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Building Online Communities in Forestry: the Cases of Timberia.org and the Urban Ecology Collaborative

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BUILDING ONLINE COMMUNITIES IN FORESTRY:
THE CASES OF TIMBERIA.ORG AND THE URBAN ECOLOGY
COLLABORATIVE

A Thesis Presented

by

ANDREY V. SEMENOV

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

May 2007

Forest Resources

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DEDICATION

This thesis is dedicated to my lovely wife Yuliya.

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CHAPTER 1

INTRODUCTION

In recent years, a second generation of Web-based technologies have emerged what is sometimes referred to as “Web 2.0” (Musser and O’Reilly 2006, for references: http://www.oreilly.com/catalog/web2report/chapter/web20_report_excerpt.pdf). At the core of Web 2.0 are web-based services and social networking and online collaborative functions. Forestry, like other disciplines, has the potential to take advantage of these technologies to alter or change the way traditional interaction between forestry professionals and other interested parties is undertaken. This dissertation explores the use of Web 2.0 and social networking technologies in two domains: (1) eBusiness and (2) Urban Ecology. The thesis is designed to provide essentially two chapters that stand on their own, and describe the background and the design and development of two Web 2.0 online systems. In addition to the text in this dissertation, a “supplement” to this dissertation are two computer systems and databases that the author developed over the course of 2006-2007.

Chapter 2 of this thesis includes the research on the applicability of the online community model for today’s forest sector electronic businesses-to-business platforms. The objectives of this chapter are (1) to examine the existing forest product web-based applications and find strong and weak points of their business and data management models; (2) analyze trends in today’s Internet environment in order to find out how a forest sector business-to-business web-based application could utilize principles of the online community model; and (3) describe the design and implementation of a forest sector e-business Web 2.0 system I developed called “Timberia.org”.

To address the above objectives, the chapter contains a literature review of the latest trends in the forest sector eBusiness and analysis of currently operating business-to-business websites with respect to their operations, business models, pricing mechanisms and means for revenue generating will be conducted. Lastly, the design and implementation of the Timberia.org business-to-business online community is presented.

In Chapter 3, I research how data integration along with a “content management system” designed for a social network website can be exploited to improve collaboration among geographically distant researchers, policy makers and other stakeholders interested in Urban Ecology. The reported work is not entirely theoretical. The chapter reports my efforts to develop a system to support an established working group called the “Urban Ecology Collaborative”, and a Google search of this group will return, in the first hit, the website I have designed and developed that this group currently uses.

Consequently, the chapter reports my efforts to design and build this Urban Ecology social networking site. In this chapter I (1) conduct an analysis of users and software requirements for the Urban Ecology Collaborative with respect to the existing collaboration schema of the UEC working groups, (2) build a conceptual model for the UEC content management system, (3) assess the applicability of web-services approach to design such a system as an online community based on the social network site content management model; and (4) describe the architecture and technical components of the system I ultimately produced that is now in production at urbanecologycollaborative.org.

I close the dissertation with a short summary and comparison of the findings from both chapters.

CHAPTER 2

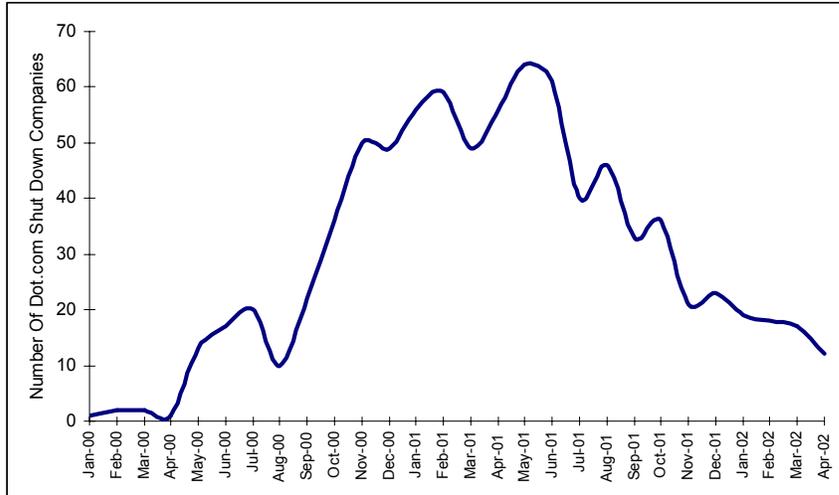
TIMBERIA.ORG - OPEN MARKET B2B ONLINE COMMUNITY

2.1 Introduction to Chapter 2

The dot.com bubble that crashed at the beginning of the Millennium caused a large number of business bankruptcies in the United States. In two years after this collapse about 840 companies went under (Figure1).

Thirty-six% of these companies provided services in a form of electronic business-to-business (B2B) marketplaces (<http://www.webmergers.com> 2002). B2B electronic marketplaces are “[d]istinct system of suppliers, distributors, commerce, services providers, infrastructure providers and customers that use Internet for communication and transactions” (A Report by Federal Trade Commission Staff. 2000, pp 1-2). The primary goal of such B2B marketplaces, also known as eMarketplaces or eMarkets, was to generate value by decreasing inefficiencies in supply chain and buffering companies from industry business cycles (Shook and Vlosky 2004).

The growth of B2B exchanges started in 1999, and contributed partially in the hype that all traditional businesses can be revolutionized through the online market outreach, cost optimization, and group collaboration in trading. However, inertness in adaptation to new technologies, imperfect eBusiness models, and a lack of an audience for B2B marketplaces in part due to the economic aftermath of the 9-11 event, hindered electronic B2Bs from effectively competing in markets where traditional industries had already been operating for many years.



**Figure 1: Number of shut down dot.com companies
(Source: <http://www.webmergers.com> 2002)**

Forest Products, one of the oldest and perhaps most conservative industries on Earth, is an example of such an industry where electronic B2Bs failed to compete. This traditional industry today generates more than \$750 billion of the gross revenue at the global market with the U.S. share of \$250 billion (Shook and Vlosky 2004).

Back in 1999, forest product manufacturers and traders did start to utilize the Internet to establish better business relationships with their customers. But investments in Internet technologies made by those companies rarely exceeded \$10,000 (Pitis and Vlosky 2000) and the majority of businesses used Internet primarily for e-mail and simple web hosting. According to the 1999 study by Pitis and Vlosky, only 14.3% of U.S. forest product exporters used the Internet as a platform for e-commerce (meaning transaction processing of orders and sales). But 60% of these companies a company web presence, and almost all companies (95%) used e-mail as a communication tool (Pitis and Vlosky 2000). In the wood production industry, 47% of US-based wood producers used the Internet to contact customers, 45% had a static homepage, 44% used it as a marketing

tool, and about 30% utilized Internet capabilities for e-commerce business transactions (Vlosky and Pinches, 2000). A comparable study conducted in Canada in 2000 found that 24% of Canadian secondary wood product manufacturers in British Columbia sold their products online while 50% of them had web sites (Stennes and Stonestreet, 2006). The greater use of e-commerce technologies by Canadian companies can be explained by the fact that wood products represent a primary export good of Canada and the realization that the use of the Internet could help create a substantial niche in the international forest products market.

Though Damery (2002) argued that the forest products industry is historically a follower, not an innovator, in the use of the Internet to conduct business, many forest product businesses considered using network technologies and a web-presence for public relations. These technologies were seen as tools to help companies reduce promotional costs and to improve marketing strategy (Vlosky and Smith, 2003). With thoughtful web design even a small company could enhance its image and market itself as a large enterprise using cutting-edge modern technologies. The Internet provided some in the forest industry an ability to exchange information almost instantly through the entire supply chain that increased industry operating effectiveness, boosted sales, and reduced costs of doing business (Pitis and Vlosky 2000).

Although the Internet might seem a promising marketing tool for forest industry participants, its capabilities were not fully exploited because of a variety of factors. According to the study conducted in order to determine business applications of the Internet for small wood product manufacturers in the Adirondack County Region of New York and in the state of Louisiana, 58% of the New York respondents indicated that the

percentage of company sales conducted through the Internet would be greater than 11% while in the Louisiana only 25% of respondents believed that this would be a case (Holmes and Vlosky, 2004).

The adoption of the Internet often required reorganization of a company and reengineering of operating processes as well as demanding a commitment by the entire organization to the innovation. All of this represents risks. Also, both employees and customers in the forest industry supply chain were accustomed to the traditional ways of conducting business and were resistant to change. The U.S. Department of Commerce reported that in 2005 among 21 sectors of national industry, the pulp and paper industry was ranked 14th in Internet sales (eCommerce), while the timber and lumber sector was last in their list of industries studied (Kallioranta and Vlosky, 2006). These and other impediments resulted in some forest-sector B2B failures. Yet others survived.

The goal of this chapter is to scrutinize existing forest product B2B exchanges, to find strong and weak points of their business models, describe www.timberia.org, a new model to forest sector B2B design and organization that the author designed and developed, and illustrate its competitive advantages.

2.2 Analysis of the existing forest sector eMarketplaces

Many predictions regarding the growth of forest-related eMarketplaces being made at the beginning of the dot.com revolution have not been realized. For example, the predictions that auction sites would become the place to sell surplus inventory while closed exchanges would handle most of the consistent, day-to-day transactions was incorrect (Brindley 2000). As presented in Table 1, forest industry B2Bs that still operate

today do not use an auction scheme as a pricing mechanism. Online auctions appeared to be appropriate for products that are unique and differentiated and also simple to describe and understand (A Report by Federal Trade Commission Staff. 2000, p. 10). Forest products do not fit that description. Their qualities are complex due to different grading and volume measurement systems. Many promising and aggressive B2Bs that appeared to take the lead in the industry, such as HardwoodsOnline.com, TALPX.com, HardwoodSearch.com, Timbex.net, and TheLumbermarket.com, have failed and are shut down. The reasons for these failures were fully discussed by Shook and Vlosky (Shook and Vlosky 2004), and consequently, we will not address them here. Instead, we will analyze the forest industry B2Bs that survived the dot.com crises and continue to operate.

The top 26 currently operating forest product eMarketplaces are presented in Table 1. 13 of these eMarketplaces (50%) are based in the United States, 2 in Canada, 4 in Europe, 5 in Asia, 1 in Africa, and 1 in the Pacific. In this section, we will describe them along several dimensions: business model, scheme for pricing determination, method of revenue generation, and ownership and services provided.

Table 1: Currently operating forest industry B2Bs (As of May 2006)

| Forest Industry B2B | Minimum Features Use Cost | All Features Use Cost | Country | Organization | Pricing Mechanism | Ownership | Mechanism to Generate Revenue |
|-------------------------|---------------------------|-----------------------|--------------|--------------|--------------------------|--------------------|---|
| www.asiatimber.net/ | \$0 | \$425 | China | Vertical | Supply Chain Management | Independent | Membership Fee |
| www.asiatimbers.com | \$0 | \$200 | Malaysia | Horizontal | Directory | Private | Membership Fee |
| www.asiawoodweb.com | \$99 | \$699 | India | Horizontal | Directory | Independent | Membership Fee |
| www.contractorhub.com | \$372 | \$6000 | USA | Horizontal | Directory | Private | Membership Fee, Advertising |
| www.e-wood.com | \$50 | \$50 | USA | Horizontal | Trading Hub | Industry-sponsored | Membership Fee, Brokerage. (Commission Per Transaction 5-10%) |
| www.forest2market.com | \$119 | \$550 | USA | Vertical | Supply Chain Management | Independent | Membership Fee, Marketing Services, Data Sales, Middleman. |
| www.forestexpress.com | \$0 | \$0 | USA | Horizontal | Trading Hub | Industry-sponsored | Brokerage (Commission Per Tone \$0.10-\$0.25) |
| www.forestindustry.com | \$0 | \$0 | Canada | Horizontal | Directory | Independent | Web Services, Publishing, Advertising |
| www.globalwood.org | \$98 | \$260 | China | Horizontal | Negotiation | Private | Membership Fee |
| www.forestweb.com | \$0 | \$0 | USA | Vertical | Supply Chain Management | Industry-sponsored | Data Sales and Marketing Services |
| www.landandfarm.com | \$240 | \$600 | USA | Horizontal | Negotiation | Independent | Membership Fee, Advertising |
| www.lesprom.com | \$360 | \$1500 | Russia | Horizontal | Negotiation | Industry-sponsored | Membership Fee |
| www.logsplitters.com | \$40 | \$800 | USA | Horizontal | Directory | Independent | Membership Fee, Advertising, Web Design |
| www.sticktrade.com | \$600 | \$2400 | USA | Horizontal | Directory | Private | Membership Fee, Advertising |
| www.timberandmore.com | \$1030 | \$5160 | Italy | Horizontal | Directory, Negotiation | Industry-sponsored | Membership Fee, Advertising, Web Design |
| www.timber-exchange.com | \$600 | \$2500 | Germany | Horizontal | Negotiation | Independent | Membership Fee |
| www.timberhunt.com | \$99 | \$1999 | India | Horizontal | Directory | Independent | Membership Fee, Advertising |
| www.timbersa.com | \$0 | \$190 | South Africa | Horizontal | Negotiations | Independent | Membership Fee, Data Sales. |
| www.timberweb.com | \$360 | \$1350 | UK | Vertical | Supply Chain Management | Independent | Membership Fee, Middleman. |
| www.veneernet.com | \$40 | \$150 | USA | Horizontal | Directory | Independent | Membership Fee, Advertising |
| www.woodfibre.com | \$200 | \$2500 | USA | Horizontal | Directory | Private | Membership Fee |
| www.woodnet.co.nz | \$200 | \$200 | New Zealand | Horizontal | Directory | Independent | Membership Fee, Brokerage (Commission per transaction \$2) |
| www.woodweb.com | \$0 | \$1 | USA | Horizontal | Directory | Independent | Advertising, Transaction Fee (\$1 Per Listing) |
| www.woodplanet.com | \$315 | \$1610 | USA | Horizontal | Trading Hub, Negotiation | Independent | Membership Fee |
| www.woodproducts.nb.ca | \$500 | \$500 | Canada | Horizontal | Directory | Independent | Membership Fee |
| www.wwwood.net | \$315 | \$3000 | USA | Vertical | Supply Chain Management | Independent | Membership Fee |

2.2.1 Business Models

Analyzing the development of forest product B2Bs from 1999 to present day, one could classify B2B business models as either horizontal or vertical in organization. Horizontal organization refers to B2B services provided for different industries without a focus on a particular product group. The vertical organization of a B2B is often industry specific and “[r]eflects orientation along many steps in the supply chain of one product group” (A Report by Federal Trade Commission Staff. 2000, p. 6). B2B models with horizontal organization specialize in the sales of raw material and components, also called as “direct inputs”, that will be reprocessed in the further manufacturing process or become parts of a final product sold by a retailer (Kaplan and Mohanbir 2000, p. 98). In contrary, a vertical organization may imply “indirect inputs” – operating inputs that are necessary in a manufacturing but do not become a part of a final product (Kaplan and Mohanbir 2000, p. 98).

2.2.2 Pricing Mechanisms

Most of the forest products eMarkets that emerged as a result of the dot.com revolution hype exhibited horizontal organization and used directories (catalogs), trading hubs, online negotiation platforms, and online chain supply management tools to implement a mechanism to establish a price on forest products and enhance the price transparency of the forest product marketplace. The analysis of today’s B2Bs presented in Table 1 demonstrates that 13 companies, a majority, use directory listings as a pricing mechanism.

Seven companies determine prices on forest products with negotiation platforms and five companies offer wood and forest industries capabilities of online supply management tools while only three companies provide an automatic match between a buyer and a seller operating as trading hubs (Figure 2).

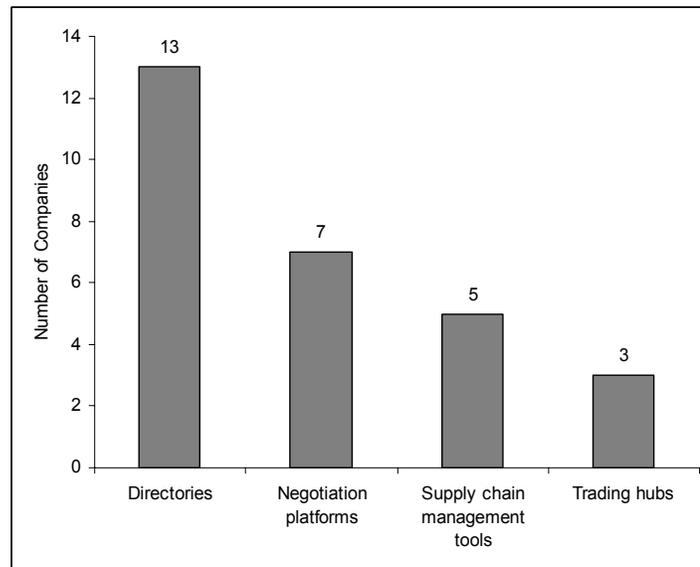


Figure 2: Number of companies by pricing mechanism

2.2.2.1 Online Directories

Online directories and catalogs accept information about direct inputs from suppliers through online submission forms and facilitated a search process for buyers of forest products using catalog navigation in which forest products were aggregated by categories and then by subcategories. ForestIndustry.com and StickTrade.com are typical examples of forest products directories. While most online directories were simple to use there were disadvantages for such systems. For example, suppliers were unable to update information about product availability and prices on a regular basis without being first reviewed by an administrator that resulted in a delay. Also, prices for products in those

directories were fixed and a negotiation on price between a supplier and a buyer never occurred. Essentially, an online electronic catalog or directory of forest products in its business model was similar to a traditional e-commerce store.

2.2.2.2 Trading Hubs

Forest product trading-hubs emerged as another pricing mechanism utilized by forest eMarkets with horizontal organization. The idea behind electronic trading hubs was to match offers posted to the system by buyers and suppliers automatically and then to email both buyer and supplier if a match is found (A Report by Federal Trade Commission Staff 2000, p. 11). The classic example of a forest product trade hub is the buyer-oriented WoodPlanet.com. After a seller posts his offer, a buyer receives a notification if an offer satisfies his request. The main disadvantage of this mechanism was the absence of human involvement in the process of finding matches. Since this process is supposed to be entirely automated and take into account only a few criteria, for example the price and product categories, participants of a trade-hub received many superfluous offer notifications. And the flexibility of negotiation between a seller and a buyer was impeded since sellers and buyers were forced by the system to deal on matched offers only.

2.2.2.3 Negotiation Platforms

Negotiation platforms allow more flexibility than trading hubs do. The idea behind the negotiation online platforms is that a buyer can search through a database of seller's offer profiles and could contact them directly. If a seller responds, they can then deal directly with each other. Negotiation platforms appear to be a successful business model

for forest product B2Bs since it provides flexibility to adjust an offer to the benefits of both buyers and sellers. Timber-Exchange.com is a Germany-based B2B negotiation platform and is probably the largest eMarketplace in Europe that facilitates negotiations among buyers and sellers of forest products.

2.2.2.4 Supply Chain Management Tools

Finally, online supply chain management tools provided capabilities to facilitate collaboration between businesses (Shook and Vlosky 2004). Such collaboration often includes optimization of a company workflow and provides tools for electronic exchange of documents such as order, order confirmation, change order, shipment notifications, invoices, and product catalogs and integrated different businesses of one supply chain through the web based application.

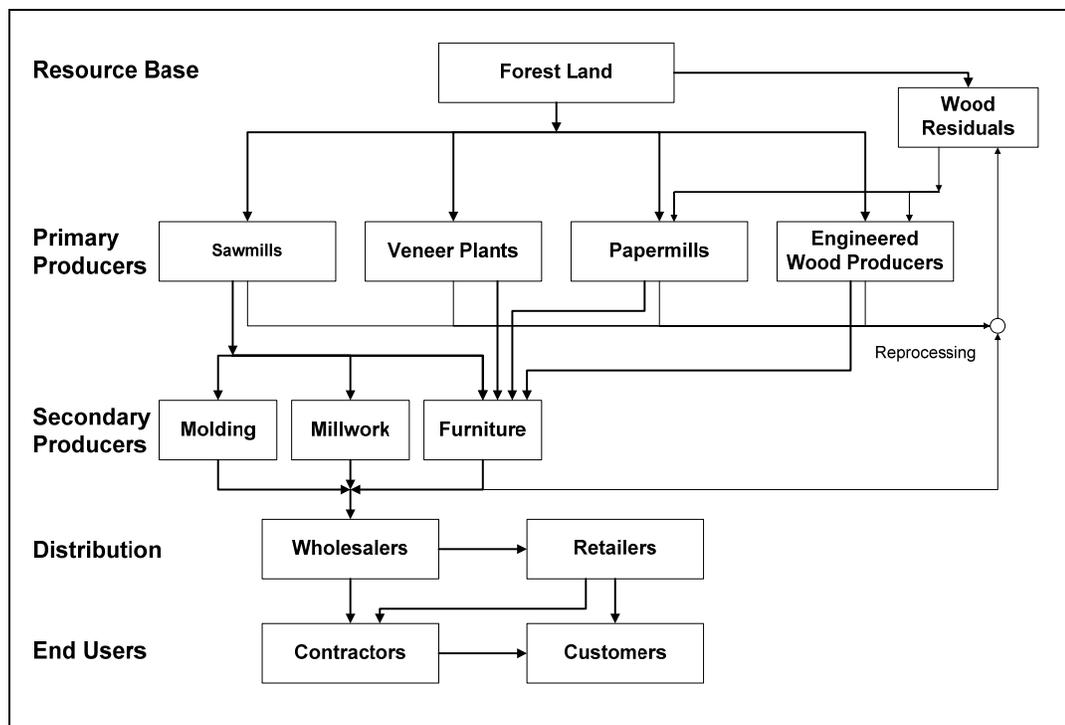


Figure 3: Value-added distribution chain for forest products (Damery 2002)

For example, TimberWeb.com eMarketplace, based in the United Kingdom, uses specialized software called eTrader that provides buyers and sellers with effective workflow management solutions that allows them to conclude deals online and manage the entire supply chain from making an online contract to the final delivery of forest products to the end customers.

