A NATIONAL PROFILE OF THE U.S. HARDWOOD SAWMILL INDUSTRY

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ABSTRACT

A nationwide survey of the hardwood sawmill industry was conducted in the fall of 1999. The objectives of the survey were to generate a current demographic profile of the hardwood sawmill industry and identify the preferred information sources for the hardwood sawmill industry. These objectives were chosen because timely information was not available for the hardwood sawmill industry. The survey consisted of a mail questionnaire that was sent to over 2,000 hardwood sawmills. The results from the mail survey found that the average yearly lumber production was 7.6 million board feet per sawmill. The most common type of scanning and optimizing technology, headrig optimization, was only in use by 27 percent of the responding mills. Advanced scanning and optimizing technology such as edger-optimizers and trimmer-optimizers were only in use by 10 percent and 5 percent of the respondents, respectively. Regarding information sources, plant visits and peer conversations were rated the highest, and the Internet was rated last. Overall, the use of advanced technology within the hardwood sawmill was not common, production was a key issue, and hardwood sawmillers preferred hands-on or personal interaction for their information needs.

The hardwood lumber industry plays a significant role in the U.S. economy. Estimates for U.S. hardwood lumber consumption in 1997 were over 13 billion board feet (BF) (5). From a dollar perspective, this volume of rough green lumber would be valued at approximately $8 billion (2). This hardwood lumber volume is used to produce many different value-added products including furniture, pallets, cabinets, millwork, and flooring. The final value of these value-added hardwood products would fall into the tens of billions of dollars (11). Hardwood sawmills form the foundation for these markets. In order to better serve the hardwood lumber industry, it is important to understand the hardwood sawmill, which forms the basis of the hardwood industry.

Traditionally, hardwood sawmills were small, family-operated businesses. Unlike the softwood sawmill industry with its high-production mills, the typical hardwood sawmill has been smaller and existed in a more fragmented industry (7). This is beginning to change. Estimates from the National Hardwood Lumber Association (NHLA) in the 1980s and 1990s placed the number of sawmills nationwide at 4,300; however, that number is likely an overestimate. Recent consolidation by large hardwood sawmill companies demonstrates an ongoing trend toward larger and fewer hardwood sawmill firms. Competition for logs along with high log prices favor large companies with sufficient production and capital to withstand such volatility in the log market (8).

These changes, though gradual, have eroded our understanding of the hardwood sawmill industry. It is important to understand this industry because timely market information is essential to the equipment and service industries that supply hardwood sawmills. Also, timely supply information is critical to those

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companies manufacturing value-added products from hardwood lumber. Finally, timely market information is important to hardwood sawmills for strategic business and market planning.

Objectives

The goal of this study was to develop a timely picture of the U.S. hardwood sawmill industry. The specific objectives were to 1) generate a current demographic profile of the hardwood sawmill industry, including company demographics and individual respondent demographics; and 2) identify the preferred information sources for the hardwood sawmill industry.

Methodology

Population

The population of interest was hardwood sawmills in the United States. Given the nature of the hardwood forest resource in the United States, the majority of the sawmills sampled were in the eastern half of the United States; however, it was not limited to this region.

Sample frame

Two recently compiled hardwood sawmill mailing lists were acquired. These included the NHLA's hardwood sawmill membership list and a non-NHLA-member hardwood sawmill list. Since there may be an inherent bias in any trade association membership list, it was important to incorporate this second group. A total of 2,042 sawmills were used, including all NHLA-member hardwood sawmills and a random selection of the non-NHLA-member hardwood sawmills.

Data collection

The questions were designed to gather timely information on the hardwood sawmill industry. This included questions on company size, production figures, and sales figures. In addition, information was gathered on the respondents' characteristics, such as position within the sawmill, age, and trade association affiliation. Finally, Likert-type scales were used to gather information on sawmill system management and pertinent sources of information (1). A 7-point Likert-type scale was used (1 = least important; 7 = most important).

