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Electronic Commerce Adoption in the Hardwood Industry

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Abstract: *The U.S. hardwood industry must follow the lead of corporate America in adopting e-commerce to remain competitive domestically and globally. A mail survey was conducted to investigate e-commerce adoption and trends among West Virginia primary and secondary hardwood industries. About 47% of the respondents have adopted e-commerce in their business. Factors influencing e-commerce adoption include firm output, export activity, and industry type. The top three reasons for adopting e-commerce include greater exposure to potential customers, improvement of service to customers, and improvement of company's competitiveness. The three major concerns for not adopting e-commerce include profitability, information security, and cost.*

Introduction

Extension forestry programs work with forest landowners and the forest products industry to develop local and sustainable industries that can have major impacts on

community development. This is especially important in rural areas, where forestry activities often take place and where other industries and opportunities are typically scarce. Markets for forest products are not typically located where forests and mills are located. This requires the forest products industry to network and market their products on a regional, national, or even global scale. However, physical markets are no longer absolutely necessary in the buying and selling of goods and services. Digital technology has paved the way to the development and growth of a digital economy and the electronic market place.

The electronic market place has grown tremendously in the last two decades. Market transactions in this market place can be referred to as "electronic commerce" or "e-commerce" and includes activities such as marketing and selling over the Internet, electronic data interchange (EDI), online research, emailing, and computer faxing (Barkely, Lamie, & Markley, 2007). E-commerce has created a new paradigm for carrying out business transactions and can have important impacts on business operations. It reduces transaction costs, allows for faster and more effective communication, removes geographic and temporal limits, and gives consumers a wider range of product choices (Perry & Schneider, 2002). The use of e-commerce to carry out business transactions has become a priority for many businesses (Ngai &Wat, 2002).

Many U.S. companies, ranging from electric utilities to credit card firms to computer equipment manufacturers, have adopted e-commerce (Georgiou & Stefaneas, 2002) to maintain a competitive advantage in their businesses. There is also a growing interest in the forest products industry in the adoption of e-commerce, but its application has been limited, and adoption rates have remained low. In fact, a comprehensive review of key studies from 1996 to 2008 regarding e-commerce adoption in the U.S. and Canadian forest product industries conducted by Hewitt, Sowlati, and Paradi (2011) revealed that both U.S. and Canadian forest product firms have been slow in incorporating information technology into their business.

While a number of studies have looked at e-commerce adoption among forest products firms, most were done in mid 1990s to early 2000s. With the rapid nature of technological advancement in e-commerce, more research is needed to examine how e-commerce adoption in the forest products industry has changed during the past few years (Hewitt et al., 2011). Moreover, these studies have focused on e-commerce activities of relatively large companies, mainly primary industries and exporters (e.g., Vlosky, Westbrook, & Poku, 2002; Stennes, Stonestreet, Wilson, &

Wang, 2006). While these relatively large companies have began adopting e-commerce in their business operations, other industries (i.e., secondary industries, smaller companies) must follow suit to survive. Of particular interest is how the forest products industries in the U.S. hardwood sector, which are typically small and independent (Vlosky & Smith, 2003), are responding to e-commerce.

The U.S. hardwood industry is one of the largest hardwood producers in the world. However, with the downturn of the economy and increasing global competition, this industry has suffered tremendously in the past few years. Increasing participation in e-commerce becomes even more important to increase productivity and efficiency. Approximately 97% of total hardwood production in the U.S. is coming from the eastern forests. West Virginia (WV) serves as a classic example of a hardwood-producing region in the U.S. Hardwoods make up over 90% of the state's forest cover (Griffith & Widmann, 2003). In addition, 97% of the industrial roundwood processed by WV's primary wood-using mills were hardwood species (Piva & Cook, 2011), reiterating the state's role as a major hardwood producer.

There is limited information available on e-commerce adoption among any specific hardwood-producing region and more so on the factors affecting e-commerce adoption. This article investigates e-commerce adoption in WV's hardwood forest products industries as well as the factors driving e-commerce adoption among these industries. The results of the study can help forestry and community development Extension specialists and county-based Extension agents throughout the region to develop appropriate outreach educational opportunities and support services that can demonstrate the benefits and use of e-commerce technologies with this industry.