The value-added distribution chain for forest products is presented in Figure 3. All B2Bs presented in Table 1 that provide online supply management tools to their clients mainly facilitate workflow process between primary and secondary producers and the distribution tier of the supply chain depicted on the Figure 3. The exception is ForestToMarket.com system that also connects landowners (Resource Base) and Primary Producers of forest products.

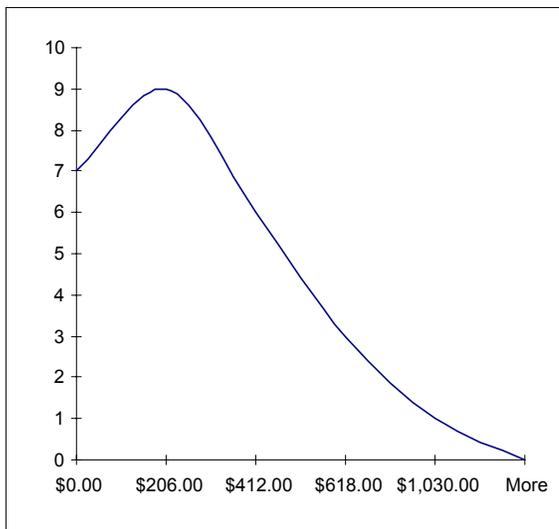


Figure 4a: Minimum price to use basic web site features

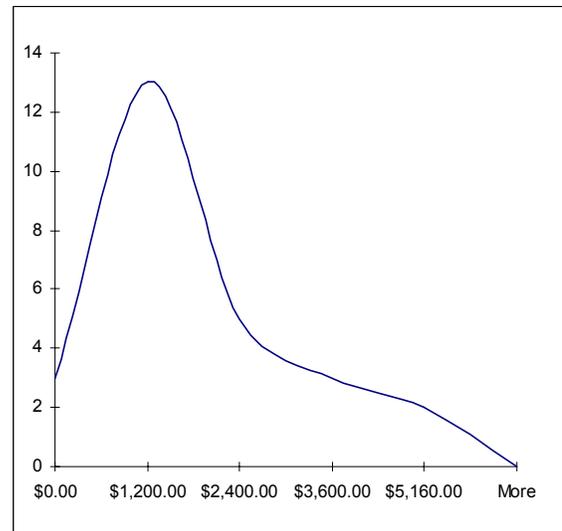


Figure 4b: Price to use full web site capabilities

2.2.3 Revenue Generation

Table 1 also summarizes the means by which different B2B platforms generate revenue. According to this analysis, the following revenue mechanisms can be identified:

- 1.) Membership fees
- 2.) Brokerage
- 3.) Middleman
- 4.) Data sales and marketing services
- 5.) Advertising (rich-content web site)
- 6.) Auxiliary services

2.2.3.1 Membership Fees

About 96% of forest products trading web systems in this analysis use membership fees to generate revenues and stay in business (Figure 5.). Membership fees are paid periodically by B2B participants. All B2Bs discussed in this paper that use membership fees in their business models charge their members annually. The amount of a membership fee varies. Almost all B2B systems with membership fees provide users with introductory features that may be either free of charge or a minimum charge may apply. For example, timberweb.com hides contact information of users who posted their offers to the trading system from website guests and reveals this information to members only. Figure 4a shows the distribution of a minimum charge among B2Bs presented in the Table 1. It shows that the distribution pick demonstrating the maximum number of occurrences lies in the range between \$200 and \$250 USD. Figure 4b demonstrates distribution of a charge when all web system features are available to a B2B member. This distribution shows \$1,200 as an average amount with the highest frequency.

The membership fee as a means to generate revenue has its advantages and disadvantages. The main advantage is that it provides a B2B company with annual fixed revenue and thus allows predictions and business planning. The main disadvantage is that revenue that a B2B company generates during the year is limited by the number of members. Also, users that commit transactions online only one or two times per year may be reluctant to pay high membership fees, or perhaps membership at all. For example, an owner of a forestland who sells timber every five years would unlikely use a B2B portal that charges a high membership fee. This leads to inability of membership fee oriented B2Bs to facilitate transactions between a resource base owners and primary producers (Figure 3). Indeed, as mentioned above, most forest trade systems with membership fees focus on facilitating transactions between primary and secondary producers. Another disadvantage with membership fees is that it is hard to get a large number of users, especially if a B2B is a young startup company. Membership grades and introductory free basic features may increase the number of registered users but it does not guarantee that all users would use all capabilities of a web trading platform, and will be willing to pay for a full membership.

During the early stages of forming online business models, when there were a small number of online competitors, the first B2Bs charged membership fees. However, increasingly these companies have come to realize the importance of providing free services (Mahadevan 2000).

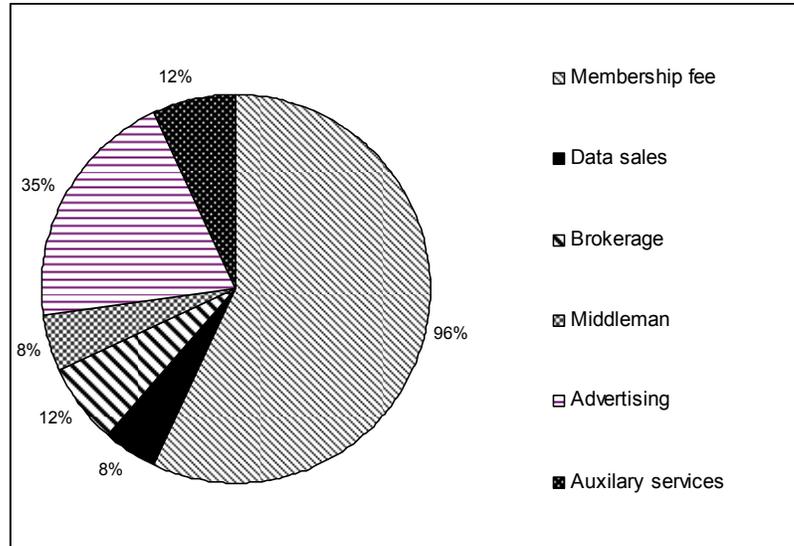


Figure 5: Mechanisms of generating revenues used by forest B2Bs

2.2.3.2 Brokerage

The brokerage is another mean of generating revenue for a B2B company. B2Bs that use this as a revenue generating tool charge a fixed or percentage fee from each transaction made by web site members. Brokerage is often combined with membership fees. E-wood.com charges from 5 to 10 percent of the total monetary amount of a transaction and requires its members to pay a \$50 annual fee. Forestexpress.com applies a fee of \$0.15 - \$0.25 per one ton of products being transacted. Our analysis reveals that only three B2B companies (12% from total) use a brokerage business model.

Brokerage is a more flexible instrument to generate revenue for a B2B company compared to a membership fee model. The advantage is that the company primarily depends on the number of transactions generated. The total number of members is still important, but becomes a secondary factor.

2.2.3.3 Middleman

Another revenue generating tool for online forest product industries is acting as a middleman. In middleman business models, the company does not charge a transaction fee, though it may apply an annual membership fee. An example is Timberweb.com – the biggest European B2B web-based company that facilitates trade of forest products. This company not only charges a membership fee from members but also assists in all aspects of international trade including preparation of contracts; help with insurance, and resolving financial matters among parties involved. Though the middlemen schema is used only by 2% of B2Bs presented in Table 1, this model of generating revenues has many advantages. Middlemen function as a bridge that connects conservative old-school forest businesses with new technological solutions. The establishment of such connections becomes possible through partial human involvement in the process that creates trustworthiness in utilizing the company’s online trading tools.

2.2.3.4 Data Sales and Marketing Services

Data sales and marketing services are another way of generating revenue for a B2B company. For instance, Forest2Market.com assists forest businesses by providing information on prices for forest products in micro markets in the Southern United States. This B2B sells licenses to users so that they can use the services of the company. Though this, to some extent, has similarity to membership fees, it differs because a registrant buys a package of services that helps to market his forest products or to facilitate business in small geographic areas called micro markets. By purchasing a license, a landowner or a small business owner may request that the online firm conduct a marketing analysis,

order price quotes, and find a seller or buyer. Therefore, Forest2Market.com primarily facilitates the supply chain connection between resource base (forest landowners) and primary manufacturers.

The advantage of this data sale model is that a landowner or a small business can obtain information services for decision-making on the local market of forest products. The disadvantage is that such B2Bs, like Forest2Market do not look for an actual buyer-seller match for buyer and seller but rather shows them the general picture of the micro market under analysis. Data sales require very good knowledge of regional markets which relies on company staff expertise. In some instances, the accuracy and validity of data might become an issue. Collecting data can be expensive.

2.2.3.5 Advertising

35% of B2B companies presented in Table 1 use advertising as an additional means to increase revenues from their operations (Figure 5). Usually, advertising coincides with a membership fee mechanism and usually by itself, cannot support a B2B company. Advertising can only be efficient if the web content is rich, thus it is interesting to view or read and the web site receives a sufficient number of visitors (viewers) to justify charges applied for placing an advertisement. Well thought through, correctly organized and frequently updated content can attract more viewers.

Forestindustry.com is an example of an efficient web site which utilizes advertising as revenue generation mechanism. They combine the Internet and print products to give participants of the forest products market an opportunity to meet their needs by maximizing the effectiveness of the Web. Along with the Internet, this company also

uses traditional channels such as hosting trade events and connecting forest businesses through leading associations. Another B2B that utilizes advertising is Woodweb.com. They create rich content through maintaining a knowledge base, wood product directory, and topic-based discussion forums that provide woodworkers with reference material and product information they need to run their businesses, and provide a real-time problem solving platform.

The main disadvantage of advertising for revenue generation is that advertisements interfere with the web page content and format. Advertising reduces the amount of space available for other information. It can distract a user's attention and in can decrease the usability of the web site in general. Moreover, some graphic advertisements can impact the time to download and to render a web page. The delay in page downloading and rendering may negatively impact the end-user's experience. Thus the trade-off between the number of advertisements and the value of the content is analogous to trade-off between a price and quality of a product and thus should be considered carefully (Dewan and Freimer 2002).

2.2.3.6 Auxiliary Services

Logsplitters.com and Timberandmore.com provide their customer with so-called auxiliary services that do not connect sellers and buyers of forest products directly but may help them to improve their marketing positioning on the web. This is done by providing customers with services such as web site design and hosting, search engine optimization tailored to the wood and forest industries, and web site promotion through niche banner exchange.

Figure 6 shows the relationship between pricing mechanisms of B2B companies presented in Table 1 and their means of generating revenues. This figure shows membership fees, a mean to generate revenue, is found in 45-60% of the firms, regardless of a pricing mechanism. Directories, as the least technically sophisticated B2Bs, extensively use advertising to increase their revenues. The share of advertising for directory-based B2Bs constitutes about 40%. At the same time purely technically complex implementations for pricing mechanisms with minimal human involvement, such as trading hubs, rely either on the brokerage model or membership fees, or both.

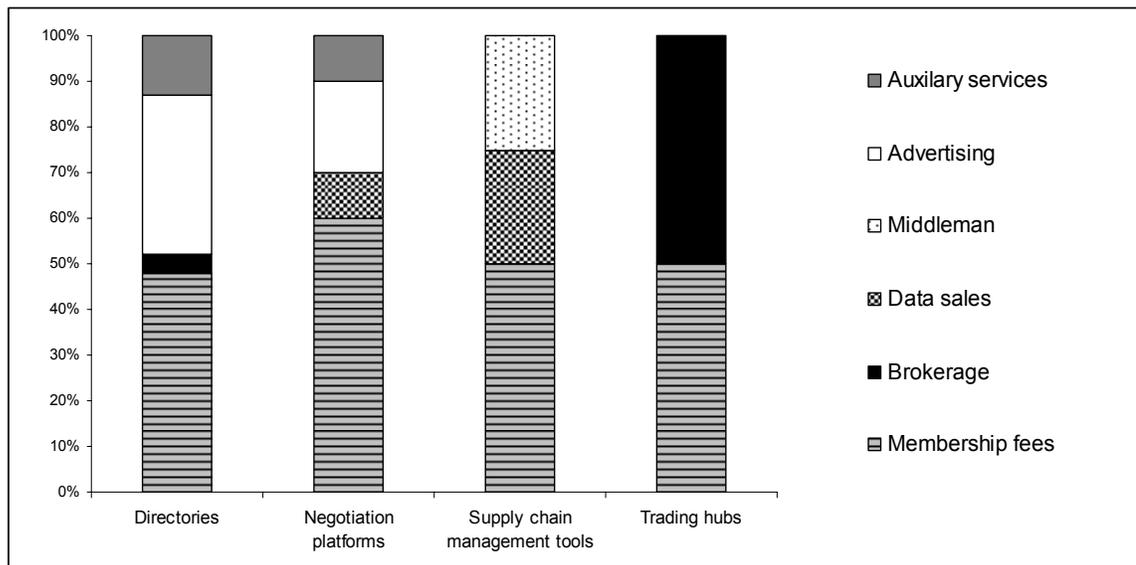


Figure 6: Relations between pricing and revenue mechanisms for B2B companies presented in Table 1

This can be explained by the fact that these technical solutions use Internet protocols to run their software that is, as in case of Forestexpress.com, not necessarily browser-based. Companies that use their B2B services to facilitate supply chain management rely equally on data sales and middleman schemas. Negotiation platforms do not utilize brokerage business approaches, a buyer and seller meet each other using the platform but

conduct the transaction outside the system. Consequently, negotiation platforms utilize advertising and data sales to generate revenues. In this analysis, B2Bs that act as negotiation platforms represent the highest share (60%) of the membership fee approach.

2.2.4 Online communities and forest sector eBusiness

The analysis conducted above reveals both strengths and weaknesses of the existing business models, pricing mechanisms, and means to generate revenues. There is a feature that all these models have in common. Almost all B2Bs presented in Table 1 are survivors of the dot com crash and their business models have not been adequately adjusted to the changing trends in post-crises Internet environment. According to the study of how the Internet impacts different social interactions in the modern American society conducted by Nie and Erbring (2002) “the data strongly suggested a model of social change with not only a growing number of Internet users, but with web users doing more and more activities on the Internet in the future” (Nie and Erbring, 2002, p. 278). Forest product B2Bs presented in our analysis were not be able to respond adequately to the new types of social and business interactions that emerged as a result of the rapid growth in the number of Internet users and development of new web-based technologies. Business models of these companies were formed during the era of the dot com bubble and targeted a “classic Internet user-businessman” who used the Internet merely as a tool of communication through electronic mail and search for information on products and services.

The study conducted by Koh and Nam (2005) provides empirical evidence that Internet business applications are evolving with respect to the value chain framework that include inbound logistics, operations, outbound logistics, marketing and sales, as well as customer service. Unfortunately, for most forest product eMarketplaces the Internet is still only a tool to disseminate information thus its applications are likely to be found at the marketing and sales phase. Only two companies, ForestExpress.com and E-wood.com, use the Internet as a transaction processing mechanism, and presently only one company, Timberweb.com, uses the Internet as an integrated technical infrastructure to support different types of operations for its clients. However, even this site has no capabilities to seamlessly integrate all value chain phases; in particular, it is incapable to support outbound and inbound logistics operations.

Another drawback that is common for most B2Bs presented in Table 1 is that their online processes are rather oriented to asynchronous user's inquiries to static web or dynamic database content and lack, or have no tools, that would increase social and business interactivities among members. Moreover, interactions among members of an eMarketplace might contradicts to its business model because, especially in cases of negotiation platforms and directories, its members pay a membership fee to get instant access to contact information of potential buyers and sellers registered in the company's database. An isolation of B2B members from free-of-charge interacting with each other prevents a company from building an online community – an organization of online environment based on the human desire for social and business interactions (McInnerney and Roberts 2004).

De Souza and Preece (2004) defined online community as the people who come together for a particular reason or purpose, and who are guided by policies that include rules and norms and supported by software. An online community is not a business model in itself, but potentially part of the customer relationship (Osterwalder and Pigneur 2005). This is a virtual space in which people tend to have common interests, needs and goals and where they can easily find and communicate with each other and establish relationships (Andrews and Preece 2001). At the beginning of the Internet era online communities were seen as social phenomena without commercial focus (Schoberth et al. 2003). However as the number of Internet users grew and new technologies emerged online communities become strong stimuli to eBusinesses (Hagel and Armstrong 1997).

In the forest sector, a product focused or region focused online community can help to build a sustainable collaborative platform for long term-business relationships among its members. According to the surveys conducted in Vermont, Massachusetts, and New Hampshire, approximately 75% of family forest owners are online (Belin 2002). However, 20% or fewer forest owners use the Internet for selling timber and land online due to the absence of web tools applicable to their specific needs at a particular decision point (Belin and Kittredge 2005). These tools can help in disseminating specific up-to-date information, providing a mechanism for eBusiness transactions, catalyzing regional business activity, and increasing sales leads (Kallioranta and Vlosky 2006). An online community focused on forest products may contribute in educating its members about many aspects of this business and could make them operate more efficiently and profitably. Two newly born forest industry communities, the Louisiana Forest Products Community www.laforestproducts.org and the Oregon Forest Industry Directory

www.orforestdirectory.com, were recently mentioned by Kallioranta and Vlosky (2006). Both “candidates” are non-profit web-sites oriented to regional markets of forest products and have no online tools implemented to provide a fully interactive environment for their users and thus qualifying them as online communities. The Oregon Forest Industry Directory is rather a typical example of a web-based regional directory (catalog) of forest products. The only attribute of an online community that may be recognized on this web site is the discussion forum. The Louisiana Forest Products Community publishes news-releases, government documents, and related external links online but has no technical solutions for the users to interact with each other on the web site. Neither one of the web sites has policies supported by software that is an attribute of an online community.

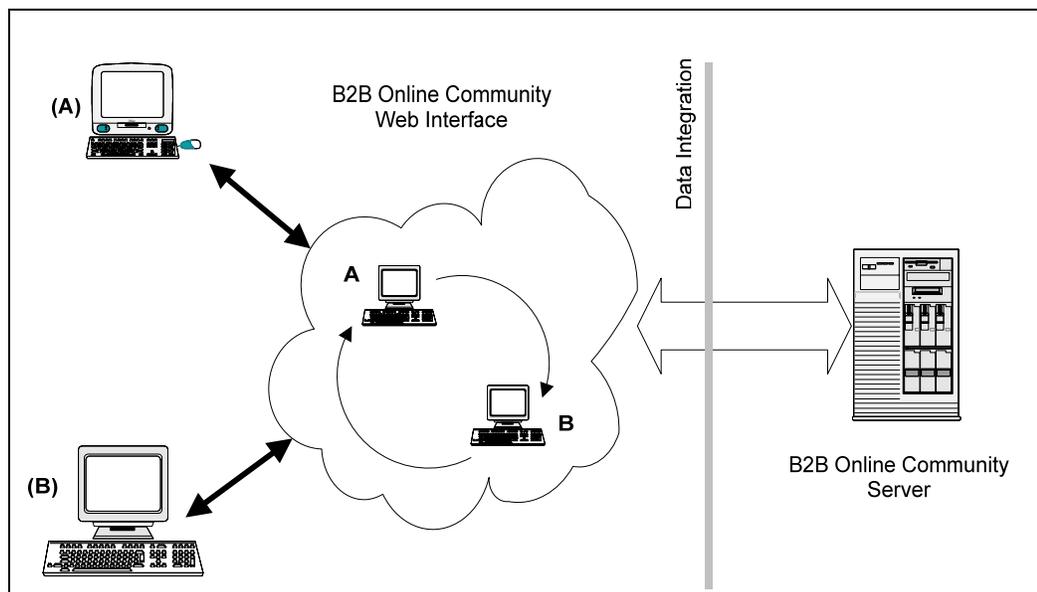


Figure 7: B2B data integration in B2B online community

Policies supported by software means that the system applies rules or standards for input, storage, and output of data. Rules define how inputs received from different members of an online community should be integrated. Rules also define standards for

data entry, database design, and formats for data output while norms regulate an appropriateness and validity of a content that the system displays on a web site. Data integration is a key element of a business to business online community (B2B-OC) primarily because of the fact that its members tend to store information about their product and services in different data formats and may define the same products differently. For example, a small sawmill business (A) may maintain its inventory in Microsoft Access database while a large secondary manufacturer (B) may use Oracle or SQL Server for its data warehouse (Figure 7). To exchange information between these two business entities in order to originate a transaction, the product specification rules and information exchange format should be defined. As presented on Figure 7, both members of B2B-OC should define information about properties of their products they submit to the B2B-OC database according to the certain rules to make this information equally accessible to all participants. The problem of data integration is how to manage the data generated by the B2B-OC so that members of the community can access such data with ease without discarding their own software (Adiele and Ehikioya 2005).