Specific questions within the questionnaire were designed to meet the research objectives. Experts from Virginia Tech and the USDA Forest Service Southern Research Station assisted in the questionnaire development. Question types and formats were pre-tested in March at the 1999 Hardwood Lumber Manufacturers trade show in Charleston, North Carolina. During the summer of 1999, the completed survey was faxed to 10 hardwood sawmills for final pre-testing. Eight companies responded. Only minor formatting issues were identified and changed during the pre-testing phase.

The survey mailing occurred in the fall of 1999 and was patterned after the Total Design Method (10). This involved four mailings. The first mailing included a cover letter and a questionnaire form. The cover letter explained the nature and importance of the survey. It also stressed company anonymity for any information provided. Business-reply postage was included so no cost would be incurred by the sawmill. Two weeks after the first mailing, a follow-up postcard was sent. The postcard thanked the sawmills for their response or urged them to reply if they had not. Two weeks after the second mailing, a questionnaire and a revised cover letter was mailed to those companies that had not responded. Finally, 1 week after the third mailing, a reminder postcard was sent.

Data analysis

The returned questionnaires were examined for completeness and usability. Usable surveys were coded and entered into an SPSS® Statistical Data Analysis package computer spreadsheet.

To understand the differences and similarities between groups, comparisons were generated from the questionnaire data. The primary comparisons were made between three group types. These included company size, trade association affiliation, and existing sawmill technology.

Employee numbers were used to define company size. Two general categories were defined: small companies (19 or fewer employees) and large companies (20 or more employees). This breakdown was consistent with other research in the wood products industry (6).

The second comparison group used trade association affiliation. The NHLA was chosen for two reasons. First, the NHLA sets the standards and certifies hardwood lumber grades, and it is the largest trade association for hardwood sawmills. Second, our mailing database was segregated by NHLA members and non-NHLA members, which made for logical comparisons.

Finally, the third comparison group separated the responding companies by adopters and non-adopters of "current" installed scanning and optimizing technology. This equipment included bucking-optimizers, headrig-optimizers, edger-optimizers, trimmer-optimizers, grade mark readers, and automated sorting.

Results and discussion

Response

Questionnaires were mailed to 2,042 companies. From these, 212 were returned undeliverable. Undeliverables included companies that have gone out of business or companies that moved without a forwarding address or had an expired forwarding address. Nineteen companies requested by phone or by letter to be removed from the study. One company was determined to be a duplicate between the two mailing lists. Subtracting these companies from the total number left 1,810 companies as potential respondents.

In total, 600 questionnaires were returned. Usable responses from hardwood sawmills totaled 424, bringing the adjusted response rate to 23.5 percent. Unusable responses were those returned by companies that were not (or were no longer) in the hardwood sawmill business. In addition, seven of the returned surveys were deemed unusable due to lack of completeness. Certain companies chose not to answer particular questions within the questionnaire. This resulted in totals that did not sum to 424.

Non-response bias

Companies that did not respond were randomly selected, contacted by phone, and asked five questions as they were printed on the questionnaire. A total of 30 calls were completed. Given the sample size, nonparametric statistical methods were used to check for statistical differences between the survey respondents and non-respondents. No significant differences were found between the respondents and non-respondents (Mann-Whitney test, alpha = 0.05).

Demographic profiles

To better categorize the information from the hardwood sawmills, several questions collected demographic information. This information was divided into two general categories: company demographics and individual respon-

dent demographics. The following sections discuss this information.

Company demographics. — When gathering information on production volumes or numbers of employees, it is important to know if the responding company is providing information for a single operation or providing corporate information for multiple production facilities. When asked if their company was a single- or multiple-facility operation, 283 companies reported being a single facility while 139 companies reported being a multiple facility.

Information on employee numbers was also gathered. Respondents were instructed to report the total number of employees at their sawmill. This was further clarified by asking for the single-facility number of employees, not the corporate or multiple-facility number of employees. The mean and median number of employees were 34.3 and 22, respectively. Employee numbers ranged from 0 to 250. A 5 percent trimmed mean reduced the mean number of employees to 29.5. A mean is often extremely sensitive to even a single outlier and the median is often extremely insensitive to several outliers (4). A trimmed mean is a compromise between these two situations. In this case, 5 percent of the ordered observations were deleted from each end of the distribution. Companies with large employee numbers were expected since a number of companies had secondary manufacturing in addition to a hardwood sawmill.

