



# **Change in Wood Use Patterns by the Furniture Industry**

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## **Introduction and Background**

The U.S. furniture industry is one of the largest in the world and the second most important user of solid hardwood products after pallets and containers. The wood furniture categories represented by SIC 2511, Wood Household Furniture; SIC 2512, Upholstered Household Furniture; and SIC 2521, Wood Office Furniture account for a significant market for hardwood products, particularly higher quality, preferred species. The last comprehensive assessment of material use by the furniture industry was conducted in 1993.<sup>1</sup>

Competitive challenges are changing the way furniture is manufactured today. Since the 1993 study, many changes have occurred in the furniture industry including advances in composite technologies, increasing pressure to improve utilization and efficiency, changing demographics, and increased competition. Composite materials, such as particleboard and medium density fiberboard (MDF) are increasing their use in furniture products. These materials reduce the cost of manufacture, have superior dimensional stability, and provide design flexibility in case goods. Specifically, in the upholstered furniture segment, changes in manufacturing technologies have influenced the evolution of furniture frames from solid hardwood to panel products such as hardwood plywood, softwood plywood, OSB, and other structural materials. The changes have had an impact on markets for low grade hardwoods and the hardwood sawmills that were dependent on these markets.

The growth of the dimension manufacturing industry indicates that furniture companies purchase more component parts than in the past. Many source out components that would otherwise be too costly to manufacture in their facilities. This study will provide volume estimates for both hardwood and softwood lumber, composite products, and veneer quantities used in 2000 and volumes manufacturers expected to use in 2001. Specifically, which species were used, drying condi-

tions, and lumber grades are reported. Finally, the products manufactured from the raw materials, including case goods, upholstered furniture, and packaging and crating products are reported.

Because of this industry's importance in the U.S. economy, and the fact that many factors are driving the industry to change traditional manufacturing practices and material use, a comprehensive study to track changes in patterns of wood use by this industry is needed. This study was conducted to provide a comprehensive assessment of material use by the furniture industry and to track the changes in material use since 1993.

### **Study Objectives:**

Specific objectives of this study include:

1. Determine the predominate wood raw material forms being used by various segments of the furniture manufacturing industry. These forms include hardwood and softwood lumber, hardwood and softwood plywood, medium density fiberboard (MDF), particleboard, oriented strand products (OSB, OSL), laminated veneer lumber, veneer, and component parts.
2. Determine the quantities of each raw material form being used by each industry segment.
3. Compare the results in Objectives 1 and 2 with the results of the 1993 study by Hansen to determine what shifts have occurred in raw material selection and usage volumes.
4. Assess future trends within industry segments which might increase or decrease current materials use

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<sup>1</sup>Hansen, Eric, Robert Bush, and John Panches. "Wood Materials Use in the U.S. Furniture Industry: 1992-1994". Research Report. Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. September 1993.

## Research Methodology

### Sample Design

For comparison with previous wood materials use studies conducted in 1991<sup>2</sup> and 1993<sup>3</sup>, Standard Industrial Classification Codes 2511, Wood Household Furniture; 2512, Upholstered Household Furniture; and 2521, Wood Office Furniture; were chosen for the study population. The list of furniture manufacturers sampled in this study was purchased from the commercial industry list generator Dunn and Bradstreet and included only those companies with more than 50 full-time employees. The total number of surveys mailed was 892 and the study was national in scope. The population for each segment of manufacturers is listed below. It should be noted that some companies were categorized in more than one SIC code group.

	Number of Surveys Mailed
Wood Household Furniture	416
Upholstered Household Furniture	360
Wood Office Furniture	<u>198</u>
	974

### Survey Design

This study was modeled after the two previous wood materials use studies. The two survey instruments were reviewed and when possible, the same terminology and categories were used in this current study in order to make some comparisons of data possible. In fact, many of the same questions were included and the funding agency of both studies reviewed and edited the final survey instrument. For example, care was taken to make certain to use the same U.S. Census Bureau region categories for this survey in the question pertaining to location of production facilities. The survey for this study however, was condensed in size in order to fit on a one-page (8 ½ x 11 inch) front and back survey card.

### Data Collection

A survey packet was developed which included the one-page front and back survey, a one-page cover letter and a self-addressed return envelope with postage paid permit designation. The letter explained the reasons for the survey and how the resulting information from this study could benefit the recipient. The cover letters were all signed by hand. The survey cover letter was personally addressed to presidents or general managers of each company and explained how to receive a copy of the results when available. Several faculty at Mississippi State University reviewed the survey instrument for accuracy, clearness and ease of completion.

The first set of surveys were mailed in January 2001. After receiving 57 surveys back, a second set of surveys were sent to the remaining 835 non-respondents. Final number of responses and response rates after two mailings is listed below by SIC Code.

	# of Responses	Response Rate %
2511 Wood Household Furniture	40	9.62
2512 Upholstered Household Furniture	30	8.33
2521 Wood Office Furniture	13	6.57

Total number of responses after two mailings is 72 respondents. The number of responses above by SIC Code totals 83 because some companies were classified according to 2 or more SIC Codes. Overall survey response rate was 8.75%. This rate was obtained by the following formula which was used in the 1991 Forbes study.<sup>4</sup>

$$\text{Response Rate (8.75\%)} = \frac{\text{\# of Usable Responses Received (72)}}{\text{Adjusted \# of Surveys Mailed (823)}}$$

<sup>2</sup>Forbes, Craig L., John Punches, and Steven Sinclair. "Materials Use in the U.S. Furniture Industry: 1990-1992". Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. October 1991.

<sup>3</sup>Hansen, Eric, Robert Bush, and John Punches. "Wood Materials Use in the U.S. Furniture Industry: 1992-1994". Research Report. Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. September 1993.

