

MANAGEMENT

THE USE OF EBUSINESS IN THE PACIFIC NORTHWEST SECONDARY FOREST PRODUCTS INDUSTRY

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ABSTRACT

Electronic-based technologies (e.g., Internet, World Wide Web) have launched a revolution in business activities in recent years. The use of eBusiness technologies within the context of forest products manufacturing has been studied very little despite the fact that these technologies have the potential to dramatically change how wood and wood-based products are marketed and exchanged between buyers and sellers. This study intends to provide additional information concerning the use of eBusiness technologies in the forest products industry to the small body of literature reporting on the subject. A census of secondary forest products manufacturers in three Pacific Northwest states (Idaho, Montana, and Washington) was conducted. The relationships between how manufacturers use eBusiness technologies and their demographic features were evaluated. Results suggest that the use of eBusiness technologies by secondary forest products manufacturers in the Pacific Northwest is independent of geographical location but significantly correlated with manufacturing plant size. Results concerning future use of eBusiness technologies by surveyed firms are also reported in this study.

The growth in the use of the Internet and the World Wide Web has been explosive over the last decade. For example, the number of people utilizing on-line services has increased from 50 million in 1996 to over 373 million in 2000; it is projected that in 2005 there will be 765 million people on-line (18). The exponential growth of the on-line population, coupled with economic globalization, has made the application of the Internet in commerce not so much a symbol of technological advances but an imperative for daily exchange. The last decade has witnessed the evolution of computer-based business from conceptual vision to concrete reality in today's business world. The ongoing convergence

of the global Internet with commerce is revolutionizing the way business is being conducted. Although the fundamental business concerns are those that merchants have faced for hundreds of years, the emergence of the Internet has

changed the commercial environment by employing technological capabilities that forge new interfaces between manufacturers, wholesalers, retailers, and customers.

"eBusiness" is defined by the U.S. Department of Commerce's Economic and Statistics Administration as "any process that a business organization conducts over a computer-mediated network" (5). Examples of on-line eBusiness processes include: purchasing, selling, vendor-managed inventory, production management, and logistics, as well as communication and support services such as on-line training and recruiting. Computer-mediated networks are electronically linked devices that communicate interactively over network channels.

There are many motivations for a company to be involved in eBusiness. The Internet provides businesses the ability to improve customer service. Even small companies can efficiently

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reach customers around the world. The technological nature of Internet infrastructure enables a business to know more about its customers' profile, build more informative channels to bridge its products and services with customers' needs, and accordingly improve firm-customer intimacy with the expectation of increasing sales, margins, and profits.

One of the more evident advantages of the Internet is that it significantly lowers the distribution costs for information. The costs of the network are shared across multiple applications and passed on to end-users. Businesses and consumers connected to the Internet pay for their own connections; they are then free to use the network for any number of purposes. Consequently, a provider of information does not need to pay for a distribution system other than its own connection to the network. The cost of accessing Internet infrastructure is amortized across a wide variety of applications since many users share the network. Additionally, Internet commerce dramatically improves the ability to keep information current. In a world where customers are demanding more information about the products and services they purchase or intend to purchase, the ability to deliver that information economically and efficiently can become a crucial element for success in business.

EBUSINESS AND THE FOREST PRODUCTS INDUSTRY

Vlosky and Gazo initiated research on applications of the Internet in the U.S. forest products industry in 1996 (17). Their research indicated that better access to product information and direct contact with the sales department ranked as the greatest incentives for Internet applications in the forest products industry. Overall, they found that the Internet was being used more as a selling tool than as a purchasing tool. Secondary manufacturers, believed to be more consumer-oriented, were found to use the Internet more intensively than primary manufacturers in both sales and purchasing. Vlosky and Gazo comment that wider adoption of Internet applications by large primary producers will be inevitable as sourcing information from the Internet will become more and more imperative to create competitive advantages. For example, the Internet can create a competitive advantage by enabling companies to short-circuit traditional

"bricks and mortar" distribution channels, thereby reducing several types of transaction-related costs.

Additional research has been conducted on the adoption of extranets within the forest products industry. An extranet is an aspect of eBusiness that allows business partners to economically link to one another through the Internet. One survey of the forest products industry found that order management techniques, such as tracking, order status, and shipping notices, were the most cited extranet applications (4). In a 1996 survey, Vlosky and Pitis compared extranet applications in the forest products industry with that of the general U.S. industry (18). Their research revealed that the forest products industry's overall concern with using extranets was generally higher than other industries. One concern was that the use of extranet technology in the forest products industry would reduce customer contact with the company's sales force.

