

MANAGEMENT

AN ANALYSIS OF NORTHERN HARDWOOD LUMBER BUYERS' USE OF ELECTRONIC COMMERCE

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ABSTRACT

This article examines eCommerce use by U.S. purchasers of northern hardwood lumber in the northern region of the United States. The primary data analyzed in this study come from a mail survey administered in November 1999 to 460 firms. This research examines the use of Internet-based activities and the importance of these activities to responding firms. These data indicate that eCommerce activity among buyers of hardwood lumber can be thought to represent three underlying dimensions: communication, sourcing, and order handling. Although respondents are relatively ambivalent toward the role of e-commerce in their operations, differences in usage patterns exist between buyer segments.

Although consumer-oriented online "eRetailers" received much of the media's early attention, the vast majority of electronic commerce conducted today is found within the backroom activities of companies using the Internet to simplify how they sell products and services to other companies. In 2000, U.S. eCommerce transactions amounted to nearly \$500 billion, of which business-to-business transactions are thought to account for approximately \$450 billion of this total. An Internet researcher firm, Forrester Research, estimates that by the year 2004 North American business-to-business eCommerce will reach \$3.5 trillion, nearly 13 percent of all business-to-business sales (5). Specifically within the forest products sector, industry experts estimate that cost savings related to eCommerce could be as high as 20 percent (6).

BACKGROUND AND JUSTIFICATION

The initial wave of business-to-business eCommerce has been dominated by Electronic Data Interchange (EDI) networks that automate off-line processes between partners, but the considerable expense of physically connecting computers, as well as the relatively inflexible nature of these networks, have opened the door to new Internet-based EDI systems and third-party eMarketplaces. Recent developments surrounding e-Commerce have "technically" redefined traditional

EDI networks, predominantly through the replacement of proprietary communications protocols with the de facto standard for transmitting data over networks: TCP/IP. The Transmission Control Protocol/Internet Protocol (TCP/IP) is the protocol suite that is actually composed of several protocols including IP, which handles the movement of data between host computers, and TCP, which manages the movement of data between applications. The greater standardization achieved through this type of Internet-based EDI increases the potential uses of this technology, which suggests that "organizations of different industries, sizes and countries will increasingly rely on electronic means to transact data" (14). The one-to-one electronic relationships facilitated by EDI networks are also being challenged by the more dynamic many-to-many eMarketplaces that have emerged within specific industries to assist in matching buyers and sellers. These new trading arenas are gaining increased attention because: 1) inefficiencies continue to plague most transactional processes; 2) eMarket-

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places lower the technology barriers of industries struggling to convert obsolete and incompatible legacy systems; and 3) venture capitalists disenchanted with consumer-oriented "dot coms" have turned much of their attention to business-to-business Internet start-ups (5,8). eMarketplaces like Buildnet, PaperExchange, E-Steel, and TALPX are beginning to emerge as a means for old-line manufacturing industries to share in the growth of the "new economy." In the forest products industry, over 30 Internet-only companies have emerged and are actively selling paper and building materials (10). While trade is expected to increase through eMarketplaces, very few of these sites are expected to flourish over the long term. Many of the new vertical eMarketplaces will be forced out of business or acquired by other firms as a result of increased competition, and investment, from better-aligned Internet companies and established industry players (5). For example, the newly created ForestExpress.com (a venture between Georgia-Pacific, International Paper, Mead Corporation, Boise Cascade, and Willamette) touts its vertical eMarketplace for building materials, paper, recycling, and timber as the first and only industry-backed eCommerce solution serving the forest products industry (4).