Methods

A mail survey was conducted in 2007 to collect information related to e-commerce adoption among primary and secondary hardwood industries in West Virginia. The survey included questions from previous forest industry studies (e.g., Shook, Zhang, Braden, & Baldridge, 2002; Vlosky & Smith, 2003). A summary of the information collected from the survey include:

- Industry demographic characteristics (e.g., firm age, no. of workers, output)
- E-commerce activities (e.g., customer contacts, web sites, marketing, sales)
- Perceived benefits from adopting e-commerce (e.g., increased access to industry information, increased exposure to potential customers, reduced costs

of business operations)

- Impediments/constraints in the adoption of e-commerce (e.g., availability of technical resources, security, availability of IT personnel, costs)

Names and addresses of the companies surveyed were obtained from the Forest Industry Database maintained by the Appalachian Hardwood Center (AHC). Dillman's (2000) Tailored Design Method was used in developing and administering the survey. Three mailings were sent to potential respondents to ensure a high response rate: initial mailing, follow-up mailing (3 to 4 weeks after the initial mailing), and final mailing to non-respondents (3 to 4 weeks after the follow-up).

Summary statistics were calculated for the variables collected from the survey. In addition, a regression analysis was conducted to examine factors affecting e-commerce adoption among West Virginia forest products firms. The response variable in the model was whether or not a firm adopted e-commerce in its business. Descriptions of the variables included in the model are reported in Table 1. These variables were found to be significant factors influencing e-commerce adoption among businesses (e.g., Chaterjee, Rajdeep, & Sambamurthy, 2002; Van Beren & Thompson, 2002; McGregor & Vrazalic, 2005; Hong & Zhu, 2006). Thus, these variables were also hypothesized to influence e-commerce adoption among WV forest products firms. Because there was a strong correlation between firm size and output, only the latter was included in the model and was used as a proxy for firm size.

Because the response variable is binary, a linear estimation is not appropriate. Therefore, the model was estimated using logistic regression. LIMDEP (Version 8.0) software was used to estimate the model parameters.

Table 1.

Descriptions of the Variables Used in the Regression Model That Examines Factors Affecting E-Commerce Adoption Among Forest Products Industry Survey Respondents, West Virginia

Variables	Description
ECOMMERCE	E-commerce adoption; coded 1 if the firm adopted any of the e-commerce tools in its business and 0 if not.
AGE	Firm age; coded 1 if more than 40 years and 0 if

	otherwise.
OUTPUT	Previous year gross sales revenue; coded 1 if >$500,000 and 0 if otherwise.
CUSTOMER	Customer base; coded 1 if wholesaler and 0 otherwise.
EXPORT	Firm export activity; coded 1 if the firm is involved in the export market and 0 if otherwise.
INDUSRTY	Industry type; coded 1 if primary and 0 if secondary.

Results

Survey Results

Of the 287 questionnaires that were initially mailed out, 19 were returned due to undeliverable addresses and industries that were already out of business. Thus, the effective sample size was reduced to 268. The survey resulted in 56 usable responses or a 21% response rate. The response rate achieved in this survey is typical of studies in the forest products industry, such as 15.2% in Quesada-Pineda, Conn, and Sanchez (2011), 20% in Buehlmann, Espinoza, Smith, and Bumgardner (2011), 30% in Naka (2009), and 18% in Denig (2008).

To address for the possibility of a non-response bias, the distribution of early respondents was compared to the distribution of late respondents based on two demographic variables (i.e., firm size and years in business) using the Kolmogorov-Smirnov test (K-S test). The basic assumption is that late respondents are a proxy for non-respondents (Lin & Schaeffer, 1995). Results of the K-S tests indicate that the distribution of the early respondents with respect to firm size (K-S statistic = 0.18; p-value = 0.72) and firm age (K-S statistic = 0.14; p-value = 0.92) was not statistically different from that of the late respondents. Thus, the survey results are representative of the study population.

Industry Characteristics

Most respondent companies are small, with less than 10 employees per company and have been in business for more than 50 (Table 2). The majority of respondents have gross sales revenue of greater than $500,000 through a wholesale customer base and have not yet participated to any great extent in export markets.

Table 2.