No existent forest products B2B operating today can provide a sufficient technological solution for data integration across the entire value added chain. We present Timberia.org - an attempt to design a web-based platform built on B2B-OC principles with strong considerations for data integration and facilitation of the information exchange on each phase of the value chain framework for forest products.

2.3 Timberia.org – open market B2B-OC

The Timberia.org (Figure 8) is an open market B2B-OC that facilitates transaction of forest products, logging and woodworking equipment by providing wood industry professionals with a tool to market their products and services on the Web. The Timberia.org is a database driven web application that utilizes the capabilities of ColdFusion MX 7 Server. The user web interface is written in ColdFusion Markup Language (CFML) and JavaScript. SQL Server 2005 is used to manage data received from the community members.



Figure 8: Timberia.org front page

The Timberia.org also provides an application programming interface (API) built on web-services that could allow other web sites, for example personal web pages of forest landowners or large industrial web portals, to receive information posted to the Timberia.org B2B-OC and seamlessly incorporate it into their designs.

Table 2: Types and categories of transactions for Timberia.org markets

| Market | Transaction Type | Transaction Category |
|--|---|--|
| Timber Market | <ul style="list-style-type: none"> ▪ Sell ▪ Buy ▪ Exchange | <ul style="list-style-type: none"> ▪ Chips & Wood Residues ▪ Engineered Wood & Panel Products ▪ Flooring & Decking ▪ Moulding & Millwork ▪ Paper & Paperboard ▪ Poles, Piles, Ties & Construction Logs ▪ Pulpwood, Cordwood & Firewood ▪ Sawlogs & Veneer Logs ▪ Sawn Timber & Lumber ▪ Standing Timber, Stumpage ▪ Veneer Sheets ▪ Wooden Furniture |
| Equipment Market | <ul style="list-style-type: none"> ▪ Sell ▪ Buy ▪ Lease/Rent | <ul style="list-style-type: none"> ▪ Woodworking & Furnishing Equipment ▪ Logging & Forestry Equipment |
| Services Market (Consultant Board) | <ul style="list-style-type: none"> ▪ Offer Service ▪ Request Service | <ul style="list-style-type: none"> ▪ Finding, Mapping, and Marking Property Boundaries ▪ Forest Inventory and Appraisal ▪ Planning Estates, Taxation Matters ▪ Selling & Buying Timber ▪ Stewardship Plan ▪ Timber Stand Improvement (TSI) ▪ Wildlife Habitat Enhancement ▪ Forestry Service ▪ Export and Import ▪ Equipment Installation and Maintenance ▪ Freight Service ▪ Other |
| Financial Market (Investment Proposals) | <ul style="list-style-type: none"> ▪ Invest ▪ Submit Proposal | <ul style="list-style-type: none"> ▪ Forestlands ▪ Commodities ▪ Real Estate ▪ Bonds & Loans ▪ Stocks & Shares ▪ Joint Venture |

The design of the Timberia.org user interface reflects the structure and business activities of the forest sector. It has been designed in a way to provide its members with guidance that helps them to select an action (e.g. sell or buy) and complete such an action quickly with the assistance of the software. At the design stage, an assumption was made that the forest sector can be segmented into four major “Markets”: Forest Products (Timber Market), Equipment, Services Market (Consultant Board), and Financial.

To participate in Timberia.org eMarketplace a member must register using an online registration form. Both registration and membership are free. After registration has been complete, a member receives a login and password to access the system. A logged-in participant initiates transactions at the Timberia.org front page by hitting a post-an-offer button. At the next step a member selects one of the four markets relevant to the transaction. A community member decides whether he/she would like to:

- trade timber, lumber, and other forest products,
- trade woodworking machinery and logging equipment,
- use/provide services of a professional forester (a business consultant),
- submit an investment proposal

After the user selects a market to participate in, the system offers a web-interface designed for this specific market. Using this interface a member can specify a type and category of a transaction (Table 2).

2.3.1 Timber market

Timber Market is the primary market of Timberia.org and contains twelve major categories (Table 2). Transactions in this market are either buy or sell. This market is designed to connect landowners, log buyers, sawmills, lumber buyers, and other primary and secondary producers. To help explain the process of conducting a transaction by a member in this market, we present four transaction examples: Sawn Timber & Lumber, Standing Timber (Stumpage), Sawlogs & Veneer Logs, and Engineered Wood & Panel Products.

2.3.1.1 Sawn Timber & Lumber

The first step a user must take is to assign relevant product properties for their desired transaction. Assignment of properties of a product in Sawn Timber & Lumber category takes two sequential steps. At the first step a user defines product species, sawing method, and lumber surfacing. Next a user selects the lumber grade and qualitative characteristics of a transaction such as volume, units of measure, and price.

Timberia.org encourages users to provide supplementary information about Green Certification of the forest products being traded in order to promote responsible forestry practices. Therefore, when specifying the properties of their lumber, a user can specify whether the product matches certification standards developed by one of the following organizations:

- Forest Stewardship Council (www.fscus.org)
- Sustainable Forestry Initiative (www.sfiprogram.org)
- The American Tree Farm System (www.treefarmssystem.org)
- Canadian Standards Association & Sustainable Forest Management System (www.csa-international.org)
- International Organization for Standardization (www.iso.org)
- Programme for the Endorsement of Forest Certification (www.pefc.org)

As data is entered the system passes control to a script that configures the next form.

After certification data is entered the user is taken to a form where they can specify whether the product(s) are hardwood or softwood. Then based on the geographic origin of wood, the system provides an option to select a species type and product grade. For softwood lumber and timber, a user specifies a class of softwood lumber, first and then a grade for the class selected.

Both softwood and hardwood lumber grades are based on the standards developed by US-based organizations, for example APA, WWPA, and RIS. An international member is encouraged to define grade of his/her lumber following the rules established by these organizations.

The classification system for softwood lumber grades used by Timberia.org have been derived from the different sources (SPIB 2002, RIS 2000, WWPA 2005, USFPL 1999). The American softwood lumber standard PS-20 (USDC 2005) is a basis for the classification of lumber grades presented in Table 3.

Timberia.org classifies softwood lumber for five major classes. Each class has its own grading rules. Common lumber (Table 3) are boards that are less than 2 inches in nominal thickness and 2 inches or more in nominal width. Appearance lumber, also known as Finish or Selects, are boards for making quality softwood furniture with a

natural finish or softwood lumber that has been custom milled to a pattern or surfaced on all four sides.

Table 3: Classes and grades for softwood lumber

| | | Classes of Softwood Lumber | | | | |
|---------------|-------------------------------|----------------------------|---|-----------------------------------|--------------------------|----------------|
| | | Common | Appearance | Dimension | Timbers | Factory & Ind. |
| Lumber Grades | ▪ No. 1 Common - Construction | ▪ Superior | ▪ Construction Standard & Better | ▪ Select Structural | ▪ Molding & Better | |
| | ▪ No. 2 Common - Standard | ▪ Prime | ▪ Standard Utility & Better | ▪ Non-Dense Select Structural SYP | ▪ Molding Factory Select | |
| | ▪ No. 3 Common - Utility | ▪ Clear | ▪ Utility Economy Dense Select Structural SYP | ▪ No. 1 Dense SYP | ▪ Select Shop | |
| | ▪ No. 4 Common - Economy | ▪ B&Better Select | ▪ Dense Select Structural SYP | ▪ No. 1 & Better | ▪ No. 1 Shop | |
| | ▪ No. 5 Common - Economy | ▪ C Select | ▪ Select Structural Non-Dense Select Structural SYP | ▪ No. 1 Structural | ▪ No. 2 Shop | |
| | | ▪ D Select | ▪ No. 1 Dense SYP | ▪ No. 1 & Better | ▪ No. 3 Shop | |
| | | ▪ Clear All Heart | ▪ No. 1 & Better | ▪ No. 1 Non-Dense SYP | ▪ No. 1 Mining | |
| | | ▪ A Grade | ▪ No. 1 Utility | ▪ No. 2 Dense SYP | ▪ No. 2 Mining | |
| | | ▪ B Grade | ▪ No. 2 Dense SYP | ▪ No. 2 & Better | ▪ No. 1 Scaffold | |
| | | ▪ E Grade | ▪ No. 1 Non-Dense SYP | ▪ No. 2 Structural | ▪ No. 2 Scaffold | |
| | | | ▪ No. 1 Stud | ▪ No. 2 Utility | ▪ Foundation | |
| | | | ▪ Economy Stud | | | |

Dimension lumber is softwood lumber that is nominally 2 to 4 inches thick. This class of lumber is widely used in residential construction. The “Timbers” Lumber class represents lumber that is 5 inches or larger at least one dimension and is generally used in heavy construction. Finally, Industrial lumber is used in industrial applications and

Factory lumber are boards used by secondary producers and manufacturers graded on the basis of the percentage of the area which will produce a limited number of cuttings of a specified, or a given minimum, size and quality.

Table 4: Hardwood lumber grades

| Grade | Minimum Board Length | Minimum Board Width | Minimum Cutting Size | Minimum Area of Clear Cuttings |
|---------------|----------------------|---------------------|----------------------|--------------------------------|
| FAS | 8' | 6" | 4" x 5' 3" x 7' | 83-1/3% |
| SELECT | 6' | 4" | 4" x 5' 3" x 7' | 83-1/3% |
| No. 1C | 4' | 3" | 4" x 2' 3" x 3' | 66-2/3% |
| No. 2AC & 2BC | 4' | 3" | 3" x 2' | 50% |
| No. 3AC | 4' | 3" | 3" x 2' | 33-1/3% |
| No. 3BC | 4' | 3" | 1-1/2" x 2' | 25% |

The classification of hardwood lumber is based on standards developed by the US National Hardwood Lumber Association in which a piece of hardwood lumber is determined by the proportion of a piece that can be cut into a certain number of smaller pieces of material, commonly called “cuttings”, which are generally clear on one side, have the reverse face sound, and are not smaller than a specified size (USFPL 1999). As presented in Table 4 hardwood lumber is usually manufactured to random widths and lengths. Table 4 provides minimum values of these dimensions.

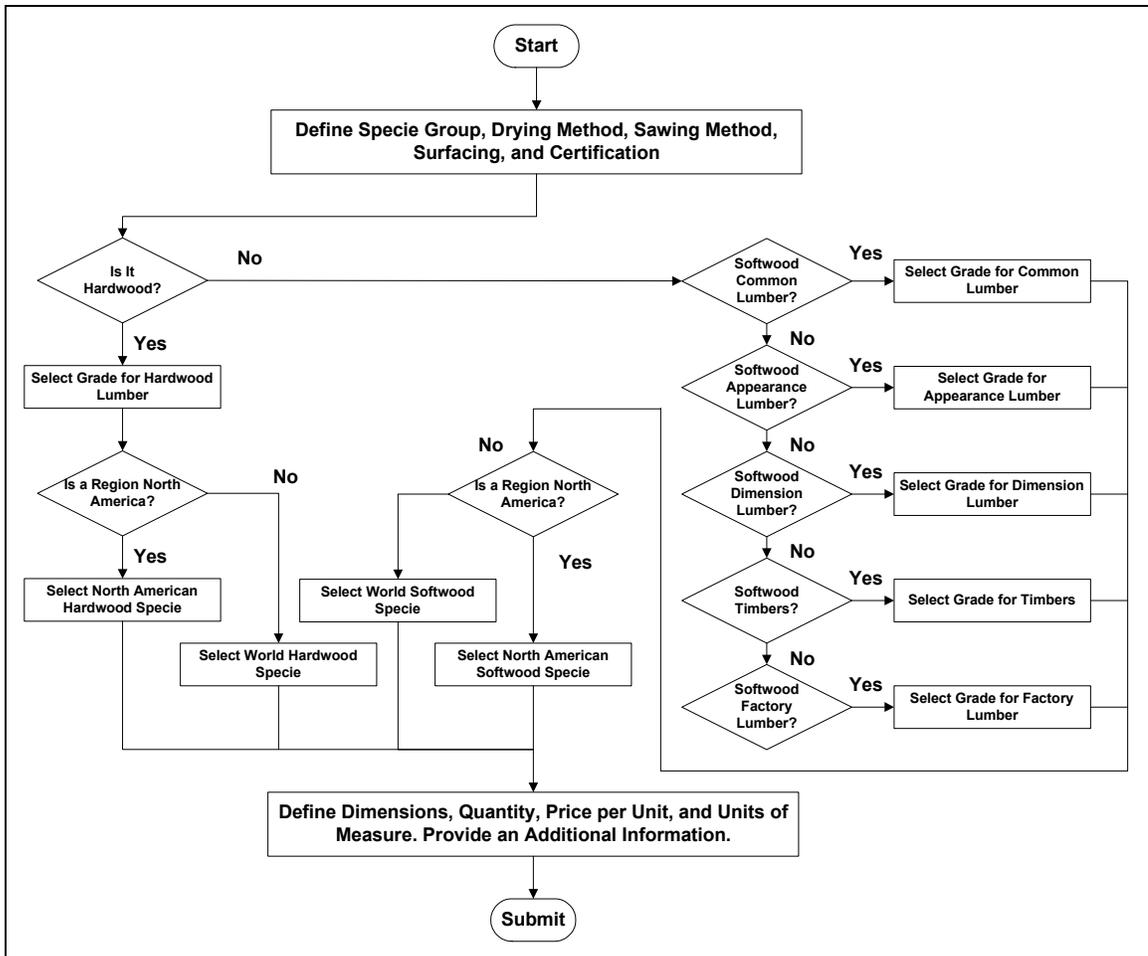


Figure 9: Decision-making diagram to define properties of lumber

The complete decision-making tree that leads a member through the process of defining product properties for this category is presented on Figure 9. After species and grade have been specified, the user enters lumber dimensions, units of measure, transaction volume, price per unit, and quote type. Quote type is an international commercial term that defines the trade contract responsibilities and liabilities between buyers and sellers.

All prices in the system are converted to the United States dollar equivalent using the present conversion rate at the Federal Reserve Bank of New York. The dynamically generated user's interface allows selection of appropriate units of measure for both dimensions (board thickness, width, and length) and transaction volume. This is the last stage of the input process and the user's specified data are then saved into the database.

There are B2B community rules, that on the one hand, restrict a member's options but on another hand provide data integration for the Timberia.org eMarketplace. One of these rules is that a member can commit only one transaction at a time. For example, if a member is selling appearance lumber graded as FAS and also dimension lumber graded as Economy, he/she should conduct two sequential transactions. Lumber of different grades and types can not be entered at the same time. There must be transactions conducted both for the lumber graded as FAS and also for the dimension lumber graded as Economy. The same rule applies if a user is selling or buying, for example, FAS graded lumber and his/her lumber inventory consists of two species, for instance red oak and birch. Again a Timberia.org member must submit two offers: one for the red oak lumber and another one for the birch lumber. An exception arises when lumber has different dimensions but all other characteristics are the same. In this case only one transaction is needed but a user has to specify minimum and maximum dimension ranges for board thickness, width, and length.

The same approach is applied for all categories of wood products at the Timberia.org Timber Market. This approach guarantees a correct specification of all product characteristics including price and volume in a standardized format that allows Timberia.org to quickly integrate data received from its members and make these data accessible for a parameterized search and available for sharing through web-services.

2.3.1.2 Saw Logs and Veneer Logs

When the Saw Logs & Veneer Logs category is selected the logic to define properties of logs are similar to the definition of lumber properties. Based on a species group, a member of the online community selects a log grade first, and then defines the quantitative properties of a transaction.

Table 5: Hardwood log grades (Source: Kittredge 2004)

| Grade | Minimum Diameter (DBI) | Minimum Length | Clear Faces |
|-----------|------------------------|----------------|-------------|
| PRIME | 16" | 9'6" | 4 |
| VENEER | 14" | 8'8" | 4 |
| SELECT | 12" | 8'8" | 4 |
| GRADE 1 | 12" | 8'8" | 3 |
| GRADE 2 | 12" | 8'8" | 2 |
| GRADE 3 | 10" | 8'8" | 0 |
| GRADE 4 | 10" | 8'8" | 0 |
| GRADE 5 | 8" | 8'8" | 0 |
| TIMBER 1* | 12" | 20'4" | 0 |
| TIMBER 2* | 12" | 14'4" | 0 |

* Knots must be sound and 4" or less in diameter. Logs must be straight with no double heart on the small end

To assist a user in defining a grade correctly, Timberia.org provides a grading system for hardwood and softwood logs presented in Table 5 and Table 6. As shown in Table 5, hardwood log grades are based on the minimum diameter (DBH), minimum length, and number of clear faces. This grading system was a result of generalization of log grading systems being used in the Northeast of the United States (Kittredge 2004).

Softwood logs are graded with the same principles as hardwood sawlogs and veneer logs except the system reflects a narrower spectrum of grades, and the requirements for clear faces, minimum diameter and length are less strict (Table 6). This is because softwood sawlogs are usually used for structural purposes and the appearance is less important, than it is for hardwood sawlogs.

Table 6: Softwood log grades (Source: Kittredge 2004)

| Grade | Minimum Diameter | Minimum Length | Clear Faces | Properties |
|---------|------------------|----------------|-------------|---|
| PRIME | 16" | 8'8" | 4 | Surface clear. |
| veneer | 14" | 8'8" | 4 | Surface clear. |
| GRADE 1 | 12" | 8' | 3 | A net scale after deduction for defect of at least 50% of the gross contents of the log, 6" trim. Maximum knot size 3", or no larger than 1/6 scaling diameter. No black knots allowed. |
| GRADE 2 | 10" | 8' | 0 | A net scale after deduction for defect of at least 50% of the gross contents of the log. 6" trim, 3" maximum knot size or 1/6 scaling diameter. |
| GRADE 3 | 9" | 8' | 0 | 50% of gross scale. Maximum knot size 4", 6" trim. |
| GRADE 4 | 6"-8" | 8'-12' | 0 | 50% of gross scale. Maximum knot size 4", 6" trim. |

Timberia.org also provides its users with the ability to identify the measurement of the wood volume contained in sawlogs, commonly known as “log scaling”. A user is required to specify ranges for diameters at both ends of the log as well as to select a log rule if volume is being measured in board feet or indicate that no log rule is used if volume itself in cubic feet as opposed to board feet.

Table 7: Log rules

| | | | | |
|-------------------------|------------------|------------------|------------------|--------------|
| International 1/8 inch | Brereton | Cuban | Herring | Northeastern |
| International 1/4 inch | British Columbia | Cumberland River | Hoyt | Northwestern |
| International 5/16 inch | Brubaker | Delaware Middle | Hyslop | Ontario |
| Doyle | Calcasieu | Diameter | Knouf's | Orange River |
| Scribner | Carey | Derby | Licking River | Parson's |
| Ake | Cedar Log Scale | Drew | Maine | Partridge |
| Ashe | Champlain | Dusenberry | Margolin | Preston |
| Ballou | Chapin | Favorite | Massachusetts | Quebec |
| Bangor | Clements | Finch & Aprag | McKenzie | Ropp |
| Baughmans 1/8 inch | Click | Forty Five | Mississippi Pine | Roy |
| Baxter | Columbia River | French's | New Brunswick | Saco River |
| Boynton | Taper | Hanna | Newfoundland | Sammi |
| | Constantine | | | |

Over one hundred log rules have been developed in the North America. Some of these rules are based upon the lumber tallies of individual mills, while others are developed by either diagramming the cross-section of boards in the ends of logs or using mathematical formulæ. The Doyle, Scribner, and International log rules are the most frequently used rules in the United States. Log rules are usually not used when the net volume of wood is calculated in cubic meters, but in the unit of measurement is board feet, buying or selling of stumpage should be agreed upon the log rule. Log rules presented in Table 7, constitute part of a data entry form in Timberia.org, and can serve as a useful method for scaling logs, as long as both the buyer and seller agree to it (Kittredge 2004).

2.3.1.3 Engineered Wood and Panel Products

In Timberia.org design, panel products such as fiberboards, particleboards, and laminated lumber are grouped under the “Engineered Wood and Panel Products” category that has the following product subclasses:

- Exterior Siding
- Glued Laminated Timber (GLULAM)
- Hardboard (HB)
- I-Joist
- Insulation Board
- Laminated Strand Lumber (LSL)
- Laminated Veneer Lumber (LVL)
- Medium Density Fiberboard (MDF)
- Melamine Faced Chipboard (MFC)
- Oriented Strand Board (OSB)
- Oriented Strand Lumber (OSL)
- Parallel Strand Lumber (PSL)
- Particleboard (PB)
- Plywood
- Rim Board
- Stress-Skin Panel
- Vinyl Overlay Panel

To specify the properties of these products a user must fill in two subsequent data entry forms. As is the case with lumber and logs, qualitative properties must be defined first. For Glued Laminated Timbers, Hardboards, Medium Density Fiberboards, and Oriented Strand Boards a member is required to select a proper grade. Grades for these products are based on different characteristics such as exposure durability, type of use, water resistance, density, and physical-mechanical properties.