These examples point to the growing number of forest products companies involved in developing eCommerce solutions and this fact is also supported by academic research. Vlosky and Gazo estimated that, in 1995, only 38 percent of forest products companies engaged in e-mail activities and a mere 28 percent made use of the World Wide Web (16). By 1997, nearly half of all forest products companies had invested at least \$10,000 in eBusiness applications (15), and in 1999, 80 percent of forest products exporters used the Internet, 59 percent of forest products exporters indicated the use of company intranets (Internet-based private networks), 32 percent used Internet-based EDI networks, and 20 percent indicated the use of extranets (secure networks linking

business partners via the Internet) (11). These studies have also helped identify motivations for businesses embarking upon eCommerce strategies. Motivations for, or expected benefits from, investing in eCommerce can most easily be described as falling into one of two categories: 1) improving efficiencies; and 2) improving service quality to current and potential customers. Although the anticipation of cost savings associated with improved operating and administrative efficiencies have been well documented (3,9), greater access for customers, improved service, and enhanced corporate image have consistently been rated by suppliers as primary benefits expected as a result of eCommerce (11,15).

Many suppliers are looking toward the electronic medium to provide a more effective means of processing orders, building stronger relationships, providing greater access to product information and specifications, improving response time to requests, handling customer complaints, and lowering prices. In each of these activities, the Internet becomes a vehicle by which value-added services are delivered. Value is typically created by a supplying firm in three ways: 1) through proprietary advantages in product quality over competition; 2) through more convenient and/or cost-effective service offerings than those of competitors; and 3) through more favorable perceptions of consistency created by branding messages and established relationships.¹ Suppliers, then, compete based on their ability to improve customers' operations, through valued offerings, relative to the next best solution. Therefore, the value provided through eCommerce networks is contingent on current and potential buyers' acceptance of this technology and their attitudes regarding its use.

The objective of this paper is to further examine the use and attitudes of business-to-business eCommerce among buyers of northern hardwood lumber. More specifically, this study identifies trends in lumber buyers' usage levels helpful in the development of eBusiness customer segmentation strategies. A number of recent studies have emerged examining the use of eCommerce activities in the forest products industry (3,11,12,15). However, these studies have primarily focused on the use of electronic methods in promotional, logistics, and export activities, or, have examined the

use of proprietary networks between relatively large buyers and sellers. This paper addresses the use of electronic activities among purchasers of hardwood lumber, and begins to identify associations between eCommerce technology usage and the specific attributes of companies.

METHODS

A mail survey instrument was designed to address customer perceptions related to the use of eCommerce activities. The initial questionnaire was administered in November 1999, with a follow-up survey mailed in December 1999. A convenience sample of 460 U.S. purchasers of northern hardwood lumber was identified based on customer and prospect lists of two hardwood lumber operations in the upper Midwest. Of these, nine surveys were returned as undeliverable or were returned by the company indicating that their business operations were not appropriate for the study. In total, 110 usable responses were returned, resulting in an adjusted response rate of 24.4 percent (110/[460-9]).

The existence of possible non-response bias was investigated by comparing responses from early respondents to respondents returning surveys after follow-up efforts were made (2). Using two-tailed t-tests, these comparisons did not uncover any significant differences ($\alpha = .05$) within eCommerce importance ratings, eCommerce usage rates, or measures of company size and business affiliation. Therefore, concerns of non-response bias have been set aside.

RESULTS AND DISCUSSION

RESPONDENT PROFILE

Overall, nearly 90 percent of respondents indicated either an upper-level management position or a marketing/sales middle-level position. This would suggest that the vast majority of individuals responding to the survey are aware of the purchasing decisions of the company and are knowledgeable in the content of the survey subject matter.

Given the geographic focus of the sample scheme, it is not surprising that the majority of respondents were located in the Great Lakes and Midwest regions (Fig. 1); 63 percent of respondents operated in these two regions. Western and Southeastern respondents were fairly well represented, with 18 and 12 percent, respectively. Very few

¹ Within this conceptualization of value, price distributes value between buyer and supplier. Whereas the three mechanisms just listed create value, pricing strategies attempt to capture a portion of that value in the form of company profits.

