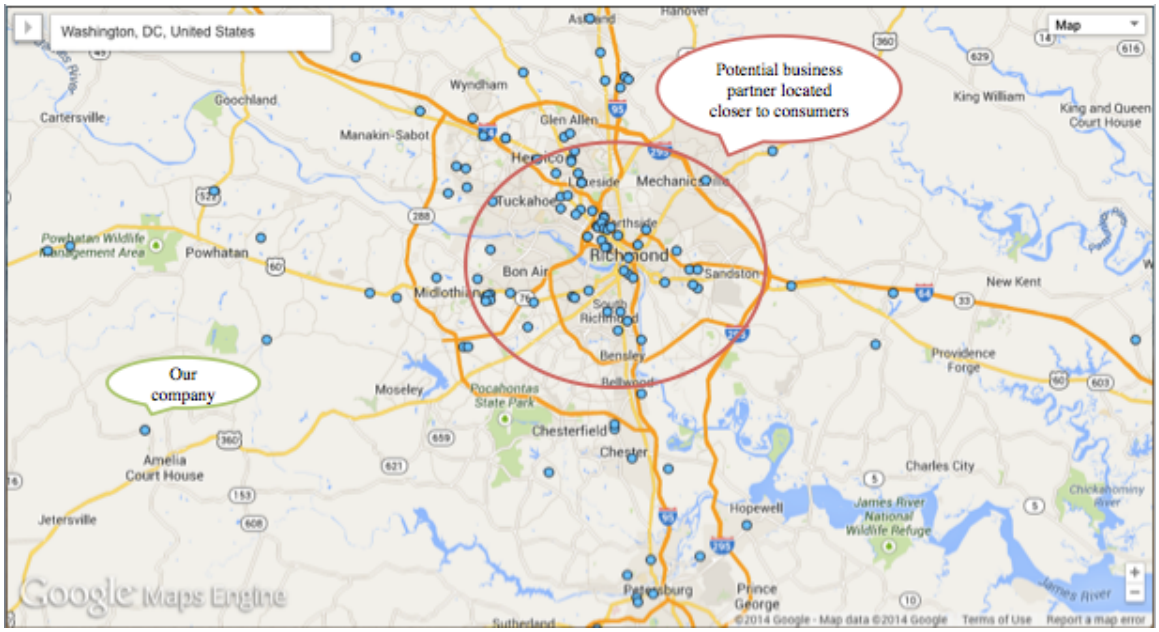


Figure 4. GIS tool application on products.

- **Price**

    - Look for distance form the customers to price the product or service.
    - Understand the distance from the suppliers or main ports to price the product or service.
    - See competitors around you to price correctly the product or service.
    - Among others

Marketing mix price example with the GIS application tool. Figure 5 shows an example referring to the localization of competitors.to understand the distance from the company to the consumers in order to price correctly the product.

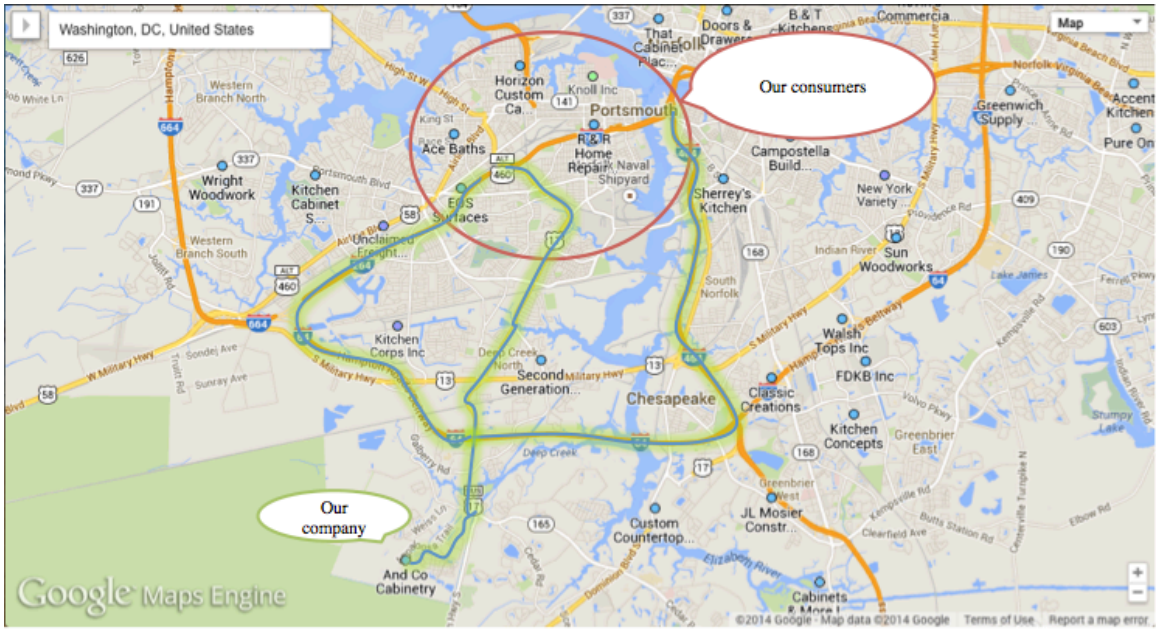


Figure 5. GIS tool application on price.