<sup>4</sup>Forbes, Craig L., John Punches, and Steven Sinclair. "Materials Use in the U.S. Furniture Industry: 1990-1992". Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. October 1991.

Where:

Usable responses = responses that are correctly filled out and represent a producer of wood furniture, and

Adjusted # of Surveys = (all surveys mailed) - (Undeliverable surveys) - (surveys representing firms not producing wood household, wood office, or upholstered furniture).

As previously noted no manufacturers reporting less than 50 full-time employees were surveyed in this study.

As was the case in the Forbes 1991 study, a determination had to be made as to a value of zero (material was not used by the respondent) or a non-response (the question was not answered) when the respondent left a blank in the space provided for yearly volumes of specific materials. This situation was handled in the same manner as in the Forbes 1991 study. That is, if volumes were given for the materials on a survey, it was assumed that the materials for which volumes were not given were not used. Therefore, a zero response was posted for such cases and when no volumes were given for any material in that year, the response was seen as a missing value or non-response and left blank.<sup>5</sup>

## Non-Response Bias

The potential for differences between survey respondents and survey non-respondents is always a consideration with survey data. Non-response bias questions whether data from the non-respondents would be systematically different from respondents data. Based on a random sample of non-respondents that were telephoned and asked to provide data on volumes used of lumber, dimension parts, particleboard, MDF, Hardboard, OSB, plywood and veneer to the survey questions, it was determined that non-response bias was not a significant problem with this survey.

## Interpreting Results

The greatest level of comfort when interpreting statistics from experimental sample data or surveys is always around the mean of the sample. Likewise, the greatest confidence in survey data always exists at the highest level of aggregation. It should be stressed that results presented here, especially the 2001 usage predictions, are based on what respondents thought would happen to their respective companies. The trends presented by summary of these usage predictions should be tempered by the reader with the understanding that the furniture industry was under stressful economic conditions at the time the survey was completed. Tables of wood usage by individual SIC codes represent several levels of disaggregation.

This study excluded companies reporting less than 50 employees in the survey process. Discussions with industry executives about the omission indicated that the general trends reported in this study would be valid and that volume estimates might be slightly understated. These executives stated that "80 to 90% of the furniture is produced by the largest 20% of manufacturers" which were included in the survey.

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<sup>5</sup>Forbes, Craig L., John Panches, and Steven Sinclair. "Materials Use in the U.S. Furniture Industry: 1990-1992." Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. October 1991.

## Respondent Profiles

### Sales

Annual sales of more than \$50 million were reported by 28% of respondents, 12% reported sales of \$20-50 million and 48% reported sales of \$5-20 million dollars annually. Only 12% of respondents reported sales of \$1-5 million and 0 reported sales of less than \$1 million dollars. Therefore, 40% of respondents reported sales of \$20 million or more and 88% reported sales of \$5 million dollars or more. Dunn and Bradstreet reported sales figures for 50 of the 72 survey respondent companies. Total sales for these companies (about 70% of respondents) totaled 3,143,099,750 dollars.

### Percent Responses by Sales

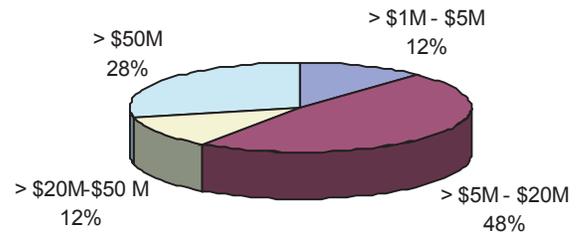


Figure 1. Percent responses for annual sales from survey data.

### Employees

Almost half of the responses (48%) came from medium-sized companies with 51-200 employees. Companies which number 201-500 employees made up 17% of responses, 6% had 501-1000 employees and 22% of responses came from companies with more than 1000 employees. So collectively, about 45% of responses came from companies with more than 200 employees.

Seven percent of the responding companies stated that they had less than 50 employees even though companies with less than 50 employees were omitted from the survey. Since these companies had previously reported more than 50 employees, it is believed that these companies downsized due to the economic conditions that existed in the furniture industry at the time of the survey.

### Percent Responses by Number of Full-Time Employees

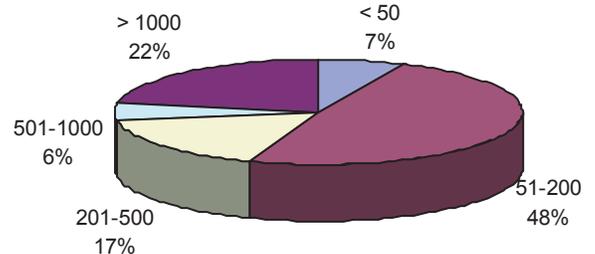


Figure 2. Percent responses for number of full-time employees from survey data.

### Region

In Hansen's 1993 study, most respondents were from the South (35.5%) followed by the North Central (Mid-West) (23.2%), West (21.8%), and the Northeast (19.6%).<sup>6</sup> Respondents in this study indicated a slightly higher percentage of responses from the South (51%), followed by the Mid-West (North Central) (21%), West (15%), and New England (Northeast) (13%) areas. Using the Chi Square Statistical Test it was determined that the distribution of responses (Chi Square Statistic = 11.3) was significantly different between the 2000 study and the 1992 study. The southern response rate increased while the remaining geographic areas decreased and may be attributable to a difference in the proximity of Mississippi State University to the southern industry relative to Virginia Polytechnic Institute, where the previous study was conducted.