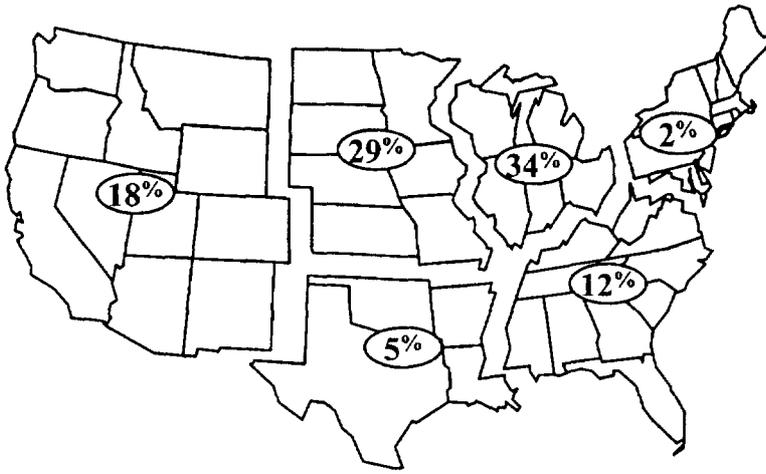


Figure 1. — Respondents by geographic region (n = 108).

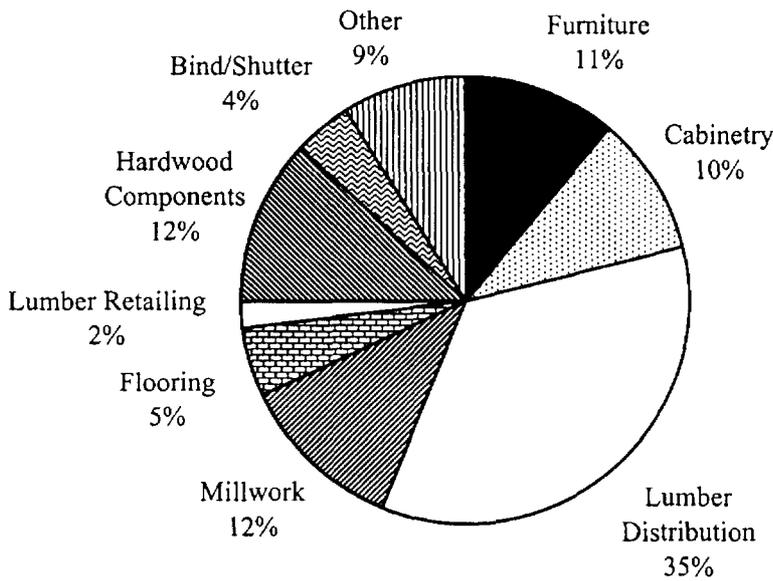


Figure 2. — Respondents by primary line of business (n = 100).

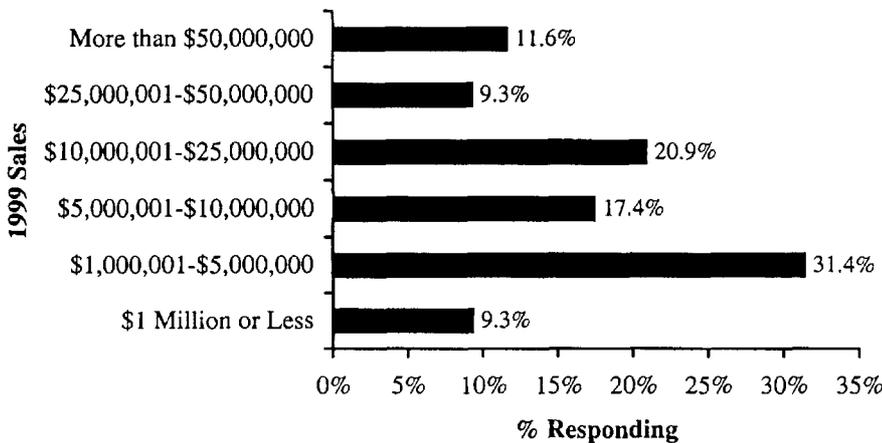


Figure 3. — Reported 1999 respondent sales (n = 86).