- **Promotion**

  - Maximize promotion by recognizing the mayor routes
  - Understand were the customers are located and pin it t the map.
  - Target the biggest clusters of companies to have an effective promotion strategy.
  - Design a promotion strategy based on the location of the companies.
  - Among others

Marketing mix promotion example with the GIS application tool. Figure 6 shows an example referring to the localization of competitors.to target main point in which many customers might visit and promotion will be successful.

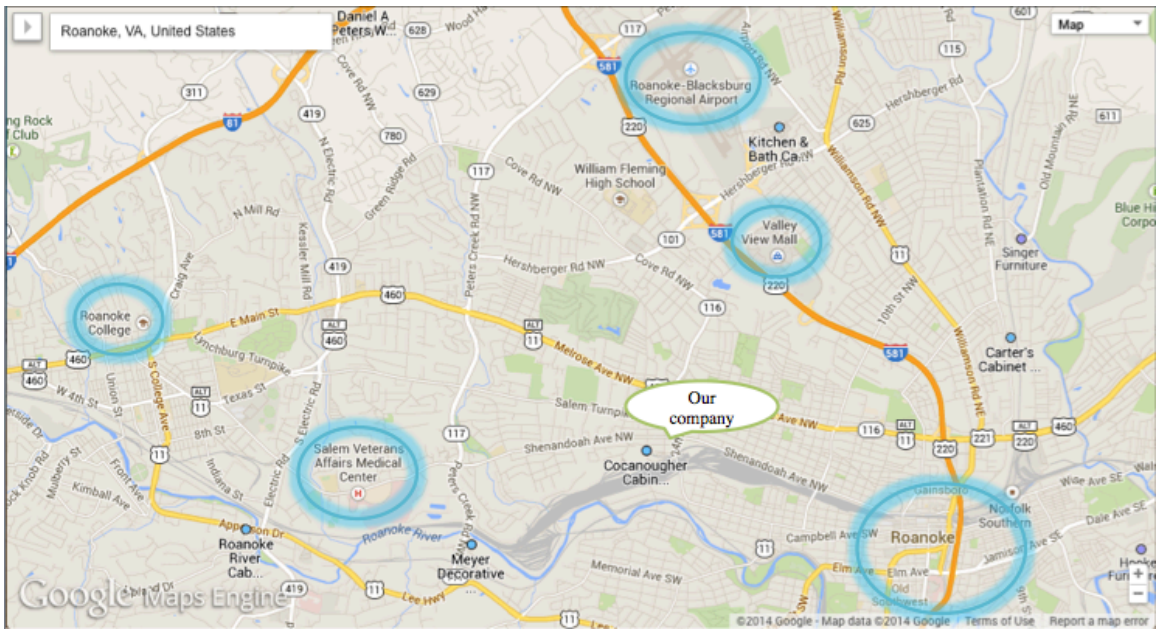


Figure 6. GIS tool application on promotion.

12.6 More GIS application on marketing

Marketing of all the business sectors is perhaps one of the most obvious to which to apply GIS. In general, marketing emphasis on demand (customers) and supply (outlets, retail, shopping centers), are easy to analyze and see in the geographic information systems (Toppen & Wapenaar, 1994). There are research articles, news and investigations about GIS application in every industry, in marketing is generally found in topics such as; Customer Marketing Analysis, (Toppen & Wapenaar, 1994) Penetration & Winning Strategies (Thompson, 2010), Customer Profiling & Costumer Behavior (Badea, Bagu, Gap, Badea, & Moises, 2009), Business Analysis (Raduj, 2009), Market segmentation (Musyoka, Mutyauvyu, Kiema, Karanja, & Diriba, 2007) among others. By combining conventional marketing techniques with geospatial methods enables users to picture the spatial distribution of data in maps -such as the distribution process, the market diverse- also complementing it with statistical graphs and diagrams will link marketing and GIS (Musyoka, Mutyauvy, Kiema, Karanja, & Diriba, 2007).

One important aspect of the strategic marketing plan is the marketing mix in which the company analyze the four P's and develop a plan of action for each one of them. In one way or another research conducted in recent years may be associated with the marketing

mix made by companies, for example research such as Surveying and mapping wood residues (De Hoop et al, 1997) can be associate with the product, Planning the use of information technology in marketing (Toivonen, 1999) can be related with promotion, Consumer behavior in forest products (Anderson et all, 2005) with price, Green advertising in forest sectors (Grillo, Tokarcsyk & Hansen, 2008) related with promotion, Availability of biomass residues for bioenergy production (Parhizkar & Smith, 2008) can be associated with product and Forest cover changes (Kumar, 2011) with price or product to mention some.

Some research articles founded about the GIS application on the marketing mix in the industry; Geographic Information System (GIS) market in retail sector (M2 Presswire, 2010), DSS implementation in the UK retail organizations: A GIS perspective (Nasirin & Birks, 2003), Methods for evaluating agricultural enterprises in the framework of uncertainty facing tobacco producing regions of Virginia (Halili, 1999), Put your firm on the map (Talsky, 1996) among others.

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