### Percent Responses by Region

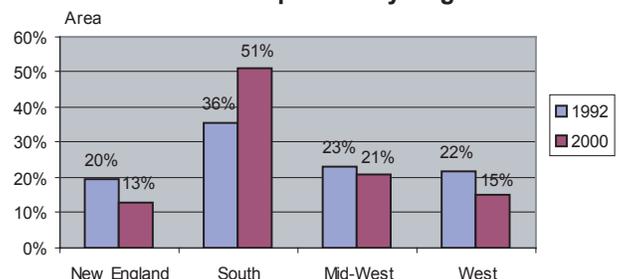


Figure 3. Percent responses for region of U.S.A. from Hansen's 1993 study and 2000 study.

<sup>6</sup>Hansen, Eric, Robert Bush, and John Panches. "Wood Materials Use in the U.S. Furniture Industry: 1992-1994". Research Report. Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. September 1993.

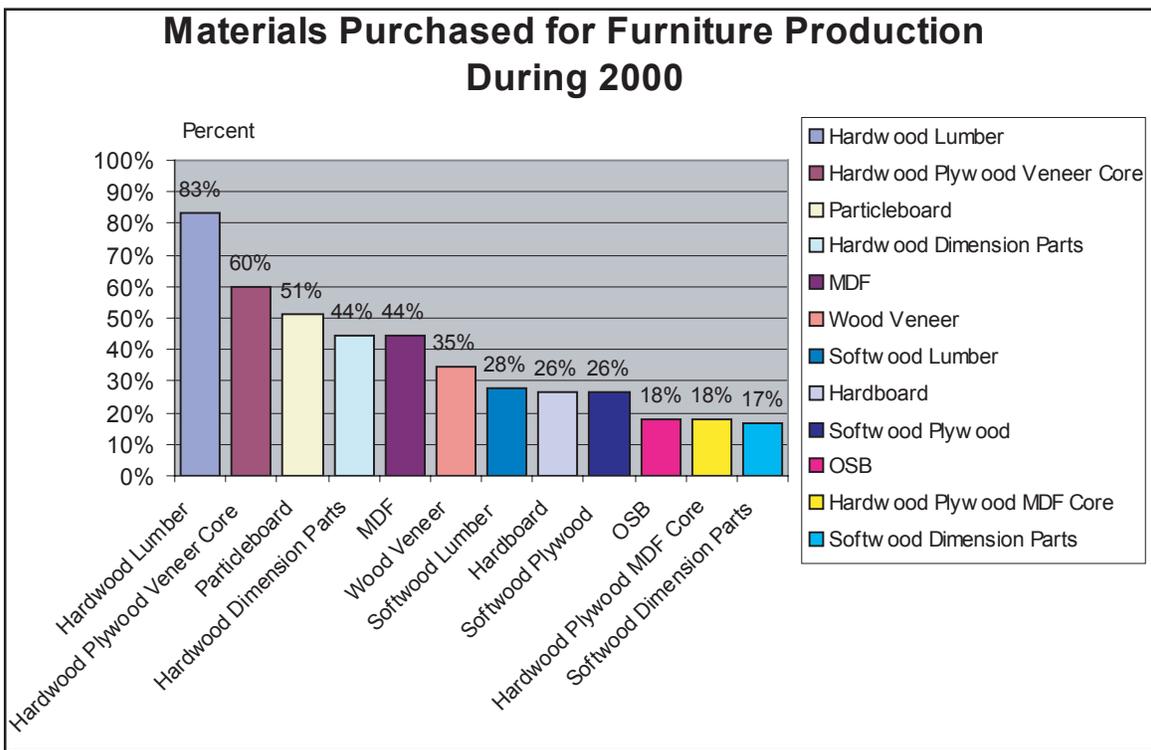


Figure 4. Percent of respondents reporting purchase of specific materials in 2000.

## Results

### Materials Purchased for Furniture Production

The chart above demonstrates the percent of total respondents whose companies purchased the various wood materials for furniture production during 2000. Hardwood lumber purchases were made by more than 83% of the firms responding. Hardwood plywood veneer core and particleboard purchases were also made by more than 50% of responding firms. The next often cited purchases for furniture production were hardwood dimension parts and MDF.

### Volumes of Wood Materials Purchased for Furniture Manufacture

Respondents were asked to supply volume estimates of lumber, plywood, and other wood materials used during 2000 to manufacture furniture and volumes that the company was expected to use during 2001. Lumber, both hardwood and softwood, and dimension parts, both hardwood and softwood were reported in board feet. The average volume of lumber used per plant in 2000 was about 5,114 MBF and the expected average volume per plant in 2001 was predicted to be 4,687 MBF; a decrease of about 8%. Volume of dimension parts was expected to decrease in 2001 from 1,787 MBF to 1,274 MBF or a decrease of about 29%. See Figure 5.

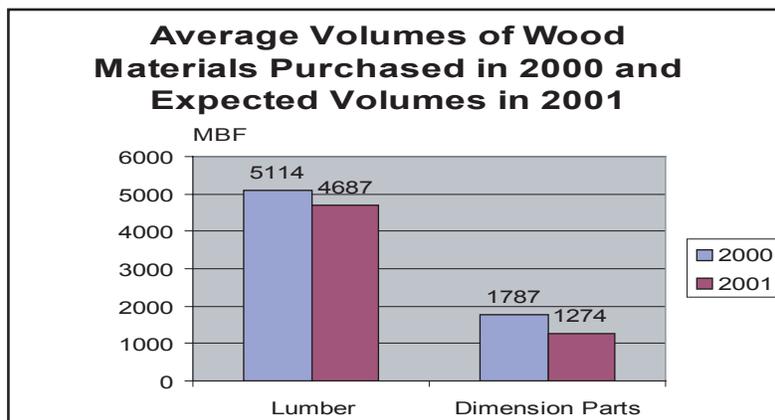


Figure 5. Average volumes of lumber and dimension parts purchased for furniture production in 2000 and average expected volumes for 2001.