respondents came from the South Central and Northeast regions. Red oak was the species purchased by the greatest number of respondents (82% of respondents indicated purchasing this species from at least one of their top three suppliers), followed by hard maple (62%) and black cherry (51%). Those purchasing black cherry generally purchased very little of this species; on average, only 10 percent of these respondents' purchases (in terms of volume) were black cherry. Overall, 34 percent of the respondents' purchase volume was red oak, 15 percent was hard maple, and 9 percent was poplar. Basswood, ash, and soft maple were the next most purchased species by volume, representing 7, 6, and 6 percent of respondents' purchases, respectively.

Respondents were also asked to indicate their companies' primary line of business. Results are presented in Figure 2. The largest percentage of respondents (35%) indicated lumber distribution as their primary line of business. This category was followed by more traditional hardwood lumber buyers: hardwood components (12%); millwork (12%); furniture (11%); and cabinetry (10%). Self-reported 1999 projected sales were used as a measure of respondent company size (Fig. 3). The largest percentage of respondents were from companies with sales between \$1 million and \$5 million, followed by those with sales from \$10 to \$25 million. The average number of employees was 109, with furniture and cabinet manufacturers employing the most people (155 and 342, respectively) and millwork and component manufacturers employing the fewest people (73 and 59, respectively). The respondent data are relatively consistent with past research examining hardwood lumber buyers (1, 7, 13); therefore, the sample is thought to reasonably approximate the perceptions of the northern hardwood lumber industry.

IMPORTANCE RATINGS OF ECOMMERCE ACTIVITIES

Respondents were asked to rate nine eCommerce activities on a 7-point scale, where 7 = very important and 1 = not at all important. Overall, respondents indicated e-mail communication with customers as the most important e-based activity (4.08), followed by accessing the Internet (3.92) and e-mail com-

TABLE 1. — Importance ratings of e-Commerce activities for purchasers of hardwood lumber.

Activities (respondents engaged in activity)	Overall mean	Engaged in activity	Not engaged in activity	p-value ^a
E-mail communication within your company (54)	3.58	5.00* ^b	1.95	.000
E-mail communication with suppliers (48)	3.42	3.92	2.86	.013
E-mail communication with your customers (54)	4.08	4.93*	2.87	.000
Accessing the Internet (70)	3.92	4.37*	2.68	.000
Accessing stock lists from supplier Web page (43)	3.34	3.84	2.94	.029
Accessing pricing information from supplier Web page (25)	3.25	4.36	2.87	.002
Accessing inventory forecasts from supplier Web page (18)	3.20	4.44	2.92	.005
Placing orders on-line (13)	2.85	4.39	2.66	.005
Tracking of orders on-line (13)	3.14	4.92	2.87	.002

^a Values less than .05 represent significant differences between importance ratings among respondents engaged in the activity versus those not engaged.

^b *indicates activities with mean importance ratings significantly greater than 4.00 (the neutral point on a 7-point scale, where 7 = very important and 1 = not at all important).

TABLE 2. — Factor analysis results for e-Commerce engagement.

Activities (n = 95)	Mean	Standard deviation	Factor loadings ^a		
			Factor 1 communication	Factor 2 sourcing	Factor 3 order handling
E-mail communication within your company	.537	.5013	.746	.212	.037
E-mail communication with suppliers	.474	.5020	.810	.138	.069
E-mail communication with your customers	.540	.5000	.788	.039	.383
Accessing the Internet	.684	.4673	.815	.263	.046
Accessing stock lists from supplier Web page	.432	.4979	.379	.745	.083
Accessing pricing information from supplier Web page	.242	.4306	.110	.860	.207
Accessing inventory forecasts from supplier Web page	.190	.3940	.105	.829	.234
Placing orders on-line	.116	.3217	.090	.401	.775
Tracking of orders on-line	.126	.3340	.156	.129	.869
Eigenvalue			4.00	1.59	1.02
Cumulative variance explained			44.44%	62.08%	73.38%

^a A principal component analysis extraction method was used to identify the three components. The component matrix was rotated using a varimax rotation with Kaiser Normalization to aid interpretation. Factor loadings presented in bold indicate the dimensions on which eCommerce activities loaded most heavily.

munication within their company (3.58) (Table 1).

