

**An Analysis of Hardwood Lumber and
Other Wood-based Materials Use
in the Wood Furniture Industry**

By

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Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of


Master of Science

in

Forest Products

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(Abstract)

U.S. manufacturers of wood household, wood office and upholstered furniture were surveyed to (1) assess wood material use for 1990 and estimate use for 1991, and 1992, and (2) to examine consumer perceptions of certain hardwood lumber and supplier attributes in order to ascertain which are most influential in consumer purchase decisions. This study also provided information about the respondents, RTA and unfinished furniture, and green lumber purchases.

Total 1990 hardwood lumber used in wood furniture was estimated at over 2.4 billion board feet. Use was expected to increase 13% from 1990 to 1992. Softwood lumber used in wood furniture in 1990 was estimated at over 839 million board feet. A 6% increase in softwood lumber use was expected from 1990 to 1992. Red oak was the most commonly used hardwood species

and southern pine was the most used softwood. Furniture manufacturers indicated a decrease in particleboard and MDF use, and an increase in hardboard and OSB/softwood plywood use from 1990 to 1992.

Product consistency was the attribute which most influenced the purchase of hardwood lumber, followed by accurate grading, supplier's knowledge of lumber, correct orders, and shipping on time. The least influential attributes were square end trimming, square edges, protective wrapping, end coating and supplier's ability to surface.

Just over 20% of the respondents manufactured Ready-to-Assemble furniture and just over 15% manufactured unfinished furniture. Overall, 26% of respondents purchased green hardwood lumber, most being larger firms. Most firms' purchases of green lumber either have not changed, or have increased, over the last 5 years.

Acknowledgements

This project would not have been possible without the contributions of many. I would like to express my sincere gratitude to all those who have generously offered their time and support throughout this project. I would especially like to express thanks to the following, who have been essential in my pursuit of this goal:

- * Dr. S.A. Sinclair for his leadership, advice, support, patience and friendship, not limited to this project. His dedication to the forest products industry, the University and its students has been inspiring.
- * Dr. R.A. Smith and Dr. F.M. Lamb for their generous assistance as committee members, providing professional counsel throughout the project.
- * Dr. G. Ifju for his courtesy throughout this project.
- * The Hardwood Manufacturers Association and the United States Forest Service for their sponsorship in this project.
- * Joanne and Cathy for their many hours of assistance with this project.
- * All my fellow students, the faculty and the staff at the Brooks Forest Product Center, for their assistance and suggestions.

Preface

This thesis is organized into four separate sections. The first section is a brief literature review. The second and third sections are formatted for publication and are thus intended to be inclusive. Since these two manuscripts are intended to be all-encompassing, some repetition inevitably exists in the methodology sections of these articles.

The fourth section addresses results from additional data collected by the survey that was included in a report prepared for the sponsors of this study. The format of this section is a reflection of the report requirements.

The author hopes the composition of this thesis causes the reader no inconvenience.

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Problem Statement/Justification

✓ The wood furniture industry is the largest domestic user of high grade hardwood lumber, and the second largest user of hardwood lumber (Sinclair 1992, Luppold 1988, Luppold 1987). Considerable volumes of other wood products, including softwood lumber, particleboard, medium density fiberboard (MDF), hardboard, oriented strand board (OSB), softwood plywood, veneer, etc. (Meyer et al. 1992, Luppold 1987) are also used in the manufacture of wood furniture.

In spite of the importance of wood furniture manufacturing to the wood products industry, available information on wood-based materials use is limited. Much of the information available is either out of date, disputed by industry experts or both. Census data on material use are only published in detail every five years and the data are generally not published for at least three years after they are gathered. Even then, researchers spend a great deal of time attempting to interpret and validate the results (Luppold 1990). Without dependable material use estimates, the wood-products manufacturing industry is less able to make accurate business plans for the future.

✓ Hardwood lumber, on a cost basis, is the most important material used by the wood furniture industry (Luppold 1987). ✓✓ Hardwood lumber distribution channels are numerous, and prices are relatively homogeneous (Sinclair 1992).

To remain competitive, hardwood lumber manufacturers are modifying their marketing techniques primarily toward product differentiation and focus strategies (Bush and Sinclair 1991). Hardwood lumber manufacturers and suppliers must emphasize product and/or service attributes that are perceived by their customers to be important and unique. Knowledge of which attributes are most important to the purchase decision of hardwood buyers in the wood furniture manufacturing industry are crucial to hardwood lumber suppliers targeting this industry. However, little research has been done investigating purchase influencing attributes of hardwood lumber as perceived by the wood furniture industry¹.

The purpose of this study was to aid the wood products industry by providing information on material use in the wood household, upholstered, and wood office furniture industries and to ascertain the most purchase influential attributes of hardwood lumber and suppliers of hardwood lumber catering to these industries. The material use portion of this study will aid in forecasting raw material, production and work force requirements by providing information about the current and predicted demands of wood products used in the wood furniture industry. Manufacturers of raw materials used in

¹ Bush et al. (1991), looked at purchase influencing attributes of hardwood lumber in the wood household furniture manufacturing industry, among other hardwood using industries. The sample of this study, however, consisted only of the largest manufacturers and wood household furniture manufacturers were the only wood furniture manufacturer type surveyed.

furniture, timber owners and harvesters, and furniture manufacturers, are among those who will benefit from this data. Experience gained from this study will be applied in developing more efficient methods of estimating material use volumes.

Information from the attribute analysis portion of this study will allow hardwood lumber manufacturers a superior marketing position by providing a basis for tailoring production and marketing techniques to meet the desires and needs of their customers. Wood furniture manufacturers will benefit by receiving more of the lumber and supplier attributes they perceived to be purchase influencing, since their input will influence the strategies of lumber manufacturers and suppliers. By knowing which attributes are influential in the purchase decision of hardwood lumber, those researching and developing hardwood lumber manufacturing equipment may design products that will aid hardwood lumber manufacturers to incorporate these attributes in their lumber.

Objectives

The specific objectives of this project include:

1. To ascertain the purchase influence of various hardwood lumber and hardwood lumber supplier attributes to manufacturers of wood household furniture (SIC 2511), upholstered furniture (SIC 2512), and wood office furniture (SIC 2521).
2. To identify the differences in the purchase influential attributes by consumer size, segment and region.
3. To determine wood and wood-based materials use by customer size, segment and region.

A Brief Literature Review

Material Use

The increased use of hardwood lumber substitutes (ie., particleboard, softwood lumber, etc.) is a concern to the hardwood lumber producers. Other concerns include: improved efficiency in the breakdown of hardwood lumber, more efficient and smaller furniture designs using less lumber, increases in imported parts and changing population demographics (Haynes 1989, Luppold 1988). These topics are discussed below.

The United States furniture industry is a major user of high grade hardwood lumber. However, over the past few decades, wood products other than hardwood lumber, hardwood veneer and hardwood plywood have emerged as significant components in furniture production (Figure 1). Use of hardwood lumber, hardwood plywood and hardwood veneer has been replaced by softwood veneer, particleboard, hardboard, and MDF in many production applications (Luppold 1987).

Wood processing techniques are also having an effect on lumber demand. Technological advancements in the manufacturing of furniture will allow increased part yields from the lumber and thus lower the lumber requirements needed to make an equivalent amount of furniture. Improvements in the

quality of composite panels may also reduce the demand for lumber (Haynes 1989).

✓ In addition, furniture design has an affect on hardwood use. Some manufacturers have engineered improved designs which require less lumber, as well as substituting other products where lumber was once used. Downsizing of upholstered designs may also have an affect on lumber demand (Luppold 1988).

✓ Demographics are also an important determinant of lumber demand. The population from age 25 to age 44 is a good indicator of demand for household furniture (Luppold 1988). This population is expected to decline in the period from 2000 to 2030 (Luppold 1988, USDC BOC 1986). The demand shift for hardwood lumber will also be affected by the quality of furniture demanded by the consumer. Less expensive furniture designs will most likely continue to be produced from lower priced composite panels, whereas high quality furniture designs will use more lumber. The medium quality designs may fall either way, depending on consumer preference as well as the relationship between lumber and composite material supply and demand (Luppold 1988).

✓ Faced with such changes, hardwood lumber suppliers must consider strategies that will maintain or increase their competitive advantage. Strategies must account for product demand, as well as customer needs and

desires. To develop such strategies, information must be obtained on past material use, on future trends, and on product and service attributes expected by the customer. Such information, as related to hardwood lumber, is limited (Meyer et al. 1992, Luppold 1990, 1988, 1987, Cardellichio and Binkley 1984, Spelter and Phelps 1984).

Attribute Analysis

Knowledge of product and service attributes that are most important to consumer decision making are important to marketing strategies (Wallace and Sherret 1973). The better a product and/or service meets customers' expectations, the more likely these customers will become regular patrons (Bearden 1977).

Consumers view products as bundles of attributes, features or benefits, and each attribute contributes differently to product perception (Sinclair and Stalling 1990, Lumpkin et al. 1985). Those attributes characteristic to a product or service that lead to the customer's choice of that product are determinant attributes (Alpert 1971). If an attribute is perceived to be equally present in all products and services of different competitors, or if not equally present, the attribute is of little importance as far as the customer is concerned, the attribute is not determinant (Lumpkin et al. 1985).

Attribute analysis can be used to identify the attributes which are important yet discriminating (Sinclair and Stalling 1990, Lumpkin et al. 1985, Bearden 1977, Wallace and Sherret 1973, Alpert 1971). To perform attribute analysis, a set of salient characteristics (i.e. attributes) about the product or service to be studied must be accumulated. This set of attributes is best acquired through use of past research combined with personal interviews with individuals knowledgeable about the product or service (Bearden 1977). A dual questioning technique can reflect how important each attribute is thought to be in determining a choice and how much difference is perceived among the competing products and services (Sinclair and Stalling 1990, Bearden 1977, Alpert 1971).

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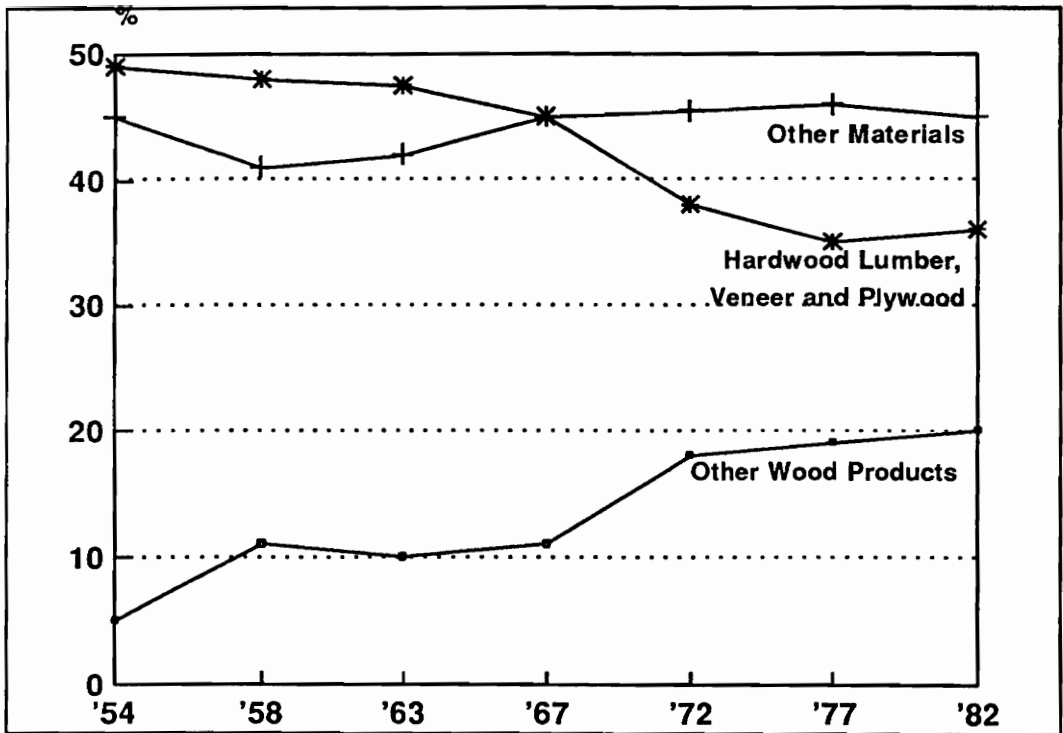


Figure 1. - Percentage of material cost for hardwood lumber, veneer and plywood, other wood products, and other materials used in furniture production. Source: Luppold 1987.

Wood Material Use in the U.S. Furniture Industry: 1990-1992

(Prepared for Submission to Forest Products Journal)

Abstract

United States' wood household, upholstered and wood office furniture manufacturers were sampled to assess the volumes of several raw materials used in wood furniture in 1990, and to predict the volumes to be used in 1991 and 1992. Total 1990 hardwood lumber used in wood furniture was estimated at over 2.4 billion board feet. Use was expected to increase 13% from 1990 to 1992. Softwood lumber used in wood furniture in 1990 was estimated at over 839 million board feet. A 6% increase in softwood lumber use was expected from 1990 to 1992. Red oak was the most commonly used hardwood species and southern pine was the most used softwood. Wood furniture manufacturers consumed over 1.2 billion square feet of particleboard (3/4" basis) in 1990, 248 million square feet of medium density fiberboard (3/4" basis), 125 million square feet of hardboard (1/8" basis) and 318 million square feet of OSB/softwood plywood (7/8" basis). Furniture manufacturers expected a decrease in particleboard and MDF use, and an increase in hardboard and OSB/softwood plywood use from 1990 to 1992.

Introduction

Knowledge of market demand and trends are essential to a forest products industry when making decisions regarding raw material use, production plans and work force size. Unfortunately, little current information on demand or trends of materials use in the wood furniture industry exists. Often the available data are disputed by industry experts and are obsolete by the time of its publication (Luppold 1991, Luppold 1990, Luppold and Dempsey 1989, Luppold 1988, Luppold 1987, Cardellichio and Binkley 1984, Spelter and Phelps 1984). Without dependable estimates of current and predicted material use by furniture manufacturers, suppliers of materials are less able to make accurate business plans regarding raw material use, production plans and work force size.

The objective of this paper is to provide estimates of current and predicted demand for various wood products used in the wood furniture industry. This paper builds on 1989 estimates of wood products use in the furniture industry provided by Meyer et al. (1992). Manufacturers of wood products, timber owners and harvesters, furniture manufacturers and researchers are among those who will benefit from this data.

Methodology

Sample Frame

The sample frame for this study consisted of United States' manufacturers of wood household, upholstered and wood office furniture. The sample used was a combination of a list provided by Dun's Marketing¹ and Furniture Design and Manufacturing's "FDM 300"² (Furniture Design and Manufacturing 1989). To get maximum coverage of the largest users of wood materials, all firms on the "FDM 300" list that manufactured wood office, wood household or upholstered furniture were included in the sample. All firms on Dun's list with over 100 employees, but not on the FDM 300 list were also included. The remaining firms on Dun's list were divided into two groups based on the number of employees; firms with 10-99 employees and firms with less than 10 employees. Both groups were randomly sampled at a 25% rate. The final sample was as follows:

¹ Dun's Marketing Services, Inc. Three Sylvan Way, Parsippany, NJ 07054.

² The "FDM 300" is Furniture Design and Manufacturing's annual report listing the largest manufacturers of furniture, cabinets, architectural woodwork/millwork and related wood products based on annual sales volumes.

Sampling Groups

Firms in Sampling Groups

| | |
|--|-----------------|
| 1. Top 221 firms (100% Sample) | Firms 1-221 |
| 2. Other firms with >100 employees (100% Sample) | Firms 222-377 |
| 3. Firms with 10-99 employees (25% sampling) | Firms 378-1107 |
| 4. Firms with <10 employees (25% sampling) | Firms 1108-2183 |

Data Collection

A mail survey, the most efficient and cost effective method of securing data from such a geographically dispersed population (Dillman 1978), served as the primary data collection vehicle. The questionnaire was designed to estimate furniture manufacturers' material use volumes from the previous year (1990) and to predict their material needs for two years into the future (1991 and 1992). The survey was pretested by industry experts including staff members from the Hardwood Manufacturers Association (HMA). The revised survey was mailed in March 1991.

Response Rate

Several treatments were used to increase response rates. Treatments included: personalized, hand-signed pre-notification letters and cover letters,

a small gift of appreciation included with the questionnaires, hand-signed follow-up postcards, and (up to two) follow-up questionnaires. Such practices have been shown to increase response rates (Duhan and Wilson 1990, Dillman 1978). Treatments and final response rates for each sampling group are shown in Table 1.

Non-Response Bias

In any survey where people are free to choose to respond or not to respond, the potential exists for nonresponse bias. That is, those who responded may be different than those who did not, thus making the data from the responding firms not representative of the total industry.

Tests for non-response bias were based on the assumption that late responders react more like non-responders (Fowler 1984) and thus a comparison of early respondents to late respondents would give results similar to a test of respondents vs. non-respondents. Data from approximately the first 180 surveys received and the last 180 surveys received were tested for non-response bias.

Response rates and adjusted volumes were computed for each group of respondents. Chi-square tests ($\alpha = 0.05$) were performed between respondent

groups on the population distributions of hardwood and softwood species use. Independent-sample t-tests were performed on the average material use between early and late respondents (comparing means). Any statistically significant variance between the early and late respondents could have indicated the potential for non-respondent bias. No significant differences were found at the .05 level.

Volume Estimates

Respondents' reported volumes were adjusted using the sampling rate, response rate and coverage ratio to obtain an adjusted volume. Respondents' adjusted volumes were then summed to obtain total volume estimates. The formula for adjusted volume is as follows:

$$\text{Adjusted Volume} = \frac{\frac{\text{Volume Reported}}{\text{Response Rate}}}{\text{Coverage Ratio} \times \text{Sampling Ratio}}$$

Where:

Volume Reported = the volume reported by the respondent for each material for each year.

Response Rate = the percent of usable responses received from the adjusted total of surveys mailed.

Coverage Ratio = the ratio representing the thoroughness of the sample frame estimate. The coverage ratio is estimated from the percent of the population thought to be represented by the sample.³

Sampling Ratio = the ratio representing the proportion of the sample frame sampled.

Response rates were computed for each material for each year. Response rates were calculated using the following formula:

$$\text{Response Rate} = \frac{\text{\# of Usable Responses Received}}{\text{Adjusted \# of Surveys Mailed}}$$

³ Because of the completeness of the "Top 221" sampling group, a coverage ratio of .9 was estimated for this sampling group. A coverage ratio of .7 was estimated for the remaining sampling groups.

Where:

Usable Responses = surveys that are correctly filled out and represent a producer of wood furniture.

Adjusted # of Surveys = (all surveys mailed) - (undeliverable surveys) - (surveys representing non-producers of wood household, wood office and upholstered furniture).

Results

Profile of Respondents

More than 57% of the respondents were either owners, presidents or CEOs. Other frequent titles of respondents were purchasing manager, plant/general manager, vice president and lumber buyer. The average number of full-time employees in the respondents' firms was 225.

Four geographic regions, roughly following those used by the census, were utilized for geographic segmentation. The South contained 43.4% of the respondents and was followed by the Midwest (21.0%), West (20.3%) and Northeast (15.3) regions. Of the reported wood furniture sales, 41% of sales represented wood household, 36% upholstered and 23% wood office.