Company size was examined by NHLA affiliation. Over 88 percent of the large companies were NHLA members and over 65 percent of the small companies were non-NHLA members **(Table 1).** This discrepancy in membership could represent two possibilities. The first is that the smaller companies produce and sell a product that does not utilize NHLA grading rules such as custom sawing, cants, or pallet stock. Second, it is possible that these smaller companies are unable to see the benefit of membership in trade associations or are unable to justify the cost.

Information on value-adding capabilities was gathered. The respondents were able to select the types of value-adding services that they offered **(Table 2).** NHLA grading and end coating were the two most common value-added processes among the respondents at 63 and 55 percent, respectively. Note that in addition to NHLA grading, almost 32 percent of the respondents offered custom grading.

TABLE 1. — Company size based on NHLA affiliation. [a]

	Small company		Large company	
Affiliation	Frequency	Percentage	Frequency	Percentage
		(%)		(%)
NHLA member	66	34.4	198	88.4
Non-NHLA member	126	65,6	26	11.6

[a] Small company = 19 or fewer employees (*n* = 192); large company = 20 or more employees (*n* = 224).

TABLE 2. — Value-added processes. [a]

Value-added process	Frequency	Percentage
		(%)
NHLA grading	267	63.0
End coating	234	55.2
Air-drying	218	51.4
Kiln-drying	184	43.4
Custom grading	167	39.4
Surfacing	148	34.9
Custom grading	135	31.8
Dimension manufacturing	103	24.3
Other	49	11.6

[a] *n* = 424.

TABLE 3. — Existing sawmill technology. [a]

Existing technology	Frequency	Percentage
		(%)
Bucking-optimizer	2	0.5
Headrig-optimizer	115	27.1
Edger-optimizer	43	10.1
Grade mark reader	18	4.2
Trimmer-optimizer	19	4.5
Automated sorting	30	7.1
Other	21	5.0

[a] *n* = 395.

This question also provided a validity check. Sixty-three percent of the overall respondents were NHLA members, which corresponds with those selecting the NHLA value-added category. Forty-nine responding companies also listed "other" value-added processes; common examples of these included custom sawing and sizing, pallet manufacturing, flooring manufacturing, and cabinet and furniture manufacturing.

Information on the current state of advanced sawmill technology was collected **(Table 3).** Headrig optimization was by far the most frequent existing advanced technology in use (27% of the responding companies). This category included a range of technologies from computer-assisted setworks to more advanced headrig optimizing systems. The next most prevalent advanced technology was the edger-optimizer, which was in use by 10 percent of the respondents. Less than 5 percent of the respondents had trimmer-optimizer systems. The most frequent examples of "other" advanced technologies listed by the respondents were specific brands of the technologies listed in **Table 3.** Further examples of "other" technologies included lasers, optimizing chopsaws, optimizing ripsaws, and most interestingly, good people who care.

Table 3 indicates that advanced technology in hardwood sawmills is not that

TABLE 4. — 1998 production and sales figures [a]

Statistic	Small company	Large company	All companies
Production (BF)			
Mean	2,573,906	11,674,753	7,582,668
Median	2,500,000	10,000,000	5,000,000
Mode	3,00,000	10,000,000	3,000,000
5% trimmed mean	2,284,516	10,690,416	6,700,995
Range	400 to 17,500,000	1,600,000 to 54,000,000	400 to 54,000,000
Sales ($)			
Mean	1,650,326	8,640,492	5,627,343
Median	1,259,000	6,364,284	3,500,000
Mode	2,000,000	3,500,00	3,000,000
5% trimmed mean	1,425,221	7,914,453	4,809,185
Range	160 to 16,000,000	330,000 to 43,000,000	160 to 43,000,000

[a] Small company = 19 or fewer employees (*n* = 127); large company = 20 or more employees (n = 159).