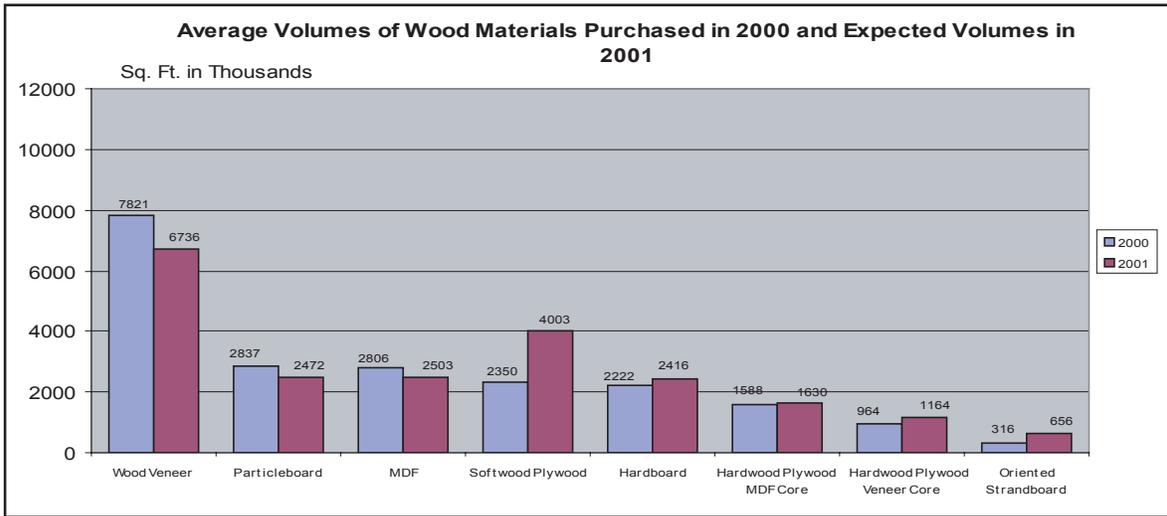


Figure 6a. Average volumes of wood materials purchased for furniture production in 2000 and average expected volumes for 2001.

Figure 6a above shows the average volume per respondent plant, of other wood materials purchased for use in furniture manufacture and the expected changes in average volumes from 2000 to 2001. Volumes are reported in thousands of square feet. Wood veneer had the highest volume of use among the wood materials included in the survey (excluding lumber and dimension parts which are shown in Figure 5). Particleboard use followed wood veneer but was predicted to be overtaken by softwood plywood in 2001. The percent change in the various wood materials used in 2000 to

expected changes in 2001 are shown in Figure 6b. Softwood plywood is expected to surpass MDF and particleboard in 2001. However, growth in OSB was predicted to be 38% more than softwood plywood as illustrated in Figure 6b. OSB started with a small usage base value but OSB and softwood plywood appear to be displacing particleboard and MDF. Wood veneer usage is also predicted to decrease but would be linked to changes in styles or outside purchases of dimension parts since plywood and OSB cannot be used as show wood.

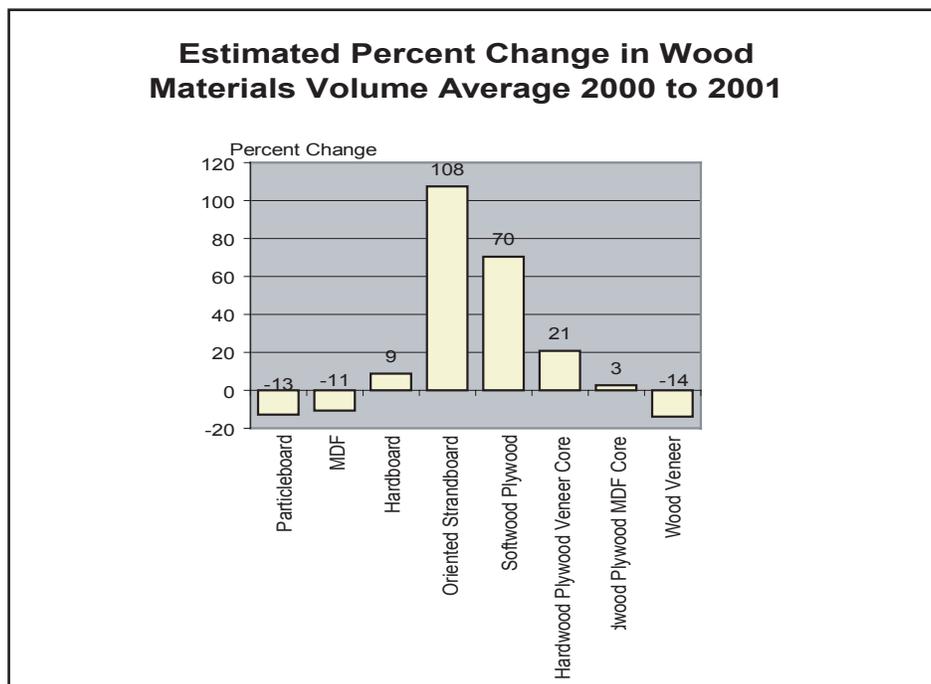


Figure 6b. Percent change in average volumes of wood materials purchased for furniture production in 2000 and average expected volumes for 2001.