Hardwood Lumber Use Estimates

Total hardwood lumber used in 1990 was estimated at more than 2.4 billion board feet (Table 2). Total growth in hardwood lumber use from 1990 to 1992 was projected to be approximately 13% (Figure 1). Manufacturers of wood household furniture used nearly 1.2 billion board feet of hardwood lumber, followed by manufacturers of upholstered furniture (1.1 billion bd. ft.) and wood office furniture (121 million bd. ft.) (Tables 3,4 and 5)⁴. Hardwood lumber used from 1990 to 1992 in the wood household furniture industry was projected to increase 11% and the faster growing upholstered and wood office furniture segments were expected to grow at 15% and 21% respectively (Figures 2,3 and 4).

⁴ Materials use volumes by type of furniture manufactured were calculated as follows: if a firm reported using 80 MMBF of hardwood lumber and 25% of their total sales were in wood office furniture while 75% of their sales were in wood household furniture, it was estimated that 20 MMBF of hardwood lumber were used for wood office furniture and 60 MMBF were used for wood household furniture. The manufacture of different types of furniture within a firm generally does not imply that equal proportions of materials are being used, however, it was assumed in order to achieve the best estimates within the constraints of this study. As a result, materials use estimates by furniture type may reflect some inaccuracies.

Softwood Lumber Use Estimates

Total softwood lumber consumption was 839 million feet in 1990 (Table 2). Wood household manufacturers used 744 million board feet, upholstered furniture manufacturers used 64 million board feet and wood office furniture manufacturers used 31 million board feet (Tables 3,4 and 5). Total growth in softwood lumber use is estimated at 6% from 1990 through 1992 (Figure 1). Softwood lumber use for wood household furniture was expected to grow by 4% and by 38% for upholstered furniture. A 19% decrease in softwood lumber use was expected for wood office furniture (Figures 2,3 and 4).

Wood-Based Panel Use Estimates

In excess of 1.2 billion square feet of particleboard (3/4" basis) were consumed in 1990, along with 248 million square feet (3/4" basis) of medium density fiberboard and 318 million square feet (7/8" basis) of OSB/softwood plywood (Table 2).

The largest users of particleboard were the wood household furniture manufacturers (1.1 billion sq. ft.) followed by wood office (80 million sq. ft.) and upholstered furniture manufacturers (50 million sq. ft.) (Tables 3,4 and 5). Total use of particleboard was expected to decrease 5% from 1990 to 1992

(Figure 1). However, this decrease was due to the 8% decrease in use predicted by wood household furniture manufacturers (Figure 2). Upholstered and wood office furniture manufacturers predicted 18% and 19% increases in particleboard use (Figures 3 and 4).

Wood household furniture manufacturers consumed 212 million sq. ft. of MDF, upholstered furniture manufacturers used 19 million sq. ft. and wood office manufacturers used 17 million sq. ft. (Tables 3,4 and 5). Total use of MDF was predicted to decrease 12% from 1990 to 1992 (a 17% decrease in the wood household segment and 11% and 24% increases in the upholstered and wood office segments) (Figures 1, 2, 3 and 4).

Total use of hardboard is expected to increase 12% from 1990 to 1992 (Figure 1). The wood household segment which consumed 74 million sq. ft. in 1990 predicted a 15% increase whereas the upholstered segment (consuming 10 million in 1990) predicted a 20% increase and wood office furniture manufacturers (41 million sq. ft. consumed in 1990) predicted a 5% increase in use (Tables 3,4 and 5, Figures 2,3 and 4).

Upholstered furniture manufacturers were the largest consumer of oriented strandboard (OSB) and softwood plywood (245 million sq. ft.) followed by wood household (69 million sq. ft.) and wood office (4 million sq. ft.) furniture manufacturers (Tables 3,4 and 5). A total increase of 15% was predicted in OSB/softwood plywood use from 1990 to 1992 (an 18% increase

predicted by the upholstered segment, a 3% increase by the wood household segment and a 25% increase by the wood office segment) (Figures 1, 2, 3 and 4).

Hardwood Lumber Use by Species

Figure 5 provides 1990 hardwood lumber use and projected 1992 hardwood lumber use by species. Red oak represented 30% of the hardwood lumber used in 1990 and its use was expected to increase to 32% by 1992. White oak was the second most used hardwood in 1990 representing 16% of hardwood lumber used. White oak use was predicted to grow to 18% by 1992. Yellow poplar represented 11% of total hardwood use, but was estimated to decrease to 10% of total hardwood used by 1992. A detailed breakdown of hardwood lumber use by species can be found in Table 6.

Softwood Lumber Use by Species

Southern pine was the predominantly used softwood specie in 1990, accounting for 58% of the softwood lumber used that year in the manufacture of wood household, upholstered, and wood office furniture (Figure 6). Southern pine use was projected to account for just under 51% of the softwood used in

1992. Eastern white pine represented nearly 17% of 1990's softwood lumber use and was projected to increase to nearly 21% of the total softwood lumber used in 1992. More detailed results of softwood lumber use may be found in Table 7.

Anecdotal evidence suggests large volumes of softwood lumber are used by furniture manufacturers in shipping and packaging, and not in the actual furniture. Future research will provide more insight on this point.

Comparison with Other Data

Other researchers have provided estimates of materials use in the wood furniture industry. However, much of this data is out of date and not directly comparable to this study. Census of Manufacturers (1987a, 1987b) data, for instance, is not comparable with this study for several reasons. This study had a broader coverage of firms than in census reports. Data in census reports is categorized based on a firm's primary product, even when a firm manufactures more than one type of furniture. This study attempted to categorize material use for each type of furniture manufactured, including secondary manufacturers. This study also included lumber purchased by furniture plants to be used for dimension which generally is reported in a different census category. Bureau of Census reported that 1987 hardwood lumber use was

822.5 billion board feet for the wood household segment (Census of Manufacturers 1987a). As would be expected, Bureau of Census data estimated much lower amounts of material use than does this study.

Data collected by Spelter and Phelps (1984) and Spelter et al. (1978) give estimates of wood materials used in the furniture and fixtures industry. Data from these studies are also not comparable since material use figures are provided only in total for the entire furniture and fixture industry. Materials use in the wood furniture industry are not given independently.

Estimates were also provided by Cardellichio and Binkley (1984) and Luppold (1991, 1990, 1987). Cardellichio and Binkley examined hardwood lumber demand, estimating consumption of hardwood lumber by the wood furniture industry in 1980 to be near 2.25 billion board feet. Luppold examined lumber use in the wood household and upholstered furniture industries in his studies. Luppold reports 1987 consumption of hardwood lumber in the wood household industry to be 1.058 billion board feet and 309 million board feet in the upholstered furniture industry. The most current estimate of softwood lumber consumed in the wood household industry was 464 million board feet in 1982 (Luppold 1987). However, since Cardellichio and Binkley and Luppold's estimates were derived using Bureau of Census data, their results cannot be directly compared to this study. Their results do not

include materials used by secondary manufactures, nor do they include materials used by dimension part facilities owned by furniture companies.

Estimates reported by Meyer's et al. (1992), however, are comparable, since this study used an adaption of Meyer's methodology. A comparison of Meyer's results of 1989 materials use and this study's is provided in Figure 7. Hardwood lumber, and OSB/softwood plywood experienced increases in use from 1989 to 1990, whereas, softwood lumber, particleboard, MDF and hardboard use decreased. Because of unusual forces on the economy during 1989 and 1990 (i.e., the Gulf War and the recession), changes in material use are difficult to interpret. The volumes used of all materials were influenced by the recession. However, sales of high priced furniture are affected less by a recession than lower priced furniture, and high priced furniture tends to be constructed of more hardwood lumber (Luppold 1987). Thus, the increase in hardwood lumber use is consistent with the economic conditions. The largest relative decreases in material use volumes were in MDF and particleboard, both substitutes for hardwood lumber. The increase in OSB/softwood plywood may be attributed to an increase in upholstered furniture manufacturers substituting these composite products in place of hardwood lumber.

Summary

Manufacturers of wood office, wood household and upholstered furniture were surveyed to estimate volumes of wood based raw materials used in 1990, and to predict the use of these materials in 1991 and 1992. Over 2.4 billion board feet of hardwood lumber was estimated to have been used in 1990. In excess of 839 million feet of softwood lumber was used. A 13% growth in hardwood lumber purchases and a 6% growth in softwood lumber purchases from 1990 to 1992 was expected by survey respondents.

Oak continues to dominate hardwood lumber purchases. It represented 46% of purchases in 1990 and was projected to grow to 50% of purchases by 1992. Maple use was projected to decrease. Southern pine represented 58% of softwood lumber purchases in 1990 and was projected to decline to 51% of purchases by 1992. Use of eastern white pine, western pine and radiata pine was projected to increase.

In excess of 1.2 billion square feet of particleboard (3/4" basis) were consumed in 1990, along with another 248 million square feet (3/4" basis) of medium density fiberboard, 125 million square feet of hardboard (1/8" basis) and 318 million square feet of OSB/softwood plywood (7/8" basis). Furniture manufacturers indicated a 5% decrease in particleboard use, a 12% decrease

in MDF use, a 12% increase in hardboard use, and a 15% increase in OSB/softwood plywood use from 1990 to 1992.

The furniture industry is an important consumer of a wide variety of wood products and merits continued study. Future work will expand the number of wood products studied and will include data on lumber grades.

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Table 1. - Treatments and response rates by sampling group.

| Sampling Groups | Treatments | Response Rate |
|---|---|----------------------|
| Top 221 Firms | Pre-notification letter Initial Survey (with gift) 2 Follow-up Surveys 3 Follow-up Postcards | 61% |
| Other Firms with >100 Employees | Pre-notification letter Initial Survey (with gift) 2 Follow-up Surveys 3 Follow-up Postcards | 56% |
| Firms with 10-99 Employees | Pre-notification letter Initial Survey (with gift) 1 Follow-up Survey 2 Follow-up Postcards | 25% |
| Firms with <10 Employees | Pre-notification letter Initial Survey (with gift) 1 Follow-up Survey 2 Follow-up Postcards | 21% |
| Cumulative | | 31% |

Table 2. - Total Material Use for Wood Household Furniture, Upholstered Furniture, and Wood Office Furniture.^{1/}

| Material | 1990 | 1991 | 1992 |
|------------------------------------|---|-----------------|----------------|
| | Volume 95% Confidence Interval ^{2/} | | |
| Hardwood Lumber (MMBF) | 2,425 ± 1.8% | 2,566 ± 1.8% | 2,752 ±1.7 |
| Softwood Lumber (MMBF) | 839 ±4.0% | 840 ±3.9% | 887 ±3.8% |
| Particleboard (MMSF) ^{3/} | 1,259 ±7.5% | 1,267 ±7.4% | 1,193 ±7.1% |
| MDF (MMSF) | 248 ±3.0% | 243 ±3.3% | 218 ±3.2% |
| Hardboard (MMSF) | 125 ±8.0% | 131 ±3.1% | 140 ±2.9% |
| OSB/Softwood Plywood (MMSF) | 318 ±4.4% | 345 ±4.5 | 366 ±4.6% |

^{1/} Data for hardwood plywood, veneer, and dimension parts were also collected but due to definitional problems and a variety of industry usage problems it was not reported.

^{2/} These intervals should be interpreted as, there is a 95% probability that the true number is between the upper and lower limits given that the respondents perfectly represent the population and that the estimated coverage ratios are correct.

^{3/} Data for all panel products were collected in units of thousand square feet (MSF) surface measure. Thicknesses can vary between products and within a product category. No attempt was made to gather data for each panel product by the variety of thicknesses it is purchased in, however, the most common thicknesses are: particleboard 3/4", MDF 3/4", hardboard 1/8", OSB/softwood plywood 7/8".

Table 3. - Material Use for Wood Household Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 1,196 | 1,251 | 1,329 |
| Softwood Lumber (MMBF) | 744 | 743 | 774 |
| Particleboard (MMSF) | 1,129 | 1,128 | 1,039 |
| MDF (MMSF) | 212 | 206 | 176 |
| Hardboard (MMSF) | 74 | 78 | 85 |
| OSB/Softwood Plywood (MMSF) | 69 | 69 | 71 |

Table 4. - Material Use for Upholstered Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 1,108 | 1,185 | 1,277 |
| Softwood Lumber (MMBF) | 64 | 71 | 88 |
| Particleboard (MMSF) | 50 | 53 | 59 |
| MDF (MMSF) | 19 | 19 | 21 |
| Hardboard (MMSF) | 10 | 10 | 12 |
| OSB/Softwood Plywood (MMSF) | 245 | 271 | 290 |

Table 5. - Material Use for Wood Office Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 121 | 130 | 146 |
| Softwood Lumber (MMBF) | 31 | 26 | 25 |
| Particleboard (MMSF) | 80 | 86 | 95 |
| MDF (MMSF) | 17 | 18 | 21 |
| Hardboard (MMSF) | 41 | 43 | 43 |
| OSB/Softwood Plywood (MMSF) | 4 | 5 | 5 |

Table 6. - Percentages of Various Hardwood Lumber Species Used by Manufacturers of Wood Office, Wood Household and Upholstered Furniture in 1990 and estimates for 1992.

| Species | % of Total in 1990 | % of Total in 1992 |
|----------------|-------------------------------|-------------------------------|
| Red Oak | 30% | 32% |
| White Oak | 16% | 18% |
| Yellow Poplar | 11% | 10% |
| Soft Maple | 9% | 7% |
| Black Cherry | 7% | 7% |
| Hard Maple | 6% | 5% |
| Ash | 3% | 3% |
| Beech | 3% | 2% |
| Mahogany | 2% | 2% |
| Sap Gum | 2% | 2% |
| Hickory/Pecan | 2% | 2% |
| Yellow Birch | 1% | 2% |
| Alder | 1% | 2% |
| Black Walnut | 1% | 1% |
| Elm | <1% | <1% |
| Hackberry | <1% | <1% |
| Other | 4% | 4% |
| Total | 100% | 100% |

Table 7. - Percentages of Various Softwood Lumber Species Used by Manufacturers of Wood Office, Wood Household and Upholstered Furniture in 1990 and estimates for 1992.

| Species | % of Total in 1990 | % of Total in 1992 |
|-------------------------|-------------------------------|-------------------------------|
| Southern Pine | 58 | 51 |
| Eastern White Pine | 17 | 21 |
| Western Pine | 3 | 11 |
| Radiata Pine | <1 | 2 |
| Other | 12 | 12 |
| Not Reported By Species | 9 | 3 |
| Total | 100% | 100% |

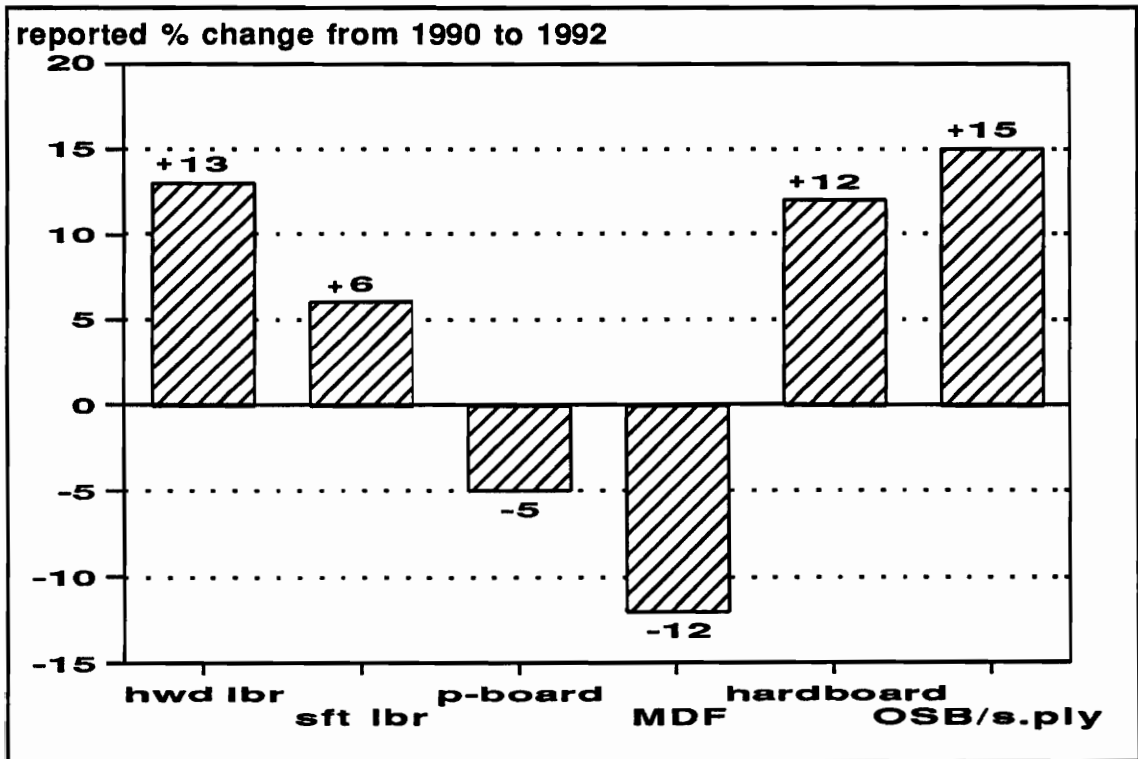


Figure 1. Material Use Changes 1990-1992: All Furniture Categories.

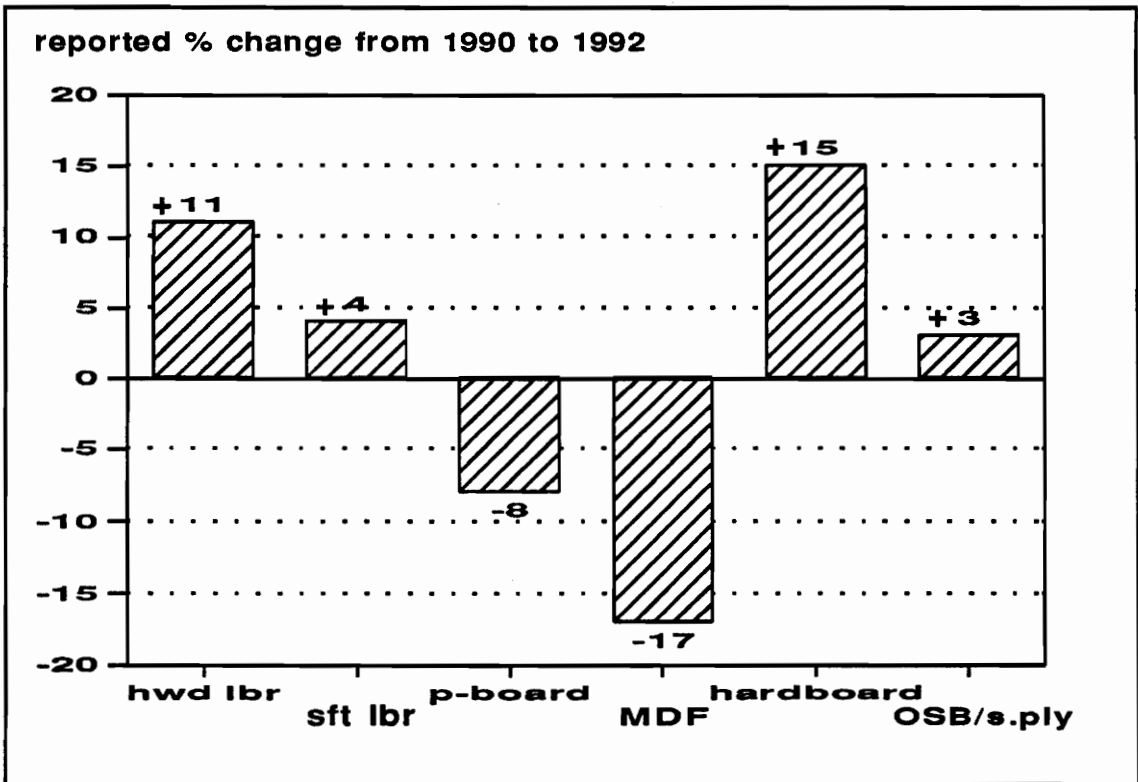


Figure 2. Material Use Changes 1990 to 1992: Wood Household Furniture.

