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**MATERIAL USE, PRODUCT PROFILE AND CHANNELS OF DISTRIBUTION
IN THE U.S. WOOD FURNITURE INDUSTRY**

by

Christopher John Meyer

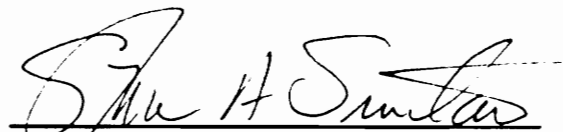
Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Forest Products

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January, 1991

Blacksburg, Virginia

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by

Christopher J. Meyer

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(ABSTRACT)

U.S. manufacturers of wood household (SIC 2511), upholstered household (SIC 2512) and wood office furniture (SIC 2521) were surveyed to assess wood materials use within these three industry segments. The final sample frame contained 5,016 manufacturing locations. This investigation also provides a profile of the types of products produced and the channels of distribution used to move these products to the final consumer from a second sample of 347 manufacturers of wood household furniture.

In 1989 the three industry segments surveyed consumed an estimated 2.3 billion board feet of hardwood lumber, 865 million board feet of softwood lumber, 1.3 billion square feet of particleboard (3/4" basis), and 370 million square feet of medium density fiberboard (3/4" basis). Further, an estimated 268 million square feet of softwood plywood (3/8" basis), 1025 million square feet of veneer and 310 million board feet of dimension stock were used in 1989 to produce wood furniture within the three industry segments examined.

Within the second sample containing solely manufacturers of wood household furniture, solid hardwood furniture was most commonly produced. Over 50% of the responding companies manufactured bedroom, dining room and occasional furniture. Responses regarding the volumes of furniture shipped

through channel intermediaries revealed over 60% of sales were through manufacturer's representatives to retailers and wholesalers. Weighted by company sales, the largest volumes of wood household furniture were sold through free-standing furniture stores (28.9% of respondent's sales) and manufacturer's own stores (23.4%).

ACKNOWLEDGMENTS

In that no man is an island, no research project can become a success without the help of many people. I wish to first thank the Lord for his never ending comfort and guidance and then the following people whom without their help this project could not have been a success:

My parents, John and Elinor Meyer and my brother Greg, for their patience and care.

Dr. S.A. Sinclair, for his advice and support throughout this research project.

Judd Michaels and "Jo", for their fervent assistance and dedication to the success of this project.

Dr. J.R. Loferski and Dr. N.M Klein of my committee, for their guidance and suggestions.

The sponsors of this project, especially Sue Regan and the staff at the Hardwood Manufacturers Association and Bill Luppold at the U.S. Forest Service.

Philip Araman of the U.S. Forest Service, for his useful supply of secondary information.

Dean Kirstein and all those at Virginia Tech User Services, for their help with trouble shooting the mainframe.

The Virginia Tech Statistical Consulting Group, for providing insightful techniques for improving the methods of data analysis.

The faculty, staff and graduate students at the Brooks Forest Products Center, for all their assistance, especially in assuring the timely mailing of the large volume of survey questionnaires.

PREFACE

The organization of the thesis includes a Literature Review, Methodology, two articles prepared for submission to the Forest Products Journal, and an Appendix. Although the information found in the Methodology section is similar to that in the articles, the Methodology section includes additional information to guide future efforts to replicate this study. The tables in Appendix B provide a synopsis of all the material use data gathered in this study, including information not found in the material use article.

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PROBLEM STATEMENT

The U.S. wood furniture industry is the major end-user of high-value hardwood lumber and an important market for softwood lumber, hardwood dimension, particleboard, hardboard, medium density fiberboard and a number of other wood products (Luppold 1988). Producers of these products depend on current and future estimates of demand within major end-use markets to help guide their business plans. The U.S. government also mandates the collection of material use estimates to track the demand for the nation's forest resources. Many of these estimates are used to direct government funding for timber management. Much of what is currently available on material use by the wood furniture industry, however, is either out of date, disputed by industry experts or both.