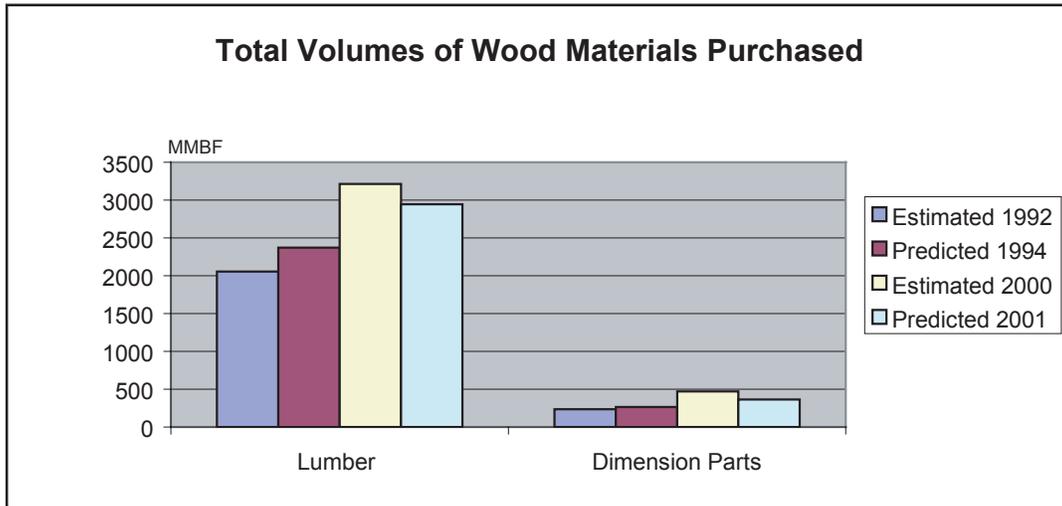


Figure 6c. Total volumes of lumber and dimension parts purchased.

Adjusted total volume estimates of wood materials estimates and predictions from the Hansen study as well as this current study are shown below in Figures 6c and 6d.<sup>7</sup> Adjusted estimates for the current study (2000 and 2001) were calculated by dividing the total volumes reported by usable survey respondents by the survey response rate.



Figure 6d. Total volumes of particleboard, MDF, hardboard, OSB, softwood plywood, hardwood plywood veneer core, hardwood plywood MDF core, and wood veneer purchased.

\* Panel products are reported without an assigned basis. The following are the most common thicknesses utilized by the furniture industry: particleboard (5/8" & 3/4"), hardboard (1/8" & 1/4"), MDF (5/8" & 3/4"), veneer core hardwood plywood (3/4"), fiber core hardwood plywood (3/4"), and softwood plywood and OSB (3/4" & 7/8").

<sup>7</sup>Hansen, Eric, Robert Bush, and John Punches. "Wood Materials Use in the U.S. Furniture Industry: 1992-1994". Research Report. Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. September 1993.

The overall volume of lumber and dimension parts increased between survey periods. The mid- to late 1990's were good growth years for furniture in general. However, the economy slowed around the turn of the century. The reductions in lumber and dimension parts that companies were expecting to use in 2001 are reflective of overall economic conditions in the general economy at the time that the survey was completed by the respondents. Another factor contributing to the decrease in lumber usage during this period was a structural technology change in the upholstered furniture industry in frame building techniques. Upholstered frames were traditionally constructed out of hardwood lumber using oak, sweet gum, and yellow poplar as primary species. The industry shifted to panel products for frames, mainly softwood plywood and OSB, to reduce manufacturing costs. Companies with traditional

rough mills closed many of them and purchased CNC routers and band saws to produce frame parts. This manufacturing technology change is responsible for the movement of position in softwood plywood from a relatively small material usage in 1992 and 1994 to the number two player behind wood veneer in the estimated 2001 usage.

The data for wood material use for use in furniture manufacture for 1992, 1994, 2000 and 2001 are shown in Table 1. The data for 1992 Estimated and 1994 Predicted data was taken from the Hansen study. The hardwood lumber and softwood lumber estimates for 1992 and 1994 from Hansen's study were combined for a total lumber estimate. Hardwood dimension, southern pine dimension and other softwood dimension categories were combined for 1992 and 1994 estimates.<sup>8</sup>

	Estimated 1992	Predicted 1994	Estimated 2000	Predicted 2001
Lumber (MMBF)	2056	2372	3215	2946
Dimension Parts (MMBF)	234	263	470	364
Particleboard (MMSF)*	1194	1394	843	763
MDF (MMSF)	319	369	609	572
Hardboard (MMSF)	176	202	406	387
OSB (MMSF)	12	12	25	68
Softwood Plywood (MMSF)	102	120	483	869
Hardwood Plywood Veneer Core (MMSF)	220	253	298	359
Hardwood Plywood MDF Core (MMSF)	109	136	182	168
Wood Veneer (MMSF)	1361	1529	1519	1309

*Table 1. Estimated total wood material use for use in furniture manufacture for 1992, 1994, 2000 and 2001.*

\* Panel products are reported without an assigned basis. The following are the most common thicknesses utilized by the furniture industry: particleboard (5/8" & 3/4"), hardboard (1/8" & 1/4"), MDF (5/8" & 3/4"), veneer core hardwood plywood (3/4"), fiber core hardwood plywood (3/4"), and softwood plywood and OSB (3/4" & 7/8").

<sup>8</sup>Hansen, Eric, Robert Bush, and John Panches. "Wood Materials Use in the U.S. Furniture Industry: 1992-1994". Research Report. Center for Forest Products Marketing, Virginia Polytechnic Institute and State University. September 1993.