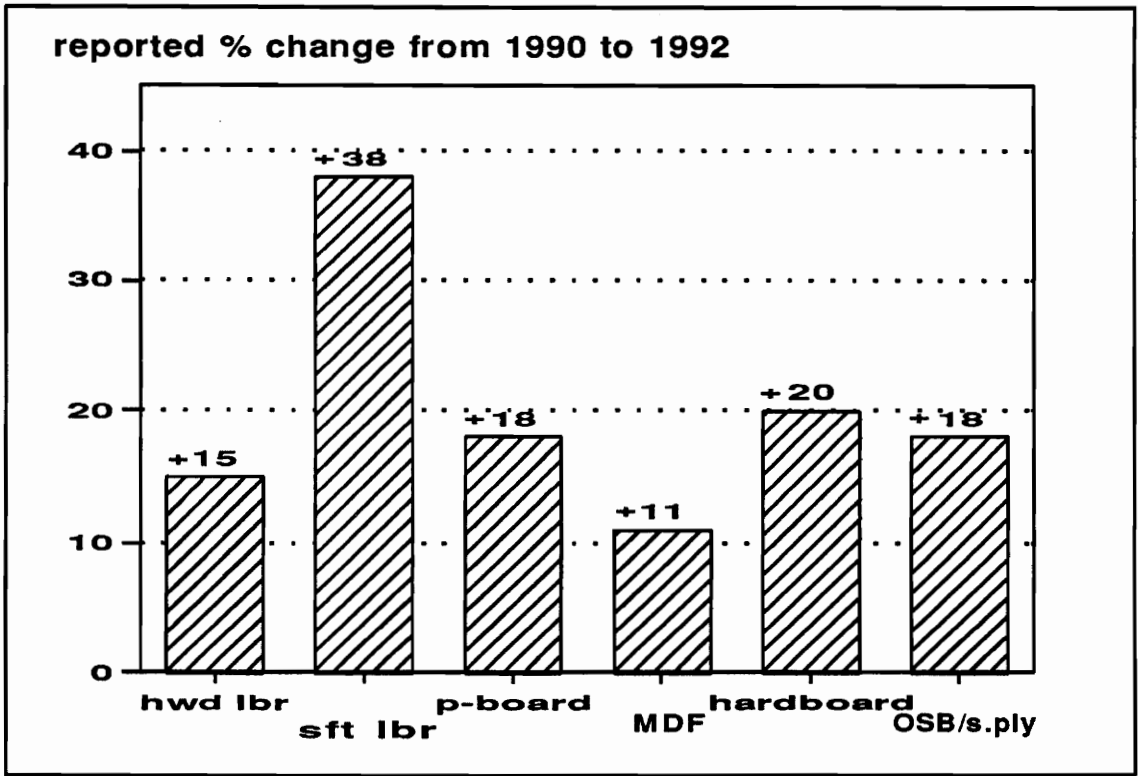


Figure 3. Material Use Changes 1990-1992: Upholstered Furniture.

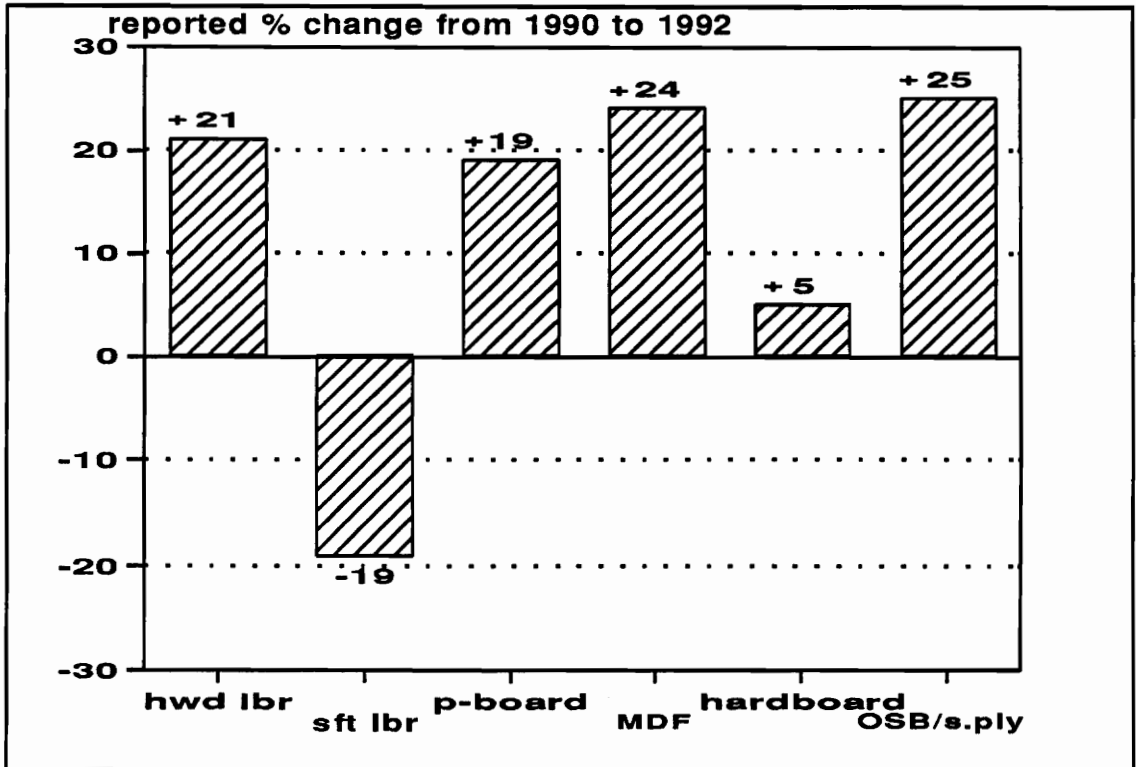


Figure 4. Material Use Changes 1990-1992: Wood Office Furniture.

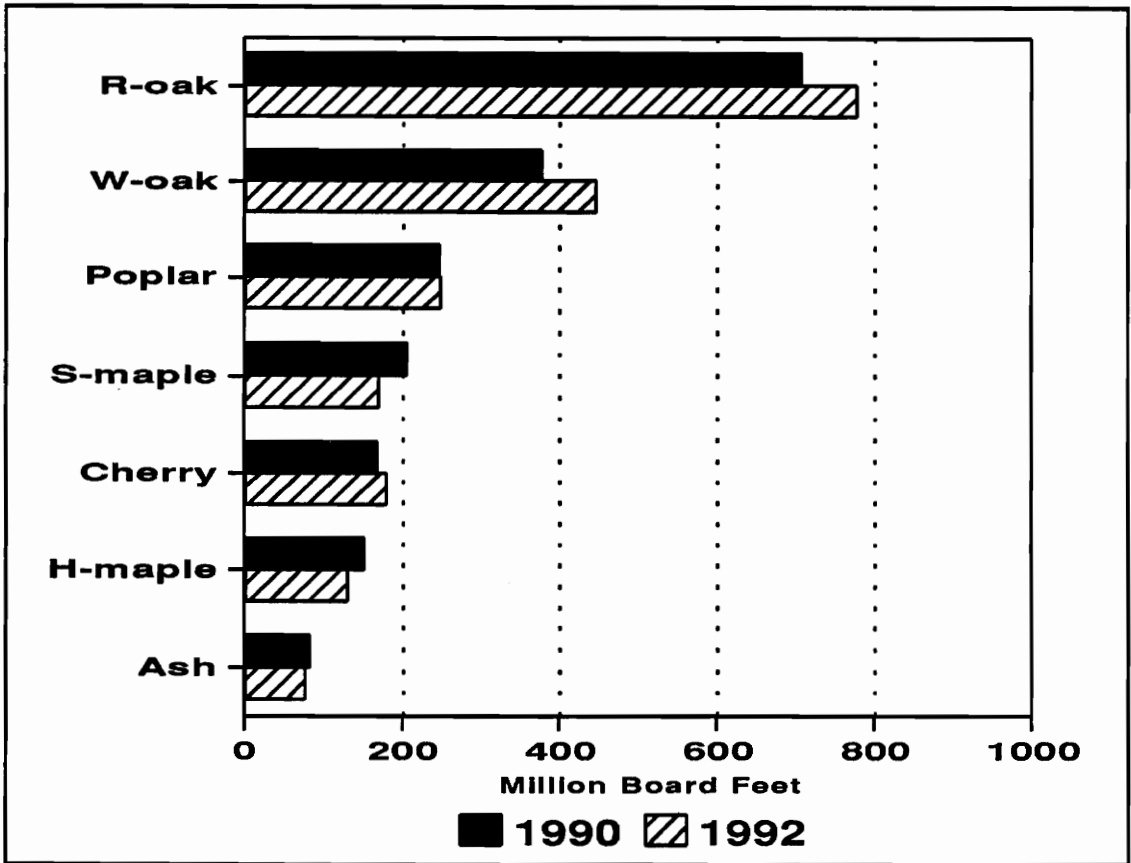


Figure 5. Hardwood Lumber Use by Species: 1990 and 1992.

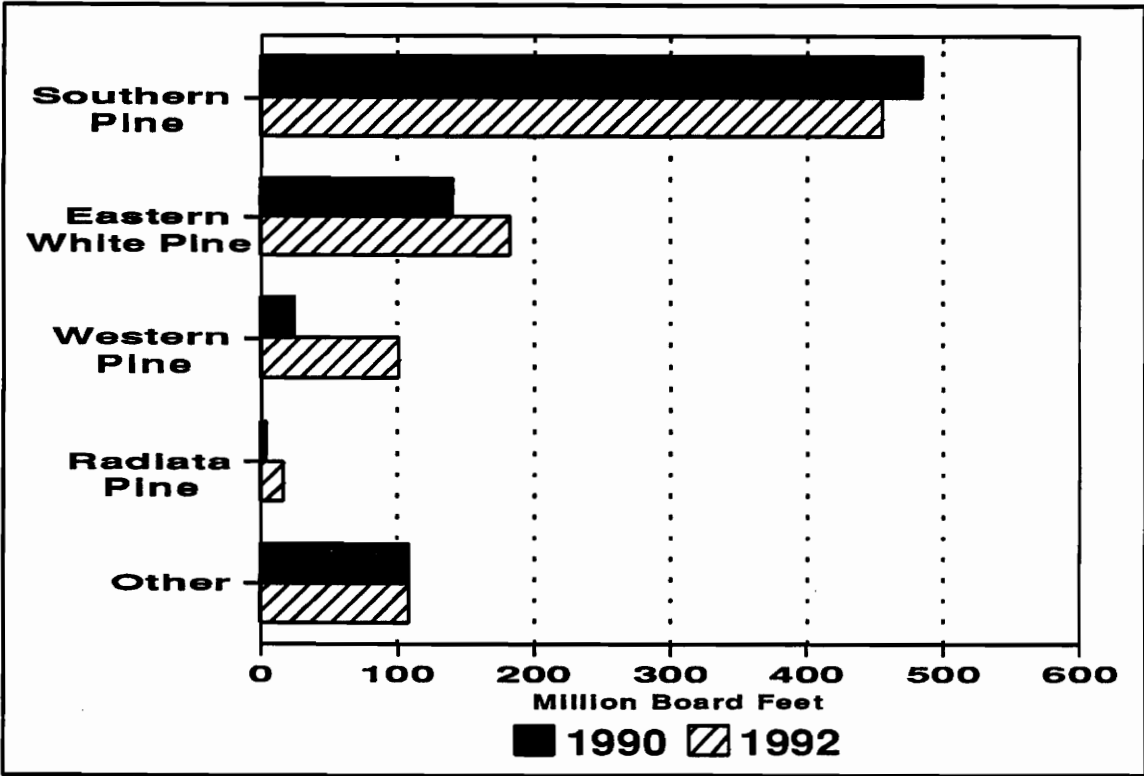


Figure 6. Softwood Lumber Use by Species: 1990 and 1992.

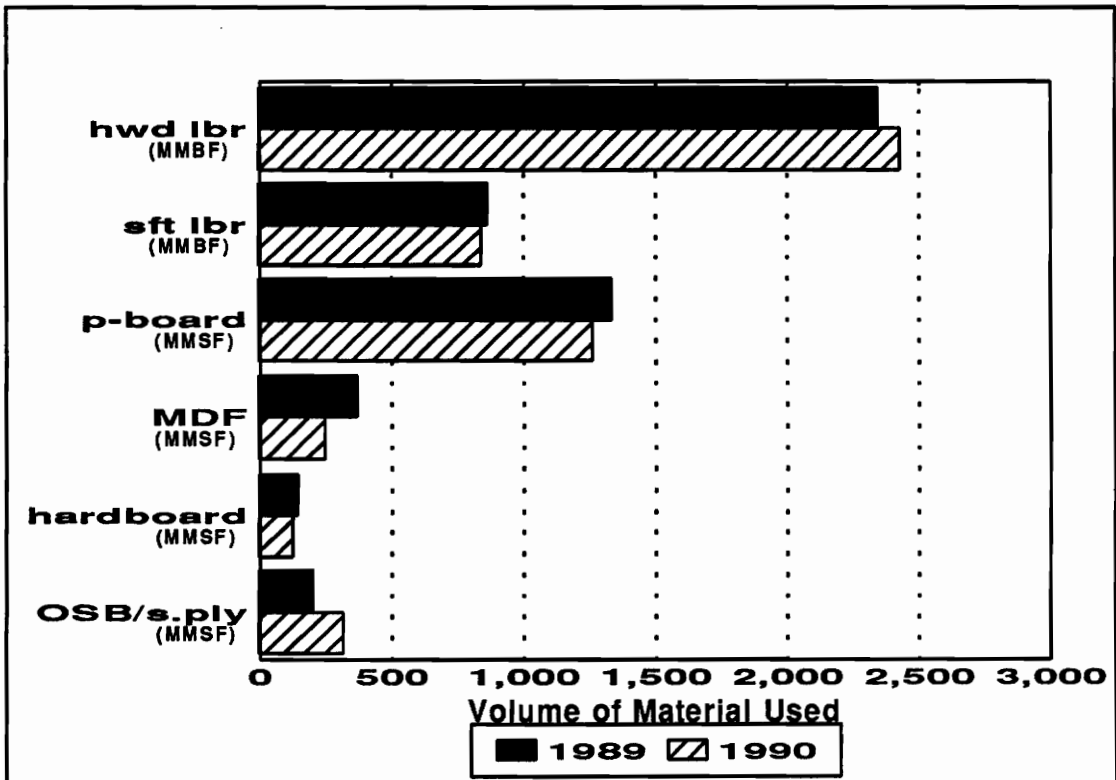


Figure 7. Comparison of 1989 (Meyer et al. 1992) and 1990 material use data.

**Influence of Product and Supplier Attributes on Hardwood Lumber
Purchase Decisions in the Furniture Industry**

(Prepared for Submission to Forest Products Journal)

Abstract

This study was conducted to determine the relative influence of various product and supplier attributes on hardwood lumber purchases by wood office, wood household and upholstered furniture manufacturers. Professional lumber buyers, through a dual questioning technique, rated the importance of each attribute and the difference across suppliers of these attributes. A purchase influence score was calculated for each attribute, and attributes were ranked by scores. Purchase influence scores were examined (1) in total, (2) by furniture manufacturer type, (3) by geographic region and (4) by firm size. Product consistency was the attribute which most influenced the purchase of hardwood lumber, followed by accurate grading, supplier's knowledge of lumber, correct orders, and shipping on time. The least influential attributes were square end trimming, square edges, protective wrapping, end coating and supplier's ability to surface.

Introduction

The wood furniture industry, one of the more stable markets for hardwood lumber, is the second largest user of hardwood lumber and the largest user of high grade hardwood lumber (Sinclair 1992, Luppold 1988, Luppold 1987). Approximately 97% of the hardwood lumber purchased by the wood furniture industry is through wholesalers / distributors(18%), brokers(15%) and direct from sawmills(64%) (Forbes et al. 1991). Because of the numerous firms supplying hardwood lumber, buyers usually have multiple options when choosing a supplier.

Prices for hardwood lumber of the same species, grade, origin, thickness and dryness are published weekly¹, and are available to both buyers and suppliers. As a result of the availability of "market price" information, pricing from most suppliers is generally similar.

Because of the relative homogeneity of product, pricing and pricing information, combined with numerous supplier options for buyers, the hardwood lumber industry is very competitive. To maintain a favorable market position, a variety of strategies are employed by firms within this industry. However, research has indicated a trend toward the adoption of

¹ Average hardwood lumber market prices are published weekly in the *Weekly Hardwood Review*, P.O. Box 471307, Charlotte, NC 28247-1307 and the *Hardwood Market Report*, P.O. Box 241325, Memphis, TN 38124-1325.

strategies emphasizing differentiation (Bush and Sinclair 1991). To achieve product differentiation, hardwood producers are implementing techniques including brand naming recognition, offering proprietary grading, enhancing promotional activities, and emphasizing customer service (delivery times, credit terms, etc.) (Bush and Sinclair 1991). Some firms have indicated intentions to employ a dual differentiation/focus strategy².

Hardwood lumber suppliers implementing such strategies, must emphasize product or service attributes which are perceived by buyers to be both important and unique. Understanding the customers' expectations will aid suppliers in developing such marketing strategies and thus, gain a superior market position (Schofield and Arnold 1988, Webster 1979). The better the product and/or service meets customers' expectations, the more likely these customers will become regular patrons (Bearden 1977). Therefore, favorable market positions may be achieved by hardwood lumber suppliers who learn which attributes are most influential to their customers' purchase decision, and assimilate these attributes into their marketing strategies.

² Differentiation refers to a competitive strategy in which a firm positions itself apart from its competitors by offering products and/or services which are perceived industry-wide to be unique to that firm. A focus strategy is characterized by a firm concentrating on serving a particular market segment very well. By targeting a narrow market segment, a firm can be more effective and efficient in that segment than firms competing more broadly.

The objective of this study was to rank certain hardwood lumber and supplier attributes, based on their influence on the purchase decision as perceived by lumber buyers in the domestic wood furniture industry. A method of attribute analysis was employed in which, for each attribute studied, a score was calculated representing the perceived purchase influence of that attribute. This score considered how important lumber buyers perceived each attribute as well as the perceived difference between suppliers of this attribute. Distinctions in purchase influencing attributes were made between manufacturers of different furniture types, firm sizes and geographic locations.

Methodology

Sample Frame

Domestic manufacturers of wood household, upholstered and wood office furniture were the population for this study. A list of firms provided by Dun's Marketing³ was cross-checked with Furniture Design and Manufacturing's "FDM 300" (Furniture Design and Manufacturing 1989) to develop the sample frame. To get maximum coverage of the largest users of wood materials, all manufacturers of wood household, upholstered and wood office furniture on the "FDM 300" list, and all firms on Dun's list with over 100 employees were

³ Dun's Marketing Services, Inc. Three Sylvan Way, Parsippany, NJ 07054.

included in the sample. Firms on Dun's list with less than 100 employees were randomly sampled at a 25% rate. The final sample consisted of 2,184 firms.