Census data on material use is only available in detail every five years and the data is generally not published for at least three years after it is gathered. Even then, researchers spend a great amount of time attempting to interpret and validate the results (Luppold 1990). In addition, no data currently exists on material use predictions gathered from a broad sample of furniture manufacturers.

Limited information pertaining to the types of products manufactured by the wood furniture industry is available through Census, but little to no current data concerning channels of distribution is commercially available. Again with the limitations on the availability and interpretability of the available data, there is a need for current information regarding the types of products and channels of distribution used in the U.S. wood furniture industry. This study first concentrated on estimating material use volumes for ten major wood products in the three largest wood furniture segments, the wood household, upholstered

household and wood office furniture industries; and second, on profiling the products and channels of distribution in the largest wood utilizing furniture segment, the wood household furniture industry.

OBJECTIVES

The primary objective of this study was to develop a data base on wood materials use in the U.S. furniture industry. Specific objectives include:

1. To estimate the volumes of ten major wood materials used for the manufacture of wood household, upholstered household and wood office furniture in 1989.
2. To segment the market and identify differences and similarities in wood materials use between and among U.S. wood household, upholstered and wood office furniture manufacturers and between geographic regions.
3. To produce a profile of the products and channels of distribution within the U.S. wood household furniture industry.

LITERATURE REVIEW

U.S. Furniture Industry

The U.S. furniture industry as a whole is a major end-use market for hardwood lumber, particleboard and other wood and wood-based products. Broken down into more defined segments the industry is first classified according to end use, then by the type of material used for constructing furniture (USDC-ITA 1985). The major end-use segments include household, office, and public building furniture, which are then further segmented into the categories of wood, upholstered, and metal (USDC-ITA 1985). For the purpose of this study, material usage trends will be examined for three major furniture industry segments utilizing wood and wood-based materials, including the wood household, upholstered household and wood office furniture industries.

Wood Household Furniture

The U.S. wood household furniture industry (SIC 2511) produces mainly living room, dining room, and bedroom furniture (USDC-ITA 1985), including juvenile and outdoor furniture (Balchen 1984). The major material inputs used in the manufacture of wood household furniture are hardwood lumber, softwood lumber, particleboard, medium-density fiberboard, and hardboard. Due to the accessibility of these materials, along with the inexpensive and plentiful labor supply, wood furniture producers are most advantageously located in the Southeastern region of the United States. North Carolina has been the leading state in terms of production for the past three to four decades (USDC-ITA 1985).

Recent statistics from the Census of Manufactures show that the U.S.

production of wood household furniture is widely dispersed among many small manufacturers. Approximately 70% of the 2,910 establishments producing wood household furniture in 1987 had fewer than 20 employees (USDC-BOC 1987). From 1977 to 1987, the total number of firms decreased 2.4% from 2,982 to 2,291 and the number of firms with 20 or more employees increased 5% from 815 to 857. The total number of employees decreased, however, by 4%, where production workers experienced the largest decrease of about 5%, from 124,600 in 1977 to 118,400 in 1987 (USDC-BOC 1987). With fewer firms and fewer total employees, industry sales in the wood household furniture industry have climbed sharply. Figure 1 shows that the value of shipments for wood household furniture nearly tripled between 1972 and 1987 from \$2,870.0 to \$7,929.3 million (USDC-BOC 1987).

Upholstered Household Furniture

The upholstered household furniture (SIC 2512) industry primarily produces sofas, love seats, couches, motion chairs (i.e., recliners), and all other upholstered furniture. The major materials used in the manufacture of upholstered furniture include upholstery, padding (ie, polyester and polyurethane foam), and parts (plastic, metal and wood, in the forms of hardwood dimension and hardwood and softwood lumber and plywood) (ITA 1984; ITA 1985).