Tables 2a and 2b show the respective amount of raw materials used by manufacturers classified by SIC codes 2511, 2512, and 2521 for the year 2000 and estimated for 2001. The Others SIC Code classification appears because some manufacturers indicated that some of their production fell into other SIC classifications and is a very small overall percentage of material use. The three materials that had the largest percentage gain in Figure 6b are OSB, softwood plywood, hardwood plywood veneer core. These overall gains are presented in Table 1 and are broken down by industry segment SIC code in Tables 2a and 2b.

Softwood plywood made its largest gain in the upholstered furniture industry. Surprisingly, overall lumber usage was expected to be down in 2001 in wood household furniture but up in upholstered furniture.

The original intent was to use the hardwood and softwood lumber percentages and hardwood dimension parts and softwood dimension parts percentages to split lumber and dimension parts into hardwoods and softwoods. However, careful examination of the data returned by manufacturers indicated that these calculations would not be meaningful.

Year 2000	Lumber	Dimension Parts	Particle-board	MDF	Hardboard	OSB	Softwood Plywood	Hardwd Plywd Veneer Core	Hardwood Plywood	
									MDF Core	Veneer
2511	2773	375	726	262	339	9	105	188	162	1480
2512	403	94	11	8	0	16	378	108	0	2
2521	26	0	93	338	66	0	0	1	17	34
Others	13	1	13	1	0	0	0	0	3	4
Total	3215	470	843	609	406	25	483	298	182	1519

Table 2a. Estimated raw material usage by SIC for year 2000.

Year 2001	Lumber	Dimension Parts	Particle-board	MDF	Hardboard	OSB	Softwood Plywood	Hardwd Plywd Veneer Core	Hardwood Plywood	
									MDF Core	Veneer
2511	2491	288	580	217	319	13	160	233	149	1277
2512	416	63	101	7	0	45	709	124	0	1
2521	25	0	99	348	68	0	0	1	16	30
Others	13	12	11	1	0	9	0	0	3	2
Total	2946	364	791	572	387	68	869	359	168	1309

Table 2b. Projected raw material usage by SIC for year 2001.

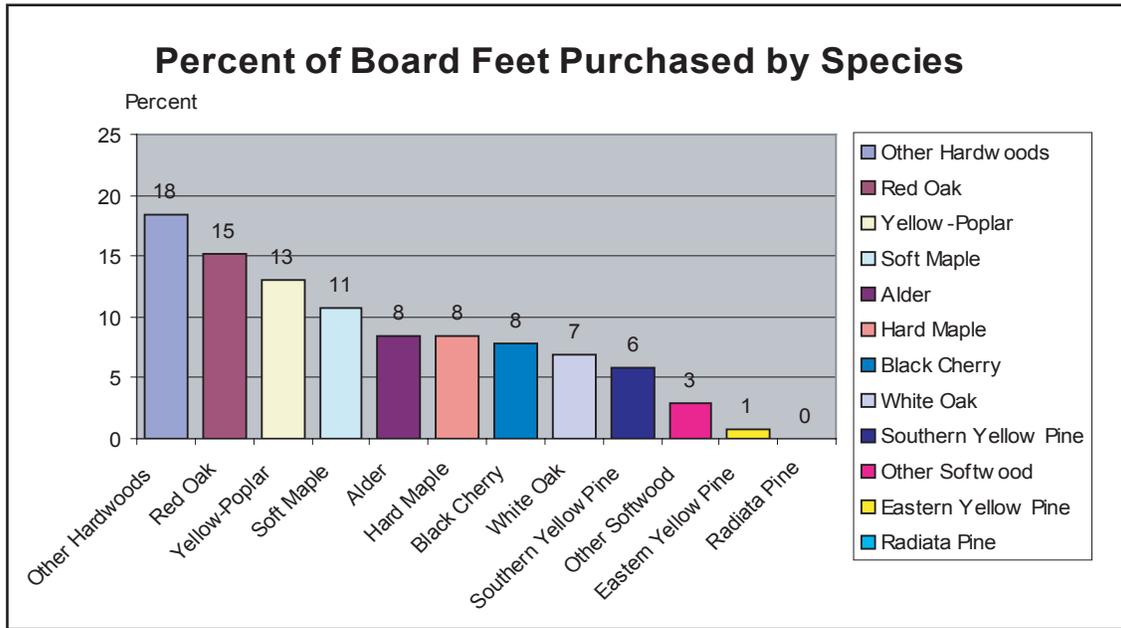


Figure 7. Percent of board feet purchased for furniture production in 2000 by species.

The third question of the 2000 survey asked respondents to provide percentage of total board feet purchased for furniture production by species. Both hard and softwood species were grouped in the same question. Other hardwoods received the highest percent of responses at 18.42%. Red oak made up 15.26% of materials purchased followed by yellow-poplar (13.07%) and soft maple (10.78%). Figure 7 details the percent of purchases for all species listed on the survey. Other hardwoods consisted of (in decreasing order of occurrence), ash, mixed, yellow birch, poplar, walnut, cherry, mahogany, sycamore, beech, and hickory.

Respondents were also asked to provide percentage of green and air dried lumber, and kiln dried hardwood lumber purchases for 2000. Responses were nearly evenly split between the two choices with green and air dried lumber making up 49.01% of purchases and kiln dried making up 50.99% of purchases. Figure 8 only shows the percentages of lumber purchased in terms of green and air dried versus kiln dried. By studying Figure 8, it would be relatively easy to conclude that companies are attempting to increase product quality by purchasing more kiln dried lumber. However, the survey did not capture the usage of on-site kilns by individual companies and probably simply reflects the economics of kiln operation and purchasing kiln dried lumber.

Respondents were also asked to divide 2000 softwood lumber purchases between boards (less than 1.5 inches thick) and dimension lumber (1.5 inches or thicker). Figure 9 shows the results.