The final sample by firm size was as follows:

| Firm Size (based on number of employees) | Number of Firms in Sample |
|--|----------------------------------|
| Firms with > 100 employees | 378 |
| Firms with 10-99 employees | 730 |
| Firms with < 10 employees | 1,076 |
| Total | 2,184 |

Questionnaire Development

Attribute lists from previous studies (Bush et al. 1991, Bush et al. 1990) provided the starting point for this study's attribute list. Personal interviews with industry specialists, including hardwood lumber producers, wholesalers, distributors and brokers, were conducted to evaluate the thoroughness of the attribute list. The attributes were then revised based on these interviews. The questionnaire was reviewed by university personnel

(from both marketing and forest products fields of expertise) for face validity and clarity. The revised questionnaire was then pretested by industry experts including staff members from the Hardwood Manufacturers Association (HMA).

Data Collection

Data were collected via a mail survey. To increase response rates, pre-notification letters were mailed one month prior to the mailing of the first wave of surveys. The first survey mailing took place in early March 1991, followed a week later by postcards encouraging response. Approximately one month after the first mailing, non-respondents were mailed a second survey, followed once again by a postcard. Since firms with greater than 100 employees represent the largest hardwood lumber users, responses from these firms were considered most important. Thus, they were mailed a third survey. Final response rates were as follows:

| | Response Rate |
|-----------------------------|----------------------|
| Firms with >100 Employees | 58% |
| Firms with 10 -99 Employees | 25% |
| Firms with <10 employees | 21% |
| All Firms | 31% |

Calculation of Purchase Influence Scores

The questionnaire utilized a dual questioning technique to determine the importance of certain product and service attributes to hardwood lumber buyers, and the degree of difference that buyers perceived among competing products and services. Buyers were asked to rate how important certain hardwood lumber and supplier attributes were to their company. A scale of 1 (no importance) to 5 (extremely important) was used. Buyers were also asked to rate how these attributes differed between suppliers, again on a scale of one to five (1 = no difference and 5 = big difference). Similar methods have been used in previous studies (Bush et al. 1991, Bush et al. 1990, Sinclair and Stalling 1990, Lumpkin et al. 1985, Bearden 1977, Alpert 1971).

Purchase influence scores⁴ were calculated from importance and difference scores using the following formula (derived from Bearden 1977):

$$P_{ij} = I_{ij} Y_{ij}$$

Where

- P_{ij} = Purchase influence score for attribute i and respondent j.
- I_{ij} = Importance rating for attribute i and respondent j.
- Y_{ij} = Difference rating for attribute i and respondent j.

Thus, for any given attribute, a maximum purchase influence score was twenty-five and a minimum score was one. Purchase influence scores were calculated: (1) in total, (2) by furniture manufacturer type, (3) by geographic region and (4) by firm size.

⁴ Purchase influence scores are also called determinance scores. Attributes most influencing the purchase decision are known as determinant attributes.

Non-Response Bias

Based on the assumption that late responders react more like non-responders (Fowler 1984), a comparison of early respondents to late respondents was utilized to test for non-response bias. Data from approximately the first 180 surveys received and the last 180 surveys received were compared using Chi-square tests ($\alpha = .05$) and other nonparametric tests. Based on firm size, type of furniture manufactured, and location of firm, no evidence of demographic difference between early and late respondents was observed.

Purchase influence scores were also calculated from the first 180 surveys received and the last 180 surveys received. Figure 1 shows a comparison of the five highest and the five lowest purchase influence scores, between early and late respondents. As shown by this figure, early and late responses are very similar, again giving no evidence of non-response bias. Bonferroni t-tests on the top five and lowest five purchase influence scores, indicated no significant differences between early and late respondents ($\alpha = .05$).

Results

Figure 2 illustrates the five most influential and five least influential attributes for all firms. Product consistency, accurate grading, the supplier's knowledge of hardwood lumber, correct orders and shipping on time, were the most influential attributes on the purchase decision. The high scores given for product consistency, accurate grading, correct orders and shipping on time indicate buyers of hardwood lumber in the wood furniture industry are risk adverse. Buyers want to know what to expect both in quality of product, and in delivery, when orders are placed. Thus, attributes which characterize the supplier's ability to deliver what has been agreed upon rate highly.

Least purchase influential were square end trimming, square edges, protective wrapping, end coating and surfacing.

Firm Size

Purchase influence scores for all attributes by firm size (based on the number of employees) are shown in Table 1, with a comparison of scores for the top five and lowest five attributes shown in Figure 3. Small firms (less than 10 employees) indicated that absence of warp crook or bow, correct orders and supplier's knowledge of their product were more influential than accurate grading. These firms also placed more emphasis on species variety.

The largest firms (greater than 100 employees) gave higher scores for shipping on time, correct tally, speedy resolutions of disputes, desirable width mix and stacking of the lumber, than did other firms. The larger firms' opinions of these attributes may reflect these firms' interests in avoiding downtime due to short lumber supply, avoiding re-tallying large amounts of lumber, avoiding lengthy disputes and the necessity for neat packs for efficient production line operation. The largest firms, unlike other firms, felt the ability to kiln dry and the ability to surface were the least influential attributes. Such results are not surprising since larger firms are more likely to have their own facilities perform these operations.

Geographic Region

Table 2 and Figure 4 show comparisons of purchase influence scores by geographic region. The Northeast is the only region that did not rate product consistency as the most influential attribute. Instead, the Northeast placed greater emphasis on accurate grading followed by product consistency. This region indicated that a lack of surface checks was more influential as compared to other regions. The South placed more emphasis on shipping on time and firm pricing than did other regions. The Midwest rated correct tally lower than other regions and the ability to fill large orders higher. The West region indicated that a personal relationship with the supplier, the ability to fill small

orders, arrange shipping and provide a variety of species were more influential to purchasing as compared to other regions. They were less concerned with the width mix as compared to other regions.

Furniture Type

Table 3 and Figure 5 show comparisons of purchase influence scores by type of furniture manufactured. Manufacturers of upholstered furniture generally gave lower scores for the top five influential attributes than manufacturers of wood office and wood household furniture. Upholstered furniture manufacturers rated attributes that affect the appearance of the wood (i.e. accurate grading, no surface checks, no stain, no chipped grain, species variety end coating and protective wrapping) lower than did wood office and wood household furniture manufacturers. Such observations were expected since wood used in upholstered furniture is usually out of view of the consumer, thus appearance attributes are not critical. Upholstered furniture manufacturers, however, indicated desirable width mix, extended price arrangements and the supplier's knowledge of the customer to be more influential than did wood household and wood office furniture manufacturers. Manufacturers of upholstered furniture felt protective wrapping was the least influential attribute to the purchase decision. Wood office furniture producers

rated square end trimming lowest and wood household furniture producers rated the supplier's ability to surface lowest.

Summary

Attributes were ranked in order of their purchase influence as perceived by hardwood lumber buyers for domestic wood office, wood household and upholstered furniture manufacturers. The most influential attributes included product consistency, accurate grading, supplier's knowledge of lumber, correct orders and shipping on time (predominantly attributes indicating risk aversion). Some differences were found in the perceived purchase influence of attributes between firms of different size, from different geographic regions and manufacturing different types of furniture.

Firms with over 100 employees rated attributes pertinent for efficient operation of their plants (shipping on time, correct tally, quickly resolutions to disputes, desirable width mix and stacking of the lumber) as more influential to the purchase decision than smaller firms. This is not surprising since large firms tend to employ low cost strategies (Sinclair 1992, Bush and Sinclair 1991). The large firms place less emphasis on attributes related to the supplier

providing additional processing of the lumber (i.e., surfacing and drying), probably because large firms have the facilities to perform these tasks themselves. Firms with less than ten employees were influenced more by species variety and the ability of their supplier to fill small orders.

Some differences occurred between purchase influence scores of firms in different geographic locations. Firms in the Northeast were less concerned with surface checks. Southern firms were more influenced by shipping on time than other regions. The Midwest rated ability to fill large orders higher than other regions. The West region, when compared to other regions, indicated that a personal relationship with the supplier, and the ability to fill small orders, arrange shipping and provide a variety of species, were more influential to purchasing.

Differences existed between buyers of lumber from different furniture manufacturer types. Wood office and wood household manufacturers rated accurate grading, lack of surface checks, lack of stain, lack of chipped grain, species variety, presence of end coating and presence of protective wrapping (attributes mostly affecting lumber appearance), higher than upholstered furniture manufacturers.

Discussion

The information gained from this research can be used by manufacturers and suppliers of hardwood lumber to aid in developing effective marketing strategies. Product and service attributes that are perceived by lumber buyers in the U.S. wood furniture industry to be the most influential in the purchase decision, incorporated into the hardwood lumber suppliers' marketing strategies, will aid suppliers in achieving a superior market position.

When developing strategies, however, manufacturers and suppliers should consider the cost-benefit relationship of implementing these attributes for the market segment targeted. For instance, a supplier experiencing problems with stained lumber may find it feasible to take action to correct the problem if marketing to wood office or wood household furniture manufacturers. A supplier to the upholstered industry, however, may find his customers are not willing to expend more to obtain stain-free lumber. Thus, the supplier's costs of achieving stain-free lumber are not recoverable.

Likewise, a manufacturer or supplier may not find all influential attributes achievable or practical when budgets are considered. A supplier who receives complaints of surface checks may simply not have the funds available to invest in the necessary equipment to remedy drying problems. This supplier could target their products to a different market where surface

checks are not a problem (i.e., upholstered furniture) and develop and/or emphasize attributes that are influential to the buyer's purchase, yet affordable for the supplier.

It should also be mentioned that even if an attribute is not rated as highly influential to the customer's purchase decision, it may still offer benefits significant to the supplier. For instance a brand name, or a distinguishable color end coating, may provide firm recognition for the supplier offering a favorable product or service. Even though such attributes provide little influence on the buyer's purchase decision, they may reinforce the supplier's name or offer a distinct association between the supplier and their product.

Attribute analysis can be a valuable marketing and managerial tool. Lumber buyers from different furniture manufacturer types, different company sizes and from different geographic regions have their own perceptions of what is influential in their lumber purchases. Manufacturers and suppliers can use this analysis to help design their marketing program to better fit customers in different market segments. Manufacturers of wood office, wood household and upholstered furniture will also benefit from this study, since it exposes their expectations of the lumber they buy, and of the suppliers of this lumber.

This study also has implications for researchers and equipment manufacturers involved in the development of computerized grading and optimization. Accurate grading and product consistency were rated as strongly

influencing purchases by hardwood lumber buyers of different firm sizes, different geographic regions, and of different furniture manufacturer types. Since computerized grading and optimization techniques can result in more accurate and consistent grading of lumber (Gatchell et al. 1992, Araman 1990), continued research and development of computer manufacturing and grading technologies is warranted.

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Table 1. Purchase influence scores by firm size.

| Attribute | All Firms | Firms With > 100 Employees | Firms With 10-99 Employees | Firms With < 10 Employees |
|-----------------------------|-----------|----------------------------|----------------------------|---------------------------|
| Product Consistency | 14.90 | 15.26 | 15.30 | 14.13 |
| Accurate Grading | 13.82 | 14.32 | 14.70 | 12.53 |
| Knowledge of Their Product | 13.24 | 13.26 | 13.95 | 12.66 |
| Correct Orders | 13.19 | 13.75 | 12.68 | 12.98 |
| Ship on Time | 13.15 | 14.39 | 13.58 | 11.35 |
| Competitive Price | 12.82 | 13.54 | 13.35 | 11.53 |
| No Warp, Crook, or Bow | 12.78 | 11.81 | 13.47 | 13.34 |
| Rapid Delivery | 12.61 | 13.21 | 13.64 | 11.08 |
| Accurate Moisture Content | 12.52 | 11.97 | 13.97 | 11.98 |
| Candidness | 12.50 | 13.16 | 12.40 | 11.79 |
| Reputation | 12.18 | 13.35 | 12.49 | 10.56 |
| No Surface Checks | 12.15 | 11.58 | 12.12 | 12.81 |
| Resolve Disputes | 12.00 | 13.47 | 11.89 | 10.35 |
| Correct Tally | 11.97 | 13.99 | 11.47 | 10.02 |
| Knowledge of Their Customer | 11.73 | 12.86 | 12.45 | 9.82 |
| Firm Prices | 11.66 | 11.85 | 11.97 | 11.18 |
| Personal Relationship | 11.64 | 10.92 | 12.36 | 11.87 |
| Fill Small Orders | 11.49 | 9.77 | 12.22 | 12.89 |
| No Stain | 11.32 | 10.54 | 12.01 | 11.68 |
| No Wane | 11.02 | 10.47 | 11.53 | 11.25 |
| No End Splits | 10.80 | 10.94 | 11.74 | 9.87 |
| Answer Questions | 10.65 | 11.15 | 10.96 | 9.82 |
| Accurate Machining | 10.46 | 11.09 | 11.26 | 9.10 |
| No Chipped Grain | 10.34 | 9.33 | 11.56 | 10.45 |
| Desirable Width Mix | 10.34 | 11.14 | 10.68 | 9.15 |
| Ability to Kiln Dry | 9.62 | 8.69 | 10.76 | 9.72 |
| Arrange Shipping | 9.55 | 9.11 | 11.03 | 8.83 |
| Species Variety | 9.24 | 7.97 | 8.87 | 11.02 |
| Cleanliness | 8.99 | 10.20 | 8.73 | 7.72 |
| Mixed Loads | 8.82 | 7.60 | 9.75 | 9.51 |
| Fill Large Orders | 8.79 | 10.40 | 9.10 | 6.54 |
| Extended Price Arrangements | 8.78 | 8.86 | 11.25 | 6.63 |
| Special Sorts | 8.68 | 8.55 | 9.40 | 8.24 |
| Provide Technical Info | 8.56 | 8.46 | 9.04 | 8.29 |
| Stacking | 8.49 | 10.70 | 8.47 | 5.80 |
| Custom Grade | 8.48 | 7.99 | 9.00 | 8.66 |
| Arrange Credit | 8.04 | 7.17 | 9.63 | 7.76 |
| Surfacing | 7.45 | 6.71 | 8.64 | 7.33 |
| End Coating | 7.25 | 8.68 | 6.71 | 6.02 |
| Protective Wrapping | 6.59 | 7.25 | 7.29 | 5.21 |
| Square Edges | 6.52 | 8.13 | 6.44 | 4.68 |
| Square End Trimming | 5.91 | 7.66 | 6.09 | 3.69 |

Table 2. Purchase influence scores by region.

| Attribute | All Firms | South | North-east | Midwest | West |
|-----------------------------|-----------|-------|------------|---------|-------|
| Product Consistency | 14.90 | 15.56 | 13.75 | 14.87 | 14.88 |
| Accurate Grading | 13.82 | 13.93 | 14.34 | 13.34 | 13.73 |
| Knowledge of Their Product | 13.24 | 14.04 | 11.71 | 11.82 | 14.21 |
| Correct Orders | 13.19 | 13.77 | 12.37 | 11.84 | 13.58 |
| Shipping on Time | 13.15 | 14.43 | 12.45 | 12.07 | 11.93 |
| Competitive Price | 12.82 | 13.43 | 12.41 | 11.50 | 13.00 |
| No Warp, Crook, or Bow | 12.78 | 12.47 | 13.51 | 12.43 | 13.25 |
| Rapid Delivery | 12.61 | 12.96 | 12.00 | 11.87 | 12.84 |
| Accurate Moisture Content | 12.52 | 12.23 | 12.51 | 12.59 | 13.34 |
| Candidness | 12.50 | 13.19 | 11.52 | 12.03 | 12.35 |
| Reputation | 12.18 | 13.09 | 11.30 | 11.42 | 11.87 |
| No Surface Checks | 12.15 | 11.27 | 14.00 | 11.91 | 12.74 |
| Resolve Disputes | 12.00 | 12.53 | 12.07 | 11.41 | 11.68 |
| Correct Tally | 11.97 | 13.22 | 11.44 | 9.94 | 11.36 |
| Knowledge of Their Customer | 11.73 | 12.31 | 10.63 | 11.41 | 11.83 |
| Firm Prices | 11.66 | 12.71 | 10.56 | 10.27 | 11.70 |
| Personal Relationship | 11.64 | 11.69 | 11.00 | 10.21 | 13.43 |
| Fill Small Orders | 11.49 | 11.47 | 11.60 | 10.12 | 12.21 |
| No Stain | 11.32 | 10.25 | 13.03 | 11.69 | 11.84 |
| No Wane | 11.02 | 10.60 | 11.92 | 11.03 | 11.03 |
| No End Splits | 10.80 | 10.70 | 11.92 | 10.73 | 9.99 |
| Answer Questions | 10.65 | 11.39 | 9.89 | 9.85 | 10.51 |
| Accurate Machining | 10.46 | 10.19 | 10.91 | 9.94 | 11.10 |
| No Chipped Grain | 10.34 | 9.87 | 11.69 | 9.25 | 11.17 |
| Desirable Width Mix | 10.34 | 10.64 | 10.52 | 10.49 | 9.38 |
| Ability to Kiln Dry | 9.62 | 9.36 | 9.96 | 9.78 | 9.59 |
| Arrange Shipping | 9.55 | 9.82 | 9.16 | 8.70 | 10.04 |
| Species Variety | 9.24 | 9.58 | 8.23 | 7.62 | 10.42 |
| Cleanliness | 8.99 | 9.37 | 8.45 | 9.15 | 8.59 |
| Mixed Loads | 8.82 | 9.09 | 9.40 | 8.22 | 8.11 |
| Fill Large Orders | 8.79 | 8.86 | 7.36 | 10.34 | 8.04 |
| Extended Price Arrangements | 8.78 | 9.46 | 7.87 | 8.12 | 8.66 |
| Special Sorts | 8.68 | 8.39 | 9.75 | 9.17 | 8.01 |
| Provide Technical Info | 8.56 | 8.86 | 7.63 | 8.24 | 9.18 |
| Stacking | 8.49 | 9.61 | 7.97 | 8.51 | 6.71 |
| Custom Grade | 8.48 | 8.84 | 8.65 | 7.69 | 8.56 |
| Arrange Credit | 8.04 | 8.56 | 8.66 | 5.55 | 8.75 |
| Surfacing | 7.45 | 7.24 | 6.74 | 6.64 | 8.68 |
| End Coating | 7.25 | 7.15 | 7.07 | 8.23 | 6.68 |
| Protective Wrapping | 6.59 | 6.38 | 6.24 | 7.43 | 6.67 |
| Square Edges | 6.52 | 6.99 | 5.65 | 6.84 | 5.61 |
| Square End Trimming | 5.91 | 6.46 | 5.27 | 6.04 | 5.07 |

Table 3. Purchase influence scores by furniture manufacturer type.*

| Attribute | Upholstered | Wood Office | Wood Household |
|-----------------------------|-------------|-------------|----------------|
| Product Consistency | 14.09 | 16.11 | 15.37 |
| Accurate Grading | 12.73 | 13.97 | 14.02 |
| Knowledge of Their Product | 11.98 | 12.55 | 13.43 |
| Correct Orders | 12.50 | 12.87 | 13.48 |
| Shipping on Time | 12.66 | 13.00 | 13.79 |
| Competitive Price | 11.95 | 13.57 | 13.10 |
| No Warp, Crook, or Bow | 12.21 | 11.69 | 13.17 |
| Rapid Delivery | 12.39 | 12.77 | 11.54 |
| Accurate Moisture Content | 11.82 | 12.52 | 11.95 |
| Candidness | 11.63 | 12.73 | 12.92 |
| Reputation | 11.90 | 12.60 | 12.74 |
| No Surface Checks | 8.19 | 13.43 | 12.95 |
| Resolve Disputes | 10.63 | 12.68 | 12.39 |
| Correct Tally | 12.18 | 11.33 | 12.85 |
| Knowledge of Their Customer | 12.27 | 10.72 | 11.66 |
| Firm Prices | 11.37 | 11.23 | 11.91 |
| Personal Relationship | 9.03 | 11.00 | 11.75 |
| Fill Small Orders | 9.43 | 12.38 | 10.04 |
| No Stain | 6.54 | 11.79 | 12.80 |
| No Wane | 9.02 | 10.52 | 11.77 |
| No End Splits | 10.13 | 10.67 | 11.65 |
| Answer Questions | 9.57 | 9.60 | 10.76 |
| Accurate Machining | 9.37 | 11.00 | 11.24 |
| No Chipped Grain | 6.87 | 11.62 | 11.16 |
| Desirable Width Mix | 12.48 | 9.81 | 9.94 |
| Ability to Kiln Dry | 8.93 | 10.21 | 9.12 |
| Arrange Shipping | 9.07 | 8.80 | 9.81 |
| Species Variety | 6.72 | 11.03 | 8.17 |
| Cleanliness | 9.16 | 9.57 | 9.59 |
| Mixed Loads | 8.98 | 8.13 | 7.75 |
| Fill Large Orders | 8.34 | 8.30 | 8.61 |
| Extended Price Arrangements | 9.05 | 8.27 | 8.57 |
| Special Sorts | 7.73 | 7.66 | 8.01 |
| Provide Technical Info | 7.10 | 7.41 | 8.34 |
| Stacking | 8.90 | 8.43 | 9.12 |
| Custom Grade | 7.02 | 6.93 | 8.18 |
| Arrange Credit | 7.82 | 8.83 | 7.62 |
| Surfacing | 8.35 | 8.17 | 6.38 |
| End Coating | 5.80 | 8.67 | 7.64 |
| Protective Wrapping | 5.17 | 7.40 | 6.65 |
| Square Edges | 6.86 | 6.86 | 7.27 |
| Square End Trimming | 5.91 | 6.14 | 6.65 |

* To better distinguish differences in purchase influence attributes between manufacturers of different types of furniture, only firms with homogeneous product lines (at least 90% of their production in one furniture type classification) were analyzed.