TABLE 5. — Hourly production rates. [a]

Hourly production volume	Frequency	Percentage
		(%)
0 to 1,000 BF per hr.	74	18.0
1,001 to 2,000 BF per hr.	95	23.1
2,001 to 3,000 BF per hr.	65	15.8
3,001 to 4,000 BF per hr.	51	12.4
4,001 to 5,000 BF per hr.	49	11.9
5,001 to 6,000 BF per hr.	30	7.3
6,001 to 7,000 BF per hr.	16	3.9
Greater than 7,000 BF per hr.	32	7.8

[a] *n* = 406.

common. Even though carriage or headrig optimization is the most common technology in the hardwood sawmill, approximately 73 percent of hardwood sawmills still do not have this technology. Concerning scanning and optimizing technology such as edger-optimizers and trimmer-optimizers, approximately 90 and 95 percent, respectively, of companies do not have this technology.

Comparisons by company size reveal that only 15 percent of the small companies had the advanced technologies shown in **Table 3,** while over 53 percent of the large companies utilized advanced technology.

Estimates of yearly hardwood lumber production were collected **(Table 4).** The mean and median lumber production values for 1998 were 7,582,668 and 5,000,000 BF, respectively. A 5 percent trimmed mean was 6,700,995 BF. Overall, production volumes differed greatly and ranged from 400 to 54,000,000 BF. A few responding companies sawed both hardwoods and softwoods. In these cases, only the hardwood volumes were considered. It should be noted that these hardwood volume estimates are higher than past hardwood volume estimates.

An examination of hardwood production volume by company size helps one visualize the small and large companies. Mean production for the small companies (19 or fewer employees) in 1998 was 2,573,906 BF. Large companies (20 or more employees) generated a mean production of 11,674,753 BF. On average, large companies produce 4.5 times more than small companies produce.

Hardwood production volumes can also be examined by organizational affiliation. Responding companies that were NHLA members had a mean production value of 10,262,284 BF. In contrast, non-NHLA-member companies had a mean production value of only 2,806,940 BF. Five percent trimmed means for NHLA members vs. non-NHLA members were 9,300,377 and 2,349,352 BF, respectively.

To complement the 1998 hardwood lumber production data, the respondents were asked to provide their 1998 hardwood lumber sales. The mean and median lumber sales in 1998 were $5,627,343 and $3,500,000, respectively **(Table 4).** A 5 percent trimmed mean for the 1998 hardwood lumber sales was $4,809,185. This is almost $1 million less than an untrimmed mean. This is to be expected since several data points over $30,000,000 were not included in this trimmed calculation. Paralleling the production volumes, sales values differed greatly and ranged from $160 to $43,000,000.

An examination of the data by company size and NHLA affiliation was performed. Mean hardwood lumber sales for large companies were over five times greater than for small companies. The maximum sales figure was 2.7 times greater for large companies vs. small companies.

In 1998, responding companies that were NHLA members had a mean sales value of $7,698,046. In contrast, non-NHLA members had a mean sales value of only $1,647,579. Five percent trimmed means for NHLA members vs. non-NHLA members were $6,959,525 and $1,410,262, respectively. These results reflect the disparity shown in the lumber product comparison.

In addition to the total hardwood lumber volume and sales data, specific data were collected on the species processed by the responding sawmills. This information, in conjunction with the total hardwood lumber production in 1998, provides a clearer picture of the hardwood lumber market. Ranking the highest, red oak was processed by 357 of the responding companies representing 34.2 percent of the production of the responding companies. Yellow-poplar and white oak followed with 16.0 and 15.5 percent ofproduction, respectively.

Hourly production rates were evenly distributed **(Table 5).** The largest response category was 1,001 to 2,000 BF per hour, accounting for 23 percent of the responses. Interestingly, 32 sawmills (7.8%) had production volumes that fell into the highest category, greater than 7,000 BF per hour. Not surprisingly, 31 of these companies were classified as large companies (one of the 32 companies chose not to reveal the company size).

With respect to the non-NHLA members, a considerable drop in the number of companies that produce more than 2,000 BF per hour can be noticed. NHLA members have a more even distribution, with a greater number of companies that operate at higher production rates **(Fig. 1).**

Individual respondent demographics. — Information on the individual that answers the questionnaire may lead to further insights. People of different backgrounds may perceive technology differently. This is especially important to this study. Information on the responding individual's position within the company, level of education, and age were examined.