Table 8: Medium density fiberboard (MDF) grades (Source: CPA 2002)

| Grade | Nominal thickness (mm) | Modulus of rupture | Modulus of elasticity | Internal bond (MPa) | Screw-holding (N) | | Formaldehyde emission (ppm) |
|-------------|------------------------|--------------------|-----------------------|---------------------|-------------------|-------|-----------------------------|
| | | | | | Face | Edge | |
| HD Interior | | 34.5 | 3,450 | 0.75 | 1,555 | 1,335 | 0.30 |
| MD Interior | < 21 | 24.0 | 2,400 | 0.60 | 1,445 | 1,110 | 0.30 |
| | > 21 | 24.0 | 2,400 | 0.55 | 1,335 | 1,000 | 0.30 |
| LD Interior | | 14.0 | 1,400 | 0.30 | 780 | 670 | 0.30 |
| MD Exterior | < 21 | 34.5 | 3,450 | 0.90 | 1,445 | 1,110 | 0.30 |
| | > 21 | 31.0 | 3,100 | 0.70 | 1,335 | 1,000 | 0.30 |

For example, grades for MDF panels (Table 8) are based on density and durability. Also, these panels could be designed for interior or exterior use and be of high (HD), medium (MD), and low (LD) density.

Oriented Strand Board (OSB) is also graded by their durability. OSBs of exterior exposure durability have usually a fully waterproof bond and manufactured for applications with permanent exposure to moisture while panels of Exposure 1 grade are designed for applications that can be exposed to moisture temporarily. However, grades of OSB panels are also determined by the type of use. Panels with Sheathing grade are used mostly for subflooring, wall and roof sheathing. Boards of Sturd-I-Floor grade are used in single-layer flooring applications. OSB for industrial application are called Industrial grade.

The Grading system for insulation boards used in Timberia.org is similar to grading system used for OSBs. The Interior grade indicates that this insulation board has been manufactured to be used as a building board for interior construction, ceiling insulation tile, or sound-deadening board to control noise levels in buildings. Exterior insulation board grade is used as sheathing for exterior construction, decking for a flat roof floor underlayment, or backing behind aluminum siding to improve the insulation of

aluminum-sided houses. Industrial insulation board grade may be included in various products such as expansion joint strips, furniture boards, and boards for automotive industries.

Table 9: Basic hardboard grades (Source: CPA 2004)

| Grade | Surface | Thickness | Water resistance. Water absorption based on weight | | Thickness swelling (max av per panel) | | Modu- lus of rupture (min. average per panel) | Tensile strength (min av per panel) | |
|----------------------|-----------------|-----------|--|---------|---|---------|---|--|----------------------------------|
| | | | S1S | S2S | S1S | S2S | | parallel to surface | perpendic- ular to surface |
| | | inch | percent | percent | percent | percent | psi | psi | psi |
| Tempered | S1S & S2S | 1/12 | 30 | - | 25 | - | 7000 | 3500 | 150 |
| | | 1/10 | 20 | 25 | 16 | 20 | | | |
| | | 1/8 | 15 | 20 | 11 | 16 | | | |
| | | 3/16 | 12 | 18 | 10 | 15 | | | |
| | | 1/4 | 10 | 12 | 8 | 11 | | | |
| | | 5/16 | 8 | 11 | 8 | 10 | | | |
| 3/8 | 8 | 10 | 8 | 9 | | | | | |
| Standard | S1S & S2S | 1/12 | 40 | 40 | 30 | 30 | 5000 | 2500 | 100 |
| | | 1/10 | 25 | 30 | 22 | 25 | | | |
| | | 1/8 | 20 | 25 | 16 | 18 | | | |
| | | 3/16 | 18 | 25 | 14 | 18 | | | |
| | | 1/4 | 16 | 20 | 12 | 14 | | | |
| | | 5/16 | 14 | 15 | 10 | 12 | | | |
| 3/8 | 12 | 12 | 10 | 10 | | | | | |
| Service- Tempered | S1S & S2S | 1/8 | 20 | 25 | 15 | 22 | 4500 | 2000 | 100 |
| | | 3/16 | 18 | 20 | 13 | 18 | | | |
| | | 1/4 | 15 | 20 | 13 | 14 | | | |
| | | 3/8 | 14 | 18 | 11 | 14 | | | |
| Service | S1S & S2S | 1/8 | 30 | 30 | 25 | 25 | 3000 | 1500 | 75 |
| | | 3/16 | 25 | 27 | 15 | 22 | | | |
| | | 1/4 | 25 | 27 | 15 | 22 | | | |
| | | 3/8 | 25 | 27 | 15 | 22 | | | |
| | | 7/16 | 25 | 27 | 15 | 22 | | | |
| | | 1/2 | 25 | 18 | 15 | 14 | | | |
| | S2S | 5/8 | - | 15 | - | 12 | | | |
| | | 11/16 | - | 15 | - | 12 | | | |
| | | 3/4 | - | 12 | - | 9 | | | |
| | | 13/16 | - | 12 | - | 9 | | | |
| | | 7/8 | - | 12 | - | 9 | | | |
| 1 | - | 12 | - | 9 | | | | | |
| 1-1/8 | - | 12 | - | 9 | | | | | |
| Industrialite | S1S & S2S | 3/8 | 25 | 25 | 20 | 20 | 2000 | 1000 | 35 |
| | | 7/16 | 25 | 25 | 20 | 20 | | | |
| | | 1/2 | 25 | 25 | 20 | 20 | | | |

Hardboard and particleboard grades also depend on physical properties, such as water absorption, modulus of rupture, and tensile strength. In Timberia.org, basic hardboard - a panel manufactured primarily from wood fibers which are consolidated under heat and pressure in a hot-press to a density of 31 lbs/ft³ or greater with addition of other materials to improve certain properties, such as stiffness, hardness, finishing properties, resistance to abrasion and moisture, strength, durability, and utility - is classified into the grades presented in the Table 9 as advised by the American National Standard ANSI A135.4-2004 (CPA 2004).

Table 10: Particleboard grades (Source: CPA 2001, Carll 1986)

| Grade | Modulus of rupture (MPa) | Modulus of elasticity (MPa) | Internal bond (MPa) | Hardness (N) | Linear expansion max avg (%) | Screw-holding (N) | | Formaldehyde maximum emission (ppm) |
|-------|--------------------------|-----------------------------|---------------------|--------------|------------------------------|-------------------|-------|-------------------------------------|
| | | | | | | Face | Edge | |
| H-1 | 16.5 | 2,400 | 0.90 | 2,225 | NS | 1,800 | 1,325 | 0.30 |
| H-2 | 20.5 | 2,400 | 0.90 | 4,450 | NS | 1,900 | 1,550 | 0.30 |
| H-3 | 23.5 | 2,750 | 1.00 | 6,675 | NS | 2,000 | 1,550 | 0.30 |
| M-1 | 11.0 | 1,725 | 0.40 | 2,225 | 0.35 | NS | NS | 0.30 |
| M-S | 12.5 | 1,900 | 0.40 | 2,225 | 0.35 | 900 | 800 | 0.30 |
| M-2 | 14.5 | 2,225 | 0.45 | 2,225 | 0.35 | 1,000 | 900 | 0.30 |
| M-3 | 16.5 | 2,750 | 0.55 | 2,225 | 0.35 | 1,100 | 1,000 | 0.30 |
| LD-1 | 3.0 | 550 | 0.10 | NS | 0.35 | 400 | NS | 0.30 |
| LD-2 | 5.0 | 1,025 | 0.15 | NS | 0.35 | 550 | NS | 0.30 |
| PBU | 11.0 | 1,725 | 0.40 | 2,225 | 0.35 | NS | NS | 0.20 |
| D-2 | 16.5 | 2,750 | 0.55 | 2,225 | 0.30 | NS | NS | 0.20 |
| D-3 | 19.5 | 3,100 | 0.55 | 2,225 | 0.30 | NS | NS | 0.20 |

For Particleboard, a composite panel product consisting of cellulose particles of various sizes that are bonded together with a synthetic resin or binder under heat and pressure with additives incorporated to provide greater dimensional stability, better fire resistance, or to impart additional characteristics, Timberia.org uses the American

National Standard for Particleboard, ANSI A208.1, that classifies particleboard by density and physical characteristics (CPA 2001). Particleboard grades are presented in Table 10.

When selling or buying this panel product a Timberia.org user is prompted to denote a particleboard grade from the option menu as depicted in Table 10. In this table, the letter “H” represents a density greater than 50 lb/ft³, and letter “M” is a density range from 40 to 50 lb/ft³. Panels of low density, less than 40 lb/ft³ are graded as LD. Grade M–S refers to medium density; “special” grade added to standard after grades M–1, M–2, and M–3. Grade M–S falls between M–1 and M–2 in its physical properties. The PBU grade indicates that this is particleboard floor underlayment, and D grades are ones designed for manufactured home decking (Carll 1986).

A user is not required to specify the grade of overlays such as melamine face chipboard (MFC) and vinyl overlay panels due to the non-wood nature of panel surfaces. However, he/she must specify a type of an overlay core from the following options:

- Fire Resistant Particleboard Core
- Hardwood Veneer Core
- Industrial Particleboard Core
- Lumber Core
- Medium Density Fiberboard Core
- Moisture Resistant MDF Core
- Moisture Resistant Particleboard Core
- Softwood Veneer Core
- Standard Hardboard Core
- Tempered Hardboard Core

The specification of the core type is also required to define properties of plywood, a flat panel built up of sheets of veneer called piles and united under pressure using a

bonding agent to create a panel as strong or stronger than wood (APA 2001). Specifying properties of plywood, a member first selects a type of a plywood panel he/she would like to trade.

Table 11: Plywood classes, subclasses and grades (Source: APA 2001)

| Exterior plywood grades | | | | Interior plywood grades | |
|--|--|--|--|---|--|
| Marine | Structural Panels | Special Exterior | Decorative Panels | Structural Panels | Decorative Panels |
| <ul style="list-style-type: none"> ▪ A-A ▪ A-B ▪ A-C ▪ B-B ▪ A-A High Density Overlay ▪ B-B High Density Overlay ▪ B-B High Density Concrete Form Overlay ▪ B-B Medium Density Overlay | <ul style="list-style-type: none"> ▪ A-A ▪ A-B ▪ A-C ▪ B-B ▪ B-C ▪ C-C Plugged ▪ C-C A-A High Density Overlay ▪ B-B High Density Overlay ▪ B-B High Density Concrete Form Overlay ▪ B-B High Density Concrete Form Overlay ▪ B-B Medium Density Overlay ▪ B-B Medium Density Overlay ▪ Special Overlays | <ul style="list-style-type: none"> ▪ A-A ▪ A-B ▪ A-C ▪ B-B ▪ A-A High Density Overlay ▪ B-B High Density Overlay ▪ B-B High Density Concrete Form Overlay ▪ B-B Medium Density Overlay | <ul style="list-style-type: none"> ▪ A-A ▪ A-B ▪ A-C ▪ B-B ▪ A-A High Density Overlay ▪ B-B High Density Overlay ▪ B-B High Density Concrete Form Overlay ▪ B-B Medium Density Overlay ▪ Special Overlays | <ul style="list-style-type: none"> ▪ Underlay ment ▪ C-D Plugged ▪ C-D | <ul style="list-style-type: none"> ▪ N-N ▪ N-A ▪ N-B ▪ N-D ▪ A-A ▪ A-B ▪ A-D ▪ B-B ▪ B-D ▪ Underlay ment ▪ C-D Plugged ▪ C-D |

The type of plywood is based on its exposure durability. As denoted in the Voluntary Product Standard PS 1-95 designed by the Engineered Wood Association (APA 2001) plywood is manufactured either for interior or exterior use and interior plywood has three subtypes based on its adhesive durability levels:

- Interior plywood:
 - (1) interior with interior glue,
 - (2) interior with intermediate glue,
 - (3) interior with exterior glue.
- Exterior plywood

Interior and Exterior durability types have their own grades which are based on the veneers used and the panel characteristics. When a member defines properties of plywood, Timberia.org allows the user to define the plywood type first, then to specify which class this plywood is, and then specify a proper grade for this class. The classification of plywood used to support the decision making process for the user is presented in Table 11.

The letters denote the grade of the face and back veneers. A premium N-grade of veneer panel indicates that a panel is free from knots, knotholes, pitch pockets, open splits, and other defects while the lowest D grade allows defects related to appearance of a panel, if they do not impair its strength and serviceability.

For the engineered lumber, sidings, I-joists, and rim boards a user must specify dimensions only. The exception is glued laminated timber where a member is required to enter an appearance grade, a stress grade and usage type.

2.3.1.4 Standing Timber (Stumpage)

Timberia.org B2B-OC differs from other B2B portals by its capability to conduct transactions to sell and buy standing timber (stumpage). Therefore, the Timberia.org model facilitates a direct connection between resource, forest landowners, and primary forest product producers, sawmills, veneer mills, engineered wood manufacturers, and

paper mills as well as to help forest businesses discover a fair price for stumpage in local or global markets.

Today, one of the major problems, facing both stumpage owners (landowners), and purchasers is a lack of up-to-date information on current market prices. A second issue is the lack of knowledge of the underlying factors that influence stumpage prices, both ex post and ex ante. That is, current reported stumpage prices (e.g., Southern New England Stumpage Price Reports, <http://forest.fnr.umass.edu/stumpage.htm>) do not provide any additional data such as road accessibility, site slope, harvest volume, intensity, and number of bidders, any of which can influence the reported price. This uncertainty in the cost factors of stumpage forces wood product businesses to both underbid, and to maintain larger safety stocks of raw materials in their inventory to satisfy the potential demand. This produces inefficiencies in purchase decisions that impacts the entire forest products supply chain. The lack of information on stumpage volume and price in particular geographic regions also prevents forest buyers from optimal bulk purchases from more than one landowner.

The existing price discovery system is inefficient for a number of reasons. Forest landowners, particularly small landowners, are often at a disadvantage in the stumpage market due to the infrequency of stumpage sales (often only once every 10 years) and due to their lack of knowledge of log and lumber markets. In the absence of broader market information, the bid price spread evidenced in today's stumpage markets is amazing.

According to Kittredge (Kittredge 2004), in Massachusetts "the average range between high and low bids for surveyed timber sales with two or more bids was 212% or 2.1 times, with an average number of five bids".

The author believes that an up-and-running and established Timberia.org will make it easier for both landowners and stumpage purchasers to estimate current market value, reducing the identified inefficiencies. Both timeliness, and presentation of data relevant to the pricing decision will be available to participants. This paradigm shift would allow sharing relevant data through a programmatic interface across a network. The web services interface that will be discussed in section 2.3.6 of this paper will enable landowner and business users to post and view relevant data sets, and price information without intimate knowledge of each other's IT systems. The data on stumpage including land and volume characteristics as well as prices would be collected from forest landowners who will submit their offers into the Timberia.org database to be used with an automated statistical procedure that would be run periodically to determine current and forecasted prices on stumpage by commercial species both per 1000 board feet (MBF) and per 1000 cubic meters. This information will be presented to all members of the Timberia.org B2B-OC.

The stumpage sale process within Timberia.org works as follows. Then the "Standing Timber and Stumpage" category is selected and the transaction type is "Sell" a member is prompted to describe the timber sale by filling in a data entry form that resembles a combination of both a State Forest Cutting Plan (FCP) and a timber sale contract. As a basis for the entry form design, the statutes of the Massachusetts Forest Cutting Practices Act (M.G.L. Ch. 132, 304 CMR 11.00) were taken. Though FCP

standards vary in different states and other countries, or may be absent, but much of the information taken in the Massachusetts FCP is universal and is meant to satisfy the objectives of a forest landowner who submits his/her stumpage to Timberia.org B2B-OC for sale. Currently, Timberia.org utilizes the MA FCP.

A part of the input form related to the FCP includes information such as: geographic location of a timber sale, Best Management Practices (BMP) used for stream and wetland crossings, harvesting in wetlands, type of cutting being proposed for the property, special equipment, and the volume of products to be harvested. Another part of the entry form bearing elements of a timber sale contract is designed to allow a member to (1) define a time frame of a timber sale with possible extension terms, (2) describe bidding and bonding specifications, and (3) specify utilization standards and harvesting specifications. The user also specifies a time frame for a timber sale, which includes information about completion date and terms to apply for an extension. Bidding and bonding specifications describe a payment schedule, have users specify a bid due date until which an initial bid or deposit must be made to initiate the sale, and a remainder due date until which a buyer pays must pay up in full for the stumpage. A seller is also required to provide information about the lowest acceptable bid and bid bond amount.

Timberia.org offers an effective tool to facilitate a competitive bidding process in which a landowner can determine a realistic and fair price for his/her stumpage. As mentioned above, the specific information about production factors provided by a seller

will help a contractor better estimate a price on the stumpage. At the same time, since this B2B-OC is free to use and easily accessible through the Internet, a seller may receive as many bids as possible that statistically will decrease variations in prices on stumpage at local markets (Wisconsin Forest Management Guidelines 2003).

2.3.2 Equipment Market

The Equipment Market has the same logic of data submission as the Timber Market. In this market all transactions fall into two categories: (1) Woodworking and Furnishing Equipment and (2) Logging and Forestry Equipment. A member is prompted to select an appropriate class of equipment from the Timberia.org database and then specifies its properties such as condition (used or new), quantity and price.

2.3.3 Services Market

The Services Market also, including a Consultant Board, allows professional foresters and consultants to provide information about their services to forest landowners and forest product producers, Offer Services transaction, as well as gives a tool to forest sector participants to quote requests for services in the Request Services option. In Timberia.org all services are categorized as follows:

- Finding, Mapping, and Marking Property Boundaries
- Forest Inventory and Appraisal
- Planning Estates, Taxation Matters
- Selling & Buying Timber
- Stewardship Plan
- Timber Stand Improvement (TSI)
- Wildlife Habitat Enhancement
- Forestry Service
- Export and Import
- Equipment Installation and Maintenance
- Freight Service
- Other Services

A member of B2B-OC has to provide an acceptable compensation rate whether a service is being requested or offered. The Consultant Board is meant to facilitate the process of establishing business connections between forest owners and professional foresters, as well as linking the supply and demand sides at the market of the forest products through the offers posted by providers of freight and export import services.

2.3.4 Financial Market

Producing timber or managing the forest as an investment are often not the primary reasons most people own forestland. But landowners are sensitive to what this land costs them, and at some point, many usually have an opportunity to realize income from their forest. Like everyone else, forest landowners also invest in stocks, bonds or mutual funds. Yet all too often, forestry investments are not scrutinized as critically as other financial investments (Wisconsin Forest Management Guidelines 2003). As a result, forestry investments capable of generating a favorable rate of return are not recognized, or conversely, investments are made that are sometimes not justified financially. Just as

forestry involves good stewardship of natural resources so, too, sound financial management requires careful stewardship of investment capital. The “Financial Market” of Timberia.org (Investment Proposals) allows its participants posting decision-guided offers about investment opportunities in the forest sector.

Timberia.org uses a number of criteria to help a member in evaluating the financial performance of forestry investments. Net present value (NPV), internal rate of return (IRR), benefit/cost ratio, and payback period, are used when deciding whether or not to make a specific investment. When analyzing the relative merits of a number of alternative actions the criterion might simply be which alternative offers the greatest expected IRR, an average compound interest rate that will be earned over the investment period. This IRR calculated using the discount rate that makes the sum of discounted revenues and discounted costs equal to zero (that is, the NPV will be zero).

But investment analysis that focuses only on costs and returns from timber production often ignores important non-market benefits, and provides an incomplete measure of total investment performance. On the surface, it might appear easy to include non-market benefits into the calculations, but in reality it is often difficult to quantify and value such benefits. Non-market benefits associated with establishing and managing their forest offset the shortfall in revenue, it may still be a sound investment. Timberia.org encourages forest owners to inform potential investors about the availability of a business plan or other materials that describe the property by checking an appropriate checkbox.

2.3.5 Database Architecture

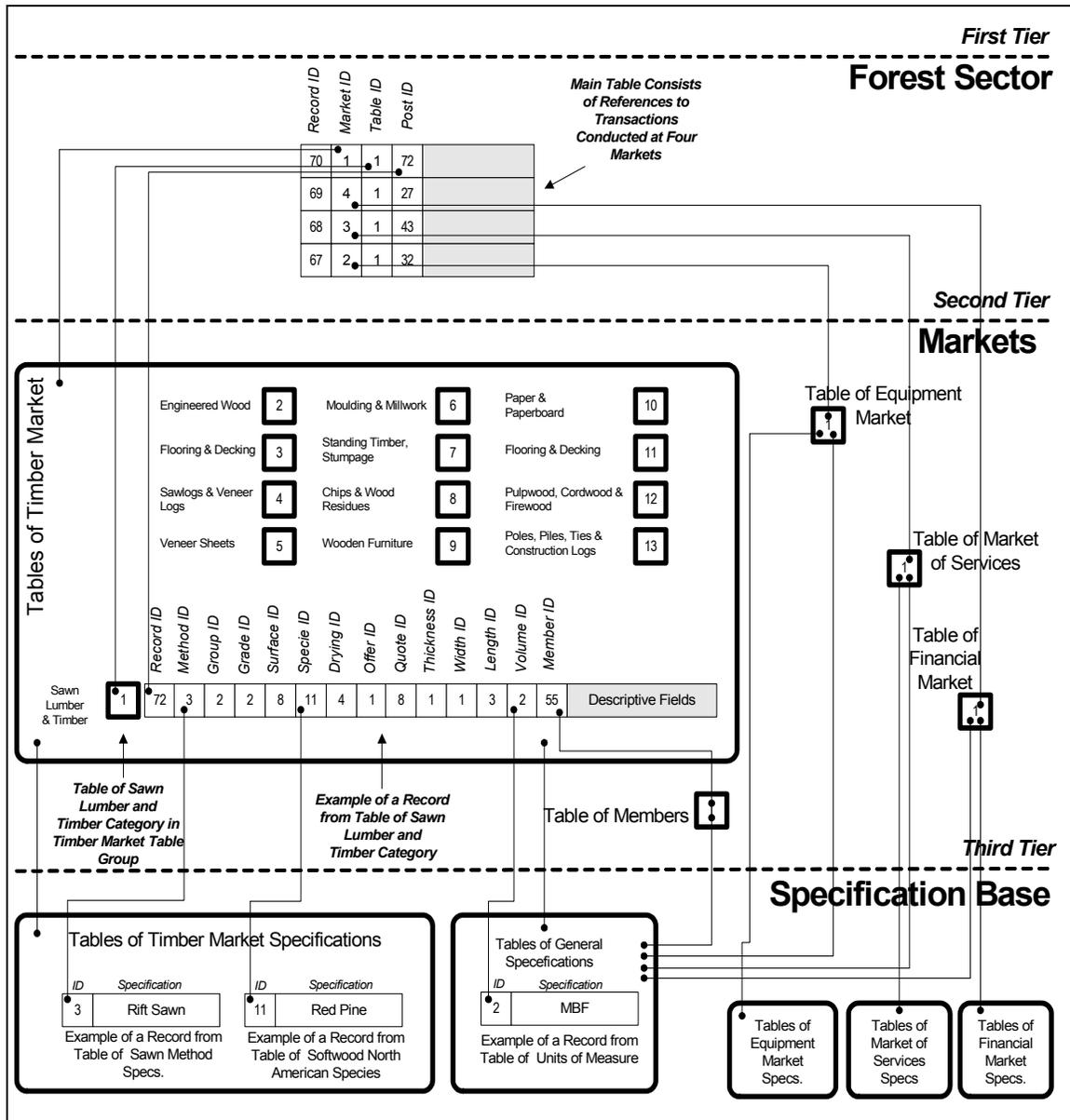


Figure 10: Timberia.org three-tier database architecture

As the above examples show, depending on an action taken by a user, Timberia.org can offer decision support capabilities to guide him/her through the entire process from the initiation of a transaction through definition of qualitative and quantitative properties

of a product or service to the transaction completion. Members enter data by selecting the most suitable options from the Timberia.org dynamically generated menus whose values are stored in the Timberia.org database.