Another study of the use of the Internet in the forest products industry revealed that 57 percent of wood products exporters believed that their industry lagged U.S. industry in general in terms of using Internet-based technologies (15). Collectively, the results found in past research suggest that the forest products industry is more conservative in applying Internet technology to its business activities compared with overall U.S. industry.

OBJECTIVES

While several research studies concerning the adoption of eBusiness technology in the forest products industry have been conducted, research has not been devoted to assessing the use of eBusiness technology by secondary forest products manufacturers using a census of firms from a concentrated region. The objectives of this study were twofold. First, utilizing an industry census, this study attempted to determine the extent that secondary forest products firms in the Pacific Northwest utilize eBusiness technology. Second, this study sought to uncover the relationship between demographic information regarding secondary forest products firms and firm usage of eBusiness technology. The information collected in this study can assist eBusiness solution providers in identifying and targeting market segments more likely to adopt eBusiness

technologies. Additionally, the results allow secondary forest products manufacturers to assess their own eBusiness use relative to industry peers.

SURVEY DESIGN AND METHODOLOGY

This study examined the use of various eBusiness technologies by secondary forest products manufacturers located in the Pacific Northwest region of the United States. Specifically, this study assessed eBusiness use within the states of Idaho, Montana, and Washington. A census of secondary wood products manufacturers located in these states was conducted using telephone survey methodology. A significant advantage of telephone surveys over mail surveys is that they can be conducted in rather short spans of time (2). Since a snapshot of industry use of eBusiness technologies was desired, it was deemed appropriate to utilize a telephone survey so that time covered in collecting the survey data would have less of a biasing effect on the survey results. Also, telephone surveys generally result in higher response rates than mail surveys (2).

Contact information for the entire population of secondary forest products manufacturers in Idaho, Montana, and Washington was collected from a variety of secondary sources (1,3,8,12-14). Additional contact information was collected from private unpublished databases at the University of Idaho, the University of Montana, Washington State University, and the University of Washington. Note that data collection was conducted at the plant level. Therefore, larger firms operating more than one production facility were contacted more than once. The number of firms operating more than one production facility in this study's census of manufacturers amounted to less than 3 percent of all respondents. A total population of 1,438 plants was included in the industry census, representing 401, 400, and 637 secondary forest products manufacturing plants located in Idaho, Montana, and Washington, respectively.

Dillman's total design methodology was employed throughout the process of conducting the census (2). Five academic researchers, with the assistance of a survey design expert, developed a preliminary telephone survey instrument. The telephone questionnaire was pre-tested by contacting approximately

TABLE 1. — Profile of Idaho, Montana, and Washington secondary wood products manufacturing plants.

Firm characteristics	State of operation ^a			Total (n = 780)
	Idaho (n = 209)	Montana (n = 228)	Washington (n = 343)	
Percentage of plants producing ^b				
Furniture, cabinets, or related components	51	55	51	52
Millwork, building, or structural components	51	48	41	46
Other products	30	37	32	33
Total dollar value of plant 1999 gross sales revenue				
Median	650,000	350,000	1,000,000	600,000
Mean	3,269,517 AB	1,394,304 A	5,099,896 B	3,501,913
Total number of full time equivalent plant employees in 1999				
Median	8	4	12	7
Mean	24.3	14.9	28.7	23.5
Percent of plant capacity utilized in 1999				
Median	85	90	80	85
Mean	79.4	81.4	77.8	79.3
Total dollar expenditure for wood-based raw materials in 1999				
Median	192,000	80,000	300,000	167,500
Mean	1,554,662 AB	365,377 A	2,701,067 B	1,687,302
Total dollar expenditure for nonwood-based raw materials in 1999				
Median	80,000	35,000	100,000	60,000
Mean	792,270	427,449	550,229	569,307
Ratio of wood-based to nonwood-based raw material expenditures in 1999				
Median	2.50	2.50	2.37	2.50
Mean	8.49	5.53	6.86	6.84

^a Comparison of means across states is represented by the capital letters A and B (Scheffé's contrast test, 0.05 α -level). States that have statistically similar means on a particular statistic share the same letter. Lack of A and B notations indicate that the means were statistically similar across all three states.