Importance ratings were also examined based on respondents' engagement in the activity. Not surprisingly, respondents engaged in electronic activities rated every activity as significantly more important to their companies than those not engaged in the activity ($\alpha = .05$). Given active engagement in each of the respective activities, e-mail communication within the respondent's company was rated most important (5.00), followed by e-mail communications with customers (4.93), and tracking orders on-line (4.92). Although tracking orders on-line was viewed as a relatively important eCommerce activity among respondents, respondents predominantly associate eCommerce with customer relations rather than supplier relations. The three activities viewed as the least important were: accessing stock lists

from supplier web pages (3.84), e-mail communication with suppliers (3.92), and accessing pricing information from supplier Web pages (4.36). When discussing the relative importance of eCommerce activities, it is also important to note that even among those engaged in eCommerce, respondents were generally undecided about its importance to their operations. With the exception of e-mail within the company, e-mail with customers, and Internet access, all eCommerce activities were viewed as being neither significantly important nor unimportant to respondents' respective companies. This ambivalence is most likely attributed to the newness of the technology to the industry and the technology's relatively slow infiltration into the industry. For example, a purchasing company engaged in accessing supplier stock lists on-line is most likely not able to view all potential supplier inventory on-line. Therefore, additional communi-

cations with suppliers are necessary, reducing the efficiency and importance of e-based activities.

E-COMMERCE USAGE AMONG HARDWOOD LUMBER BUYERS

Respondent eCommerce involvement was measured by a simple yes/no question asking if they are currently engaged in each of the nine activities, and coded 1 for yes and 0 for no. Table 2 provides mean scores for this variable, which can be interpreted as the percentage of respondents engaged in each activity. Accessing the Internet was identified as the activity employed by the largest portion of respondents; nearly 70 percent of respondents indicated that they were engaged in this activity. E-mail communications were the next most used electronic activities. E-mail within companies and with customers is being used in 54 percent of responding hardwood lumber buyer organizations, and e-mail with suppliers was indicated by 47 per-

TABLE 3. — Factor score means.

Factors	Mean factor scores				p-value
	Furniture/cabinetry	Lumber distribution	Millwork/flooring	Component/blind	
Communication (Factor 1)	.015	-.014	-.025	.204	.9257
Sourcing (Factor 2)	-.392	.335 ^a	-.353	.509 ^b	.0123
Order handling (Factor 3)	.145	-.148	-.061	.322	.5444

^a The mean factor score for the electronic sourcing dimension among respondents engaged in lumber distribution was significantly greater than scores from the furniture/cabinetry segment ($\alpha = .05$).

^b The mean factor score for the electronic sourcing dimension among respondents engaged in component and blind manufacturing was significantly greater than scores from the furniture/cabinetry segment ($\alpha = .10$).

cent of respondents. Placing orders on-line and tracking orders on-line were the eCommerce activities least engaged in by respondents, with 12 and 13 percent active in these areas, respectively.