Almost 70 percent of the respondents were owners and 25 percent responded as upper management personnel. Four companies marked the "other" category, and indicated positions such as partner or sales personnel.

Each questionnaire was targeted to the owner or upper manager. It was expected that the owner or mill manager would have the most pertinent information regarding technology in their mill. The middle management and "other" category may indicate that the questionnaire was passed down the chain of command.

Concerning education level, the largest responding group selected the high school category (36%), followed closely by the four-year college category (22%). An additional 39 percent of the respondents had a college-level education. Three percent of the respondents marked the "other" category and typical responses included NHLA Grading School, eighth grade, law school, and trade school.

The relationship between an individual respondent's level of education and the current level of technology in their sawmill was examined. Recall that this equipment included bucking-optimizers, headrig-optimizers, edger-optimizers, trimmer-optimizers, grade mark readers, and automated sorting. **Table 6** suggests a link between those respondents with lower levels of education and the lack of technology at their mills.

Finally, age ranges were collected on the individual respondents. The largest response category was 40 to 49 (41%), followed by the 50 to 59 category (25%).

The information gathered in the individual respondent profiles complement

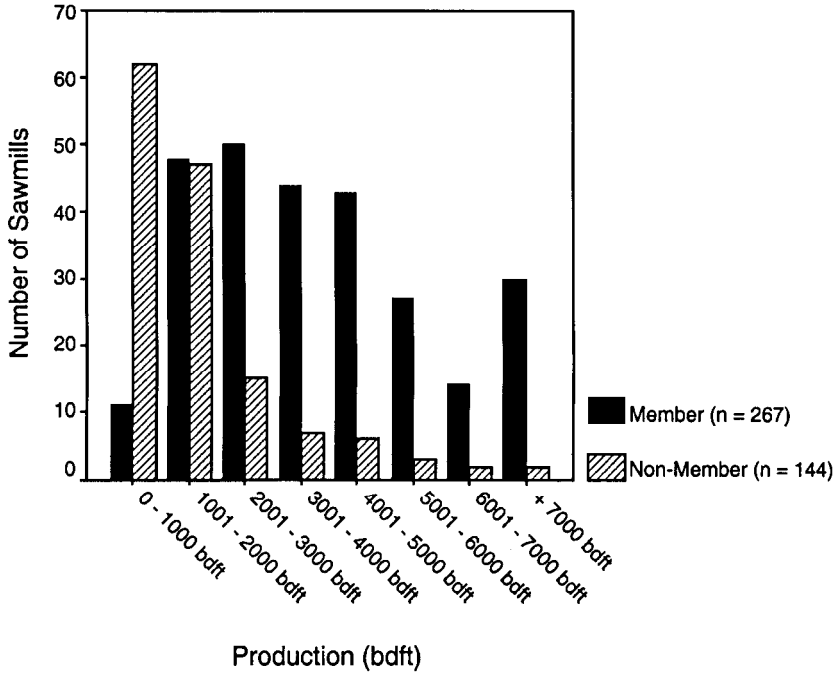

Figure 1. — Hourly production rates for NHLA versus non-NHLA members.

TABLE 6. — Level of education based on sawmill technology. [a]

	Has technology		Does not have technology	
Level of education	Frequency	Percentage	Frequency	Percentage
		(%)		(%)
High school	40	26.1	98	41.2
Two-year college	33	21.6	54	22.7
Four-year college	54	35.3	59	24.8
Graduate school	22	14.4	17	7.1
Other	4	2.6	10	4.2

[a] Technology companies: n = 153; non-technology companies: n = 238.

TABLE 7. — Information source ratings. [a]

Factor	Mean rating	Subsets (alpha = 0.05)					
Plant visits	5.3	*					
Peer conversations	5.3	*					
Association meetings	4.3		*				
Personal sales calls from manufacturers	4.1		*	*			
Meetings and symposiums	4.0		*	*	*		
Short courses	3.9			*	*		
Trade journals	3.9			*	*		
Consultants	3.8			*	*	*	
Manufacturer's ads and literature	3.8			*	*	*	
Newsletters	3.7				*	*	
Scientific journals	3.7				*	*	
University extension personnel	3.6				*	*	
Unsolicited sales literature	3.5					*	
Other	3.4						*
Internet	3.0						*

[a] n = 366; * indicates significantly different group means at an alpha level of 0.05 using Tukey's Honestly Significant Difference test for homogeneous subsets.