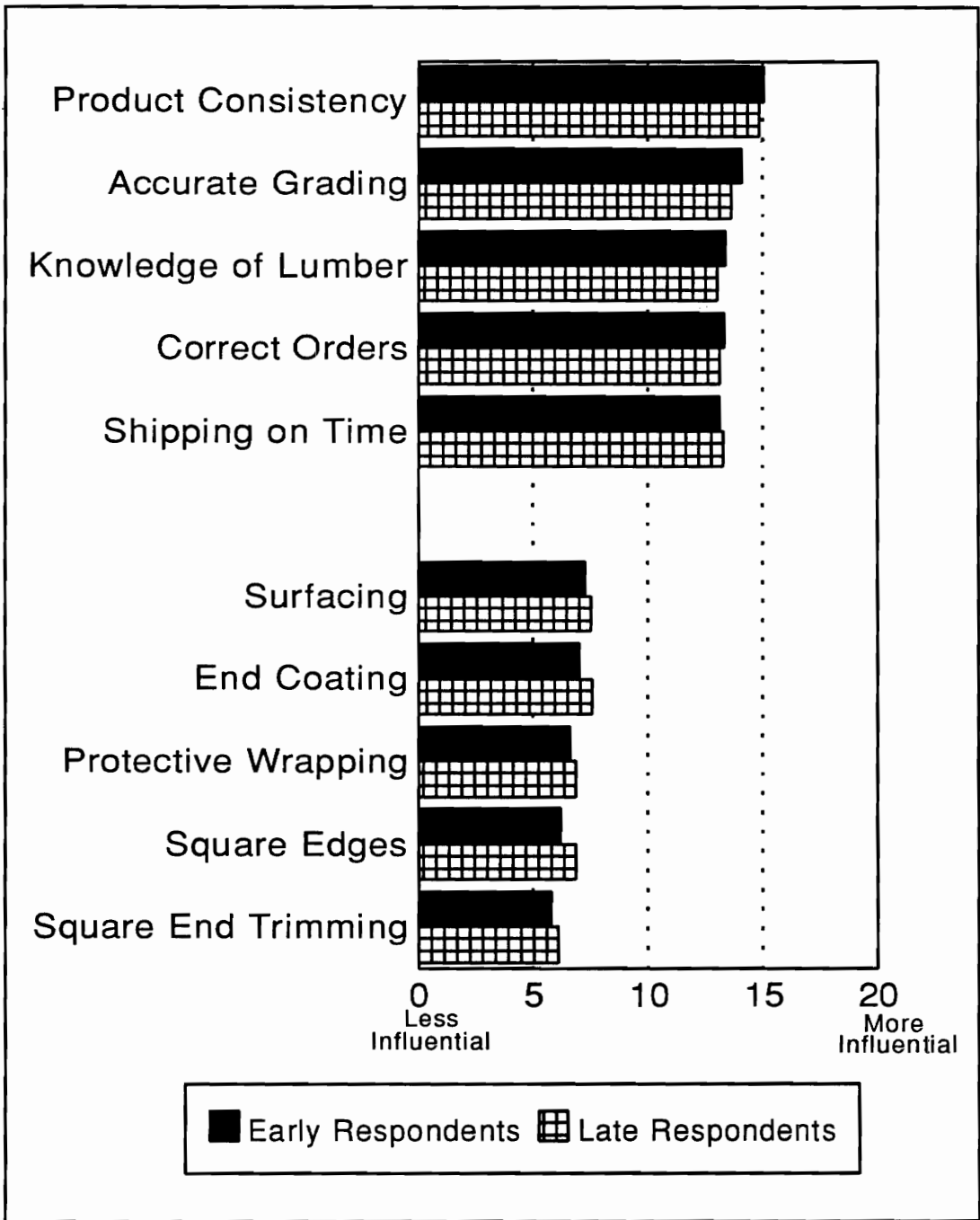


Figure 1. Top 5 and Lowest 5 Purchase Influence Scores: By Response Time

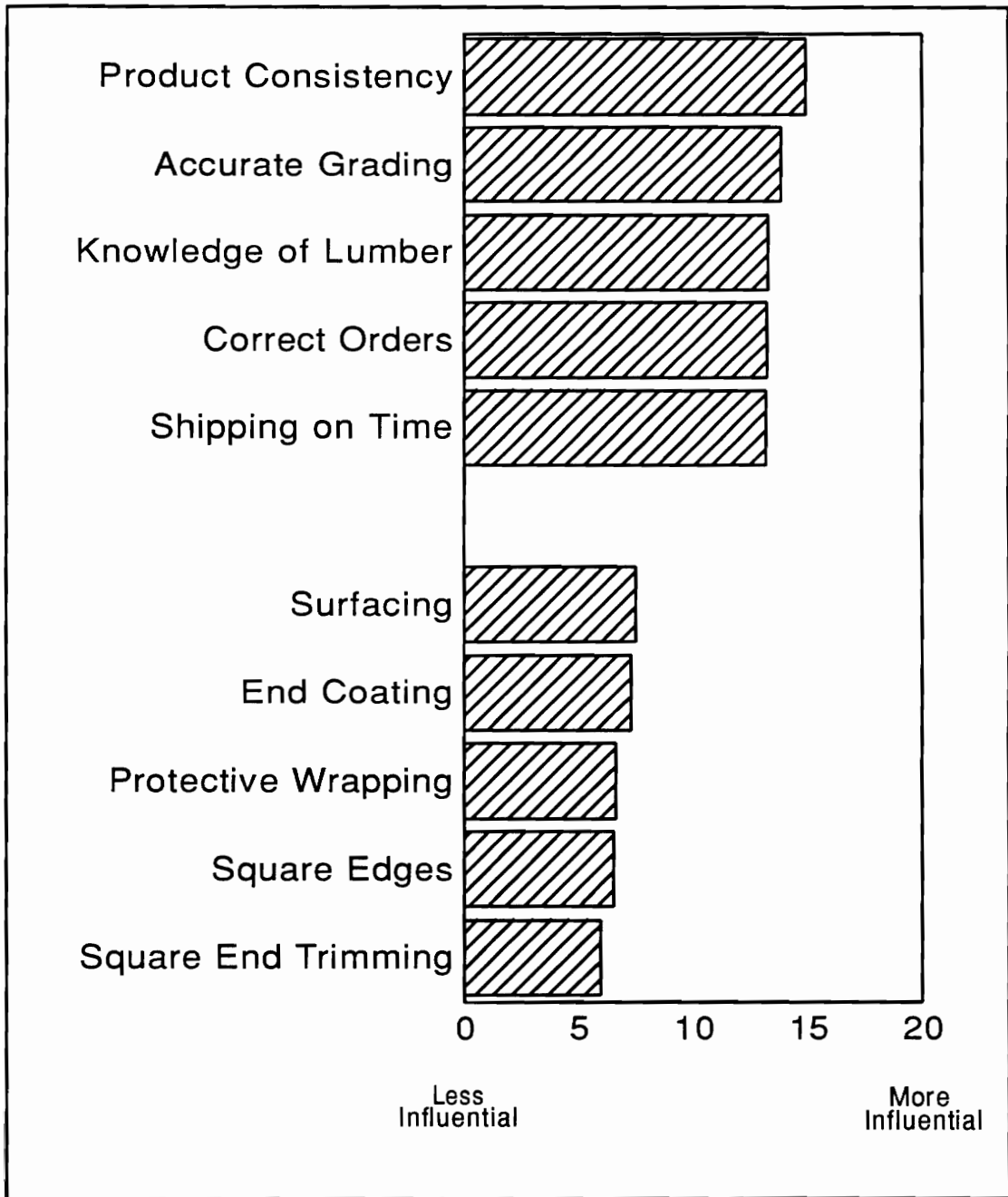


Figure 2. Top 5 and Lowest 5 Purchase Influence Scores: All Firms

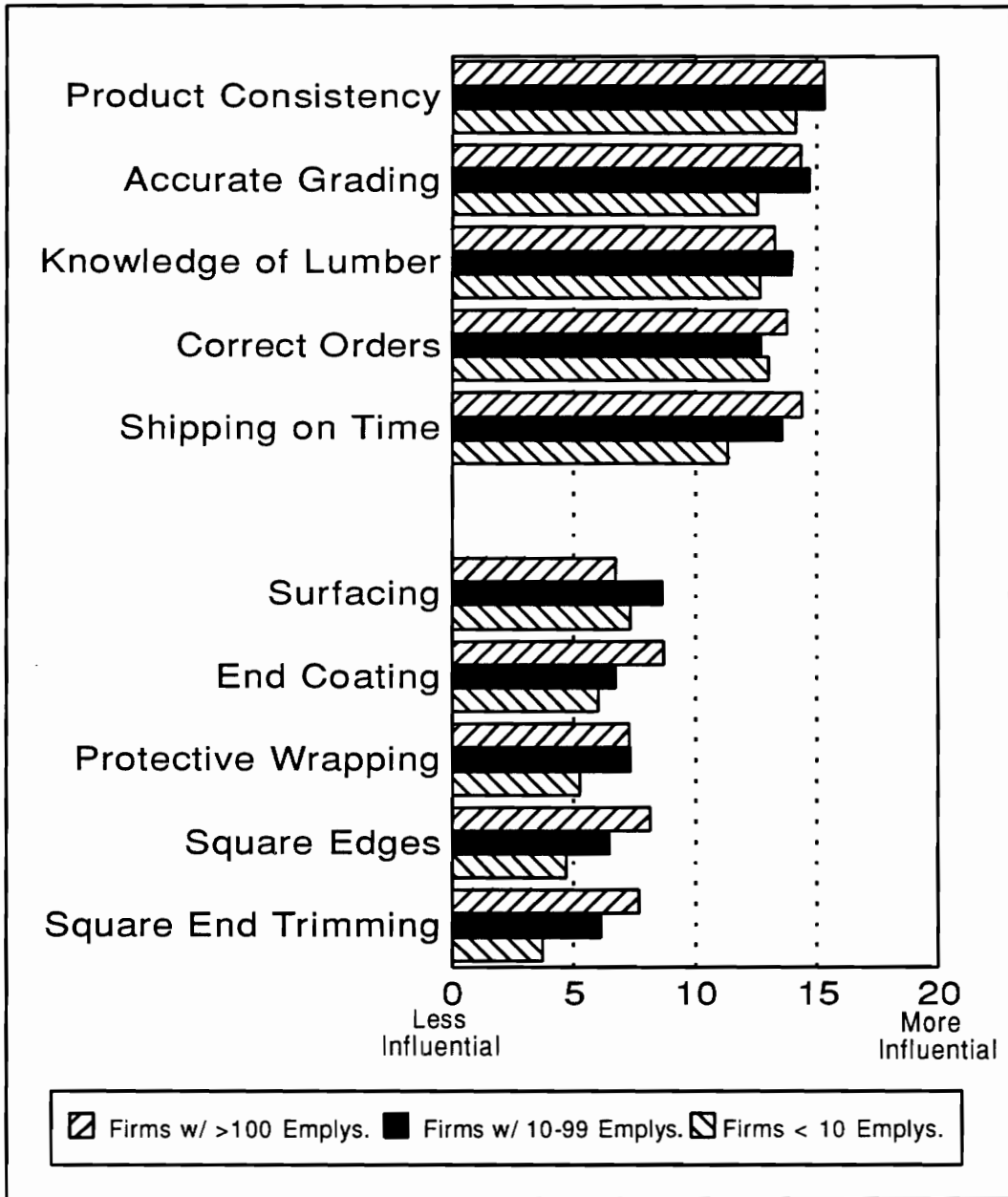


Figure 3. Top 5 and Lowest 5 Purchase Influence Scores: Firm Size

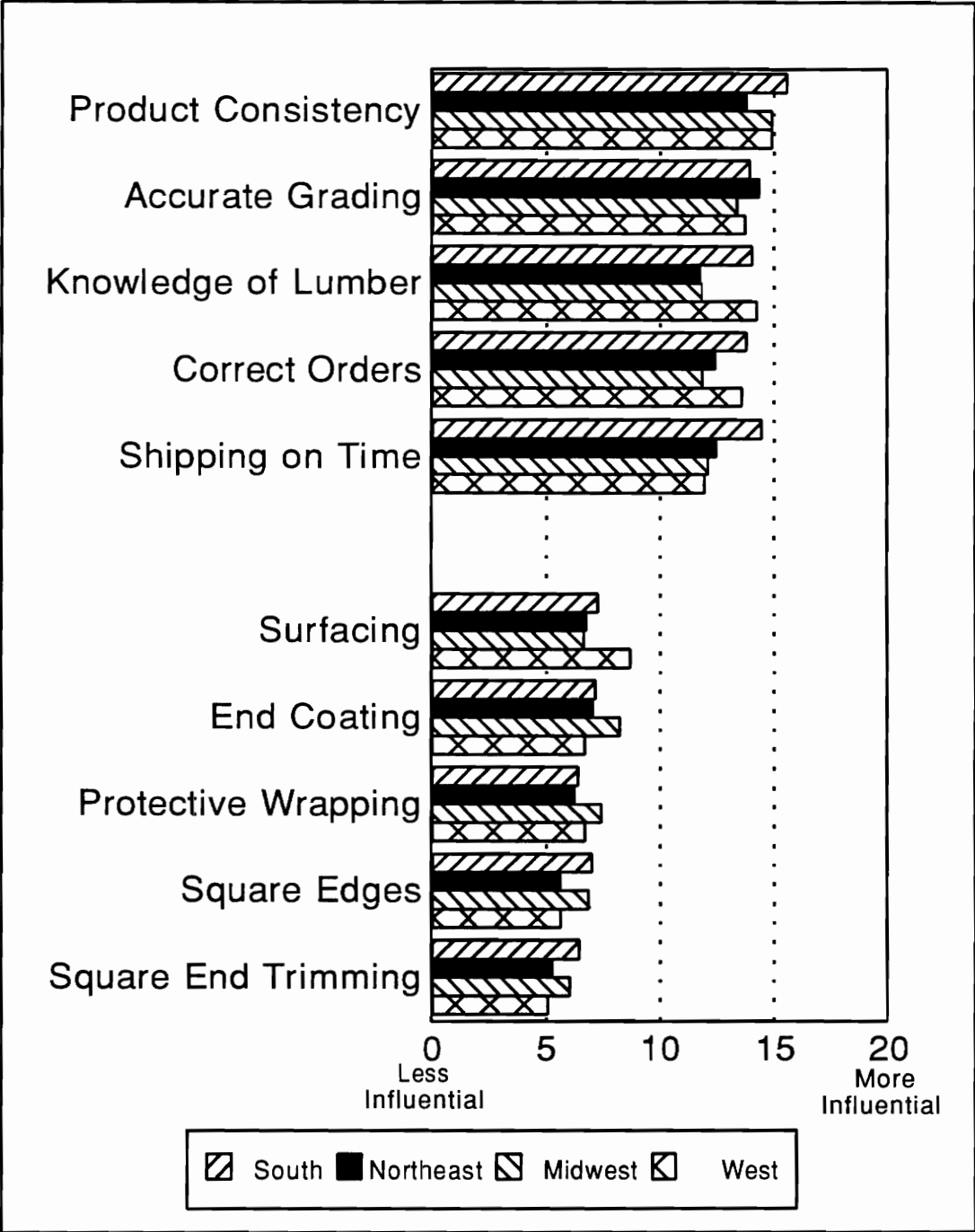


Figure 4. Top 5 and Lowest 5 Purchase Influence Scores: Geographic Region

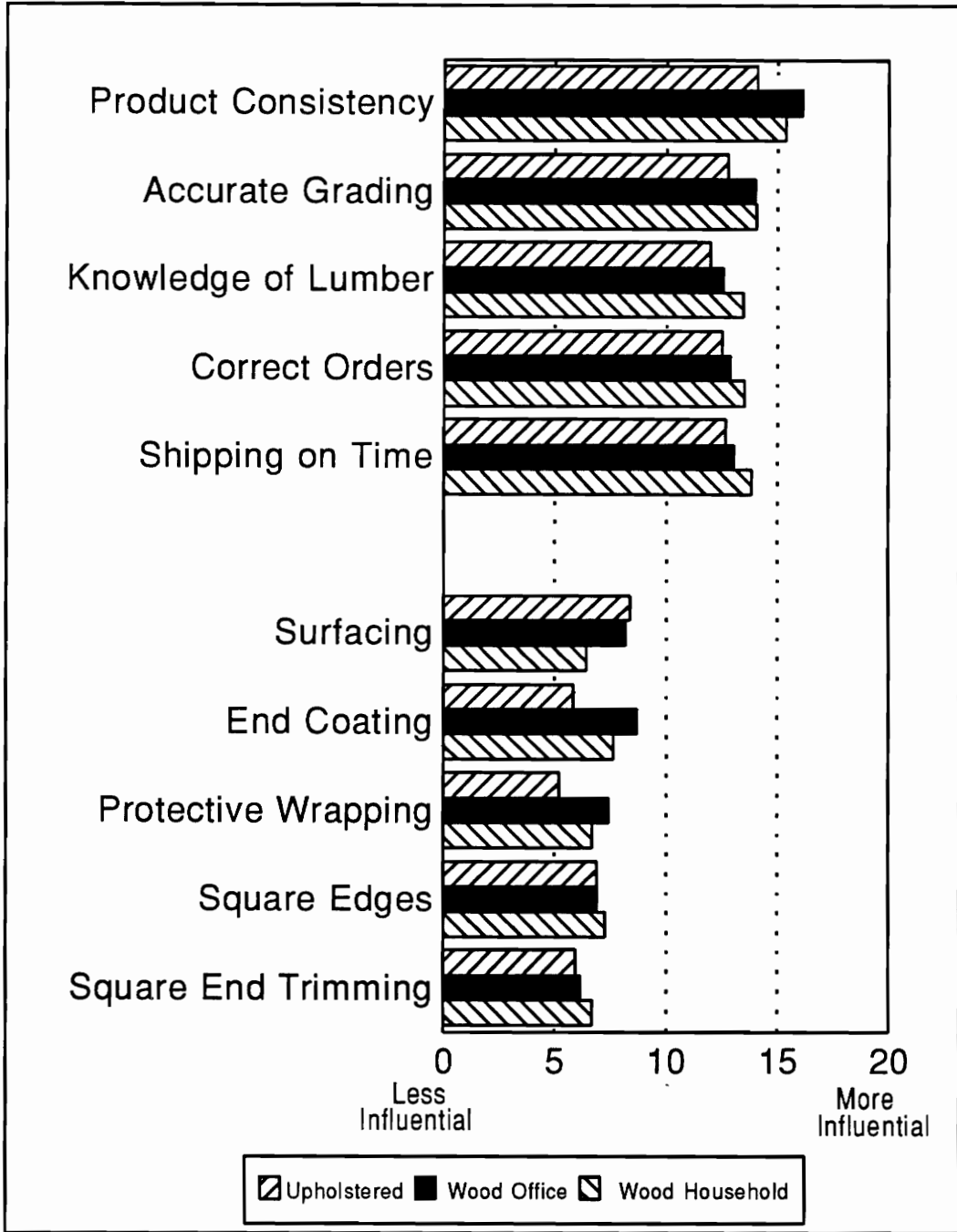


Figure 5. Top 5 and Lower 5 Purchase Influence Scores: Furniture Type

Additional Results

Additional Results

In addition to collecting material use and attribute data, other useful information was collected in this project. The following sections include information on ready-to-assemble (RTA) furniture manufacturers, unfinished furniture, and trends in green lumber purchases.