^b The sum of the percentages in the product categories for each state is greater than 100 percent since firms were allowed to be categorized into multiple product categories.

24 secondary forest products manufacturing plants that were considered to be representative of the intended respondents in each of the 3 states. Results from the pre-test were used to refine the final survey instrument used in the study. Secondary forest products plants located in Montana were contacted first, followed by manufacturers in Idaho, then Washington. Data in this study were collected during August and September 2000 at a telephone survey center housed at the Bureau of Business and Economic Research, University of Montana, located in Missoula.

RESULTS AND DISCUSSION

DEMOGRAPHIC PROFILE OF RESPONDENTS

Out of the 1,438 secondary forest products manufacturing plants surveyed, a total of 780 completed the telephone survey. A total of 33 manufacturing plants were determined to be duplicates within the survey database. Another 221 manufacturing plants were either out of business or could not be traced from the original database contact information. A total of 134 manufacturing plants were

determined to be primary forest products plants or plants that utilized no wood in their production of goods. This reduced the effective census size of the survey to 1,060 (Idaho = 280, Montana = 280, Washington = 500). The effective response rate for the survey, therefore, was 73.6 percent; this compares to response rates of 18, 36, and 45.7 percent reported in recent studies on eBusiness use in the forest products industry (10, 16, 17). The number of completed surveys for Idaho, Montana, and Washington numbered 209, 228, and 343, respectively. Firms located in Montana exhibited the highest survey response rate at 81.4 percent, followed by Idaho and Washington with response rates of 74.6 and 68.6 percent, respectively. Non-respondents to the survey were represented by either plants where an individual at the plant could not be reached ($n = 108$) or direct refusals ($n = 172$).

Demographic statistics of secondary forest products manufacturers located in Idaho, Montana, and Washington are shown in **Table 1**. The survey data revealed that 52 percent of the plants in

these states manufacture furniture, cabinets, or related components. Approximately 46 percent of the responding secondary manufacturers produced millwork, building, or structural components. One-third of the secondary manufacturers produced other products. Note that secondary manufacturers could indicate more than one product category when responding to the survey. Comparison of the products produced across states did not indicate any statistically significant differences in the percentages reported in the analysis.

The median total dollar value of plant-level gross sales revenue in 1999 across the three states was \$600,000, while the mean plant-level gross sales revenue in the same period was found to be slightly more than \$3.5 million (**Table 1**). The secondary forest products manufacturing plants responding to the survey represented more than \$2.73 billion in gross sales revenue in 1999. The \$5.10 million in mean gross sales revenue calculated for Washington plants was found to be significantly greater than the \$1.39 million in average gross sales rev-

TABLE 2. — *eBusiness characteristics of Idaho, Montana, and Washington secondary wood products manufacturing plants based on state of operation and firm size.*

eBusiness characteristic (question asked in survey)	State of operation			Plant size ^{a,b}			Total (n = 780)
	Idaho (n = 209)	Montana (n = 228)	Washington (n = 343)	Small (n = 376)	Medium (n = 193)	Large (n = 180)	
	----- (% of plants) ^c -----						
Does plant have a website?	29.9	30.0	35.0	22.2 A	37.0 B	46.6 B	32.2
Does plant use e-mail?	52.7	51.8	55.2	43.5 A	54.6 B	74.3 C	53.5
Does plant take customer orders over the Internet?	19.7	18.2	24.0	18.4 A	21.0 AB	28.4 B	20.5
Does plant advertise or sell products or services on anyone else's website?	11.8	17.3	12.0	11.2	12.9	17.5	13.1
Does plant buy supplies or equipment using the Internet?	23.6	20.9	22.2	17.1 A	25.8 AB	30.5 B	21.5
Does plant do banking functions using the Internet?	10.3	6.4	8.1	5.3 A	8.1 AB	14.7 B	7.9
Does plant search Web to gather business-related information?	61.1	60.5	67.0	53.1 A	68.3 B	80.7 C	61.5
Does plant plan on using eBusiness methods next year? ^d	64.8	64.2	65.5	58.8 A	69.6 B	73.1 B	60.5

^a Comparison of percentages across plant sizes categories is represented by the capital letters A, B, and C (Scheffé's contrast test, 0.05 α -level). Plant size categories that have statistically similar percentages on a particular statistic share the same letter. Lack of A, B, and C notations indicate that the percentages were statistically similar across all plant sizes. Note that no significant differences were found when comparing responses based on firms' state of operation.