TABLE 8. — Information source mean ratings comparisons. [a]

	Large vs. small companies		
Information source	All companies	Large companies	Small companies
Plant visits	5.3	5.7	4.8*
Peer conversations	5.3	5.5	5.0*
Association meetings	4.3	4.5	4.1*
Personal sales calls from manufacturers	4.1	4.2	3.9*
Meetings and symposiums	4.0	4.2	3.7*
Trade journals	3.9	3.9	3.8
Short courses	3.9	3.9	3.9
Manufacturer's ads and literature	3.8	3.9	3.7
News letters	3.7	3.8	3.6
Scientific journals	3.7	3.8	3.6
Consultants	3.8	3.7	3.9
University extension personnel	3.6	3.7	3.6
Unsolicited sales literature	3.5	3.5	3.4
Other	3.4	3.2	3.5
Internet	3.0	3.1	2.9
	Technology vs. non-technology companies		
Information source	All companies	Current technology	No technology
Plant visits	5.3	5.8	5.0*
Peer conversations	5.3	5.5	5.2*
Association meetings	4.3	4.6	4.1*
Personal sales calls from manufacturers	4.1	4.4	3.8*
Meetings and symposiums	4.0	4.2	3.8*
Trade journals	3.9	4.0	3.7
Short courses	3.9	3.9	3.9
Manufacturer's ads and literature	3.8	3.9	3.7
Scientific journals	3.7	3.8	3.6
Consultants	3.8	3.8	3.9
News letters	3.7	3.8	3.7
University extension personnel	3.6	3.6	3.6
Unsolicited sales literature	3.5	3.6	3.4
Other	3.4	3.2	3.4
Internet	3.0	3.1	2.9
	NHLA members vs. non-NHLA members		
Information source	All companies	NHLA member	Non-NHLA member
Plant visits	5.3	5.6	4.7*
Peer conversations	5.3	5.5	5.0*
Association meetings	4.3	4.6	3.8*
Personal sales calls from manufacturers	4.1	4.2	3.7*
Meetings and symposiums	4.0	4.2	3.4*
Short courses	3.9	4.0	3.6*
Trade journals	3.9	4.0	3.6*
Consultants	3.8	3.9	3.7
Manufacturer's ads and literature	3.8	3.9	3.6
News letters	3.7	3.8	3.4*
Scientific journals	3.7	3.8	3.4*
University extension personnel	3.6	3.7	3.4
Unsolicited sales literature	3.5	3.5	3.4
Other	3.4	3.5	3.2
Internet	3.0	3.1	2.9

[a] All companies: n = 366; large companies: *n* = 156; small companies: *n* = 205; technology companies: *n* = 138; no technology companies: *n* = 205; NHLA members: *n* = 247; non-NHLA members: n = 115; * indicates significant difference between information source ratings, independent sample t-test at alpha = 0.05.

each other. The majority of the respondents' positions in the sawmill fell into the owner or upper management categories. This agreed with the higher ages for the majority of the respondents.

INFORMATION SOURCES

When a sawmill considers adding equipment to its production facility, there are many places it can gather information. Several questions were asked to collect data on the value of different information sources.

Plant visits and peer conversations were rated the highest at 5.3 **(Table 7).** Unsolicited sales literature rated near the bottom, as did university extension personnel. The Internet rated last at 3.0 out of 7.0. This finding is contrary to current trends in training and education, but the findings are similar to other research in the wood products industry (3).

An important question to ask is if the differences in these ratings are significant. Analysis of variance (ANOVA) found that there were significant differences between factor ratings (alpha = 0.05). One method to identify which factors rate similarly and differently is the Tukey's Honestly Significant Difference (HSD) test (9). Tukey's HSD groups like means together. **Table 7** shows the factors that demonstrated like means according to Tukey's HSD (alpha = 0.05). Asterisks grouped by column show the factors where the differences were not significant. It must be noted that at alpha = 0.05, Type 1 error may result within the 15 factor ratings.