Although less geographically concentrated than the wood household furniture industry, the major portion of the upholstered industry is located in the Southeastern United States. Due to the high weight-to-volume ratio of upholstered furniture, high shipping costs have lead to a scattering of firms throughout the U.S. Approximately 1,142 establishments shipped \$5,247.7 million worth of

upholstered furniture in 1987 (USDC-BOC 1987). This represented an increase of 56% from \$2,931 million shipped in 1977 (USDC-BOC 1987). As with the wood household furniture industry, the growth in the dollar volume of shipments increased with a decreasing number of establishments and employees. The total number of employees decreased 8.5% from 1977 to 1987, while again production workers experienced the largest drop in employment (approximately 8.9%) (USDC-BOC 1987).

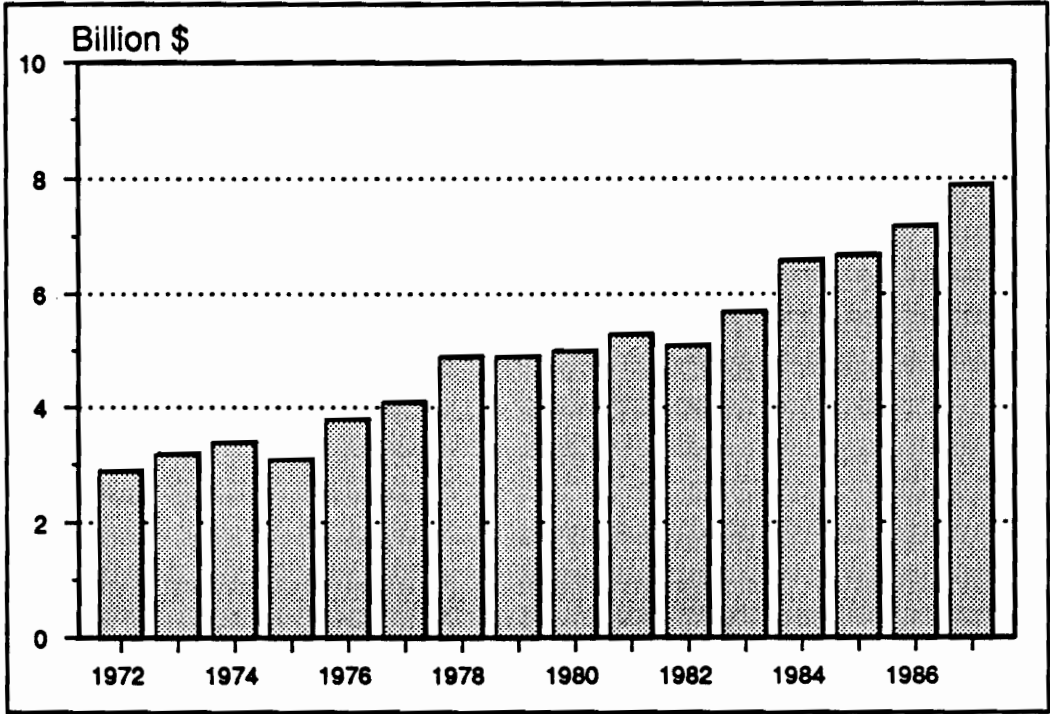


Figure 1. Value of shipments for wood household furniture from 1972 to 1987.

Source: USDC-BOC 1987

Where the wood household furniture industry is experiencing a larger growth in the greater than 20 employees per company category, the upholstered household furniture industry is growing in the less than 20 employees category. Again, however, this segment is shrinking in overall number of establishments and employees. Between 1977 and 1987, the total number of upholstered household furniture establishments fell 22%, from 1,473 to 1,142 (USDC-BOC 1987). Among these firms, 730 operated with 20 or more employees in 1977. However, only 571 establishments operated with 20 or more employees in 1987, representing a 27.8% decrease from the level in 1977. Over this 10 year period, the total number of employees decreased 8.5%.