The database of the Timberia.org has three major logical tiers (Figure 10). These tiers correspond to a mapping between the conceptual level of the database and the organization of its internal relational model (Date 1999). The first tier, referred to as the “Forest Sector”, is a structure that stores information about all transactions made for the certain period of time. At this moment Timberia.org has no limits of how long a member’s offer is stored in the Forest Sector before it gets removed and stored in the system archive. If traffic increases after the system goes live, this period may be defined from three month to one year. At the system level, the Forest Sector tier is a database table in which each record consists of references to markets.

As shown in Figure 10, each record of this table has a market reference number and a reference number (Market ID) of a table (Table ID) for this market with a Record ID in this table in which actual data about referenced transaction is stored. Markets represent a second tier of the database structure. Each of four Markets has a certain number of tables to store data about transactions. The third tier of the database is the Specification Base that consists of tables that store information about qualitative properties of products. Values from these tables are used to build a dynamic user interface to facilitate the data entry process and provide a decision support tool for a community member. Transaction data stored at the second tier is related to the Specification Base through ID referencing.

In Figure 10, the snapshot from the main table of the Forest Sector tier has four records. For the purpose of this example each record references one of four markets. Lines with dots at ends represent relationships between table groups or individual tables. First field of the main table is a record identifier that increments automatically with each new transaction. The second field indicates the associated market for the transaction. In Figure 10, the first row of the Forest Sector table stores a reference to Timber Market since field flag set to one. The second, third, and fourth records store references to tables of financial, services, and equipment markets. Field flags are set to integer number four, three, and two correspondingly. The third field is a flag by which value the system finds a table at a particular market consisting information about the transaction. This field is used for Timber Market which has 12 tables, each designed for a particular transaction category. Equipment, Financial, and Services markets use one table each so that the table flag is always set to one.

As demonstrated in Figure 10, first record has one in its third field that means that information about transaction must be searched in the first table of the Timber Market table group. Since the system knows that table number one is designed to store transaction data for the Sawn Lumber & Timber product category, it links to this table by a record identifier which is the value stored in the fourth field of the main table. In Figure 10 the system queries the table by identifier 72 that is a primary key for the table of lumber products. This record is also linked to the specification tables designed for the Timber Market and to the tables of general specifications. The table group of Timber Market stores information about product grades, species, and processing methods. The second group include tables of general specifications which content is used by all

markets. These tables store types of quotes and units of measure for volume and dimensions. Therefore, transaction data stored in a table of the second tier is merely a set of ID references to tables of the third tier. As the example in Figure 10 shows, the record in the table one in the second tier is linked to tables of specifications such as the table of North American softwood species, the table of sawing method types, and the table of the units of volume (third tier) through primary-foreign key linkage. Such design makes the database fully relational, decrease data redundancy, and optimizes its performance.

2.3.6 Output constructors and data integration

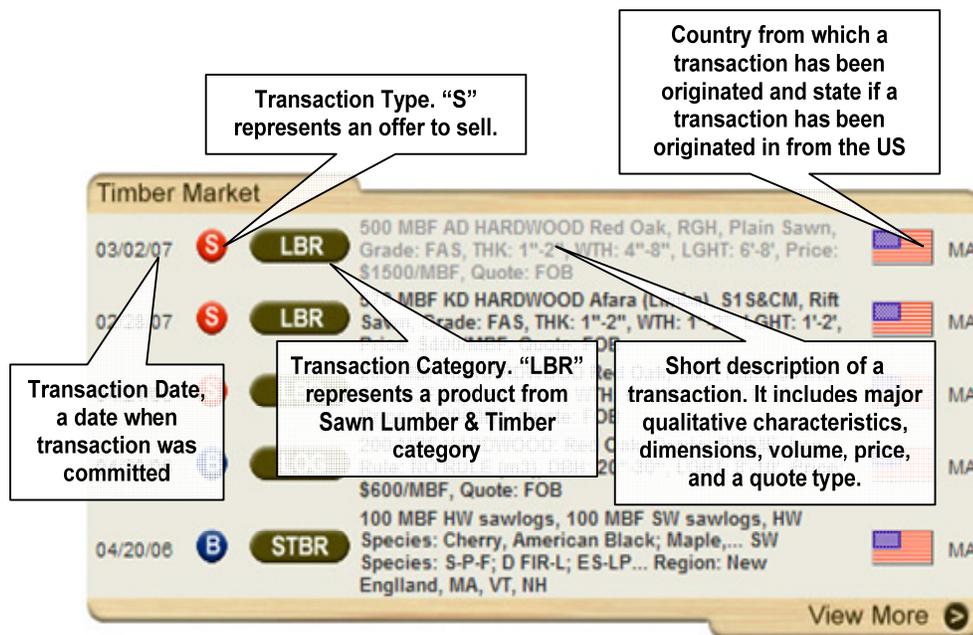


Figure 11: Front page output of the latest five transactions committed at the Timber Market generated by the Timberia.org constructor of short messages

The approach presented through Timberia.org creates standardization for data input and thus provide a solid basis for data integration capabilities of the B2B-OC. Data integration capabilities give two major advantages. These are standardized output of the

offers posted by members directly on the Timberia.org website in HTML and standardized output in XML format for web services and RSS feeds. Data integration for HTML output is implemented through ColdFusion components called constructors. Each Timberia.org market has two constructors. The first constructor creates a short message that has only major information such as a type of transaction, product category, dimensions, quote type, and important qualitative characteristics, for example a grade or a specie, and the member's geographic location. This short message is displayed on the front and search result pages (Figure 11). This message is also a dynamic link to the detailed information about the offer. When the message is clicked, the system invokes the second constructor that builds the detailed output consisting of all transaction details.

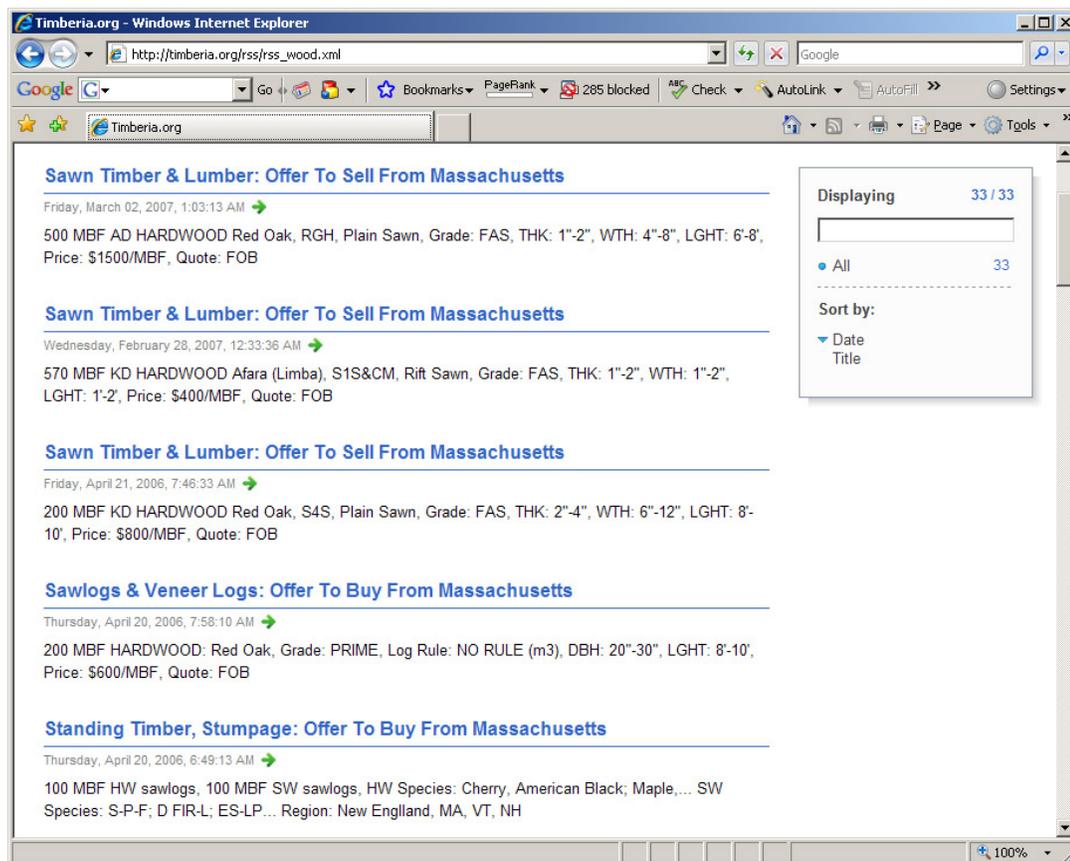


Figure 12: Timberia.org Timber market RSS feed in Internet Explorer 7

From the page where all details of a transaction are displayed, any visitor of the website can request an instant offer quote and using a custom designed web-mail form and send an inquiry about the offer to a company represented or individual who committed the transaction. Therefore, Timberia.org creates a fully environment in which the establishment a connection between supply and demand sides of the forest sector businesses is possible, and does not require a potential customer undertake any additional steps or costs to access this eMarketplace.

The web services and RSS of Timberia.org have been designed to provide the B2B-OC community with a capability that allows seamless data integration between data stored in the Timberia.org database and member software. For this purpose Timberia.org has two additional components: (1) the constructor of RSS feed and (2) the web-services constructor.

The constructor of an RSS feed is being run periodically on the server to generate an XML file consisting of information for 50 latest transactions committed in the Timber Market. The structure of this XML file is based on the RSS 2.0 standard. This standard is compatible for most known web browsers. Therefore, the XML file can be parsed and its content can be displayed on other web sites without additional programming efforts. A user simply should know a URL to the feed to which he/she has an option to subscribe. Figure 12 demonstrates how the XML file is processed by an Internet Explorer 7 web-browser.

The web services component is an application programming interface (API) that allows other web-based software to query the database of Timberia.org and receive back data in a standardized format. This component is based on the Simple Object Access

Protocol (SOAP), Web Services Description Language (WSDL), and Universal Description, Discovery and Integration (UDDI) open standards over an HTTP protocol backbone. As in case with RSS feed, XML is used to tag data on forest products. SOAP is used to encode and transfer XML data across the network, WSDL is used for describing the services (operations with the data) available, and UDDI is used for listing what services are available on the Internet. The web-services of Timberia.org have capabilities that allow users to search transactions committed in the Timber Market based on criteria of transaction type, category, and geographic location. Development of web-services that would allow the posting of new data from forest product inventories of Timberia.org users into the database is currently possible, but outside the scope of this project.

2.3.7 Additional Features

As discussed above, Timberia.org has features allowing its members to request instant quotes on offers posted to the system and thus it has an open interactive environment. In other words Timberia.org creates a genuine business online-community. Besides these capabilities users are offered additional features that have a potential to connect them in a deeper way through this web platform. The Timberia.org discussion forum allows community members to share their opinions and knowledge on different topics related to manufacturing, trade, and distribution of forest products. The sawmill finder helps members in finding buyers of unprocessed logs and suppliers for primary

producers of wood-based products. The information section of the web site provides members with helpful information such as conversion charts, timber properties, export and import regulations, legal documents, average prices on wood products, and useful materials.

2.4 Evaluation

The Evaluation of the web site performance will be made during the summer of the 2007. The analysis will be made by the total number of registrations for this period, diversity of registered businesses, number of transactions committed on four major markets, number of quotes requested and inquires sent. Web traffic will be analyzed by the total number of hits, geographic locations of website visitors, and by the number of returned users. Registered members will be surveyed with a questionnaire about the web site use, functionality, and its overall usefulness.

2.5 Conclusion to Chapter 2

The analysis of existing B2B web systems conducted in this paper reveals that most of the existing eMarketplaces operating today have business models adopted prior to the dot com crises. Classified by a pricing mechanism these models fell into the following categories: directories of forest products, supply management tools, trading hubs, and negotiation platforms. Directories of forest products is the most common and is the most static and asynchronous web business model. To generate revenues these companies use membership fees, brokerage, middleman schema, data sales, advertising, and auxiliary services. Almost all companies use a membership fee to cover operational cost and gain profits. As shown in the analysis above a membership fee is an obsolete method to

generate revenues on the web. Due to growth in both the number of web sites and the number of Internet users, the competition for website users among web sites become very intense. Therefore an obligatory membership fee may detract users from using a web site at all and thus throw an eBusiness out of the market. As new web technologies are invented the Internet becomes more and more interactive. This holds for both individual and business users. Most of the today's B2Bs lack interactive tools and sometimes even prevent their members from direct contacts. Today's eMarketplaces with old business models cannot benefit from such interactivity and thus they start to lose in the number of users and future market share. Online communities are appearing as a new form of an interactive behavior of people and business entities.

Timberia.org is an attempt to create a new B2B model based on the principles of an online community. These principles include community policies supported by software that lead a community member through processes of conducting a transaction, requesting quotes, and interacting with other members. Commitment to the community policies by a user helps in building data integration. This implies that in order to define properties of forest products, equipment, and services, users must utilize the same specification base. Therefore, their offers in the system are organized in the formalized way before these offers get saved into the database. Standard format of the data input lets Timberia.org implement optimal mapping between the conceptual activities in forest market sector and its internal representation as relations between database tables and transaction workflows. This in turn creates a basis for data integration with external web-based software through web-services and RSS feeds. Timberia.org also provides several interactive tools to its members such as topic-based discussion forum, business directory, and sawmill finder.

All these tools help Timberia.org build a social capital between its user base in the virtual environment. Timberia.org is designed as an action or activity based software. It's not a stand alone website or trading system but rather an active participant in the forest sector markets. The author believes that in future this improved system could become a part of a business model where human entrepreneurial drive will be amplified by this software.

Timberia.org is a free open market web-system designed to assist its participants in achieving their business goals at all stages of value added chain. There is no membership fee or other barriers to access the system. Since the system is free and there are no other obstacles for participation, this online community as a pricing mechanism is more efficient than the mechanisms discussed in this paper due to larger number of participating members. In bidding on stumpage, for example, the deviation in price gets less when a number of bids grows, Timberia.org aims to increase the number of registered members and boost their participation intensity by providing them with free, open, and interactive environment. As traffic grows, Timberia.org will plan on becoming a valuable resource for the forest sector. To cover its operational costs Timberia.org will generate revenue from direct participation in forest business activities as a consultant, promoting business entities on the web, creating alliances with manufacturers of forest product and equipment, as well as accept donations from interested parties.

Answering the question whether a renaissance of forest industry B2Bs is possible, one may say that it may be possible if models of emerging eBusinesses will respond not only to the development of modern network technologies but also to the paradigm shifts occurring in the global Internet community.

CHAPTER III

ONLINE COMMUNITIES IN ECOLOGY AND URBAN FORESTRY: CASE STUDY OF THE URBAN ECOLOGY COLLABORATIVE

3.1 Introduction to Chapter 3

The emergence of network-based applications, new information, communication technologies, and new imaging technologies has accelerated the process of sharing data, scientific knowledge, and experience geographically. Today this process is becoming critical for research in almost any field of science including Ecology and Forestry.

From mid 1990s onward, the combined capabilities of email, web pages and web-connected databases have led to the emergence of research collaborations among groups of researchers who no longer work in a common geographic location (or even a common organization), and work together as a virtual team (Schweik, Stepanov and Grove 2005). As the web capabilities advanced in the late 1990s and early 2000s along multiple dimensions, including dynamic content assembled from back-end databases and better supporting hardware and software infrastructure, many virtual teams became involved in developing and maintaining large web projects (McKeever 2003). These projects required robust and formal procedures to manage the collective website outputs that resulted in emergence of the content management systems (CMS).

Boiko (2001) provides the following definition of content management:

“At the highest level, Content Management is the process behind matching what you have to what they want. You are an organization with information and functionality of value. They are a set of definable audiences who want that value. This definition and the processes behind it work as well in other outlets as on the Web. In other words, at first

blush Content management may seem like a way to create large websites, but upon closer examination, it is in fact an overall process for collecting, managing and publishing content to any outlet” (Boiko 2001, p. 8).

As the demand for content management grew among virtual teams, many CMSs such as Drupal, CVS and WikiWiki emerged as independent services which other websites could utilize to create, publish, and version documents of different formats and media types. Those systems exhibited particularly strong growth in open-source (OS) solutions as the direct response to high prices of their commercial analogues (Robertson 2004) and as a tool to manage OS project themselves (Schweik and Semenov 2003).

At the end of 1990s the Baltimore Ecosystem Study (BES), a Long-Term Ecological Research (LTER) organization funded by the U.S. National Science Foundation (NSF) emerged as one of such virtual teams which began exploiting the capabilities of a web-based CMS to collaborate in collective acquiring, managing, and publishing ecological data. Currently, more than 50 affiliated scientists participating in BES research projects are physically based with organizations scattered across the eastern United States, including a variety of universities, government agencies, and other non-profit organizations (<http://www.beslter.org>). In order to provide a web-based mechanism to share geographically distributed metadata both inside within the BES-LTER affiliated research groups and outside to the general public, the Open Research System (ORS) was developed by a team at the University of Massachusetts and introduced as a solution for BES-LTER CMS in 1999. The system became fully operational in 2002 after its version 3.0 had been released (Schweik, Stepanov and Grove 2005). ORS 3.0 performed a role of a web portal or a content aggregator providing its users with an electronic gateway to the BES-LTER collection of research metadata. The ORS content management system

provided two main components, as defined by McKeever (2003): (1) a collection of content and (2) the delivery that content over the network. The first component included manual submissions of metadata to a temporary table of the ORS database through the specially designed web forms. The second component involved an administrator or “editor” to check the legitimacy of the submitted metadata and approve or disapprove the submission. Approved submissions were copied to the permanent tables, which were accessible and searchable for both BES LTER Internet and Intranet users.

However, in recent years web-based technologies continue to advance, driven by the general desire toward greater interactivity among users and organizations and continued interest to create online communities who access and share in real time digital recourses over the Internet (De Souza and Preece 2004). A primary driver of this interactivity is the “web-services” approach to data sharing over the net.

This chapter describes the author’s efforts to develop and improve the operational functionalities of the ORS CMS following this web data services model. In January 2007, ORS 4.0 has been released. ORS 4.0 differs significantly from the earlier version its predecessors which were simply user web-interfaces to the collections of metadata sets. This new 4.0 version acts as “middleware,” with a flexible application programming interface (API) that not only allows data integration and content syndication among affiliates of a particular virtual team but also provides multi-team web-based capabilities.

The ORS 4.0 API allows building independent web-applications based on the Social Networking Site (SNS) CMS model which concept is constructed on individuals, their groups and relationships between them (Breslin 2005). According to O’Murchu (2004), a

social networking site connects and presents people and their group entities based on the information gathered about them and stored in the profiles. These profiles establish protocols with which users and groups are able to present themselves to other users and groups of the network (O'Murchu 2004).

At the time of this writing, the primary user of this new release is the Urban Ecology Collaborative, described more fully below. The Urban Ecology Collaborative (UEC) is an organization of which virtual team is currently exploring the capabilities of the ORS 4.0 in order to build its own online community based on the concepts derived from the SNS CMS model. Later this year, the BES LTER will be migrating from ORS version 3.0 to ORS version 4.0.

The purpose of this chapter is to investigate how data integration, a key feature of an online community supported by software, and the SNS CMS model can be implemented to improve a process of metadata and data sharing among groups of distributed scientists, policy-makers and other stakeholders interested in ecology and urban forestry. Toward this end, I will use the UEC online community as the example.