Profile of Respondents

Title

Surveys were addressed to individuals at each firm who would best be able to answer the questions posed. With a majority of the firms in the sample having 9 or fewer employees, it was expected that many of the responses would come from persons such as the president or owner. The results shown in Table 1 indicate that this is true. More than 57% of the respondents were either owners, presidents or CEOs.

Number of Employees

Table 2 shows the average number of employees by firm size (firm size is based on number of employees). The maximum number of full-time production employees reported by a single firm was 8,000 and the overall average number of employees for all respondents was 225.

Location

Four geographic regions, roughly following those used by the census, were utilized to allow for geographic segmentation of manufacturing facilities. The South contained than 43.4 % of the respondents and was followed by the Midwest (21.0%), West (20.3%) and Northeast (15.3%) regions.

Types of Furniture Manufactured and Average Sales

Table 3 gives the number of responding firms which manufactured wood household, wood office and/or upholstered furniture. Wood household furniture was manufactured by 66% of the respondents. Total 1990 sales of respondents in wood household, wood office, and upholstered furniture was \$7.6 billion (Table 3).

Table 1. Titles of Respondents to the Material Use Survey

| Title | Frequency | Percent of Total |
|-----------------------|------------------|-------------------------|
| Owner | 170 | 31.8 |
| President/CEO | 135 | 25.3 |
| Purchasing Manager | 84 | 15.7 |
| Plant/General Manager | 63 | 11.8 |
| Vice President | 30 | 5.6 |
| Lumber Buyer | 8 | 1.5 |
| Purchasing Agent | 3 | 0.6 |
| Other | 41 | 7.7 |

Table 2. Average Number of Employees In Respondents' Operations During 1990 By Firm Size

| Firm Size (# of Employees) | Average Number of Employees |
|---------------------------------------|--|
| Top 221 | 876 |
| Other firms with >100 employees | 306 |
| Firms with 10-99 employees | 34 |
| Firms with <10 employees | 4 |
| All Firms | 225 |

Table 3. Types of Furniture Manufactured by Respondents and Respondents' Total 1990 Sales in Each Type

| Furniture Type | Frequency | 1990 Sales (\$) |
|--------------------------|------------------|------------------------|
| Wood Household | 355 | 3,161,881,000 |
| Wood Office | 189 | 1,727,254,000 |
| Wood-framed Upholstered | 239 | 2,757,334,000 |
| Total Respondents | 539 | 7,646,469,000 |

Table 4 shows respondents' average combined sales of wood office, wood household, and upholstered furniture by firm size (based on number of employees).

Table 4. Respondents' 1990 Average Sales of Wood Household, Wood Office and Upholstered Furniture by Firm Size

| Firm Size | Average Sales (\$) |
|---------------------------------|---------------------------|
| Top 221 Firms | 71,575,000 |
| Other Firms with >100 Employees | 26,220,000 |
| Firms with 10-99 Employees | 8,857,000 |
| Firms with <10 Employees | 674,000 |
| All Respondents | 14,186,000 |

RTA Furniture

Just over 20% of all respondents manufactured RTA furniture, with RTA sales of respondents totaling over \$978 million. Slightly less than five percent of these firms have 90% or more of their sales in RTA furniture. As shown by Table 5, RTA sales of responding firms with over 100 employees represent 97% of all respondents' RTA furniture sales. Also shown in Table 5 are average RTA sales by firm size.

Table 5. Average RTA Furniture Sales of Responding Firms Manufacturing RTA Furniture and Percent of Total RTA Furniture Sales by Firm Size

| Firm Size by Number of Employees | Average Sales of RTA Furniture By Firm Size (\$) | % of Total RTA Sales |
|---|---|-----------------------------|
| Top 221 Firms | 19,421,000 | 38 |
| Other Firms with >100 Employees | 31,839,000 | 59 |
| Firms with 10-99 Employees | 1,336,000 | 2 |
| Firms with <10 Employees | 97,000 | 1 |

Unfinished Furniture

Just over 15% of all respondents manufactured some unfinished furniture. Unfinished furniture sales of respondents totaled nearly \$977 million. Slightly less than six percent of these firms had 90% or more of their sales in unfinished furniture. As shown in Table 6, firms with over 100 employees represent 97% of the unfinished furniture sales of those firms manufacturing unfinished furniture.

Table 6. Average Unfinished Furniture Sales of Responding Firms Manufacturing Unfinished Furniture and Percent of Total Unfinished Furniture Sales by Firm Size

| Firm Size by Number of Employees | Average Sales of Unfinished Furniture by Firm Size (\$) | % of Total Unfinished Sales |
|---|--|------------------------------------|
| Top 221 Firms | 6,231,000 | 11 |
| Other Firms with >100 Employees | 52,331,000 | 86 |
| Firms With 10-99 Employees | 493,000 | 2 |
| Firms with <10 Employees | 105,000 | 1 |

Green Hardwood Purchases

Firms were asked if they purchased green hardwood lumber, and if so, how their purchases of green hardwood lumber have changed over the past 5 years. Overall, 26% of respondents purchased green hardwood lumber (Table 7). A higher percentage of larger firms tended to purchase green hardwood than smaller firms. This is not surprising as larger firms more often own kilns and dry a larger percentage of the lumber they purchase.

Table 7. Percentage of Respondents Who Buy Green Lumber, Respondents Who Have Kilns, and Needs Met By These Kilns

| Firm Size by Number of Employees | Percent of Respondents Who Purchase Green Hardwood Lumber | Percent of Respondents With Dry Kilns | Percent Dry Lumber Needs Met By Own Kilns |
|---|--|--|--|
| Top 221 Firms | 57 | 49 | 88 |
| Other Firms with >100 Employees | 43 | 38 | 83 |
| Firms with 10-99 Employees | 16 | 7 | 72 |
| Firms with <10 Employees | 11 | 2 | 53 |
| All Respondents | 26 | 19 | 83 |

Table 8 summarizes how those firms who did purchase green hardwood lumber have seen purchases change over the past five years. About half of the larger firms (>100 employees) have increased their purchases of green hardwood lumber by just under 30% over the last 5 years. Roughly 30% of the smaller firms have increased their purchases of green hardwood lumber.

Table 8. Respondents' Changes in Purchases of Green Hardwood Lumber Over the Past Five Years

| Firm Size by Number of Employees | % Firms With Increase | Ave % Increase | % Firms With Decrease | Ave. % Decrease | % Firms With No Change |
|---|------------------------------|-----------------------|------------------------------|------------------------|-------------------------------|
| Top 221 Firms | 49 | 29 | 17 | 13 | 34 |
| Other Firms with >100 Employees | 53 | 25 | 14 | 44 | 33 |
| Firms with 10-99 Employees | 29 | 32 | 21 | 38 | 50 |
| Firms with <10 Employees | 30 | 24 | 5 | 90 | 65 |
| All Respondents | 44 | 28 | 15 | 31 | 41 |

Suppliers of Materials

Most hardwood lumber in 1990 was purchased directly from the sawmill. However, firms with less than 10 employees tended to purchase the majority of their lumber from wholesalers (Table 9).

Brokers were the primary supplier of softwood lumber to furniture manufacturers in 1990, although much softwood lumber was purchased directly from wholesalers (Table 10). For larger firms, a considerable amount of softwood lumber was from the firms' own sawmills.

Table 9. Percentage of Total 1990 Hardwood Lumber Purchases by Source

| Source | Top 221 Firms | Other Firms With >100 Employees | Firms With 10-99 Employees | Firms With <10 Employees | Total |
|----------------------------|---------------|---------------------------------|----------------------------|--------------------------|-------|
| Wholesaler/ Distributor | 15% | 18% | 18% | 54% | 18% |
| Lumber Broker | 17% | 20% | 9% | 1% | 15% |
| Direct From Sawmill | 60% | 59% | 72% | 44% | 64% |
| Lumber Importer | 2% | 1% | <1% | 1% | <1% |
| Other | 6% | 2% | <1% | 0% | 3% |

Firms were also asked the number of suppliers they use in a typical month when purchasing hardwood lumber, softwood lumber, dimension parts, and particleboard. Firms on average used less than eight suppliers for lumber

purchases and averaged 2 or less suppliers for dimension parts and particleboard (Table 11).

Respondent Satisfaction

Firms were asked if they were satisfied with the lumber they purchased and about 30% were. However, over 40% had complaints about lumber quality and about 12% had complaints over the price (Table 12).

Table 10. Percentage of Total 1990 Softwood Lumber Purchases by Source

| Source | Top 221 Firms | Other Firms With >100 Employees | Firms With 10-99 Employees | Firms With <10 Employees | Total |
|-----------------------------|---------------|---------------------------------|----------------------------|--------------------------|-------|
| Wholesaler/Distributor | 30% | 89% | 24% | 90% | 31% |
| Lumber Broker | 20% | 8% | 75% | 8% | 67% |
| Direct From Sawmill | 2% | 2% | <1% | <1% | <1% |
| Direct From Captive Sawmill | 47% | <1% | <1% | <1% | 2% |
| Lumber Importer | <1% | <1% | <1% | <1% | <1% |
| Other | <1% | <1% | <1% | <1% | <1% |

Table 11. The Number of Suppliers (on a Monthly Basis) the Respondents Use When Purchasing the Following Materials

| Materials | Suppliers | |
|---------------------------------|------------------|--------------|
| | Average | Range |
| Hardwood Lumber | | |
| Top 221 Firms | 8 | 0 - 80 |
| Other Firms with >100 Employees | 5 | 0 - 40 |
| Firms with 10-99 Employees | 3 | 0 - 100 |
| Firms with <10 Employees | 2 | 0 - 6 |
| Softwood Lumber | | |
| Top 221 Firms | 7 | 0 - 600 |
| Other Firms with >100 Employees | 1 | 0 - 15 |
| Firms with 10-99 Employees | 1 | 0 - 5 |
| Firms with <10 Employees | 2 | 0 - 104 |
| Dimension Parts | | |
| Top 221 Firms | 1 | 0 - 8 |
| Other Firms with >100 Employees | 2 | 0 - 40 |
| Firms with 10-99 Employees | 1 | 0 - 100 |
| Firms with <10 Employees | 1 | 0 - 10 |
| Particleboard | | |
| Top 221 Firms | 1 | 0 - 8 |
| Other Firms with >100 Employees | 1 | 0 - 10 |
| Firms with 10-99 Employees | 1 | 0 - 5 |
| Firms with <10 Employees | 1 | 0 - 10 |

Table 12. Factors Respondents Are Least Satisfied with When Buying Lumber

| Factors | Hardwood Lumber Purchases | | Softwood Lumber Purchases | |
|---------------------------------|---------------------------|------------|---------------------------|------------|
| | Frequency | % of Total | Frequency | % of Total |
| We Are Satisfied | 128 | 29 | 84 | 32 |
| Lumber Quality | 194 | 43 | 110 | 42 |
| Price | 54 | 12 | 28 | 11 |
| Availability of Certain Species | 33 | 7 | 15 | 6 |
| Delivery Time | 18 | 4 | 7 | 2 |
| Credit Terms | 11 | 3 | 8 | 3 |
| Other | 9 | 2 | 11 | 4 |

Conclusions

Much information can be gleaned from the information provided in this thesis. Major conclusions are as follows:

Total 1990 hardwood lumber used in wood furniture was estimated at over 2.4 billion board feet and use was expected to increase 13% by 1992. Softwood lumber used in 1990 by wood furniture manufacturers was estimated at over 839 million board feet. Softwood lumber use was expected to increase 6% from 1990 to 1992. Red oak was the most commonly used hardwood species and southern pine was the most used softwood. Wood furniture manufacturers consumed over 1.2 billion square feet of particleboard (3/4" basis), 248 million square feet of medium density fiberboard (3/4" basis), 125 million square feet of hardboard (1/8" basis) and 318 million square feet of OSB/softwood plywood (7/8" basis). Furniture manufacturers expect a 5% decrease in particleboard use, a 12% decrease in MDF use, a 12% increase in hardboard use and a 15% increase in OSB/softwood plywood.

Over 20% of the respondents manufactured Ready-to-Assemble furniture. Over 15% manufactured unfinished furniture. Overall, 26% of

respondents purchased green hardwood lumber, most being larger firms. Most firms' purchases of green lumber either have not changed, or have increased, over the last 5 years.

Nearly two thirds of the 1990 hardwood lumber purchases by furniture producers were made direct from sawmills. Nearly 30% of the respondents were satisfied with the hardwood lumber they purchased, but approximately 40% had complaints about lumber quality and 12% about price.

Wood household furniture represents the largest portion of the wood furniture industry, followed by upholstered, and then wood office, both in frequency of plants and total sales. The South is dominant in furniture manufacturing, as well as lumber consumption, followed by the Midwest, Northeast and West.

Product consistency was the attribute which most influenced the purchase of hardwood lumber, followed by accurate grading, supplier's knowledge of lumber, correct orders, and shipping on time. The least influential attributes were square end trimming, square edges, protective wrapping, end coating and supplier's ability to surface.

Opportunities for Future Research

There are several areas that afford attractive opportunities for future research efforts:

1. A study designed to investigate hardwood lumber use by grades purchased would be informative. Furniture manufacturers often have an option as to which grades may be used in their production of furniture. Higher grades of lumber offer higher yields and less processing time, but are more expensive. Likewise, lower grades cost less, but yields decrease and labor input per board increases. Because of the differences in yield realized between low grade and high grade hardwood lumber, a change in the ratio of consumption of high grade to low grade will influence total hardwood lumber volumes used. Thus, a better way to evaluate hardwood lumber usage is to consider the volumes used by grade. This information, combined with similar results of similar studies of other hardwood lumber using industries, would allow for more accurate estimates of how hardwood lumber is consumed.

Such a study could also aid hardwood lumber suppliers design better marketing strategies by determining differences in grade use by furniture type manufactured.

2. A survey designed to assess the amount of wood-based material used by the wood furniture industry for packaging and shipping would also be of interest. Presumably, a large amount of wood products, especially hardwood and softwood lumber, are used by the wood furniture industry in packaging, crating and other shipping applications. It would be of interest investigate the materials and volumes used in such applications.

3. Using the information procured from this study combined with last year's material use study, a data base may be developed and maintained. A method may be developed to utilize easily obtainable indicators of industry changes as predictors of material use, thus reducing sample size while increasing validity and reliability. The smaller sample size should decrease the expense of the survey. Thus, a continuation of the material use data base will be possible with a limited budget.

4. Data could be collected in greater detail as to the amounts of green and air dried hardwood lumber purchased as compared to kiln dried hardwood lumber. Such information would aid hardwood lumber suppliers and manufacturers design future marketing strategies.

5. Manufactures and suppliers could be surveyed to determine their perceptions of which hardwood lumber and supplier attributes are most influential in their customers' decisions to purchase. A comparison of the perceptions of which hardwood lumber or supplier attributes are most purchase influential could be made between suppliers and buyers of this product.

Appendix

- i. Complete set of tables.
- ii. Research Instrument

Table A-1. Total Material Usage for Wood Household Furniture, Upholstered Furniture, and Wood Office Furniture.^{1/}

| Material | 1990 | 1991 | 1992 |
|------------------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 2,425 | 2,566 | 2,752 |
| Softwood Lumber (MMBF) | 839 | 840 | 887 |
| Particleboard (MMSF) ^{2/} | 1,259 | 1,267 | 1,193 |
| MDF (MMSF) | 248 | 243 | 218 |
| Hardboard (MMSF) | 125 | 131 | 140 |
| OSB/Softwood Plywood (MMSF) | 318 | 345 | 366 |

^{1/} Data for hardwood plywood, veneer, and dimension parts were also collected but due to definitional problems and the variety of industry usage it was not reported.

^{2/} Data for all panel products were collected in units of thousand square feet (MSF) surface measure. Thicknesses can vary between products and within a product category. No attempt was made to gather data for each panel product by the variety of thicknesses it is purchased in, however, the most common thicknesses are: particleboard 3/4", MDF 3/4", hardboard 1/8", OSB/softwood plywood 7/8".