Among all three SIC codes in this study, upholstered household furniture has the highest and fastest growing level of productivity. Between 1980 to 1984, the productivity indexes for upholstered household furniture increased 19.5%, wood household increased 7.3%, and wood office furniture actually decreased 13.5% (Herman 1987).

Wood Office Furniture

The wood office furniture industry (SIC 2521) produces wood seating, desks and extensions, storage units, and panel/modular systems (ITA 1985). The major materials used to produce wood office furniture include hardwoods (in the form of both lumber and veneer), particleboard, medium density fiberboard, and cabinet hardware.

The total dollar value of shipments in 1977 was \$1,087.4 million, but the industry has experienced phenomenal growth over the past decade, with the value of shipments rising to over \$2,086 million by 1987 (USDC-BOC 1987b). There has

also been a general trend towards greater wood material use in office furniture. From 1972 to 1987, the share of office furniture comprised of wood increased from 20% to nearly 26% (Garet and Kaufman 1988).

Material Use

Prior to the 1950's and up to the present time, hardwood lumber has been the largest material cost for manufacturers of wood furniture. Luppold (1987) estimated that in 1982 18% of wood household furniture manufacturer's materials costs were for the purchase of hardwood lumber. Among four of the largest wood material inputs for the manufacture of household furniture, hardwood dimension, softwood lumber, particleboard, and hardwood veneer were responsible for only 9%, 7%, 5%, and 5% of the total material costs, respectively (Figure 2). Over the past few decades, however, many other wood materials have become increasingly important in the manufacture of furniture.

The Census Bureau first reported consumption of composite panels in 1958. This was marked by the introduction of particleboard, used as an alternative substrate for core materials in furniture tops and sides. Approximately a decade later, high density fiberboard (or hardboard) was accepted as an alternative to thin veneer core hardwood plywood, used in drawer bottoms, dust bottoms, and chest backs in lower and middle-priced furniture. This is still commonly used today with the application of vinyl overlays, although to a lesser extent since the adoption of a third composite panel, medium density fiberboard (MDF). Introduced in the mid 1970's, MDF has been used in place of solid wood, hardwood plywood, particleboard, and hardboard specifically in drawer bottoms and chest backs at the lower price points.

Few sources are available publicly, or even privately, that provide estimates of the extent and magnitude of increased material usage in the wood furniture industry. The sources that are available, however, were consulted and used to construct the discussion in this section on material usage trends in the wood furniture industry.