Specifically in this chapter I will: (1) describe the UEC as a collaborative group, (2) discuss a conceptual SNS model built to encourage collaborative interactions among UEC participants, and (3) describe the supported software design and architecture, its major functions and operations built on the web-services technology.

3.2 The Urban Ecology Collaborative

The Urban Ecology Collaborative is a partnership of universities, non-profit organizations, and state, local and federal officials working in cities in the Eastern United States. The overarching purpose of this collaborative is “to cultivate healthy, safe and vibrant cities through collective learning and united action” (UEC 2007).

3.2.1 Environmental issues of American urban centers addressed by the UEC

Rebuilding cities is the most important environmental issue in the modern United States being addressed by the UEC. The protection and restoration of American urban centers and urban ecosystems is vital to the future of cities and the environment in general. Cities in the Eastern United States are experiencing ecological, economic, and demographic threats from dying inner-city neighborhoods and the associated suburban sprawl (Hecht and Lord 2007). The symptoms are evident in abandoned properties and declining property values, high rates of asthma and other diseases with an environmental etiology, and in declining “social capital” in neighborhoods (Lord 2007). Urban watersheds suffer from significant point and non-point source pollutants and air pollution continues to be a major environmental health issue in many communities. These on-going urban environmental threats are compounded by habitat loss outside of cities due to increasing suburban sprawl and land use consumption (Strauss et al. 2007).

In light of such pressures, urban natural resources, such as urban watersheds, are critical to rebuilding cities and to providing economic, civic, and public health benefits for metropolitan area residents nationwide (Strauss et al. 2007).

Community-based urban ecosystem restoration projects are a potentially powerful solution to the challenge of decaying inner cities. The “greening” of these cities may repair the physical environment while simultaneously strengthening social networks and local leadership essential to maintaining a resilient community structure (Fleckenstein 2006, Hecht and Lord 2007). Restoring urban ecosystems provides an opportunity for new and vibrant economic enterprise. Urban ecosystem revitalization creates economic opportunities linked to natural resources. Similarly, “green” marketing of cities is a strategy for attracting homeowners, offices, and businesses and can have a significant impact on property values (Hecht and Lord 2007). Urban ecosystem restoration improves public health on a number of fronts, including improved air quality to reduce respiratory illness, improved water quality to protect against water-borne diseases and ensure adequate groundwater and surface water supplies, and restoring opportunities for outdoor recreation to improve cardio-vascular and weight profiles of urban residents (Strauss et al. 2007).

An important way to rebuild green infrastructure in cities is to approach this critical issue on a multi-city scale. The multi-city scale is critical to framing new research questions at the regional level, developing and testing a comprehensive “toolkit” for urban ecosystem restoration, setting benchmarks for sustainability at the regional level, and developing a shared database of urban ecosystem data, drawing on emerging data from participating cities (Hecht and Lord 2007).

3.2.2 Purpose and partners of the UEC

To address the above issues the UEC was formed in 2002, when a group of academic and federal-level scientists, educators, non-profit and government-sector employees working in a number of cities in the northeast created a vision for a structured partnership that would allow urban areas across the region to aggregate resources and expertise (Hecht and Lord 2007). The UEC has since grown to encompass partners in six of the most urbanized areas in the Mid-Atlantic and Northeast regions of the United States: Boston, New Haven, New York City, Baltimore, Pittsburgh and Washington, D.C (UEI 2007, Fleckenstein 2006). Today the UEC has the following partners in mentioned metropolitan areas (Lord 2007):

- Urban Ecology Institute/Boston College in Boston
- Urban Resources Initiative/Yale University in New Haven
- New York City Parks Department, Environmental Education Action council and other NGOs in New York City
- Nine Mile Run Watershed Association, Pittsburgh Parks Conservancy, other non-profit and university partners in Pittsburgh
- Parks & People Foundation in Baltimore
- Casey Trees Endowment Fund in Washington, DC
- Philadelphia Green in Philadelphia.

The collaborative has also governmental partners such as the U.S.D.A. Forest Service and regional Departments of Environmental Protection (Lord 2007).

The UEC works to share and replicate successful community based urban forestry activities and education models, and is undertaking research to further the understanding of urban ecosystems. The hope is that through such an information sharing collaborative knowledge, experience, and problem-solving techniques of each city will be shared, and

ultimately, the group will create and implement a “tool kit” of well-tested field models (<http://www.yale.edu/uri/partnerships/partnerships.html>). Due to the cross-city approach to addressing urban ecology issues the UEC brings significant ability to influence policy and decision makers at every level, from the local to the national level (Strauss et al. 2007).

3.2.3 Structure of the UEC

The UEC structure has a structure of a social network which is based on the decentralization and democratic management principles that result in decision-making flexibility and the ability to leverage broad changes (Lord 2007). The core of such decentralized effectiveness is the free flow and open access of information and resources supported by a proper stewardship (Hecht and Lord 2007). Established communication links, both formal and informal are fundamental to continual success and the creation of new information, and not just processing existing data (Strauss et al. 2007). At the same time, “sufficient management attention maintained by the UEC administrators, serving not as jurisdictional, but rather as an organizational nexus, to strengthen the collaborative through efficiency and building capacity through shared asset”(Hecht and Lord 2007).

For the last five years the collaborative has been created a unique network of urban ecology researchers, educators and practitioners working through the following working groups: Restoration, Education, Green Jobs, Research, Collaborative Structures, and Steering Committee (URI 2007).

3.2.3.1 Restoration Tools group

The participants of the Restoration Tools working group collaborate to find out ways to improve local natural resource management by sharing program models and conducting joint projects (Lord 2007). This group focuses on researching and sharing methods related to urban restoration through a multidisciplinary urban and community forestry framework that includes biophysical and social guidance for participating cities and models to build stronger and healthier communities (Strauss et al. 2007). For example, the collaborative efforts of this group made possible the transfer of successful community forestry techniques in Baltimore and New Haven to Boston and Pittsburgh resulted in new forestry programs that engage multiple non-profit partners and community members in tree planting and maintenance (Hecht and Lord 2007). Also, transfer of urban watershed restoration techniques from Baltimore to Boston and Washington D.C. That transfer helped in improved understanding of participation in watershed protection by urban residents (Urban Projects 2005).

3.2.3.2 Education group

The UEC Education Working Group is a partnership of state agencies, nonprofit organizations, universities and public schools in Boston, New Haven, New York, Baltimore, Pittsburgh, and Washington, DC, that are working to bring high-quality environmental education experiences to youth in urban areas as well as to coordinate the delivery of environmental education programs, provide professional development for urban public school teachers, and conduct multi-city education research (Strauss et al. 2007). The current projects of the Education working group are aimed to build,

strengthen and sustain intra-city education networks based on the tested UEC models and the results of the recently completed Urban Environmental Education Inventory (UEEI) project (Hecht and Lord 2007). Currently this working group is building a model framework for incorporating urban ecology education into state and local standards for teaching and learning (Strauss et al. 2007). This framework is based on the protocol developed and recently tested in Baltimore. Urban Ecology Education Action Agenda for Research and Policy is another project initiated by convening a symposium of scholars, education policy leaders and education practitioners. Creating Networks, Conducting Research, and Sharing Models across Six Urban Areas is a three-year project that designed to build up the capacity of the Education working group to meet the challenge of bringing high-quality environmental education experiences to youth in urban areas (Hecht and Lord 2007). As a recent achievement of this group, one may mention a successful transfer of teacher training modules between Boston and Pittsburgh, for teacher workshops with an emphasis on field opportunities for hands-on science education (Strauss et al. 2007).

3.2.3.3 Green Jobs group

The Green Jobs working group seeks to develop a network for green collar job training, placement and career support for urban youth (Hecht and Lord 2007). It brings together partners within and across cities with successful existing programs to integrate best practices, distributes methods across the cities, and evaluates the methods and works together to dissolve systemic barriers to youth employment by building industry connections for green jobs, developing a unified certification system and growing the regional demand for these jobs (Strauss et al. 2007).

As an outcome of this group activities, development of “green collar” jobs training resulted in transfer from New York City to Washington D.C. and Boston of youth job development (Hecht and Lord 2007).

3.2.3.4 Research group

The Research working group conducts research individually and in conjunction with other UEC working groups (Lord 2007). The recent introduction of a new online peer-review journal, *Cities and the Environment*, hosted by Boston College and edited by Dean-Lorenz Szumlylo (<http://www.unri.org/cejournal/board.shtml>). *Cities and the Environment* features are two fundamental domains of scholarship: Urban Ecology Research and Urban Ecology Education (Hecht and Lord 2007). Each section will include articles that have a strongly theoretical focus and those aimed at applied research and urban transformation. The electronic format of this journal is intended to exploit the capacity of the internet to deliver articles in a dynamic format that include simulations, matrices, complex images and large databases (Hecht and Lord 2007). One of the issues each year will include the proceedings from the annual meeting of the Urban Ecology Collaborative (UEI 2007).

3.2.3.5 Collaborative Structure group

The Collaborative Structures working group focuses on developing systems for communication within and between working groups and program partners (Lord 2007). Completion of an interactive website that would replicate and support the UEC community model in the Internet environment is one of the goals of this group.

3.2.3.6 Steering Committee group

Finally, Steering Committee of the UEC is an administrative committee that provides overall guidance and management of the UEC (Lord 2007). This group has at least one representative from each of the six participating cities, the working group chairs, members from the partnering US Forest Service and selected state foresters offices (Hecht and Lord. 2007).

3.3 UEC SNS Conceptual Model

In the Fall of 2006, I was asked to take the existing ORS version 3.0 system and completely redesign and overhaul it based on the web services approach for ORS release 4.0. The primary client of this SNS CMS collaborative platform was UEC, to respond to their need described in section 3.2.3.5. This Based on the above organizational and collaborative structure of the UEC one may conclude that to design an adequate web-based SNS CMS to enhance the performance of this organization we should consider three major conceptual entities such as users, groups, and datasets.

Users are individuals registered at the UEC website. They can be affiliated both to one group and many UEC groups identified in the previous section (e.g., Steering Committee, Research Group, etc.). User authentication implies that the web-application grants a user access to use website features only if he/she provides correct login information that matches one stored in the system database.

The user authentication in ORS 4.0 includes the user's role. A user may have different roles in different working groups. The "user role" in ORS 4.0 defines a set of actions a user can undertake at a working group when he/she is authenticated at this group. This is rather complicated, so let me explain this more formally.

A user U_n has a set of properties that can be defined as $U_n \equiv \{\bar{G}, C_j, O_i\}$, where \bar{G} is a set of working groups $\{G_1, G_2, \dots, G_m\}$ a user has affiliation with, which is also a subset of the UEC domain D , a set that consists of all UEC working groups, $C_j \in \{C_1, C_2, \dots, C_k\}$ is a user's city that belongs to the set of cities \bar{C} under the UEC domain, and $O_i \in \{O_1, O_2, \dots, O_p\}$ is an organization that belongs to the set \bar{O} of the UEC partnering organizations. Therefore, the group concept can be defined as a set of users $U_g \equiv \{U_1, U_2, \dots, U_z\}$ that is also a subset of all users \bar{U} registered at the UEC web site. A group itself does not undertake actions within the system. It is rather a collective entity or a framework guiding actions of users.

The relationships between an individual user and a group entity can be defined as follows. A user may request his/her inclusion to a group, and the group, as a collective entity may grant or deny such acceptance by the decision of an appointed group administrator. Once accepted to the group (g) a user gets assigned with a group role and receives permission to access the data for the group D_g . Then, a set of actions A a user U_n can take upon D_g may be defined as $A_{U_n}^g \equiv F(R_{U_n}^g)$, that is a function of the user role R at this group.

Table 12: User action-role relationships

| User Role | Allowed Actions | | | | | | |
|---------------------|-----------------|--------------------------|----------|-------------------|------------------------------|-----------------------------------|---|
| | Add New Groups | Modify and Delete Groups | Add User | Assign User Roles | Submit and Update Group Data | Search Data Posted by Group Users | Browse Data Posted by the Group Users (anonymous) |
| Administrator | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Group Administrator | No | No | Yes | Yes | Yes | Yes | Yes |
| Group Member | No | No | No | No | Yes | Yes | Yes |
| Group User | No | No | No | No | No | Yes | Yes |
| Guest | No | No | No | No | No | No | Yes |

There are five user roles identified that maps the collaborative schema of the UEC organization (Table 12). A user with a role of Administrator has full control over the system within the UEC domain and he/she is able to add, edit, or delete any working group. This role corresponds with an authority that a member of the UEC Steering Committee has. A Group Administrator role, reflecting the responsibilities of a UEC group coordinator, allows user to assign and modify privileges of other users, to edit and add user properties, and to delete group data. If authenticated, a user with a role of Group Member, a role representing a broad spectrum of active individual participants at the UEC partnering organizations, can submit and edit datasets within a group. The Group User role permits a user to view data submitted by other group members while a role of a Guest may be considered as a role of an anonymous non-authenticated visitor of the UEC website. The last two roles represent members of urban communities involved in the UEC projects and other members of the global, Internet public that are not formally involved in UEC but are interested in viewing group data that are flagged for public consumption.

Therefore, group data can be defined as a set of data tables $D_g \equiv \{T_1 \dots T_n\}$ that have two important properties. Regardless of internal structure of the table T_i , any record of this table, together with associated files further referred as a “dataset”, may be available either for all users \bar{U} under the UEC domain or for users U_g of a group (g) only. Moreover, any dataset in the UEC database can be defined as either for public or private consumption. We discuss the UEC database organization later in this paper.

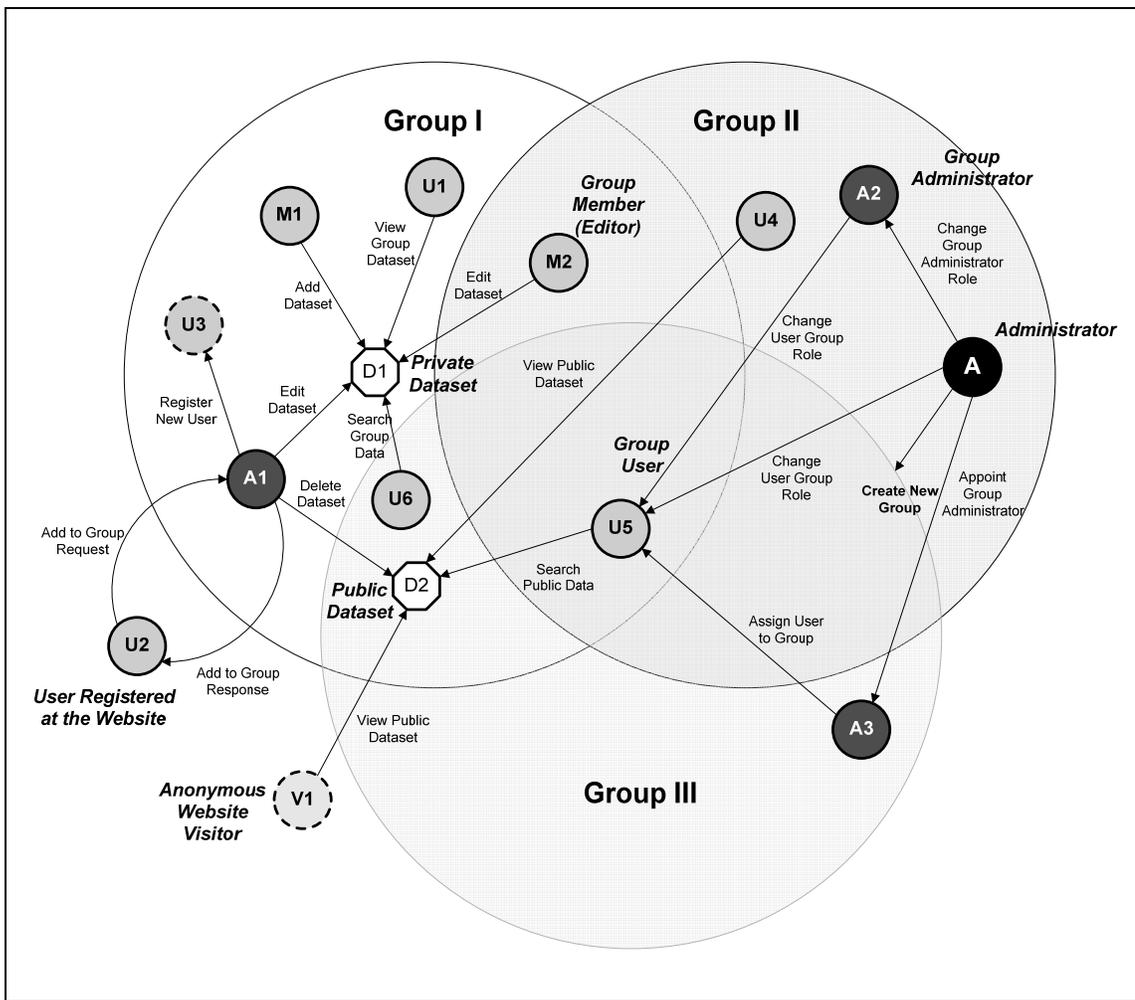


Figure 13: Conceptual diagram of the SNS model

Taking into account the above considerations, we may further justify principles for the UEC SNS CMS, its processes and data flows by presenting a conceptual diagram mapping the UEC real-life collaborative schema with its virtual representation in form of online community. The diagram on the Figure 13 demonstrates possible interactions among participants of the UEC online community. The three large circles represent three exemplary working groups. The small circles within groups represent users in a working group assigned differing group roles. The small octagons represent datasets submitted by users. The arrowed lines symbolize actions and their directions. Overlaps of group circles captures the situation where one user belongs to more than one working group.

In Figure 13, a user designated by the black circle (A) has the authority both as a group administrator and also a “global administrator”. This user has the authority to create new Groups (such as Group III), and to appoint a new group administrator (A3) for this newly created group. This global administrator also has the authority to change the role or authorities of other existing group administrators such as the group administrator (A2). Being authenticated as a global administrator has an ability to modify properties and privileges of any user with a lower role and has full control for all datasets under the UEC domain regardless the group affiliation. In the UEC case, there a designated group administrator, who has had the authority to create the various UEC subgroups described earlier (e.g., Steering Committee, Research, Education, etc.) and has the authority to manage all users within the UEC collaborative platform.

Figure 13 also depicts users assigned as group administrators for various groups (e.g., A1, A2 or A3). These administrators have multiple functions. First, they respond to requests of self-registered users who would like permission to join a group, such as in the

example of (U2) on the left side of Figure 13. Administrator (A1) receives this request and has the authority to add this new user to the group under his/her administration.

Second, group administrators can assign users already registered in other groups to also participate in their group, such as depicted in the arrow from (A3) to (U5). For example, a group administrator (A3) can assign a user belonging to both the Group I and Group II to the Group III. In the UEC case, for example, the administrator of the Steering Committee could assign a participant in the Education group to join in Steering Committee Activities. Third, group administrators can also add new users to his/her group. For example in Figure 13, group administrator (A1) adds new user (U3) to Group I.

Like global administrators, group administrators can grant users assigned to his/her group various authorities or “roles”. In the system there are several types of user roles (described below): Members, Group Users, and Group Editors. Administrators have the authority of reassigning user roles which is depicted in the Figure 13 as a connector from (A2) to (U5). Note, that a group administrator (A2) may change privileges of a group user (U5) only in the Group II while the Global Administrator (A) has an authority to change privileges of this user in any of three groups which he/she belongs to.

In addition to describing the various functions administrators can play, Figure 13 also depicts data access policy options. The “D”’s captured in octagons in Figure 13 represent various datasets the group possesses. Datasets can be any binary or text files containing ecological data. For example, the (A1) group administrator can edit or delete any dataset posted in his/her group (shown by examples D1 and D2, respectively). Group Members, such as (M1), have the authority to add new datasets (D1) their group. And other group

members, referred as Group Editors, have the right to modify submitted datasets within their groups. For example, in Figure 13, the group member (M2) can edit a dataset (D1) posted by a group member (M1). Users with a role of Group User (such as users U1 and U6), do not have the right to post and edit data but they have a right to search and view datasets in their own group even though these datasets are designated as private. If a dataset is set as public, then all users of the UEC community, including anonymous guests without authentication, can access such dataset for viewing. As Figure 13 shows, an anonymous website visitor (V1) can view a public dataset (D2), but so can a group user (U4) who has affiliation neither with Group I or Group III.

The above conceptual diagram provides us with a basis to better comprehend the design of the ORS v. 4.0 web-based application that we will discuss next.

3.4 ORS v 4.0 web-based application design methodology

Before we discuss the UEC web-based application that is driven by the ORS 4.0 system, questions about how the various participants of the UEC will access and share data and how these data can be integrated should be answered. The UEC partnering organizations are geographically scattered across the urban centers of the Northeast United States. These organizations use different software and different digital formats to maintain and store their data. Many of these organizations support their own websites and thus they may consider displaying the shared data as their own web resource in the seamless manner. Therefore, there is the need for a tool that can unify various data formats through a standardized method to submit and access data over the Web.

Web-services enable systems running in different environments and at different locations to exchange information, interoperate, and be combined more readily (Arsanjani et al., 2002). For the UEC web-based application design, the web-services standard has been chosen and ORS 4.0 middleware has been developed, creating a middle tier providing an Application Programming Interface with SQL-based query access to a SQL Server 2005 data repository.