Table A-2. Total Material Usage -- Wood Household Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 1,196 | 1,251 | 1,329 |
| Softwood Lumber (MMBF) | 744 | 743 | 774 |
| Particleboard (MMSF) | 1,129 | 1,128 | 1,039 |
| MDF (MMSF) | 212 | 206 | 176 |
| Hardboard (MMSF) | 74 | 78 | 85 |
| OSB/Softwood Plywood (MMSF) | 69 | 69 | 71 |

Table A-3. Total Material Usage -- Upholstered Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 1,108 | 1,185 | 1,277 |
| Softwood Lumber (MMBF) | 64 | 71 | 88 |
| Particleboard (MMSF) | 50 | 53 | 59 |
| MDF (MMSF) | 19 | 19 | 21 |
| Hardboard (MMSF) | 10 | 10 | 12 |
| OSB/Softwood Plywood (MMSF) | 245 | 271 | 290 |

Table A-4. Total Material Usage -- Wood Office Furniture.

| Material | 1990 | 1991 | 1992 |
|-----------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | 121 | 130 | 146 |
| Softwood Lumber (MMBF) | 31 | 26 | 25 |
| Particleboard (MMSF) | 80 | 86 | 95 |
| MDF (MMSF) | 17 | 18 | 21 |
| Hardboard (MMSF) | 41 | 43 | 43 |
| OSB/Softwood Plywood (MMSF) | 4 | 5 | 5 |

Table A-5. 1990 Material Usage by Industry Category.

| Materials | Wood Household | Upholstered | Wood Office | Total |
|-----------------------------|-----------------------|--------------------|--------------------|--------------|
| Hardwood Lumber (MMBF) | 1,196 | 1,108 | 121 | 2,425 |
| Softwood Lumber (MMBF) | 744 | 64 | 31 | 839 |
| Particleboard (MMSF) | 1,129 | 50 | 80 | 1,259 |
| MDF (MMSF) | 212 | 19 | 17 | 248 |
| Hardboard (MMSF) | 74 | 10 | 41 | 125 |
| OSB/Softwood Plywood (MMSF) | 69 | 245 | 4 | 318 |

Table A-6. 1991 Material Usage by Industry Category.

| Materials | Wood Household | Upholstered | Wood Office | Total |
|-----------------------------|-----------------------|--------------------|--------------------|--------------|
| Hardwood Lumber (MMBF) | 1,251 | 1,185 | 130 | 2,566 |
| Softwood Lumber (MMBF) | 743 | 71 | 26 | 840 |
| Particleboard (MMSF) | 1,128 | 53 | 86 | 1,267 |
| MDF (MMSF) | 206 | 19 | 18 | 243 |
| Hardboard (MMSF) | 78 | 10 | 43 | 131 |
| OSB/Softwood Plywood (MMSF) | 69 | 271 | 5 | 345 |

Table A-7. 1992 Material Usage by Industry Category.

| Materials | Wood Household | Upholstered | Wood Office | Total |
|-----------------------------|-----------------------|--------------------|--------------------|--------------|
| Hardwood Lumber (MMBF) | 1,329 | 1,277 | 146 | 2,752 |
| Softwood Lumber (MMBF) | 774 | 88 | 25 | 887 |
| Particleboard (MMSF) | 1,039 | 59 | 95 | 1,193 |
| MDF (MMSF) | 176 | 21 | 21 | 218 |
| Hardboard (MMSF) | 85 | 12 | 43 | 140 |
| OSB/Softwood Plywood (MMSF) | 71 | 290 | 5 | 366 |

Table A-8. Material Use by Region.*

| Material | 1990 | 1991 | 1992 |
|------------------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | | | |
| Northeast | 278 | 283 | 300 |
| South | 1,612 | 1,694 | 1,801 |
| Midwest | 449 | 488 | 523 |
| West | 76 | 90 | 117 |
| Softwood Lumber (MMBF) | | | |
| Northeast | 35 | 33 | 37 |
| South | 549 | 531 | 538 |
| Midwest | 107 | 112 | 128 |
| West | 148 | 163 | 181 |
| Particleboard (MMSF) | | | |
| Northeast | 48 | 56 | 59 |
| South | 1,108 | 1,100 | 1,012 |
| Midwest | 66 | 72 | 79 |
| West | 35 | 39 | 44 |
| MDF (MMSF) | | | |
| Northeast | 17 | 17 | 18 |
| South | 137 | 126 | 138 |
| Midwest | 43 | 44 | 48 |
| West | 3 | 4 | 5 |
| Hardboard (MMSF) | | | |
| Northeast | 23 | 23 | 24 |
| South | 28 | 32 | 39 |
| Midwest | 65 | 66 | 66 |
| West | 9 | 10 | 11 |
| OSB/Softwood Plywood (MMSF) | | | |
| Northeast | 4 | 4 | 4 |
| South | 161 | 165 | 168 |
| Midwest | 132 | 154 | 171 |
| West | 6 | 6 | 7 |

* Totals may be less than totals in previous tables since not all firms could be categorized by region.

Table A-9. Cumulative Material Use by Respondent Firm Size.

| Material | 1990 | 1991 | 1992 |
|------------------------------------|-------------|-------------|-------------|
| Hardwood Lumber (MMBF) | | | |
| Top 221 Firms | 610 | 620 | 654 |
| Firms with >100 Employees | 1,451 | 1,489 | 1,565 |
| Firms with >10 Employees | 2,352 | 2,480 | 2,639 |
| All Firms | 2,425 | 2,566 | 2,752 |
| Softwood Lumber (MMBF) | | | |
| Top 221 Firms | 69 | 70 | 73 |
| Firms with >100 Employees | 211 | 221 | 240 |
| Firms with >10 Employees | 819 | 819 | 866 |
| All Firms | 839 | 840 | 887 |
| Particleboard (MMSF) | | | |
| Top 221 Firms | 1,083 | 1,077 | 990 |
| Firms with >100 Employees | 1,195 | 1,198 | 1,116 |
| Firms with >10 Employees | 1,248 | 1,257 | 1,171 |
| All Firms | 1,259 | 1,267 | 1,193 |
| MDF (MMSF) | | | |
| Top 221 Firms | 118 | 133 | 143 |
| Firms with >100 Employees | 219 | 213 | 182 |
| Firms with >10 Employees | 246 | 250 | 215 |
| All Firms | 248 | 243 | 218 |
| Hardboard (MMSF) | | | |
| Top 221 Firms | 65 | 70 | 77 |
| Firms with >100 Employees | 112 | 116 | 124 |
| Firms with >10 Employees | 124 | 130 | 139 |
| All Firms | 125 | 131 | 140 |
| OSB/Softwood Plywood (MMSF) | | | |
| Top 221 Firms | 32 | 35 | 38 |
| Firms with >100 Employees | 255 | 280 | 301 |
| Firms with >10 Employees | 312 | 337 | 358 |
| All Firms | 318 | 345 | 366 |

Table A-10. 1990 Material Usage by Respondent Firm Size and Industry Category.

| Material | Wood Household | Wood Office | Upholstered | Total |
|------------------------------------|----------------|-------------|-------------|-------|
| Hardwood Lumber (MMBF) | | | | |
| Top 221 Firms | 363 | 27 | 220 | 610 |
| Other Firms with >100 Employees | 548 | 42 | 252 | 842 |
| Firms with 10-99 Employees | 229 | 45 | 627 | 901 |
| Firms with <10 Employees | 56 | 7 | 9 | 72 |
| Total | 1,196 | 121 | 1,108 | 2,425 |
| Softwood Lumber (MMBF) | | | | |
| Top 221 Firms | 55 | 6 | 7 | 67 |
| Other Firms with >100 Employees | 130 | 3 | 10 | 143 |
| Firms with 10-99 Employees | 544 | 19 | 45 | 609 |
| Firms with <10 Employees | 16 | 2 | 2 | 20 |
| Total | 745 | 30 | 64 | 839 |
| Particleboard (MMSF) | | | | |
| Top 221 Firms | 1,031 | 34 | 18 | 1,083 |
| Other Firms with >100 Employees | 78 | 20 | 14 | 112 |
| Firms with 10-99 Employees | 14 | 23 | 17 | 54 |
| Firms with <10 Employees | 6 | 3 | 1 | 10 |
| Total | 1,129 | 80 | 50 | 1,259 |
| MDF (MMSF) | | | | |
| Top 221 Firms | 110 | 3 | 5 | 118 |
| Other Firms with >100 Employees | 93 | 8 | <1 | 101 |
| Firms with 10-99 Employees | 8 | 5 | 13 | 26 |
| Firms with <10 Employees | 1 | 1 | <1 | 3 |
| Total | 212 | 17 | 19 | 248 |
| Hardboard (MMSF) | | | | |
| Top 221 Firms | 27 | 31 | 7 | 65 |
| Other Firms with >100 Employees | 43 | 3 | 1 | 47 |
| Firms with 10-99 Employees | 4 | 6 | 2 | 12 |
| Firms with <10 Employees | <1 | <1 | <1 | 1 |
| Total | 74 | 41 | 10 | 125 |
| OSB/Softwood Plywood (MMSF) | | | | |
| Top 221 Firms | 3 | <1 | 28 | 31 |
| Other Firms with >100 Employees | 24 | 2 | 197 | 223 |
| Firms with 10-99 Employees | 39 | 2 | 16 | 57 |
| Firms with <10 Employees | 3 | <1 | 4 | 7 |
| Total | 69 | 4 | 245 | 318 |

Table A-11. 1991 Material Usage by Respondent Firm Size and Industry Category.

| Material | Wood Household | Wood Office | Upholstered | Total |
|------------------------------------|----------------|-------------|-------------|-------|
| Hardwood Lumber (MMBF) | | | | |
| Top 221 Firms | 372 | 26 | 222 | 620 |
| Other Firms with >100 Employees | 558 | 38 | 273 | 869 |
| Firms with 10-99 Employees | 253 | 57 | 681 | 991 |
| Firms with <10 Employees | 68 | 8 | 10 | 86 |
| Total | 1,251 | 129 | 1,186 | 2,566 |
| Softwood Lumber (MMBF) | | | | |
| Top 221 Firms | 57 | 5 | 5 | 67 |
| Other Firms with >100 Employees | 139 | 4 | 11 | 154 |
| Firms with 10-99 Employees | 531 | 15 | 53 | 599 |
| Firms with <10 Employees | 16 | 2 | 2 | 20 |
| Total | 743 | 26 | 71 | 840 |
| Particleboard (MMSF) | | | | |
| Top 221 Firms | 1,024 | 34 | 19 | 1,077 |
| Other Firms with >100 Employees | 84 | 23 | 14 | 121 |
| Firms with 10-99 Employees | 14 | 25 | 19 | 58 |
| Firms with <10 Employees | 6 | 4 | 1 | 11 |
| Total | 1,128 | 86 | 53 | 1,267 |
| MDF (MMSF) | | | | |
| Top 221 Firms | 124 | 3 | 5 | 132 |
| Other Firms with >100 Employees | 72 | 8 | <1 | 81 |
| Firms with 10-99 Employees | 8 | 6 | 13 | 27 |
| Firms with <10 Employees | 2 | 1 | <1 | 3 |
| Total | 206 | 18 | 19 | 243 |
| Hardboard (MMSF) | | | | |
| Top 221 Firms | 31 | 33 | 6 | 70 |
| Other Firms with >100 Employees | 42 | 3 | 1 | 46 |
| Firms with 10-99 Employees | 4 | 7 | 3 | 14 |
| Firms with <10 Employees | <1 | <1 | <1 | 1 |
| Total | 78 | 43 | 10 | 131 |
| OSB/Softwood Plywood (MMSF) | | | | |
| Top 221 Firms | 3 | <1 | 31 | 35 |
| Other Firms with >100 Employees | 25 | 2 | 218 | 245 |
| Firms with 10-99 Employees | 38 | 2 | 17 | 57 |
| Firms with <10 Employees | 3 | <1 | 4 | 8 |
| Total | 69 | 6 | 270 | 345 |

Table A-12.

1992 Material Usage by Respondent Firm Size and Industry Category.

| Material | Wood Household | Wood Office | Upholstered | Total |
|------------------------------------|----------------|-------------|-------------|-------|
| Hardwood Lumber (MMBF) | | | | |
| Top 221 Firms | 386 | 28 | 240 | 654 |
| Other Firms with >100 Employees | 584 | 45 | 283 | 912 |
| Firms with 10-99 Employees | 265 | 64 | 744 | 1,073 |
| Firms with <10 Employees | 94 | 9 | 10 | 113 |
| Total | 1,329 | 146 | 1,277 | 2,752 |
| Softwood Lumber (MMBF) | | | | |
| Top 221 Firms | 60 | 5 | 7 | 72 |
| Other Firms with >100 Employees | 147 | 4 | 17 | 168 |
| Firms with 10-99 Employees | 549 | 14 | 62 | 625 |
| Firms with <10 Employees | 18 | 2 | 2 | 22 |
| Total | 774 | 25 | 88 | 887 |
| Particleboard (MMSF) | | | | |
| Top 221 Firms | 931 | 39 | 20 | 990 |
| Other Firms with >100 Employees | 87 | 24 | 15 | 126 |
| Firms with 10-99 Employees | 15 | 28 | 23 | 66 |
| Firms with <10 Employees | 6 | 4 | 1 | 11 |
| Total | 1,039 | 95 | 59 | 1,193 |
| MDF (MMSF) | | | | |
| Top 221 Firms | 134 | 3 | 6 | 143 |
| Other Firms with >100 Employees | 31 | 8 | <1 | 39 |
| Firms with 10-99 Employees | 10 | 8 | 15 | 33 |
| Firms with <10 Employees | 2 | 1 | <1 | 3 |
| Total | 177 | 20 | 21 | 218 |
| Hardboard (MMSF) | | | | |
| Top 221 Firms | 37 | 33 | 7 | 77 |
| Other Firms with >100 Employees | 43 | 3 | 2 | 47 |
| Firms with 10-99 Employees | 4 | 7 | 4 | 14 |
| Firms with <10 Employees | <1 | <1 | <1 | 2 |
| Total | 85 | 43 | 12 | 140 |
| OSB/Softwood Plywood (MMSF) | | | | |
| Top 221 Firms | 3 | <1 | 34 | 38 |
| Other Firms with >100 Employees | 26 | 2 | 235 | 263 |
| Firms with 10-99 Employees | 38 | 2 | 18 | 58 |
| Firms with <10 Employees | 3 | <1 | 4 | 7 |
| Total | 70 | 5 | 291 | 366 |

Table A-13. Material Usage for Northeast Region.*

| Material | 1990 | 1991 | 1992 |
|------------------------------------|------|------|------|
| Hardwood Lumber (MMBF) | | | |
| Wood Household | 229 | 233 | 246 |
| Upholstered | 34 | 35 | 37 |
| Wood Office | 14 | 15 | 17 |
| Total | 277 | 283 | 300 |
| Softwood Lumber (MMBF) | | | |
| Wood Household | 30 | 29 | 32 |
| Upholstered | 3 | 3 | 3 |
| Wood Office | 1 | 1 | 1 |
| Total | 34 | 33 | 36 |
| Particleboard (MMSF) | | | |
| Wood Household | 17 | 21 | 22 |
| Upholstered | 7 | 7 | 8 |
| Wood Office | 24 | 28 | 29 |
| Total | 48 | 56 | 59 |
| MDF (MMSF) | | | |
| Wood Household | 8 | 8 | 8 |
| Upholstered | <1 | <1 | <1 |
| Wood Office | 8 | 9 | 9 |
| Total | 17 | 18 | 18 |
| Hardboard (MMSF) | | | |
| Wood Household | 13 | 13 | 14 |
| Upholstered | 6 | 5 | 6 |
| Wood Office | 4 | 4 | 4 |
| Total | 23 | 22 | 24 |
| OSB/Softwood Plywood (MMSF) | | | |
| Wood Household | 2 | 2 | 2 |
| Upholstered | 1 | <1 | <1 |
| Wood Office | 1 | 1 | 1 |
| Total | 4 | 4 | 4 |

* Totals may not equal totals in previous tables since some respondents did not provide a region.

Table A-14.

Material Usage for South Region.*

| Material | 1990 | 1991 | 1992 |
|------------------------------------|-------|-------|-------|
| Hardwood Lumber (MMBF) | | | |
| Wood Household | 629 | 644 | 669 |
| Upholstered | 945 | 1,012 | 1,088 |
| Wood Office | 37 | 38 | 43 |
| Total | 1,611 | 1,694 | 1,800 |
| Softwood Lumber (MMBF) | | | |
| Wood Household | 525 | 508 | 511 |
| Upholstered | 12 | 11 | 16 |
| Wood Office | 11 | 11 | 11 |
| Total | 548 | 530 | 538 |
| Particleboard (MMSF) | | | |
| Wood Household | 1,066 | 1,060 | 968 |
| Upholstered | 27 | 27 | 28 |
| Wood Office | 15 | 14 | 16 |
| Total | 1,108 | 1,101 | 1,012 |
| MDF (MMSF) | | | |
| Wood Household | 127 | 117 | 127 |
| Upholstered | 6 | 6 | 7 |
| Wood Office | 3 | 3 | 3 |
| Total | 136 | 126 | 137 |
| Hardboard (MMSF) | | | |
| Wood Household | 24 | 29 | 35 |
| Upholstered | 3 | 3 | 3 |
| Wood Office | <1 | <1 | <1 |
| Total | 28 | 33 | 39 |
| OSB/Softwood Plywood (MMSF) | | | |
| Wood Household | 54 | 53 | 54 |
| Upholstered | 105 | 110 | 113 |
| Wood Office | 1 | 1 | 1 |
| Total | 160 | 164 | 168 |

* Totals may not equal totals in previous tables since some respondents did not provide a region.

Table A-15. Material Usage for Midwest Region.*

| Material | 1990 | 1991 | 1992 |
|------------------------------------|------|------|------|
| Hardwood Lumber (MMBF) | | | |
| Wood Household | 284 | 309 | 328 |
| Upholstered | 113 | 122 | 131 |
| Wood Office | 52 | 57 | 63 |
| Total | 449 | 448 | 522 |
| Softwood Lumber (MMBF) | | | |
| Wood Household | 89 | 99 | 116 |
| Upholstered | 2 | 1 | 1 |
| Wood Office | 16 | 12 | 10 |
| Total | 107 | 112 | 127 |
| Particleboard (MMSF) | | | |
| Wood Household | 33 | 36 | 38 |
| Upholstered | 9 | 10 | 10 |
| Wood Office | 24 | 26 | 30 |
| Total | 66 | 72 | 78 |
| MDF (MMSF) | | | |
| Wood Household | 30 | 32 | 35' |
| Upholstered | 11 | 11 | 12 |
| Wood Office | 1 | 1 | 1 |
| Total | 42 | 44 | 48 |
| Hardboard (MMSF) | | | |
| Wood Household | 32 | 31 | 32 |
| Upholstered | <1 | <1 | <1 |
| Wood Office | 33 | 34 | 34 |
| Total | 66 | 66 | 67 |
| OSB/Softwood Plywood (MMSF) | | | |
| Wood Household | 11 | 12 | 13 |
| Upholstered | 120 | 141 | 156 |
| Wood Office | 1 | 1 | 1 |
| Total | 132 | 154 | 170 |

* Totals may not equal totals in previous tables since some respondents did not provide a region.

Table A-16. Material Usage for West Region.*

| Material | 1990 | 1991 | 1992 |
|------------------------------------|------|------|------|
| Hardwood Lumber (MMBF) | | | |
| Wood Household | 50 | 61 | 82 |
| Upholstered | 11 | 12 | 15 |
| Wood Office | 16 | 17 | 20 |
| Total | 77 | 90 | 117 |
| Softwood Lumber (MMBF) | | | |
| Wood Household | 99 | 105 | 111 |
| Upholstered | 47 | 56 | 67 |
| Wood Office | 2 | 2 | 2 |
| Total | 148 | 163 | 180 |
| Particleboard (MMSF) | | | |
| Wood Household | 12 | 12 | 12 |
| Upholstered | 7 | 9 | 12 |
| Wood Office | 16 | 18 | 20 |
| Total | 35 | 39 | 44 |
| MDF (MMSF) | | | |
| Wood Household | <1 | <1 | <1 |
| Upholstered | <1 | 1 | 2 |
| Wood Office | 2 | 2 | 3 |
| Total | 4 | 4 | 6 |
| Hardboard (MMSF) | | | |
| Wood Household | 4 | 4 | 5 |
| Upholstered | 2 | 2 | 2 |
| Wood Office | 3 | 4 | 4 |
| Total | 9 | 10 | 11 |
| OSB/Softwood Plywood (MMSF) | | | |
| Wood Household | 1 | 2 | 2 |
| Upholstered | 4 | 4 | 5 |
| Wood Office | <1 | <1 | <1 |
| Total | 6 | 7 | 8 |

* Totals may not equal totals in previous tables since some respondents did not provide a region.

Table A-17.