Plant visits and peer conversations were found to be significantly different from the other groups. The Internet was found in the bottom significantly different group. The "other" category contained 18 responses and the main themes recorded in the open-ended portion of this question included: watch it in operation, talk to owners of installed equipment, verified results from operations, and see it at trade shows.

Following the previous comparison procedures, these information sources were compared between large and small companies. Significant differences were found for five information source ratings (independent sample t-test, alpha = 0.05). Plant visits, peer conversations, association meetings, personal sales calls from manufacturers, and meetings and symposiums were all rated signifi-

cantly higher by large companies **(Table 8).** All five of these information sources involve one-on-one interaction and were rated as the five highest information sources overall.

Comparison by company technology resulted in four significant differences in information source ratings. Plant visits, association meetings, personal sales calls from manufacturers, and meetings and symposiums parallel the comparisons by company size **(Table 8).**

NHLA and non-NHLA members were also compared. Nine significant differences were found between the groups. NHLA-member ratings were higher than non-NHLA-member ratings in all nine cases **(Table 8).** These differences closely paralleled the comparisons by company size and company technology. The information sources that were significantly different centered on personal interaction.

Four information sources that were not found significantly different in the other group comparisons were: short courses, trade journals, newsletters, and scientific journals. Short courses offer the previously mentioned personal interaction and are regularly organized by the NHLA and university extension personnel. The other three information sources do not offer personal interaction. It is possible that the NHLA is very effective in using print media and their members react to this media positively.

Another mechanism for gaining and sharing knowledge is through trade associations or professional associations. We asked the respondents to list the associations where they were members. Over 140 different associations were listed. Not surprisingly, the NHLA was listed most frequently (236 listings). This was expected since the NHLA membership list was used as part of the sample frame. The Hardwood Manufacturers Association followed the NHLA (107 listings). Regional associations in the Lake States, Indiana, Virginia, Kentucky, West Virginia, and Pennsylvania demonstrated their importance and influence with high frequencies.

Trade associations or professional association business meetings are additional sources of information and interaction between companies. The study participants were asked how many association meetings they attend annually. The average number of meetings was 3.0.

Conclusions

This study sought to develop a national profile of the hardwood sawmill industry. This was achieved by compiling information on hardwood sawmill demographics, the hardwood sawmill as a system, and hardwood sawmill information sources.

Company size based on the number of employees was larger than expected. A 5 percent trimmed mean of 29.5 employees suggests that a typical hardwood sawmill would fall into our classification of a large company.

Hardwood sawmills affiliated with the NHLA demonstrated several positive characteristics when compared to non-NHLA members. Over 88 percent of large companies are NHLA members while over 65 percent of small companies are non-NHLA members. On average, the NHLA members produced almost 7 million BF per year more than non-NHLA members. This trend is paralleled in the production rate data, with the majority of the NHLA members producing in the top seven production categories. The majority of the non-NHLA members produced in the bottom two production categories. Overall, comparisons showed that large companies, NHLA members, and technology companies were similar and outperformed their counterparts.

Existing sawmill scanning and optimizing equipment was examined. This study found that the majority of the hardwood sawmills have not adopted advanced technologies. Headrig optimization, one of the oldest and broadest technologies was most common and used by 21 percent of the respondents. Newer technologies such as edger-optimizers and trimmer-optimizers were in use by approximately 10 and 5 percent of the respondents, respectively. From this data, 63 percent of all sawmills have no type of scanning or optimizing equipment in their sawmill.

Advanced technology was more common with large companies. It is likely that large companies have the necessary capital and market share to justify investments in advanced technology.

Information sources were examined. Personal interaction such as plant visits and peer conversations were rated at the top. These were information sources that involved direct personal interaction. The Internet was rated at the bottom. This was true for all comparison groups and is supported by earlier wood products industry research. For the hardwood sawmill industry, the Internet is not seen as an effective information tool.

The two most cited trade associations were the NHLA and the Hardwood Manufacturers Association. Given the industries' preference for personal interaction, association forums would be well suited for research and outreach activities.

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