^b Plant size based on number of employees at secondary manufacturing facility. Plants with 7 or fewer employees were coded small plants; plants with 8 to 20 employees were coded medium-size plants; plants with 21 or more employees were coded as large plants.

^c All data reported as the percent of plants responding affirmatively to each survey question.

^d Plants were asked to indicate whether they planned on using eBusiness methods next year (2001) regardless of whether or not they were currently using eBusiness methods.

enue reported by Montana manufacturing plants (Scheffé's contrast test, p -value ≤ 0.05). The mean gross sales revenue of Idaho manufacturing plants (\$3.27 million) was found to be statistically similar to those in Montana and Washington.

The median and mean number of employees at manufacturing plants across the three states was reported to be 7 and 23.5, respectively (Table 1). Montana manufacturing plants reported a median of 4 and mean of 14.9 employees. Idaho manufacturing plants reported a median of 8 and mean of 24.3 employees, while Washington manufacturing plants reported a median of 12 and mean of 28.7 employees. No statistically significant differences were uncovered when a comparison in the number of employees by state was conducted in the data analysis.

The median dollar expenditure of wood-based raw materials purchased by manufacturing plants in 1999 was \$167,500, while the mean was reported to be \$1.69 million (Table 1). The total cost in 1999 of wood-based raw materials purchased by all responding secondary forest products manufacturers within the three states surveyed amounted to more than \$1.316 billion. Manufacturing plants located in Washington reported a median of \$300,000 and a mean of \$2.70 million in wood-based raw materials expenditures in 1999, which were found to be significantly greater

than those reported by Montana manufacturing plants, which reported a median of \$80,000 and mean of \$365,377 (Scheffé's contrast test, p -value ≤ 0.05). Similar to the gross sales revenue results discussed previously, Idaho manufacturing plants were not found to be statistically different from either Montana- or Washington-based manufacturing plants with regard to their wood-based raw material expenditures in 1999.

The median expenditure for nonwood-based raw materials purchased by manufacturing plants in 1999 was \$60,000, while the mean was reported to be \$569,307 (Table 1). The total cost in 1999 of nonwood-based raw materials purchased by all responding secondary forest products manufacturers within the three states surveyed amounted to more than \$444.1 million. Manufacturing plants located in Washington reported a median of \$100,000 and a mean of \$550,229 in nonwood-based raw materials expenditures in 1999 compared to Montana's median of \$35,000 and mean of \$427,449. Idaho manufacturing plants reported a median of \$80,000 and mean of \$792,270. No statistically significant differences were uncovered when the 1999 nonwood-based material cost data were compared across states.

The median ratio of responding plants' 1999 wood-based to nonwood-based raw material expenditures was calculated to be 2.50, which suggests that on average

responding manufacturing plants spent 250 percent more on wood-based raw materials in the production of goods than they did for nonwood-based raw materials (Table 1). A mean ratio of wood-based to nonwood-based expenditures is much larger, indicating that plants spent 684 percent more on wood-based raw materials than on nonwood-based raw materials. Idaho manufacturing plants were found to be the most intensive users of wood when evaluating usage by the raw material expenditure ratio, while Montana manufacturing plants were the least intensive. Note, however, that no statistically significant differences were uncovered in the expenditure ratio analysis when comparing data across states.

The average total wood-based and nonwood-based expenditures in 1999 represent slightly more than 64 percent of the manufacturing plants' average 1999 gross sales revenue. Montana exhibited the lowest ratio of total raw material expenditures to total gross sales revenue at 56.9 percent, while Idaho exhibited the greatest ratio at 71.8 percent (Washington = 63.8%). If we utilize these percentages as a crude measure of value-added processing by the manufacturing plants and assume that other factor inputs are equivalent between the three states, then the data suggest that Idaho manufacturing plants are adding the least value in processing, while

TABLE 3. — Characteristics between users and nonusers of various eBusiness technologies and practices in the Pacific Northwest.