Table 2 also provides the results from a factor analysis (varimax rotation) examining the interrelationships between usage levels in eCommerce activities. All factors with eigenvalues greater than 1.0 were retained in the final solution. This criterion revealed that the nine eCommerce activities represent three underlying dimensions, accounting for 73.4 percent of the variance in the data. This analysis suggests that buyers of hardwood lumber engage in three broad categories (factors) of eCommerce activities. Because a factor is a qualitative dimension, the researcher is required to name each factor based on an interpretation of the variables loading most heavily on it. The factors can be conceptualized as communications, sourcing, and order-handling activities. Factor 1 (communications) depicts relatively simple electronic means of communicating with various stakeholders of the organization. E-mail communications and access to the Internet are included within this dimension. Factor 2 (sourcing) represents eCommerce activities related to identifying adequate sources of supply. Accessing supplier stock lists, pricing information, and inventory forecasts load most heavily in this factor. Factor 3 (order handling) includes issues of transacting and servicing orders over electronic means. The activities most closely associated with this factor are placing orders and tracking orders on-line. This analysis is useful from a conceptual perspective in that it illustrates that eCommerce usage patterns differ along these three dimensions, thus providing a broader mechanism by which customer segments can be examined.

Results of a simple one-way ANOVA are shown in **Table 3**, which examines differences in mean factor scores across broad industry classifications. Factor scores are derived variables that can be calculated for each factor at the respondent level (mean = 0, standard deviation = 1). Therefore, there are three factor scores for each respondent: one corresponding to each of the three linear combinations that can be formed from the original variables. No significant difference in usage is detected between industry segments for factor 1 (communications activities) or factor 3 (order-handling activities). However, significant differences are noted along the sourcing dimension (factor 2). Further analysis using a Tukey post-hoc procedure indicates that respondents primarily engaged in lumber distribution were significantly more likely to use electronic media for sourcing activities than furniture and cabinet manufacturers ($\alpha = .05$). Likewise, hardwood component/blind manufactures were also more likely to use electronic media for sourcing activities than furniture and cabinet manufacturers at the 90 percent confidence level ($\alpha = .10$). Of the variables most heavily loading on the sourcing dimension, nearly 68 percent of lumber distributors and 77 percent of component and blind manufacturers accessed suppliers stock lists on-line, 29 percent of distributors and 50 percent of component and blind manufactures acquired pricing information on-line, and 24 percent of distributors and 36 percent of component and blind manufacturers have accessed supplier forecasts on-line. In comparison, only 17, 22, and 6 percent of respondents buying for furniture and cabinetry operations indicated their involvement in each of these respective activities.

Although the industry segment examined in this analysis is quite broad, the

results are compelling. Most importantly, the analysis in **Table 3** indicates that within at least one dimension (sourcing activities) certain segments of the forest products industry (distribution intermediaries and component/blind manufacturers) are adopting "higher level" electronic technologies faster than others. One possible explanation for these differences may be that both lumber intermediaries and component manufacturers operate based on relatively small margins generated from large volumes. The combination of heightened pressures on profitability, relatively large numbers of transactions, and the replication in the purchase process (i.e., re-buy and/or modified re-buy nature of purchases) may be driving these segments to more rapidly seek the transaction efficiencies promised by e-Commerce. Similarly, the greater differentiation between products and suppliers within the furniture and cabinetry industries may explain the slower adoption rate for this technology.

Differences in usage levels were not detected among the relatively easy to implement eCommerce communications activities, indicating that these "entry-level" eCommerce activities are being implemented throughout the forest products industry regardless of sector. Similarly, differences were not detected in usage levels of eCommerce order-handling activities. It is thought that this lack of differentiation is primarily due to the small number of respondents engaged in these activities. Only 12 percent of the total sample placed orders on-line, and only 14 percent tracked orders on the Internet. Although quantitative significance was not detected along this dimension, the data indicate some support that hardwood lumber intermediaries and component/blind manufacturers may be more likely to be involved in order-handling eCommerce

activities than other hardwood lumber purchasers. Whereas 47 percent of the sample is comprised of companies involved with hardwood lumber distribution or component/blind manufacturing, these industry segments made up nearly 60 percent of respondents who tracked orders on-line and over 80 percent of those placing orders on-line.