Characteristics of the Forest Products Industry Survey Respondents, West Virginia (n=56)

Characteristics		**% of Respondents**
Main Headquarter	West Virginia	84
	Out-Of-State	16
Number of Employees	<10	38
	11-20	14
	21-30	16
	31-40	4
	41-50	4
	51-100	9
	>100	16
Company Age	<5	4
	5-10	9
	11-15	13
	16-20	7
	21-30	16
	31-40	16
	41-50	7
	>50	29
Gross Sales Revenue in previous Year	<$500,000	25
	>$500,000	66
	No Answer	9
	Wholesalers	50

Primary Customer Base	Distributors	25
	Retailers	25
Exporter	Yes	20
	No	80

E-Commerce Application

About 46% of the respondents reported to have adopted some form of e-commerce technology in their business operations. The results of regression analysis indicate that firm output (i.e., revenue), export activity, and industry type were significant factors affecting e-commerce adoption (Table 3). Companies with earnings greater than $500,000 were more likely to adopt e-commerce. This is also true for companies that export their products abroad. In addition, primary forest products companies were less likely to adopt e-commerce compared to secondary forest products companies.

Table 3.

Results of the Regression Model That Examines Factors Affecting E-Commerce Adoption Among Forest Products Industry Survey Respondents, West Virginia (standard errors in parentheses)

Variable	**Parameter Estimate**	**Mean**
Constant	-1.89 (0.84)	-
AGE	-0.54 (0.78)	0.36
OUTPUT	1.84** (0.91)	0.72
CUSTOMER	0.18 (0.72)	0.52
EXPORT	1.61* (0.97)	0.20
INDUSRTY	-1.30* (0.76)	0.56
Likelihood Ratio = -0.27.98, Chi-Square Value = 12.62, P-Value = 0.02, Total number of observations = 50, **Significant at the 5% level, *Significant at the 10% level		

Of those who adopted e-commerce, 35% adopted e-commerce technologies prior to 2000, while the majority adopted these technologies later as these tools became

increasingly mainstream (Table 4). The most common e-commerce tool employed is email (Table 5). While most of the companies have websites, less than half use other commercial websites to market and sell their products. However, they use e-commerce technologies to take customer orders and purchase their own supplies from other websites. Most respondents have spent less than $10,000 on their e-commerce-related activities since adoption (Table 6). The majority (60%) of those who have not adopted any type of e-commerce technology reported that they have no plan of adopting e-commerce in the near future.

Table 4.

Year That Forest Products Industry Survey Respondents First Adopted E-Commerce in Their Business Operations, West Virginia (n= 26)

Year	**% of Respondents***
Prior to 2000	35
2000	15
2001	12
2002	8
2003	8
2004	12
2005	4
*Do not add up to 100% because some respondents chose not to answer the question.	

Table 5.

E-Commerce Activities Employed by the Forest Products Industry Survey Respondents Who Adopted E-commerce in Their Business Operations, West Virginia (n=26)

E-Commerce Activities	**Adoption (% of respondents)***	
	Yes	**No**
Use email for communications	100	0

Purchase company supplies online	85	12
Website	81	12
Use of internet for customer orders	77	19
Use internet banking for financial transactions	46	42
Advertise or sell products on other company's website	42	50
*Some activities do not add up to 100% because some respondents chose not to answer the question/s.		

Table 6.

Expenditure of Forest Products Industry Survey Respondents on E-Commerce Applications Since Adoption, West Virginia (n=26)

Expenditures ($)	**% of Respondents***
<10,000	46
10,000-50,000	15
50,001-100,000	8
100,001-250,000	4
250,001-1,000,000	15
*Do not add up to 100% because some respondents chose not to answer the question.	

Perceived Benefits and Constraints in E-Commerce Adoption

Customer service improvement, greater exposure to potential customers, greater access to vendors, and improvement in company competitiveness were ranked as most important perceived benefits among those who adopted e-commerce (Table 7). The three major concerns reported by respondents who have not adopted e-commerce include the security of sensitive information, cost, availability of technical resources, and profitability (Table 8).

Table 7.

Perceived Benefits from E-Commerce Adoption by Forest Products Industry Survey Respondents Who Adopted E-Commerce, West Virginia (n=26)

Perceived Benefits	**Very Important (%)**	**Important (%)**	**Not very important (%)**	**Not at all Important (%)**
Improve service to customers	83	28	0	4
Greater exposure to potential customers	77	12	4	8
Greater access to vendors	65	31	4	0
Improve competitiveness	65	19	15	0
Increased accessed to industry information	58	23	8	11
Increase sales	58	19	19	4
Enhance image of company	46	31	19	4
Increase customer retention	46	23	27	4
Lower cost of doing business	46	27	19	8
Faster product/service delivery	46	31	11	11

Lower prices to customers	27	23	35	15

Table 8.