eBusiness characteristic (questions asked in survey)	Response	Mean responses for 1999 plant data ^a				
		Value of total gross sales (million \$)	Sales from wood-based products ^b ----- (%) -----	Plant capacity utilization	No. of full time equivalent employees	Ratio of wood to nonwood raw materials costs
Does plant have a website?	Yes (n = 243)	4.54	91.0	75.9*	31.9*	5.43
	No (n = 512)	3.03	91.9	81.5*	20.0*	7.57
Does plant use e-mail?	Yes (n = 400)	4.81*	90.0*	79.7	33.3*	5.92
	No (n = 347)	1.99*	94.3*	82.5	12.1*	7.89
Does plant take customer orders over the Internet?	Yes (n = 160)	4.45	87.7*	74.7*	29.4	5.51
	No (n = 596)	3.28	93.1*	81.5*	21.7	7.23
Does plant advertise or sell products or services on anyone else's website?	Yes (n = 102)	5.27	89.2	76.1	31.6	6.39
	No (n = 655)	3.23	92.4	80.6	22.3	6.96
Does plant buy supplies or equipment using the Internet?	Yes (n = 168)	5.05*	90.8	78.1	36.9*	7.78
	No (n = 589)	3.04*	92.3	80.5	19.6*	6.58
Does plant do any banking functions using the Internet?	Yes (n = 62)	5.57	92.1	76.4	28.3	5.52
	No (n = 695)	3.32	91.9	80.3	23.1	7.02
Does plant search Web to gather business-related information?	Yes (n = 480)	4.25*	91.2	80.0	28.4*	6.77
	No (n = 276)	2.18*	93.2	80.3	14.6*	7.10
Does plant plan on using eBusiness methods next year?	Yes (n = 472)	3.85	90.7	78.8	75.9*	10.3*
	No (n = 255)	2.99	93.4	81.4	45.8*	27.5*

^a Comparison of means between "yes" and "no" respondents for each question based on independent t-test. * indicates a statistically significant difference between means (p -value ≤ 0.05 at α -level = 0.05).

^b Sales revenue generated from wood and wood-based products as a percentage of total plant sales.

Montana manufacturing plants are adding the greatest value.

Combined, the demographic information from the survey provides an indication that while the industry structure of the secondary forest products industry appears to be similar across the three states based on products produced, the scale of the industry across the three states is significantly different; Montana-based manufacturing plants are significantly smaller in scale than those located within Washington borders, while Idaho average plant scale falls between that of Montana and Washington.

USE OF EBUSINESS TECHNOLOGIES

As part of a larger set of survey questions regarding manufacturing, management, and marketing practices in the secondary forest products industry, survey participants were asked to respond to a series of eight questions that dealt specifically with their manufacturing plants' use of various eBusiness technologies (Table 2). Data were reported on a state and plant size basis, as well as in the aggregate. Manufacturing plants were classified into large, medium, and small plant size categories based on number of employees. Plants employing seven or fewer individuals were classi-

fied as small plants. Plants with 8 to 20 employees were classified as medium-size plants, while plants with more than 20 employees were classified as large plants. An independent t-test assessment between respondents that replied yes versus those that replied no to the eight eBusiness questions was made along five demographic variables (Table 3).

Survey participants were first asked to indicate whether their production plant had a website; slightly more than 32 percent of all plants responded affirmatively to this question, which is similar to results reported by Vlosky and Gazo in 1996 (17). No statistically significant differences were uncovered when comparing Web presence by state of operation. Further analysis indicated that only 22.2 percent of the small manufacturing plants indicated having a website, which is significantly less than the 37.0 and 46.6 percent exhibited by medium and large plants, respectively (Scheffé's contrast test, p -value ≤ 0.05). No statistically significant difference existed between medium and large plants. As shown in Table 3, manufacturing plants that reported that they have a website were found to have operated at significantly less capacity (75.9%) than plants without a website (81.5%) and with a

significantly greater number of full-time employees (31.9 versus 20.0 employees).

The Pacific Northwest secondary forest products industry's relatively low Web presence is similar to that of the heating, venting, and air-conditioning (HVAC) industry. In a recent survey of that industry, it was found that only 34 percent of HVAC contractors have a Web presence (6). Surveys of other industries, however, suggest that Web presence is high among some manufacturing industries. For example, a recent survey of the materials-handling equipment distributor industry found that 63 percent of respondents indicated that their firm had a Web presence (9). Interestingly, results from an inter-industry survey of 2,500 manufacturers conducted by the National Association of Manufacturers (NAM) just prior to this study's survey indicated that 80 percent of all U.S. manufacturers have a website (7).