In addition to examining eCommerce usage rates between broad industry segments, eCommerce activity was also analyzed by company size (estimated 1999 sales) and growth rate (percent change in hardwood lumber purchases in 1999 versus 1998). Overall, those involved in eCommerce activities tend to be larger in size and growing at a more rapid rate. Respondents actively engaged in eCommerce activities generated 25 percent more sales (\$23.1 million versus \$18.5 million) and grew their purchases 44 percent faster (31.8% versus 22.1%) than those not engaged in these activities.² Table 4 provides the results of one-way ANOVA tests for the eCommerce activities where significant differences in size or growth rates were detected. Respondents who engaged in e-mail within their companies, had access to the Internet at work, and/or tracked orders on-line generated significantly larger sales volumes than those not involved in these activities. Likewise, respondents accessing supplier pricing information and tracking orders on-line increased their 1999 purchases compared to 1998 purchases by significantly more than those not engaged in these activities. It is important to note that this analysis does not attempt to identify causality. Therefore, it is inappropriate to speculate whether the eCommerce activities caused increases in sales or whether larger companies tend to be first to implement eCommerce initiatives. However, one can conclude that based on these two measures, hardwood lumber buyers engaged in eCommerce activities appear to be financially healthier than their counterparts not pursuing eCommerce initiatives.

CONCLUSIONS

Although both buyers and sellers of forest products are gradually adopting

² Given that engagement levels differed among eCommerce activities, overall averages were based on a weighted average of mean sales and growth levels for each eCommerce activity.

TABLE 4. — Reported sales and growth rates by selected e-Commerce activities.

Activities	Sales (million \$)	Purchase growth rate (%)
Communication activities		
E-mail within company	27.93 ^{a*}	29.3
Do not e-mail within company	11.99	20.9
Access the Internet	23.88 ^{**b}	27.9
Do not access the Internet	10.93	20.6
Sourcing activities		
Access pricing on line	19.25	40.4*
Do not access pricing on line	20.34	20.9
Order handling activities		
Track orders on-line	33.11*	49.1*
Do not track orders on-line	18.39	22.5

^{a*} indicates significantly greater than those not engaged in activity (alpha = .05).

^{**b} indicates significantly greater than those not engaged in activity (alpha = .10).

electronic commerce technologies, this research highlights the fact that not all forest products sectors are embracing this technology equally. eCommerce networks are tremendously complex, and specialized to the needs of individual companies. Therefore, by examining the underlying dimensions associated with eCommerce purchasing, rather than specific activities *per se*, the researcher is able to detect trends in usage across business segments. This finding has strong implications for forest products practitioners who are implementing eCommerce initiatives. Specifically, this paper suggest that eCommerce managers' efforts stand to be more effective if targeted toward the lumber distribution supply chain and the hardwood component and blind industries. From a tactical standpoint, initial implementation of eCommerce networks might best be focused around specific product lines, or within particular markets, of greatest importance to customers conducting business within one or both of these "first-mover" segments.

In addition, as suppliers implement greater interactivity and transactional engines within Internet and eCommerce strategies, messages and functionality supporting sourcing and order-handling activities for customers will also be best received by these segments. Hardwood lumber wholesalers and retailers, and to a slightly lesser extent hardwood component and blind manufacturers, have indicated a significantly greater propensity to use the Internet to find and evaluate sources of supply. Significant proportions of buyers within these seg-

ments actively sought out on-line information to evaluate supplier inventory, pricing, and forecasts.

As a whole, the forest products industry has not yet reaped, or in many cases even acknowledged, the benefits of eCommerce. In many ways, this study confirms the relatively slow acceptance of Internet-based business practices. Even those hardwood lumber buyers currently engaged in eCommerce activities were uncertain about the importance of these activities, particularly the "higher order" activities associated with sourcing and transacting on-line. However, just as various customer segments hold differing value assessments of non-technological product and service offerings, the differing informational and procurement needs of customers must also be considered when developing eCommerce offerings. Suppliers who are able to identify customer segments seeking eCommerce solutions, and capable of delivering the services valued by these segments, stand to gain substantial competitive advantage in the marketplace.

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