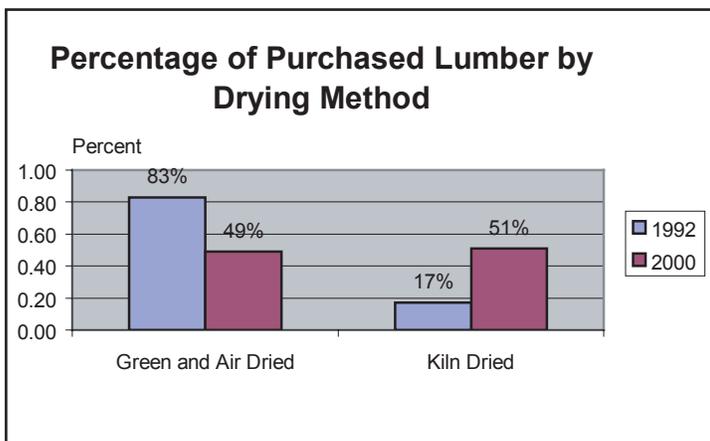


Figure 8. Percent of 2000 hardwood lumber purchases based on drying method, Hansen's 1992 Study and 2000 Study.

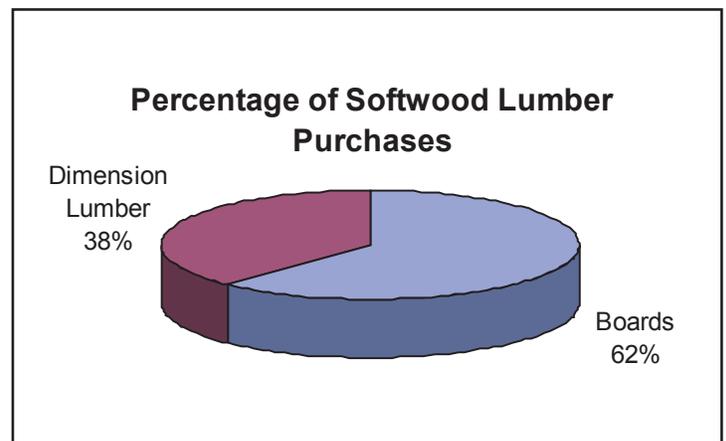


Figure 9. Percent of 2000 softwood lumber purchases based on thickness.

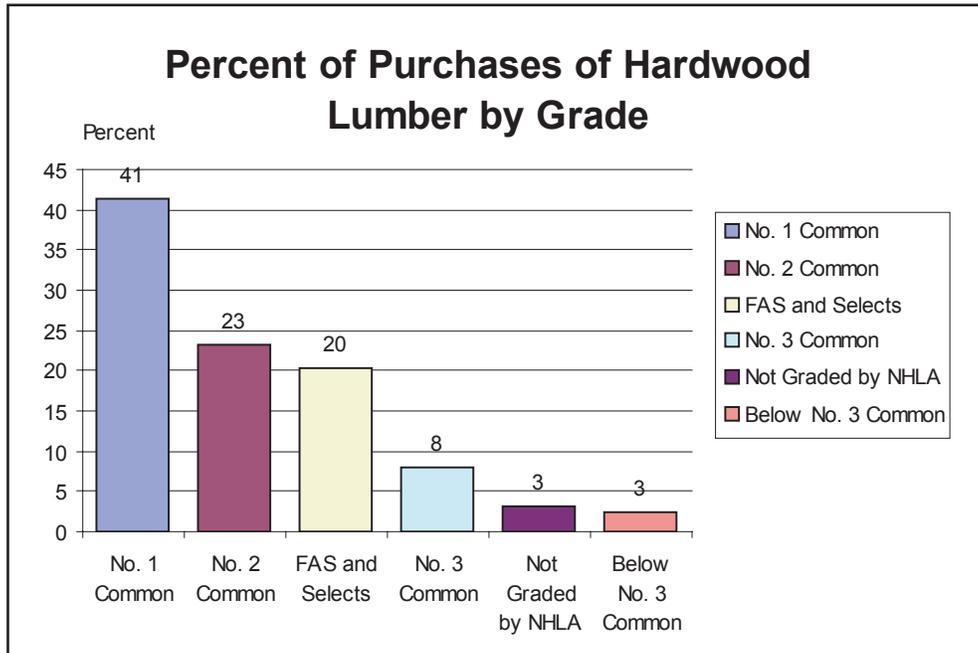


Figure 10. Percent of 2000 hardwood lumber purchases by grade for furniture production.

Question 5 of the survey dealt with grades of hardwood lumber purchases for furniture production in 2000. Responses were made based on percentage of total board feet in each category. No. 1 Common claimed 41.30% of purchases, followed by No. 2 Common (23.28%), and FAS and Selects (20.27%). The percent of purchases of No. 3 Common was 8.06% followed by Below No. 3 Common and Not Graded by NHLA. Some furniture companies purchase side boards from small tie mills as mill run lumber which accounts for the non NHLA Graded lumber.

An important factor in studying the uses of wood materials in the furniture industry is the type of furniture that will be manufactured from the materials. This survey looked at case goods, upholstered furniture, other furniture, and packaging and crating to ship their products. About 1/3 of the wood materials purchased were for use in upholstered furniture with slightly less than 1/3 for use in case goods and packaging. Only 4% of materials were purchased for use in other furniture. It is evident that the furniture industry purchases significant quantities of softwood lumber just to package products for shipment.