Approximately 53 percent of the survey participants indicated that their manufacturing plant utilized e-mail technology. Although no statistically significant differences were uncovered when comparing use of e-mail technology by state of operation, there were significant differences between all three

plant size classifications. Plants were more likely to use e-mail as their size increased. In fact, the number of large plants using e-mail technology was more than 70 percent greater than that of small plants. As a comparison, a recent survey by manufacturers across a variety of industries located in Georgia reported that 68 percent of firms used e-mail technology (19).

Several differences in e-mail use by secondary forest products plants in the Pacific Northwest were detected in the data analysis. First, plants that used e-mail reported mean gross sales revenue that was more than double the gross sales revenue of plants not using e-mail (Table 3). Second, relative to firms using e-mail, firms not using e-mail generated a significantly greater percentage of their gross sales revenue from the sale of wood and wood-based products as opposed to nonwood-based products and services. Finally, plants using e-mail averaged 175 percent more full-time employees than plants not using e-mail.

Survey participants were also asked to indicate whether their plant took customer orders over the Internet. Note that respondents were not asked to specify whether orders were taken through e-mail or through order transaction software. One-fifth of the manufacturing plants indicated that orders were taken over the Internet, with no differences being detected based on the geographic location of the operation. Small plants, at 18.4 percent, were significantly less likely than large plants, at 28.4 percent, to take orders over the Internet (Scheffé's contrast test, p -value ≤ 0.05). Medium-size plants were found to be statistically identical to small and large plants with regard to taking orders over the Internet.

For secondary forest products plants in the Pacific Northwest, a plant's ability to take orders over the Internet was related to percentage of sales from wood and wood-based products and plant capacity utilization (Table 3). Plants indicating that they took orders over the Internet derived significantly less gross sales revenue from wood and wood-based products relative to plants that did not take orders over the Internet. Order-taking plants also used significantly less plant capacity, on average, than plants not taking orders over the Internet.

To assess the use of secondary or intermediary use of the Web, survey par-

ticipants were asked to indicate if their manufacturing plant advertised or sold products/services on anyone else's website. Slightly more than 13 percent of all responding plants indicated that they did use someone else's website to advertise or sell products/services. No statistical differences were detected when comparing the manufacturing plants by state of operation, plant size classification, or along demographic variables.

Approximately one-fifth of the manufacturing plants were found to purchase supplies or equipment over the Internet (Table 2). No statistically significant differences were revealed when comparing Internet purchase of supplies or equipment across state of operation. Large plants, however, were significantly more likely to purchase equipment or supplies on the Internet than small plants (30.5% versus 17.1%; Scheffé's contrast test, p -value ≤ 0.05). Medium-size plants were found to be statistically equivalent to small and large plants in their use of the Internet to purchase supplies or equipment. Additionally, plants purchasing supplies or equipment over the Internet were found to have significantly greater gross sales revenue (\$5.05 million) and number of full-time employees (36.9 employees) than plants not using the Internet to order supplies or equipment (\$3.04 million, 19.6 employees) (Table 3).

Very few manufacturing plants (7.9%) were found to utilize the Internet to conduct banking-related functions. No statistical difference was found when comparing the use of the Internet for banking-related functions across state of operation. However, large plants were found to utilize the Internet for banking-related functions to a significantly greater degree than small plants, while medium-size plants were found to be similar to both large and small plants (Scheffé's contrast test, p -value ≤ 0.05). No statistical differences were detected when comparing the manufacturing plants along the demographic variables listed in Table 3.

Survey results suggest that the dominant use of the Internet at secondary forest products manufacturing plants in the Pacific Northwest is for searching the Web for business-related information. Collectively, over 61 percent of survey participants indicated that their manufacturing plant used the Web to gather

business-related information, with no statistical differences uncovered across state of operation. Significant differences were found across all plant size classifications. Over 80 percent of large plants used the Web to gather business-related information, followed by medium and small plants at 68.3 and 53.1 percent, respectively. Additionally, plants that use the Internet to seek out business-related information reported significantly greater gross sales revenue and number of full-time employees than plants that do not use the Internet to gather business-related information.

The final question that survey participants were asked was whether their manufacturing plant planned to use eBusiness methods next year (i.e., 2001) regardless of whether or not they were currently using various eBusiness methods. As a whole, 60.5 percent of the responding plants indicated that eBusiness methods would be used in 2001. As with all other eBusiness questions in this survey, no statistically significant differences were detected when examining this question by state of operation. Small plants, however, were found to be significantly less likely to utilize eBusiness methods in 2001 than medium or large plants (Scheffé's contrast test, p -value ≤ 0.05).