The ORS v. 4.0 API has been built purely on web-services. A web-service is an interface that describes a collection of operations that are network-accessible through the standardized XML messaging (Gottshalk et al., 2002). Web-services are an aggregation of several technologies and include four major technological components: Extensible Markup Language (XML), Web Services Description Language (WSDL), Simple Object Access Protocol (SOAP), and Universal Description, Discovery and Integration (UDDI).

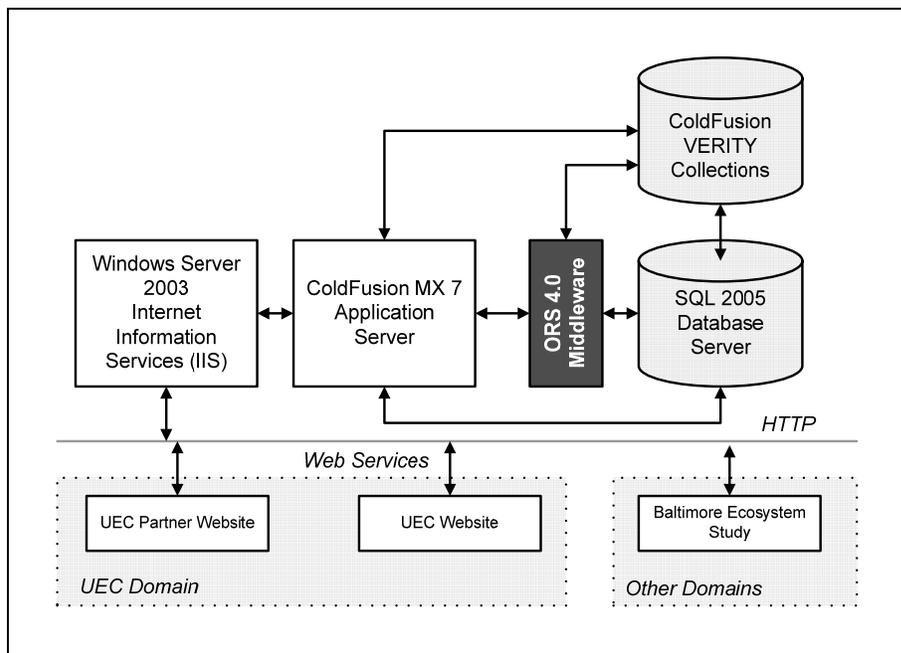


Figure 14: Connection of the virtual groups with the ORS 4.0 middleware

XML can be considered as the foundation of the web-services technology. XML provides a standardized platform independent format for exchanging data across applications (Ray 2001). A web service performs a specific task or a set of tasks and it is described with WSDL. WSDL is a formal XML notation that provides all of the details necessary to interact with the service, including message formats, transport protocols, and location (Christensen et al., 2001). SOAP is a high-level transport protocol intended for exchanging structured information over the Web in a decentralized, distributed environment (Roy and Ramanujan 2001). SOAP is an XML-based messaging framework for web-services that provides the enveloping mechanism to transport encoded XML documents over the network using the Hypertext Transport Protocol (HTTP) (Brooks-Bilson 2003). Finally, UDDI is a specification that allows registering and locating web-services (Roy and Ramanujan 2001).

The ORS 4.0 middleware is a package of web-services, which we will describe in detail later in this chapter, that is sufficient not only to build a functional web application mapping the UEC conceptual SNS CMS model, but also provides a customized API for all users under the UEC domain to access shared data programmatically as permitted by their system roles.

The integration of the UEC web-based application and the ORS 4.0 middleware is shown on the Figure 14. Using web-services implemented through the ORS API, users within the UEC community (the UEC “domain” in Figure 14) have the capability to query the SQL Server 2005 database. They also have the capability to search for data in the ColdFusion Verity collections, which are specially indexed metadata structures to speed up a search process through database fields and file content (Forta 2003). As

presented on the Figure 14, the consumers of the web-services provided by the ORS could be actual human users of the UEC website, or web-based applications of the UEC partners as well as other virtual teams similar to the UEC and their software.

3.5 UEC Website (urbanecologycollaborative.org)

Based on the above technical platform, the UEC website (<http://www.urbanecologycollaborative.org>) has been designed as a user interface to the ORS 4.0 middleware API. This website has been built as a dynamic ColdFusion-based database driven web application. Being dynamic, this web site may have different appearance from time to time because of changing content in the SQL Server database, and the site offers users different tools depending on which of two website access modes – not authenticated or authenticated -- are being used.

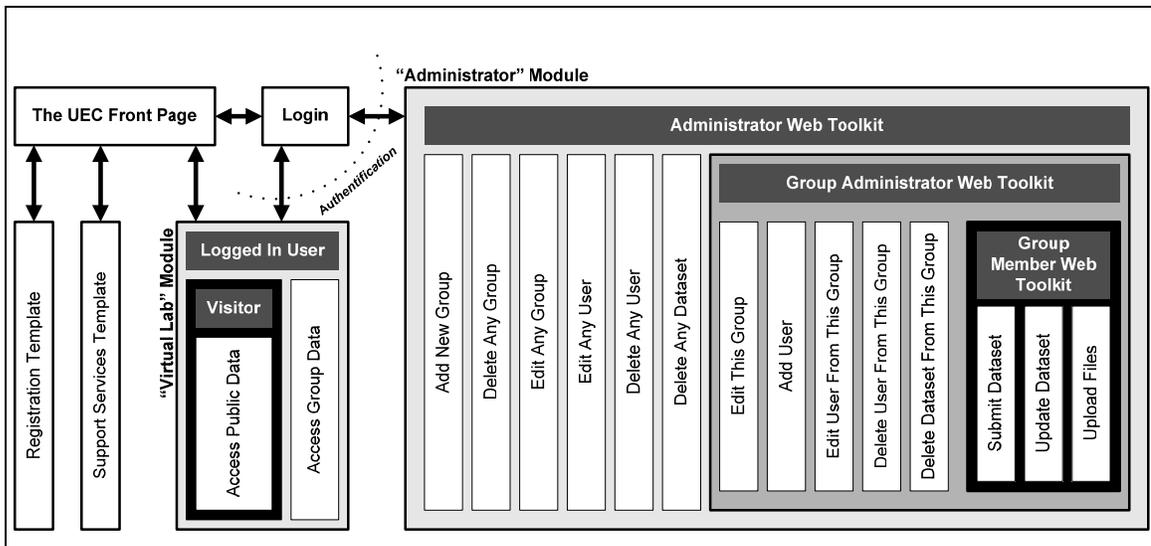


Figure 15: Modules of the UEC website

The first mode, access by a not authenticated user, occurs when an anonymous Internet user browses the pages of the UEC website. In this mode an anonymous user is permitted to view and search for public data only. The second mode, access by an authenticated user occurs when a user logs in by submitting his/her system user name, password, and working group through the special login web form. When logged in, the authenticated user receives a number of web tools (toolkits) that he/she is allowed to use via the website that are not available for the not authenticated users.

In addition, “Toolkits” are available in the “Administrator” and “Virtual Lab” sections of the website. Only authenticated users can have an access to “Administrator Web Toolkit.” As presented in Figure 15, an authenticated Administrator has access to all available tools including templates designed to add and delete working groups. An authenticated Group Administrator is limited to have access to the toolkits allowing user and data management, and only within his/her associated working group. A Group Member can only submit and edit posted datasets and has no tools available to delete any content, manage roles of other users, and edit descriptive information for a group. Group Users have no access to any section of the “Administrator Tool Kit” section of the website. However, being authenticated, a Group User receives access to search for and view datasets at his/her group’s “Virtual Lab” section of the website even though these datasets are flagged as non public. Mechanisms implemented within the “Virtual Lab” section for posting draft documents allow the solicitation of peer review from other members within a working group (Schweik et al. 2003).

As mentioned above, most web tools which the UEC website provides to its users are based on the web-services provided by the ORS middleware. Therefore the templates pages of the UEC website are merely the initiators of web-services, which send requests to the ORS 4.0 server depicted in Figure 14, process web-service responses from this server, and outputs results. Responses from the web-services come back to the UEC website templates in XML format. The UEC website itself uses the XML Path Language XPath designed to work with Extensible Stylesheet Language Transformation XSLT and fully supported by ColdFusion as a query tool for extracting data from XML documents implemented via `xmlSearch()` function (Brooks-Bilson 2003). This function uses various XPath expressions to return different portions of the XML document to a ColdFusion template that dynamically converts the received content into plain HTML.

All web-services invocations generated by the UEC website involve querying the database back-end. Whether an invocation is a request for user authentication, search for data, submission or updating a dataset, a web-service will always “talk” to the database. The database is the foundation of the UEC SNS CMS that will be discussed further.

3.6 Database

The entity/relationship (E/R) diagram of the UEC web application database back-end is presented on the Figure 16. The database is designed on the relational model and implemented with the SQL Server 2005 technology. Based on the operational purposes of the database its entities can be classified into the following four categories:

- User and Group Tables
- Auxiliary Tables
- Data Tables
- Transaction Tables

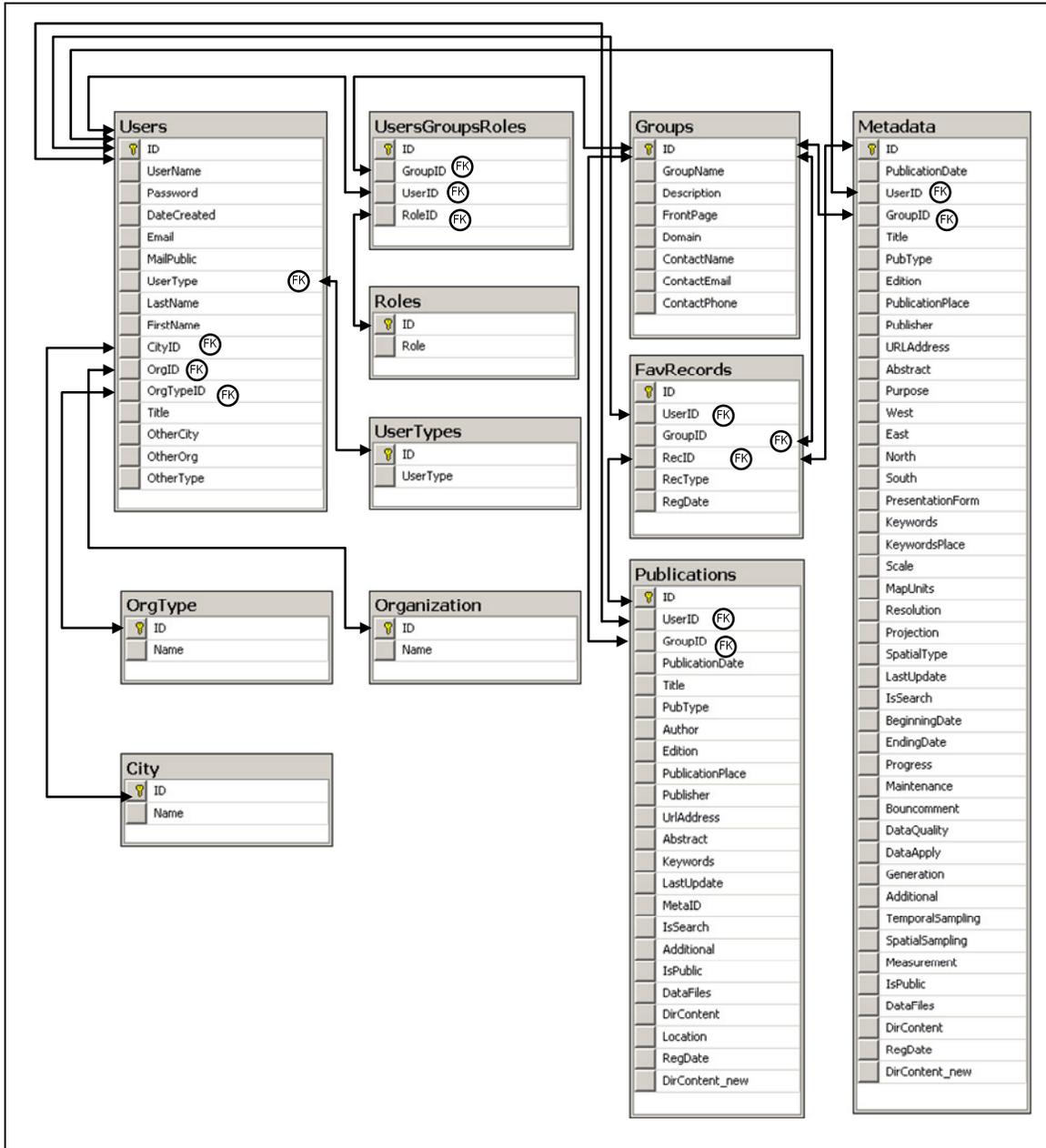


Figure 16: Database entity/relationship (E/R) diagram

The first category includes two tables. Users table consists of records with information about registered users such as name, title, mailing address, and e-mail. This table also stores users' logins and passwords that are necessary to authenticate so they can use the system in accordance with the role privileges we have discussed earlier. Three fields "UserType", "CityID", "OrgID", and "OrgTypeID" in the "Users" table are foreign keys, depicted as the circled FK on the Figure 16, that relate this table to the auxiliary tables which records store descriptive information about the UEC partnering cities and organizations as wells as classification of users and types of organizations. For example, "CityID" field in the "Users" table is a foreign key that matches a value of a candidate or primary key ID, depicted as the lock key on the Figure 16, in the "City" table. To obtain descriptive values, the auxiliary tables should be joined with the "Users" table based on the mentioned primary-foreign key relationships.

These relationships support the referential integrity of the database which states that the database must not contain any unmatched foreign key values. Therefore, the referential integrity prevents inconsistent modifications in database tables (Date 1999).

The "Groups" table consists of descriptive information about the UEC working groups and has its foreign keys in both Data and Transaction Tables. The "Domain" field of this table defines to which virtual team this group belongs. The value of this field affects a workflow of web-services by allowing only domain-legitimate SQL queries.

"Metadata" and "Publications" are two tables that consist of data of actual datasets. Fields specifications of the "Metadata" table are based upon minimum requirements of the Federal Geographic Data Commission standards (<http://www.fgdc.gov>) and the

design follows some of the “MetaLite” software structure provided by the USGS and the United Nations Environment Programme (<http://edcnts11.cr.usgs.gov/metalite>) with modifications based on our analysis of the UEC CMS requirements. The “Metadata” table combines two types of metadata: non-spatial and geographic data. Geographic metadata are usually data referring to geographic information systems (GIS) datasets. Non-spatial metadata are for non-geographical data such as presentation files, spreadsheets, and images. Most of fields of these tables are self-explanatory and we skip their descriptions in this paper. However, several fields in these tables should be mentioned since they affect the algorithmic logic of web-services.

Flag fields “IsSearch” and “IsPublic” regulate whether a record is searchable and accessible. If the “IsSearch” flag is set to zero then this record becomes inaccessible for the ColdFusion Verity engine and thus cannot be found by means of “Virtual Lab” toolkit. When set to one, the “IsPublic” flag field grants an access to a record for all users regardless of their roles and group affiliations. Otherwise, zero value indicates that this record available for viewing only by members of a group at which this record has been posted. The “UserID” and “GroupID” fields are foreign keys that link tables of Data Tables category with the tables of “Users” and “Groups”. “PubType” field is a field that flags a type of metadata. For example, in the “Metadata” table this field may have GIS or Non-Spatial values. In “Publications” table this field may have values of Publication, Announcement, News, Report, Conference Call, Feature Project, Minutes, Web Link, Meeting Agenda, and Memo. Based on the value of this field the UEC website may change dynamically appearance of the ColdFusion template designed to display content from the “Publication” table.

There are two transaction tables in the database. These are the “UsersGroupsRoles” and “FavRecords” tables. These tables do not store any descriptive information but rather provide an operational linkage between the Data Tables and the User and Group Tables. “UsersGroupsRoles” transaction table includes three foreign keys to the “Users”, “Roles”, and “Groups” tables. These relationships allow a user being authenticated in more than one working group with the ability to have different roles and privileges for each group. For instance, depending on a combination of the foreign keys in the “UsersGroupsRoles”, a user could have a role of Administrator in one working group and a role of a Group Member in the other one. However, an authenticated user may have only one role in a particular group. To obtain information about user’s role in a particular group and obtain authentication a SQL “inner join” is done for the “Users”, “Groups”, and “Roles” table through the “UsersGroupsRoles” table. This join will result in one logical record consisting of all information needed to check whether a user is assigned to this particular group, and if yes, to find out what his/her role in this group is. The “UsersGroupsRoles” transaction table is also used to extract dataset records from the Data Tables. Again, for the “Metadata” and “Publications” tables, a SQL join is done on the above transaction table. The result of the join will reveal all records in the “Metadata” or “Publication” table that would match the referential constraints.

The “FavRecords” is another transaction table that helps to keep favorite records for quicker user access. This table participates in SQL join with the “UsersGroupsRoles” table to extract user’s favorite records from the Data Tables. In the “FavRecords” table, “RecID” field keeps IDs of user’s favorite records while “RecType” field is a flag that indicates in which table, “Metadata” or “Publications”, this record can be found.

“GroupID” and “UserID” referential constraints limit a resulting query with records by selected as favorite by a user of a particular group. Therefore each user in the system has a capability to create a unique set of his/her favorite records while working with the “Virtual Lab” toolkit.

3.7 Web-services Package

The UEC web site is a consumer of web-services of the ORS 4.0 server middleware that provides a way to build loosely coupled applications from ColdFusion Components (CFCs). The architecture of the ORS web services package is presented on the Figure 17. When a client - in the Figure, the example is a ColdFusion template of the UEC website - makes a request to consume a web service, one calls a remote object to perform some action and a response is sent back to a client. In ColdFusion MX, a remote object is a CFC that has one or more methods that can be accessed remotely through the Internet. Once a CFC has been created, ColdFusion automatically creates a WSDL file that describes a purpose of a web-service and its functionalities (methods).

There are nine ColdFusion components in the web-services package of the ORS 4.0. These components provide the following functionalities allowing the UEC web application:

- To build a security policies and perform a user/group authentication
- To search metadata
- To register new users affiliated with multiple groups
- To submit and update new datasets to the system
- To update existing datasets
- To upload binary and ASCII files to a user’s file directory
- To obtain information about structure and content of user’s file directory

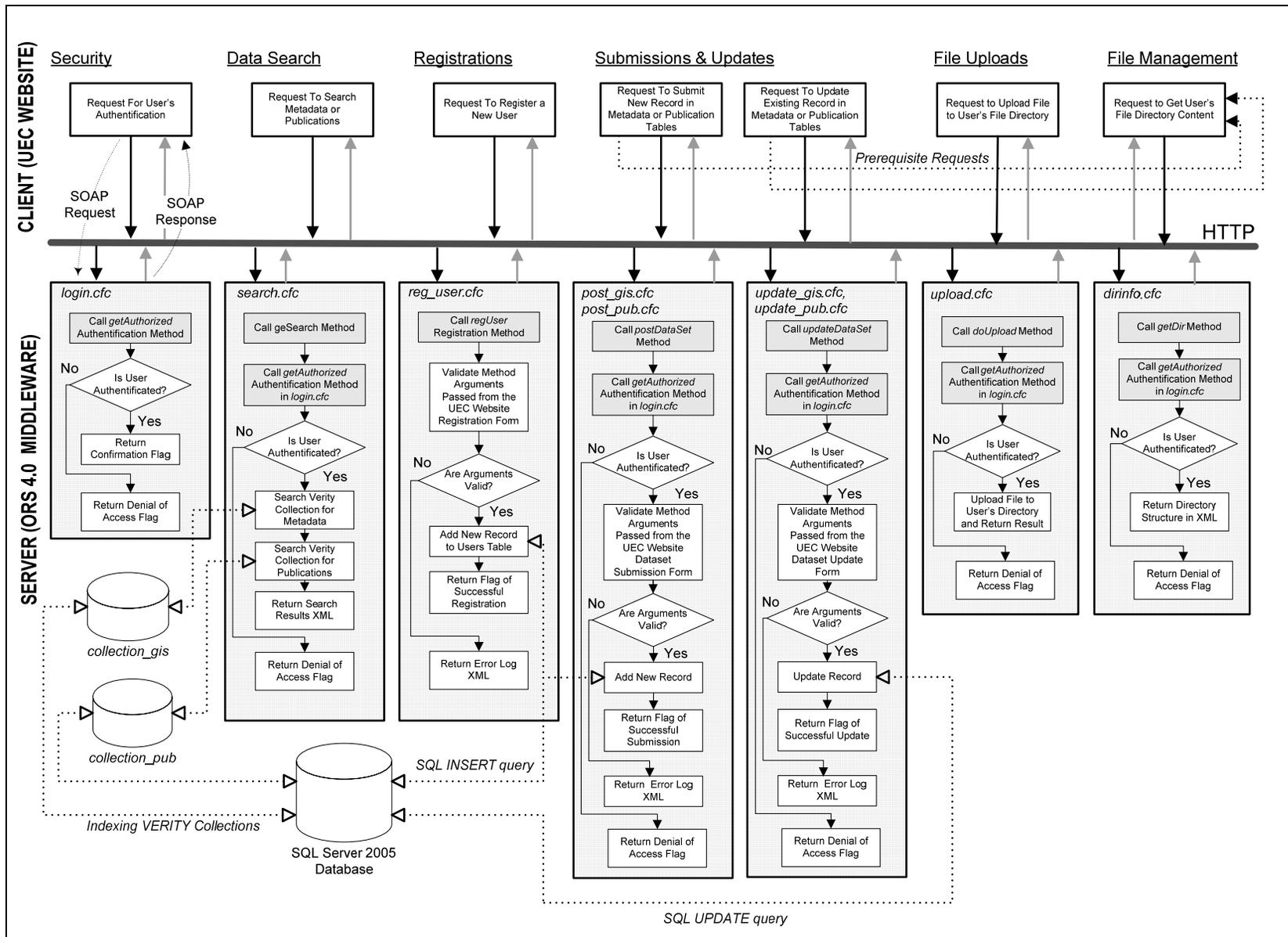


Figure 17: ORS 4.0 web-services package

To explain how web-services work we will describe login.cfc component with the getAuthorized remote method that provides a user/group authentication. The example of the ColdFusion call for the remote getAuthorized method of this web-service is shown on the Figure 17. When called, this web-service requires three parameters to be passed along with the request. These are the user's login, password, and group ID. These parameters are then handled by the SOAP that creates XML base messaging framework for a web-service by enveloping its parameters into the specially encoded structure with further transporting this structure through the network using HTTP.

```
<cfinvoke
  component=http://urbanecologycollaborative.org/ors/cfc/login.cfc?wsdl
  returnvariable="getAccess"
  method="getAuthorized">
  <cfinvokeargument name="uName" value="#username#">
  <cfinvokeargument name="pWord" value="#password#">
  <cfinvokeargument name="lGroup" value="#loggingroup#">
</cfinvoke>
```