Constraints in E-Commerce Adoption by Forest Products Industry Survey Respondents Who Did Not Adopt E-Commerce, West Virginia (n=30)

Constraints	**Major Concern (%)**	**Concern (%)**	**Not a concern (%)**	**Not a major concern (%)**
Security of sensitive information	50	27	6	17
Cost	40	30	17	13
Availability of technical resources	33	23	25	19
Not profitable	33	11	33	24
Loss of contact with customers	28	35	14	22
Training of personnel	21	33	21	25
Need to change established procedures	21	39	25	15
Need to restructure the company	8	19	32	40
It is a passing fad	4	9	33	59

Summary and Discussion

Close to 50% of the hardwood industries in WV have adopted some form of e-commerce tool. Low e-commerce adoption rate in the forest products industry was

also reported by Shook et al. (2002) and Vlosky and Smith (2003). E-commerce adoption in WV's hardwood industry has a tremendous opportunity to expand in the next decade. About 35% of those companies that have adopted e-commerce adopted practices before 2000, which corresponds well to the dramatic increase in Internet use in the forest products industry around the late 1990s (Southern Lumberman, 1998). However, almost 60% made these adoptions in the 6 years following 2000. As technology continues to become ingrained in every aspect of life, there is still a huge opportunity in the hardwood industry to facilitate appropriate e-commerce technologies to the 54% of companies that have not yet adopted any e-commerce practices.

Use of email and websites and online purchase of supplies were the most common e-commerce tools used. This is consistent with the findings of previous studies (e.g., Pitis & Vlosky, 2000; Shook et al., 2002) and supports the claim of Hewitt et al. (2011) that most forest products firms used only basic e-commerce technology. Forest products firms in general are still in the information and communication space (e.g., emails, websites) of the "Internet Business Strategy Evolution" model as oppose to the distribution and transaction space (e.g., online transactions) (Hewitt et al., 2011).

Firm output, export activity, and industry type were significant factors affecting e-commerce adoption among WV forest products industry. The results indicate that larger companies (as measured by output/revenue) were more likely to adopt e-commerce compared to smaller companies. Hewitt et al. (2011) also found that firm size is positively correlated to e-commerce adoption rates. According to Shook et al. (2002), smaller companies usually lack the internal structure to handle adoption of new technologies.

Companies that export their products were more likely to adopt e-commerce. Previous studies have also found a strong relationship between the use of e-commerce and export markets (e.g., Pitis & Vlosky, 2000; Stennes et al., 2006). E-commerce tools allow companies to lower expenses in overseas communications while greatly increasing their geographic markets. In fact, companies that are exporters tend to adopt e-commerce tools because of promotion benefits and increased operating effectiveness (Pitis &Vlosky, 2000). Additionally, secondary forest products firms were more likely to adopt e-commerce than primary forest products firms. This may be attributed to the additional processing and increased value in the secondary products, as compared to the lower valued (commodity) primary industry products (Kozak, 2002, Hewitt et al., 2011).

Not a whole lot has changed in the behavior of the forest products firms since the 1990s in terms of e-commerce adoption. Applications are still limited to basic e-commerce tools. The industry must move beyond the basics to more sophisticated applications of e-commerce (e.g., online financial transactions, EDI, supply chain management technologies). This means that firms should invest more on e-commerce technology.

With the level of e-commerce engagement and the rudimentary types of implementation in the forest products industry, Extension-based outreach has the opportunity to provide technology skills, knowledge, and frameworks to help lagging companies benefit from e-commerce. Extension programs will need to specifically target the perceived barriers to implementation identified in Table 8 through simple, industry-specific examples and resources that can be easily applied and assessed by the individual companies. For instance, with almost 60% of those who are currently not using e-commerce indicating that they have no plan of adopting e-commerce in the near future due to security of sensitive information, cost, and availability of technical resources, a workshop that discusses topics like secure payment systems could demonstrate a number of different technologies and explain the potential risks and the requirements to minimize these risks or what to do if there is a security breach. The Extension educator should provide potential resources and demonstrate how they could be incorporated into the forest product business, leaving the company with the tools and implementation strategy to assess a new e-commerce tool within their own context.

WV's hardwood forest products industry and other smaller, independent forest product companies in the region can benefit from the use of appropriate e-commerce tools and technologies to improve their operations. Extension forestry programs can provide many of the resources that will minimize risk, complexities, and improve the overall e-commerce accessibility to the industry.

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