Secondary forest products plants in the Pacific Northwest indicating that eBusiness methods would be used next year employed a significantly greater number of employees (75.9 versus 45.8) than plants indicating that eBusiness methods would not be used in the coming year (Table 3). Plants indicating future use of eBusiness methods also utilized less wood-based raw material, based on a percentage of total raw materials costs, than plants indicating that eBusiness methods would not be used in 2001.

It could be hypothesized that a manufacturing plant responding affirmatively to one of the eBusiness questions would be more likely to answer affirmatively to other eBusiness questions. For example, it could be assumed that a respondent indicating that their plant maintained a website would also be more likely to indicate that their plant searches the Web to gather business-related information. A nonparametric correlation analysis of the respondents' dichotomous yes/no replies was conducted to test this hy-

TABLE 4. — Correlation of secondary forest products manufacturers' use of various eBusiness technologies and practices in the Pacific Northwest.

eBusiness characteristic (questions asked in survey)	Kendall's tau- <i>b</i> bivariate correlation coefficients (two-tailed) ^a							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Does plant have a website? [1]	1.000							
Does plant use e-mail? [2]	0.468* ^b	1.000						
Does plant take customer orders over the Internet? [3]	0.395*	0.410*	1.000					
Does plant advertise or sell products or services on anyone else's website? [4]	0.248*	0.253*	0.193*	1.000				
Does plant buy supplies or equipment using the Internet? [5]	0.160*	0.358*	0.237*	0.069	1.000			
Does plant do banking functions using the Internet? [6]	0.142*	0.190*	0.199*	0.066	0.235*	1.000		
Does plant search Web to gather business-related information? [7]	0.294*	0.531*	0.211*	0.171*	0.346*	0.177*	1.000	
Does plant plan on using eBusiness methods next year? [8]	0.233*	0.394*	0.251*	0.166*	0.279*	0.150*	0.376*	1.000

^a Sample size for individual cell bivariate correlations ranged from 717 to 757.

^b * indicates Kendall's tau-*b* bivariate correlation is significant at 0.01 α -level (two-tailed test).

pothesis. **Table 4** displays the coefficient matrix of a Kendall's tau-*b* bivariate correlation analysis of secondary forest products manufacturers' use of various eBusiness technologies and practices. Although 26 of the 28 correlations were found to be highly significant at the 0.01 α -level (two-tailed test), nearly all correlation coefficients were found to be somewhat low. These results suggest that various eBusiness technologies and methods are not necessarily adopted concurrently.

CONCLUSION

The results of this study suggest that the use of eBusiness technologies to transact business is relatively low among forest products manufacturers in the Pacific Northwest. Although the use of the Internet to gather business-related information and for e-mail was reported to be quite high, the use of eBusiness to take orders and sell products, buy supplies or equipment, and transact banking functions was low. Results provide an indication that the industry is still in the early adoption stage with regard to conducting and transacting business via the Internet and World Wide Web.

In general, larger manufacturing plants were found to be more likely to utilize the eBusiness technologies surveyed in this study. This could be a reflection of a greater lack of internal structure at smaller plants. Determining who is responsible for implementing eBusiness technologies at smaller plants may be

more problematic since individuals at small plants are much more likely to be performing multiple business tasks relative to employees at larger plants. Similarly, smaller plants are more likely to lack a structure whereby departments are tasked with various business functions (e.g., accounting, finance, information technology, marketing, production, and sales). A potential solution to this situation is the adoption and use of third-party business-to-business exchanges. These exchanges act as intermediaries in lowering transaction costs between buyers and sellers of wood and wood-based products. Adoption of third-party intermediary business-to-business exchanges lessens the degree to which smaller firms have to invest in developing their own eBusiness trading channels.

In the face of growing domestic and international competition, companies seek to develop competitive advantages that differentiate and add value to their products and services (11). The adoption of eBusiness technologies is one strategy that can be utilized to create competitive advantages and/or enhance current competitive advantages. For example, eBusiness technologies can substantially lower promotional costs while significantly increasing promotional reach. Also, business-to-business transaction costs can be reduced considerably with eBusiness methods, thereby increasing product gross margins. It is imperative that the U.S. forest products

industry gains foresight and aggressively embraces eBusiness technologies. Failure to do so provides an additional inroad for manufacturers of substitutes to market their products against wood-based products, and increases the industry's risk of falling behind other countries in maintaining a dominant market position.

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