Volumes of Various Softwood Lumber Species Used by Respondents in 1990 and Estimates for 1992.

| Species | 1990 | | 1992 | |
|--------------------------------|--------|------------|--------|------------|
| | Volume | % of Total | Volume | % of Total |
| Southern Pine (MMBF) | 485 | 58 | 455 | 51 |
| Eastern White Pine (MMBF) | 141 | 17 | 182 | 21 |
| Western Pine (MMBF) | 25 | 3 | 101 | 11 |
| Radiata Pine (MMBF) | <1 | <1 | 17 | 2 |
| Other (MMBF) | 109 | 13 | 109 | 12 |
| Not reported by Species (MMBF) | 79 | 9 | 23 | 3 |

Table A-18. 1990 Hardwood Lumber Species Use.

| Species | MMBF Used | % of Total |
|---------------|-----------|------------|
| Red Oak | 707 | 30% |
| White Oak | 376 | 16% |
| Yellow Poplar | 247 | 11% |
| Soft Maple | 206 | 9% |
| Black Cherry | 168 | 7% |
| Hard Maple | 151 | 6% |
| Ash | 82 | 3% |
| Beech | 67 | 3% |
| Sap Gum | 52 | 2% |
| Mahogany | 52 | 2% |
| Hickory/Pecan | 49 | 2% |
| Yellow Birch | 31 | 1% |
| Alder | 30 | 1% |
| Elm | 21 | <1% |
| Black Walnut | 16 | <1% |
| Hackberry | 6 | <1% |
| Other | 86 | 4% |
| Total* | 2,347 | |

* Totals may be less than totals in previous tables because a few respondents did not provide a species breakdown.

Table A-19.

1990 Hardwood Lumber Species Use by Region.

| Species | Totals | Volume by Region (MMBF) | | | |
|-------------------|--------|-------------------------|-------|----------|------|
| | | North-east | South | Mid-west | West |
| Red Oak | 704 | 60 | 490 | 131 | 23 |
| White Oak | 376 | 7 | 349 | 19 | <1 |
| Yellow Poplar | 246 | <1 | 228 | 16 | 2 |
| Soft Maple | 205 | 26 | 107 | 70 | 2 |
| Black Cherry | 168 | 88 | 72 | 7 | 1 |
| Hard Maple | 148 | 42 | 48 | 56 | 2 |
| Ash | 82 | 8 | 52 | 21 | <1 |
| Beech | 68 | 10 | 6 | 51 | <1 |
| Sap Gum | 52 | 0 | 51 | <1 | 0 |
| Mahogany | 52 | 9 | 36 | 6 | <1 |
| Hickory/ Pecan | 49 | 0 | 48 | <1 | <1 |
| Yellow Birch | 30 | 23 | 1 | 5 | <1 |
| Alder | 30 | <1 | <1 | <1 | 29 |
| Elm | 21 | 0 | 3 | 18 | 0 |
| Black Walnut | 15 | 3 | 6 | 4 | 2 |
| Hackberry | 6 | <1 | 6 | 0 | <1 |
| Other | 86 | <1 | 71 | 14 | <1 |
| Totals* | 2338 | 278 | 1575 | 420 | 65 |

* Totals may be less than totals in previous tables because a few respondents did not provide a species and/or regional breakdown.

Table A-20.

1992 Hardwood Lumber Species Use.

| Species | MMBF Used | % of Total |
|----------------|------------------|-------------------|
| Red Oak | 777 | 32% |
| White Oak | 445 | 18% |
| Yellow Poplar | 249 | 10% |
| Black Cherry | 179 | 7% |
| Soft Maple | 170 | 7% |
| Hard Maple | 130 | 5% |
| Ash | 76 | 3% |
| Beech | 61 | 2% |
| Mahogany | 59 | 2% |
| Sap Gum | 58 | 2% |
| Hickory/Pecan | 50 | 2% |
| Yellow Birch | 43 | 2% |
| Alder | 39 | 2% |
| Black Walnut | 20 | 1% |
| Elm | 12 | <1% |
| Hackberry | 7 | <1% |
| Other | 87 | 4% |
| Total* | 2,462 | |

* Totals may be less than totals in previous tables because a few respondents did not provide a species breakdown.

Table A-21.

1992 Hardwood Lumber Species Use by Region.

| Species | Totals | Volume by Region (MMBF) | | | |
|-------------------|--------------|-------------------------|--------------|------------|-----------|
| | | North-east | South | Mid-west | West |
| Red Oak | 774 | 62 | 528 | 158 | 26 |
| White Oak | 445 | 3 | 409 | 30 | 3 |
| Yellow Poplar | 250 | 1 | 232 | 16 | <1 |
| Black Cherry | 177 | 88 | 79 | 9 | 1 |
| Soft Maple | 170 | 27 | 67 | 75 | <1 |
| Hard Maple | 127 | 45 | 52 | 29 | 1 |
| Ash | 76 | 9 | 57 | 9 | <1 |
| Beech | 61 | 11 | 6 | 44 | 0 |
| Mahogany | 59 | 6 | 45 | 7 | <1 |
| Sap Gum | 58 | 0 | 57 | <1 | 0 |
| Hickory/ Pecan | 50 | 0 | 49 | <1 | 0 |
| Yellow Birch | 43 | 2 | 26 | 14 | <1 |
| Alder | 39 | <1 | 1 | <1 | 37 |
| Black Walnut | 19 | 4 | 7 | 5 | 3 |
| Elm | 11 | 0 | 2 | 9 | 0 |
| Hackberry | 7 | <1 | 6 | <1 | 0 |
| Other | 87 | <1 | 70 | 16 | <1 |
| Totals* | 2,453 | 260 | 1,693 | 425 | 75 |

* Totals may be less than totals in previous tables because a few respondents did not provide a species and/or regional breakdown.

Table A-22. 95% Confidence Intervals* for Wood Household, Upholstered and Wood Office Furniture Material Use Estimates.

| Material | 1990 | | 1991 | | 1992 | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | Upper Limit | Lower Limit | Upper Limit | Lower Limit | Upper Limit | Lower Limit |
| Hardwood Lumber (MMBF) | 2,468 | 2,381 | 2,611 | 2,520 | 2,799 | 2,705 |
| Softwood Lumber (MMBF) | 874 | 805 | 873 | 807 | 921 | 854 |
| Particleboard (MMSF) | 1,354 | 1,164 | 1,362 | 1,173 | 1,278 | 1,108 |
| MDF (MMSF) | 256 | 241 | 251 | 235 | 225 | 211 |
| Hardboard (MMSF) | 135 | 115 | 135 | 127 | 144 | 136 |
| OSB/Softwood Plywood (MMSF) | 330 | 302 | 357 | 326 | 379 | 345 |

* These intervals should be interpreted as, there is a 95% probability that the true number is between the upper and lower limits given that the respondents perfectly represent the population and that the estimated coverage ratios are correct.

Table A-23. 95% Confidence Intervals* for Wood Household Furniture Material Use Estimates.

| Material | 1990 | | 1991 | | 1992 | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | Upper Limit | Lower Limit | Upper Limit | Lower Limit | Upper Limit | Lower Limit |
| Hardwood Lumber (MMBF) | 1,214 | 1,178 | 1,270 | 1,233 | 1,349 | 1,309 |
| Softwood Lumber (MMBF) | 776 | 712 | 774 | 712 | 805 | 743 |
| Particleboard (MMSF) | 1,220 | 1,038 | 1,218 | 1,039 | 1,120 | 958 |
| MDF (MMSF) | 219 | 205 | 214 | 199 | 183 | 170 |
| Hardboard (MMSF) | 77 | 72 | 80 | 75 | 88 | 83 |
| OSB/Softwood Plywood (MMSF) | 71 | 65 | 72 | 66 | 73 | 69 |

* These intervals should be interpreted as, there is a 95% probability that the true number is between the upper and lower limits given that the respondents perfectly represent the population and that the estimated coverage ratios are correct.

Table A-24. 95% Confidence Intervals* for Upholstered Furniture Material Use Estimates.

| Material | 1990 | | 1991 | | 1992 | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | Upper Limit | Lower Limit | Upper Limit | Lower Limit | Upper Limit | Lower Limit |
| Hardwood Lumber (MMBF) | 1,143 | 1,072 | 1,222 | 1,147 | 1,315 | 1,239 |
| Softwood Lumber (MMBF) | 67 | 62 | 74 | 68 | 91 | 84 |
| Particleboard (MMSF) | 51 | 49 | 54 | 52 | 61 | 58 |
| MDF (MMSF) | 20 | 18 | 20 | 18 | ** | ** |
| Hardboard (MMSF) | ** | ** | ** | ** | ** | ** |
| OSB/Softwood Plywood (MMSF) | 256 | 231 | 282 | 254 | 303 | 272 |

* These intervals should be interpreted as, there is a 95% probability that the true number is between the upper and lower limits given that the respondents perfectly represent the population and that the estimated coverage ratios are correct.

** Volumes are too small for meaningful confidence intervals.

Table A-25. 95% Confidence Intervals* for Wood Office Furniture Material Use Estimates.

| Material | 1990 | | 1991 | | 1992 | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | Upper Limit | Lower Limit | Upper Limit | Lower Limit | Upper Limit | Lower Limit |
| Hardwood Lumber (MMBF) | 123 | 118 | 132 | 127 | 149 | 143 |
| Softwood Lumber (MMBF) | 32 | 30 | 27 | 25 | 26 | 24 |
| Particleboard (MMSF) | 82 | 78 | 88 | 84 | 97 | 93 |
| MDF (MMSF) | 18 | 16 | 19 | 17 | ** | ** |
| Hardboard (MMSF) | 43 | 38 | 46 | 40 | 46 | 40 |
| OSB/Softwood Plywood (MMSF) | ** | ** | ** | ** | ** | ** |

* These intervals should be interpreted as, there is a 95% probability that the true number is between the upper and lower limits given that the respondents perfectly represent the population and that the estimated coverage ratios are correct.

** Volumes are too small for meaningful confidence intervals.

Wood Furniture Manufacturer Material Usage Survey



***Virginia Polytechnic Institute and State University
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Virginia Tech

Wood Furniture Manufacturer Material Usage Survey

This survey is intended to collect information from furniture manufacturers to help gain a better understanding of material usage in the wood furniture industry. If you are NOT responsible for ordering, purchasing or tracking WOOD MATERIALS please give this questionnaire to the person responsible for WOOD MATERIALS at your firm. **Thank you!**

1. Does your company produce wood furniture or wood-framed upholstered furniture?
(Please check one box)

No →

Yes
↓

Please return this questionnaire so we can remove your name from our mailing list. Just fold, staple and return. Postage is prepaid. (see back side) **Thank you!**

2. Please check the one factor your company is usually **LEAST** satisfied with when buying lumber. Please check for both hardwood and softwood if you buy both.

Hardwood Lumber Purchases

Softwood Lumber Purchases

- Lumber Quality
- Delivery Time
- Price
- Credit Terms
- Availability of Certain Species
- Other: _____
- We Are Satisfied

- Lumber Quality
- Delivery Time
- Price
- Credit Terms
- Availability of Certain Species
- Other: _____
- We Are Satisfied

3. For how many plants are you responsible for the ordering, purchasing or tracking of wood-based materials? (Please circle the proper number)

1 2 3 4 5 6 7 8 9 10 If more than 10 plants, please specify _____

4. What percentage of your company's 1990 furniture sales was in unfinished furniture?

_____ % in unfinished furniture

5. Please check your title or position.

- President/CEO
- Owner
- Plant/General Manager
- Purchasing Manager
- Vice President
- Other: _____

6. What percentage of your company's 1990 furniture sales was in each of the following categories? (Please indicate the percentage in each category.)

- _____ % Wood Household
- _____ % Wood Office
- _____ % Wood-Framed Upholstered
- _____ % Other

Total = 100%

7. Of the **SOFTWOOD LUMBER** your company used for furniture in 1990, what percentage was in each of the following species? What percentage of each species do you expect to use in 1992? (If you don't use softwood lumber, please go to the next question.)

| 1990 | 1992 |
|----------------------------|----------------------------|
| _____ % Southern Pine | _____ % Southern Pine |
| _____ % Eastern White Pine | _____ % Eastern White Pine |
| _____ % Western Pine | _____ % Western Pine |
| _____ % Radiata Pine | _____ % Radiata Pine |
| _____ % Other: _____ | _____ % Other: _____ |
| _____ % Other: _____ | _____ % Other: _____ |

Total = 100%

Total = 100%

8. Of the **HARDWOOD LUMBER** your company used for furniture in 1990, what percentage was in each of the following species? What percentage of each species do you expect to use in 1992? (If you don't use hardwood lumber, please go to the next question.)

| <u>1990</u> | | <u>1992</u> | |
|--------------|---------------|--------------|---------------|
| _____ % | Red Oak | _____ % | Red Oak |
| _____ % | Yellow Poplar | _____ % | Yellow Poplar |
| _____ % | White Oak | _____ % | White Oak |
| _____ % | Hard Maple | _____ % | Hard Maple |
| _____ % | Soft Maple | _____ % | Soft Maple |
| _____ % | Black Cherry | _____ % | Black Cherry |
| _____ % | Ash | _____ % | Ash |
| _____ % | Gum | _____ % | Gum |
| _____ % | Hickory/Pecan | _____ % | Hickory/Pecan |
| _____ % | Beech | _____ % | Beech |
| _____ % | Alder | _____ % | Alder |
| _____ % | Mahogany | _____ % | Mahogany |
| _____ % | Yellow Birch | _____ % | Yellow Birch |
| _____ % | Hackberry | _____ % | Hackberry |
| _____ % | Black Walnut | _____ % | Black Walnut |
| _____ % | Elm | _____ % | Elm |
| _____ % | Other | _____ % | Other |
| Total = 100% | | Total = 100% | |

9. Approximately, what percentage of the lumber you purchased in 1990 was from the following sources?

| <u>% of Hardwood Lumber</u> | | <u>% of Softwood Lumber</u> | |
|-----------------------------|-------------------------------|-----------------------------|-------------------------------|
| _____ % | Lumber Wholesaler/Distributor | _____ % | Lumber Wholesaler/Distributor |
| _____ % | Lumber Broker | _____ % | Lumber Broker |
| _____ % | Direct From Sawmill | _____ % | Direct From Sawmill |
| _____ % | Lumber Importer | _____ % | Lumber Importer |
| _____ % | Other: _____ | _____ % | Other: _____ |
| _____ % | Other: _____ | _____ % | Other: _____ |
| Total = 100% | | Total = 100% | |

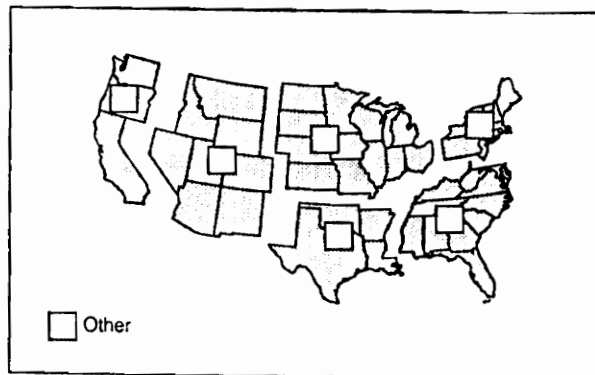
10. In a typical month, from how many suppliers (i.e., companies) do you purchase the following materials?

Hardwood Lumber - # of Suppliers _____
 Softwood Lumber - # of Suppliers _____
 Dimension Parts - # of Suppliers _____
 Particleboard - # of Suppliers _____

11. Please do your best to estimate the volumes of the following materials used by your firm to manufacture furniture in 1989 and 1990, and the approximate volumes you plan to use over the next two years. (If you do not have this data at your fingertips, would you please contact the person within your firm who can provide an estimate of this information. This data is very important to the success of this study. Thank you!)

| Material | Units | Do Not Use | 1989 | 1990 | 1991 | 1992 |
|---------------------------------|-------|--------------------------|-------|-------|-------|-------|
| Hardwood Lumber | MBF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Softwood Lumber | MBF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Particleboard | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Medium Density Fiberboard (MDF) | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Hardboard | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Oriented Strandboard | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Hardwood Plywood | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Softwood Plywood | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Dimension Parts | MBF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Dimension Parts | Piece | <input type="checkbox"/> | _____ | _____ | _____ | _____ |
| Veneer | MSF | <input type="checkbox"/> | _____ | _____ | _____ | _____ |

12. Please indicate the region where the majority of your firm's facilities are located. (Please check only a single region.)



18. How important are the following characteristics of hardwood lumber suppliers to your company? How much difference is there between suppliers?

| Hardwood Lumber Supplier Characteristics | Importance To Purchases | | | | | Difference Between Suppliers | | | | |
|--|----------------------------|---|------------------------|---|---|---------------------------------|---|-------------------|---|---|
| | No Importance | | Extremely Important | | | No Difference | | Big Difference | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supplier's ability to: | | | | | | | | | | |
| Provide Rapid Delivery | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Fill Large Orders | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Fill Small Orders | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Fill Orders Correctly | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Offer Long Term | | | | | | | | | | |
| Price Arrangements | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Arrange Credit | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Arrange Shipping | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Tally Package Correctly | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supply Mixed Loads | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Ship When Promised | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Kiln Dry Lumber | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Surface Lumber | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Quote Competitive Price | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Quote Firm Prices | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Offer Variety of Species | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Answer Questions Promptly | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Provide Special Sizes/Sorts | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Provide Custom Grades | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Provide Technical Information | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Quickly Resolve Disputes | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Provide Consistent Product; Load to Load | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Personal Relationship With Supplier | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supplier's Knowledge of Their Product | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supplier's Knowledge of Your Production Needs | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supplier's Reputation | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Supplier's Candidness | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

19. What percentage of your company's 1990 furniture sales was in RTA furniture?

_____ % RTA furniture

20. What was your company's total sales of furniture in 1990? \$ _____

13. What was the average number of people employed in your firm's furniture operations during 1990?

_____ Full-time employees

14. How important are the following lumber characteristics to your company? How much do they differ between suppliers? (Please circle the appropriate number.)

| Hardwood Lumber Characteristics | Importance To Purchases | | | | | Difference Between Suppliers | | | | |
|---------------------------------|-------------------------|---|---|---|---|------------------------------|---|---------------|---|----------------|
| | No Importance | | | | | Extremely Important | | No Difference | | Big Difference |
| | ▼ | | | | ▼ | ▼ | | | | ▼ |
| Absence of: | | | | | | | | | | |
| Chipped Grain | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Surface Checks | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| End Splits | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Wane | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Warp, Crook, and Bow | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Stain | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Presence of: | | | | | | | | | | |
| End Coating | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Square Edges | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Square End Trimming | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Desirable Width Mix | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Accuracy of: | | | | | | | | | | |
| Grading | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Moisture Content | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Machining | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Packaging: | | | | | | | | | | |
| Stacking of Pack | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Cleanliness | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Protective Wrapping | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

15. Does your company have dry kiln facilities?

No Yes → What % of your dry lumber needs are met by your own kilns? ____%

16. Does your company have facilities to surface (blank) lumber?

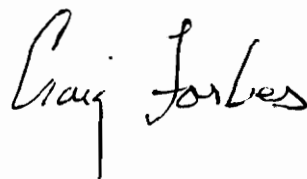
No Yes

17. How have your board feet purchases of green hardwood lumber changed over the past 5 years?

Increased, by how much? ____% No Change
 Decreased, by how much? ____% Don't Buy Green Lumber

Vita

Craig Lloyd Forbes, son of Samuel and Gwendolyn Forbes, was born in Norfolk, Virginia on November 18, 1963. In December 1987, Mr. Forbes received a Bachelor of Science degree in Wood Science and Technology from North Carolina State University. With some previous experience in the lumber manufacturing industry before completion of the Bachelor of Science degree (J.W. Jones Lumber Company, Inc), Mr. Forbes continued his career by accepting a position in lumber sales (Jerry G. Williams & Sons, Inc.). Eventually Mr. Forbes achieved a sales manager position. In August 1990, Mr. Forbes accepted a position as graduate research assistant at Virginia Polytechnic Institute and State University. Mr. Forbes will receive a Masters of Science degree in Forest Products in April of 1992 and intends to pursue a Doctor of Philosophy degree, also in Forest Products.

A handwritten signature in black ink that reads "Craig Forbes". The signature is written in a cursive style with a large initial "C" and a distinct "F".