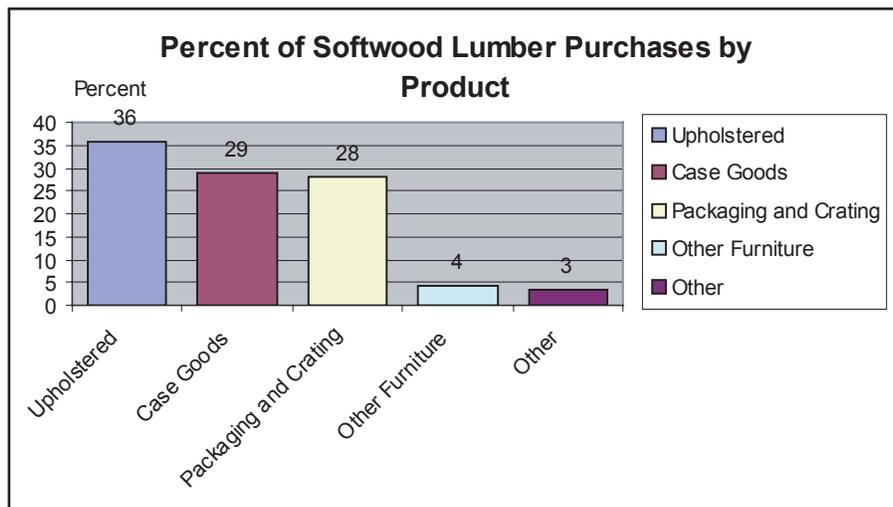


Figure 11. Percent of softwood lumber purchases for use in furniture by product.

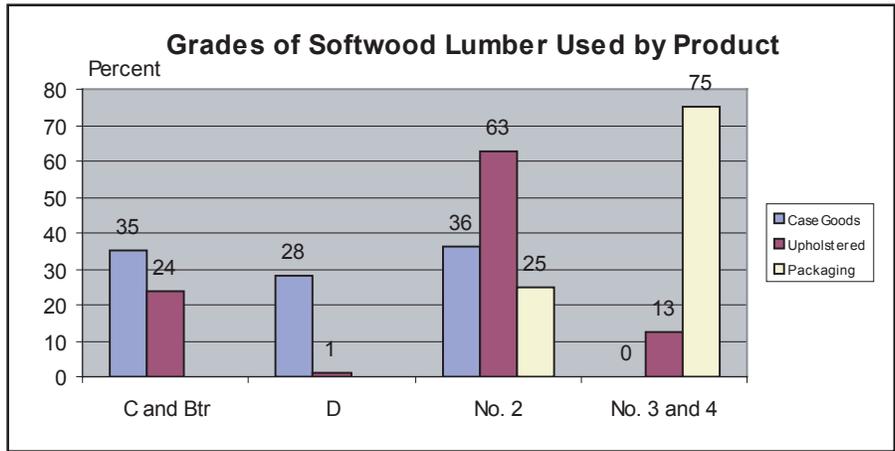


Figure 12. Percent of softwood lumber purchased by grade and product.

Question 8 asked respondents to provide the percentage of various grades of softwood lumber that was purchased in 2000 for use in case goods and upholstered furniture. Percentages for C and Btr, D, and No. 2 were fairly evenly split for use in case goods. For upholstered furniture, more than 60% of the softwood lumber purchased was No. 2 lumber. About 24% of softwood lumber purchased for use in upholstered furniture was C and Btr followed by No. 3 and 4 at 12.5% and D at 1.25%. For packaging and crating, 75% of softwood lumber purchased was No. 3 and 4 and 25% was No. 2.

## Conclusions

This study is meant to provide updated information on the volumes and types of wood materials used by the furniture industry in 2000 and the volumes estimated for 2001. It is similar in scope to previous studies conducted by Forbes in 1991 and Hansen in 1993 at Virginia Polytechnic Institute. Major findings of the study are listed below.

- Hardwood lumber was by far the predominant wood material purchased for use in furniture production in 2000 followed by hardwood plywood (veneer core) and particleboard. MDF and hardwood dimension parts were purchased by slightly less than half of respondents for furniture manufacture followed closely by wood veneer, softwood lumber, and softwood plywood.
- Average lumber (both hardwood and softwood) volumes per plant were estimated to be 5.1 MMBF in 2000 and expected to decrease to 4.7 MMBF in 2001. Dimension parts average volume per plant was estimated to be 1.8 MMBF in 2000 and 1.3 MMBF in 2001.
- The greatest changes in type of wood materials used from 2000 to 2001 was expected to be an increase of more than 100% in the use of OSB and an almost 70% increase in softwood plywood. Use of particleboard, MDF and wood veneer was expected to decrease slightly.
- Percentage of total board feet purchased for furniture production by species was led by the category other hard woods, followed by red oak, yellow-poplar and soft maple. Hansen's study also found red oak to be the most predominantly used species followed by yellow-poplar.
- Responses for drying methods for hardwood lumber was almost evenly split between green and air dried lumber, and kiln dried lumber. Percent of hardwood lumber purchases by grade was lead by No. 1 Common at 41%, followed by No. 2 Common (23%) and FAS and Selects (20%). Hansen reported No. 1 Common hardwood lumber purchases for 1992 of 54% and No. 2 Common at 31%.
- Of softwood lumber purchases, 62% was for boards (less than 1 ½ in. in thickness) and 38% was for dimension lumber (1 ½ in. or more in thickness).
- Softwood lumber was purchased by furniture companies for use in upholstered furniture (36%) followed by case goods (29%) and packaging and crating (28%).
- Grade mix of softwood lumber by product type varied as expected by type of product. Case goods manufacturers purchased mostly No. 2 Common, followed closely by C and Btr and Grade D. Upholstered furniture manufacturers bought more than twice as much No. 2 Common lumber as C and Btr and a small percentage of No. 3 and 4. Packaging and crating companies purchased about 75% of No. 3 and 4 lumber and about 25% of No. 2 grade.



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