Figure 18: Example of a web-service request from the UEC ColdFusion template

At the simplest level, SOAP makes possible a delivery of client-specified parameters and other necessary parameters of the web-service from a UEC ColdFusion template to the server-based login.cfc component. After the parameters have been received, the invoked getAuthorized method queries the database as demonstrated in Figure 19. The query results are then stored in the getGroup variable that is a variable of a local scope of this method. The value of this variable is a return value of the method. This value is being transported back by the SOAP to the client application where it becomes accessible through the getAccess return variable (Figure 18). Since this variable is a query result, the user/group authentication can be easily validated by a number of the returned query

rows. The valid authentication must return a number of rows equal one. Therefore, if the authentication is valid we may use the returned query fields to obtain all information about a user in a particular group such as name, contact information, and his/her role in a group.

```

<cfcomponent>
<cffunction name="getAuthorized" returnType="query" output="false" access="remote">

    <cfargument name = "uName" type="string">
    <cfargument name = "pWord" type="string">
    <cfargument name = "lGroup" type="numeric">

    <!-- Now one has to identify if this user exists and belongs to any group -->

    <cfquery name="getGroup" datasource="ors_lite">

        SELECT u.LastName, u.FirstName, u.UserName, u.Password, u.Email, u.Id AS uId,
        g.Domain, g.GroupName, g.Description, g.Id AS gId, p.Role, p.Id AS pId, t.UserType
        FROM UsersGroupsRoles AS r
        INNER JOIN
        Users AS u ON r.UserID = u.ID
            INNER JOIN
            Groups AS g ON g.ID = r.GroupID
                INNER JOIN
                Roles AS p ON p.ID = r.RoleID
                    INNER JOIN
                    UserTypes AS t ON t.ID = u.UserType
        WHERE u.UserName = '#arguments.uName#' AND u.Password = '#arguments.pWord#' AND
        g.Id = #arguments.lGroup#

    </cfquery>

    <cfreturn getGroup>
</cffunction>
</cfcomponent>

```

Figure 19: Web-service implementation through login.cfc ColdFusion component

The getAuthorized method contained in the login.cfc component can be called not only from a UEC ColdFusion template but also internally from other web-services to enforce the security of their usage. The internal call of the login.cfc is encapsulated in

the search.cfc component. This CFC is an implementation of a web-service designed to search “Metadata” and “Publications” tables based on a set of keywords provided by an authenticated user.

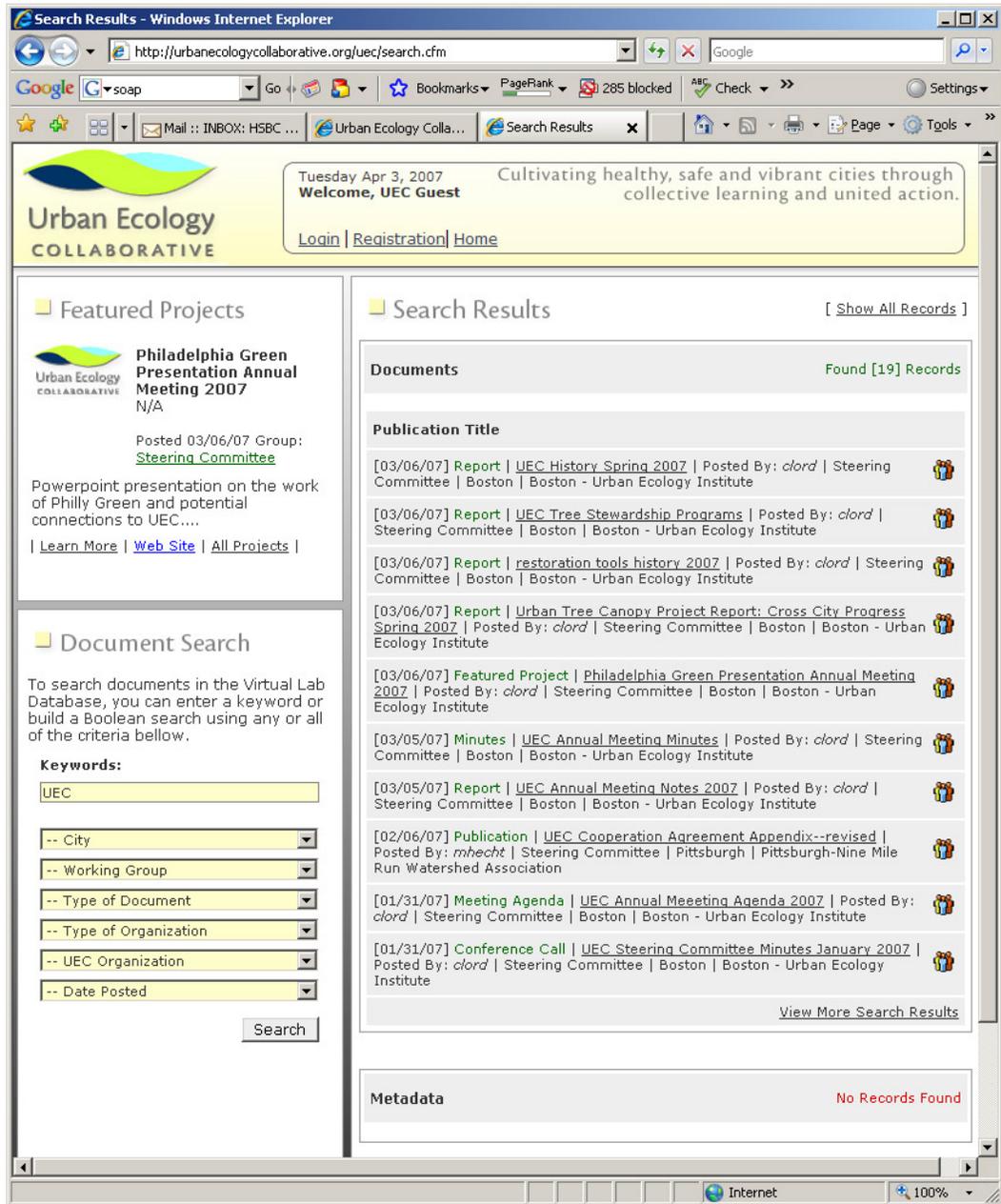


Figure 20: Search results returned from the web-services to the UEC ColdFusion template

When this web service receives a request it invokes `getSearch` method which in turn calls `getAuthorized` method in `login.cfc` to check whether a user is authorized to search data posted by members of a particular group. In case of authentication failure, the web-service returns the denial of access flag. In case of success the `getSearch` method will continue its work and obtain query results either from `collection_gis` or from `collection_pub` ColdFusion MX Verity collections. The collection for search is specified as a designated parameter of this web-service. These query results are then used to build an XML structure to return it to a client. In our example a client is the UEC ColdFusion template that invokes the web-service by submitting keyword(s) to the search web.

After the form values have been submitted, the form action template calls the `getSearch` method in `serch.cfc` that processes the web-service request and returns an XML tree of search results back to the template at which the request has been originated. The ColdFusion template processes this XML and transforms it into presentable HTML format. Figure 20 illustrates how search results in XML are transformed and presented at the `search.cfm` ColdFusion template of the UEC website after “UEC” keyword has been submitted for search and been processed by the web-service.

Web services that provide submissions of the datasets to the “Metadata” and “Publications” tables of the ORS 4.0 database are implemented as the `post_gis.cfc` and `post_pub.cfc` correspondingly. Each CFC has `postDataSet` method. When this method is invoked it calls `getAuthorized` method from the `login.cfc` in order to authenticate a user and then validates the method arguments passed as parameters of the web-service from the UEC website submission web form. The method `postDataSet` validates the arguments received and, if they are valid, saves them in a new record using SQL INSERT query. It

returns a flag of successful submission that is an attribute in the returned XML structure which also consists of all parameters passed to the web-service in order to repopulate the submission form on a client side. In case the method finds any invalidity in the set of arguments it returns the same XML structure with a flag of failure and error attributes for the invalid arguments found.

Web-services that update existing records in the database follow a similar logic to the submission web-services, except they use SQL UPDATE query to modify the existing dataset.

Calls to both submission and update web-services can be combined on a client side with requests of web-services that provide file uploads to user's file directory and allow extracting directory's structure and content with further export into XML. The first web-service has been implemented through the upload.cfc component with a main method doUpload. This method gets a binary or text file after it has been submitted from the UEC ColdFusion template and then, based on the user's authentication information accessed through the getAuthorized method of the login.cfc, transports this file through the network and saves into the user's dedicated disk space on the server hard drive. The allocation of files submitted by a user of a certain group has been designed with the following logic. Any path for a user's uploaded file on the server can be defined as ROOT\Upload\GroupID\Username\FileName. For example, if a user with a username "uecuser" belonging to the group with ID 10 uploads a file "presentation.ppt" then the path for the uploaded file relative to the root directory can be found as ROOT\Upload\10\uecuser\presentation.ppt.

Such a file organization becomes handy when another web service implemented through `dirinfo.cfc` gets a content of a user's directory based on his/her authentication. For example, if a user has a role of Group Administrator, he/she may obtain information about all files and folders belonging to his/her group. The administrator role permits a user to get the file structure of the entire virtual team domain while a group editor with Group Member role has access to his/her files only. The `dirinfo.cfc` component participates in building dynamic ColdFusion templates designed to submit and update data in order to create a list of uploaded files in select-type web forms.

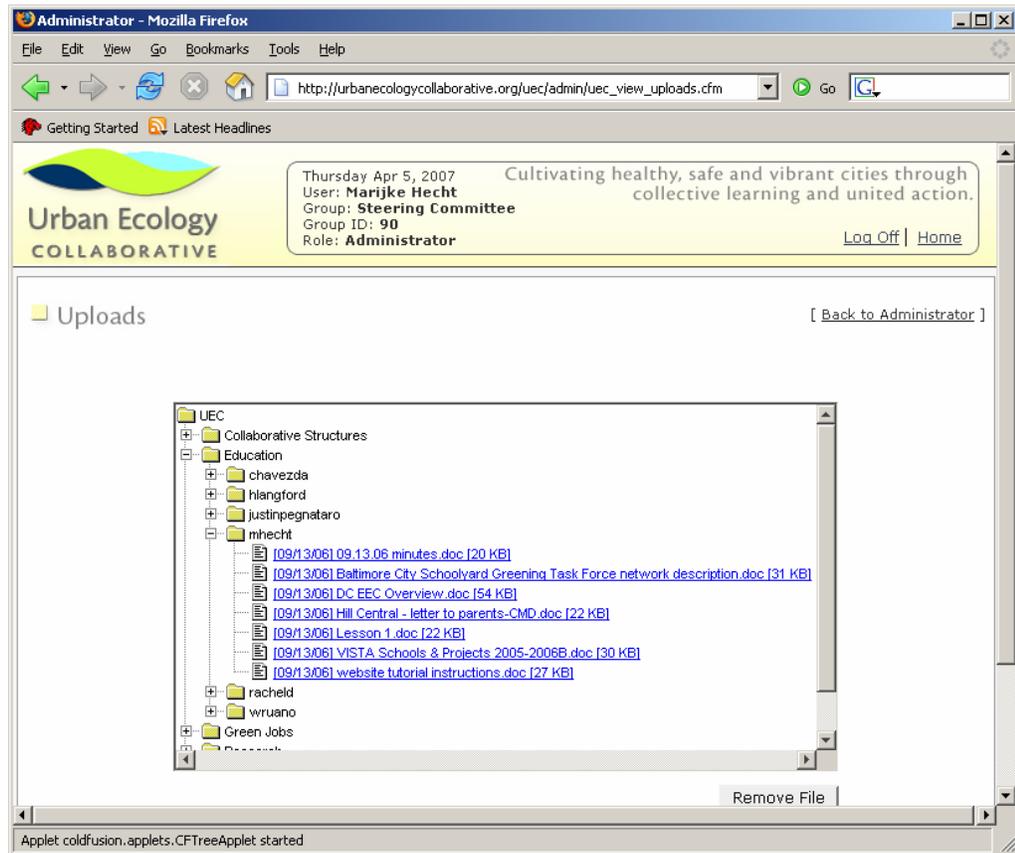


Figure 21: Organization of the uploaded documents

Therefore, before submitting a new record to the database or updating an existent record, a user may upload his/her files first so that they become available for selection at the web form. A user may select one or more files associated with the dataset and has the capability to unselect or add more files to any existing record at any time. This web-service is also used to view uploaded documents as shown on the Figure 21.

Finally, there is a web-service that allows the UEC web application to structure user registration and to invite new members to register at the website registration page. During registration, a user has to specify at which groups he/she wants to be registered with and must provide his/her contact information with parameters for authentication. This web-service has the remote method `regUser` that works similarly to the submission web-service described above, except it has no requirement to call the `login.cfc` component. It validates arguments passed to the web-service from the website registration form and either proceeds with insertion of a new record in the “Users” table in case of success or otherwise returns the XML structure back to the web form to repopulate it with data and to report errors.

3.8 Conclusion to Chapter 3

In this chapter, we first described the UEC organization. UEC is a social network of partnering organizations that is based on the decentralization and democratic management principles. To enhance its decentralized effectiveness, the UEC organization is exploring ways to promote the free flow and open access to information and resources by different means including its web application (UEC 2007). To assist the UEC in designing their web presence and collaborative platform, we took into account

(1) the current trends in the Internet towards gathering Internet users into online communities and (2) the necessity to provide the UEC web application with an effective content management system.

We developed a conceptual model for the UEC online community which incorporated principles derived from the SNS CMS model in which interactions among users are determined by their roles in certain segments of an online community. These segments or entities we referred as groups. In our conceptual model, groups and roles define relationships between a user and a dataset and thus set a framework for all possible interactions among model entities.

The UEC organization was offered to design a custom CMS to use as its website since most of the existing content management systems, for example Drupal, are authoring, blogging, or bulletin board oriented systems. These systems allow the creation and management of content -- mostly text formats -- but few of them have features to build sophisticated social network websites and to operate with large volumes of data in different formats (same concern here).

Taking into account the decentralization of the UEC we suggested ORS 4.0 middleware web-services package to build the web application for the collaborative. This package appeared as both being sufficient to implement the conceptual SNS CMS model at the UEC website and being capable to provide users under the UEC domain with access to shared ecological data through the flexible web-services API.

Currently the Urban Ecology Collaborative is actively using the system we described in this chapter. The “Administrator” and “Virtual Lab” toolkits available through the Internet are becoming important components of the UEC collaborative environment

(Hecht and Lord 2007) for urban ecosystem restoration. Though the usefulness and effectiveness of the UEC website performance needs further evaluation, over considerable time period we hope that the growing volume of share urban ecosystems data and the website capability to create new working groups will encourage new partners to join the UEC virtual team in the pursuing of “greening” of American urban centers, improving their public health, and creating new economic opportunities through revitalization of urban ecosystems.

CHAPTER IV

CONCLUSION

Chapters 2 and 3 provided examples of online communities related to the forestry sector. Chapter 2 focused on encouraging or connecting forest sector businesses over the Internet. Chapter 3 turned attention to improving collaborative efforts between organizations and sectors (public, nonprofit, private) in understanding Urban Ecology and in encouraging the sharing of knowledge and lessons learned between people working in geographically distant cities. A reader skimming this work might be asking several questions: What are the main contributions of each of these individual online community implementation experiences? What are the commonalities and differences between the two e-applications? What are some limitations of this work? And what are the broader implications of this work? I will briefly address these questions in sequence below in order.

First, what are the main contributions of the two studies? Chapter 2 of this thesis is innovative in that it provides a method for how forest products can be classified, described, and presented online. The case in the chapter could help to potentially revitalize forest sector B2B activities through the formalization of forest product specifications (e.g., the XML schema created). The absence of such specification made it difficult in the dot.com bubble era to trade forest products at the existing eMarketplaces due to complexity of their qualitative and quantitative properties. Chapter 2 of this thesis provides a reader with the approach to such formalization.

An important contribution of the case described in Chapter 3 could be used as guidance to many organizations or emerging collaborations similar to the UEC, in their efforts to exploit the capabilities the Internet to promote “virtual collaboration.” This work might also be of interest to people working in the forest sector business industry who are considering going online as a marketing tool for their products and services.

What are some commonalities to the two cases? The common feature of both systems presented in Chapter 2 and Chapter 3 is that users of these systems are geographically distributed, organizationally decentralized, and independent from each other in terms of data formats and software. At the same time, like other industries, forest sector businesses, research organizations, and organizations involved in forest management and policymaking are experiencing a strong demand for the application of content management systems (CMS) to promote collaboration. The web-services technologies, utilized in both case studies, are very effective and state-of-the-art mechanisms to (1) develop online CMS systems, (2) solve data integration challenges, and (3) create capabilities for growth both in the number of users and in the volume of data posted.

Though two mentioned systems have some commonalities they differ by the drive of why these systems have been created. While the Urbanecologycollaborative.org has been designed based on *the desire* of the existing UEC organization to enhance their collaborative activities with the Internet and present to the world what they do through the Internet, Timberia.org has been created rather based on *the demand* that forest sector experiences today and its community has just been started to form and grow. These are two very different system user-base trajectories. The UEC may have a better chance of continuing because it has a well-established user base. It is an open question whether

Timberia.org will be successful – for it depends on how well the system gets known and how fast it can build a database of products and sellers and how well it gets promoted to others (a diffusion of innovation question). By making the interface simple, and promoting direct email exchanges, and being aware of Internet search engine indexing strategies, it is hoped that Timberia.org will take off in terms of a user base, over time.

Both systems also face different issues regarding future financing. In the UEC case, it is whether the UEC group members can continue to raise money to support the collaborative system. In the Timberia.org case the financing of this system may be reached through establishing industry-specific sponsorships and alliances, providing marketing services and consultancy, advertising forest businesses, and accepting donations and contributions from the members.

What are the limitations of this work? The primary limitation of this research is that no real evaluation of both systems have been yet been conducted. The justification for such limitation is that the evaluation, whether it is a quantitative analysis of web traffic or a qualitative survey of system users, must be done over considerable time period. At time of this thesis submission these systems were just operational online. Consequently, in terms of server logs and other methods of tracking usability, there is not yet sufficient data to really evaluate either systems' performance. But an important component of this kind of work is some thinking of how to evaluate performance, but is outside the scope of this thesis. Undoubtedly, this evaluation will involve both qualitative indicators such as usefulness (e.g., an end-user survey) and replicability of the system, as well as quantitative metrics such as number and frequency of hits, geography of users, and number and frequency of submissions.

What are some broader implications of the work? We discussed Timberia.org and Urbanecologycollaborative.org as two examples of CMS solutions for forest sector eBusinesses and non-profit collaborative partnership. But the systems could be seen to provide two types of collaborative models in general (one in business, one in the nonprofit, research and education domain).

For example, the methodology of creating a collaborative platform presented in Chapter 3 of this thesis may provide a basis for long-term environment research groups who desire working in virtual teams to share research data and to participate in collaborative authoring of scientific content. I have already heard about groups like the NSF Long Term Ecological Research community or groups interested in studying and modeling the Earth's Pan-Arctic region in their need to collaborate globally. Some of these areas of research require an Internet platform for collaboration simply because the problems and issues scale to the globe and no one organization can tackle the problems alone. Further, and more on a technical side, the web-services technology described in Chapter 3 allows receiving inputs from any source such as human, web-based software, or any type of environment-sensing device. This flexibility embedded in the system design makes a process of research data collection easy and straight forward regardless of whether the end user is a human or a computer.

Though the presented methodologies undoubtedly can bring benefits to the above entities, there is an important consideration about the cost and utility of developing and supporting a system such as the ones I have developed. For example, people involved in the UEC wanted a custom system because of their high level of collaborative complexity. No open source existing CMS appeared to have all the functionality they desired.

However, before making a decision about adoption of this methodology and creating a custom CMS as one presented in this thesis, one should consider the proposed system with existing open-source CMS (e.g., Drupal) in order to find a trade-off between the expected utility and development cost.

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