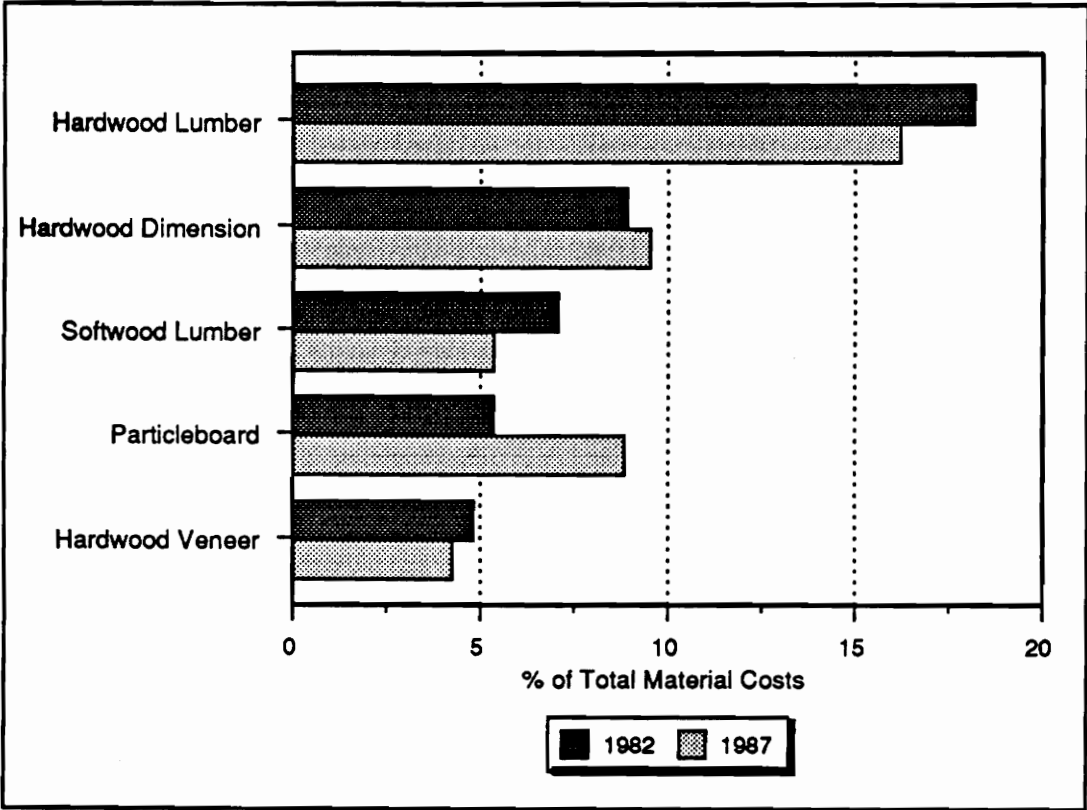


Figure 2. Percentage of material costs for five predominant material inputs for the production of wood household furniture in 1982 and 1987.

Source: USDC-BOC 1989

Luppold (1987) indicated two major trends in wood materials usage in the wood furniture industry over the past few decades. From 1963 to 1972, the proportion of material costs for hardwood materials (i.e., hardwood lumber, veneer, and plywood) decreased, as Luppold estimated, by nearly 30%. At the same time, the proportion of material costs for other wood products such as softwood lumber, particleboard, fiberboard, and medium density fiberboard increased 300%. Between 1972 and 1982, again hardwood material usage decreased by about 7%, while softwood lumber (14% increase) and other substitute materials usages were still climbing (Luppold 1987).

Published every fifth year ending in 2 and 7, Census of Manufacturers reports provide total costs for materials consumed by kind for all major manufacturing industries. Between 1972 and 1987, the total cost for materials and supplies (excluding materials and supplies, n.s.k)¹ within the wood household, household upholstered and wood office furniture industries increased dramatically from \$2,026.1 million to \$5,192.0 million (USDC-BOC 1977a, 1977b, 1987a, 1987b). Material costs for hardwood lumber (rough and dressed) increased, however, from \$290.9 million to only \$587.4 million (Figure 3). Actual material volumes given in the Census of Manufacturers reports are inconsistent and incomplete, and therefore are not provided here. However, referring to another published source of estimates on material use volumes, Cardellichio and Binkley (1984) found that, when accounting for the growth in the furniture industry, between 1950 to 1980, hardwood lumber consumption in the furniture industry increased by about 25%,

¹Total cost of materials for establishments that did not report detailed materials data.

from approximately 1,800 MMBF to 2,250 MMBF.

Census data show that material costs incurred by the furniture industry for eight major wood and wood-based materials other than hardwood lumber have all increased between 1972 and 1987. These materials, given in the Census of Manufacturers, include: hardwood plywood, hardwood dimension, hardwood veneer, softwood lumber, softwood plywood, particleboard, hardboard, and medium density fiberboard (MDF) (estimated for only 1977 through 1987). The largest increases included particleboard (\$204.0 million in delivered costs), hardwood dimension (\$140.8 million) and hardwood veneer (\$109.8 million) (Figure 3).

While the delivered costs for each of the materials included in the Census of Manufacturers has increased, primarily due to the growth in the overall furniture industry, a comparison of relative market shares for these materials indicates declining relative usage for six of the nine materials (Figure 4). The materials with increasing market shares included particleboard, hardwood veneer and medium density fiberboard.

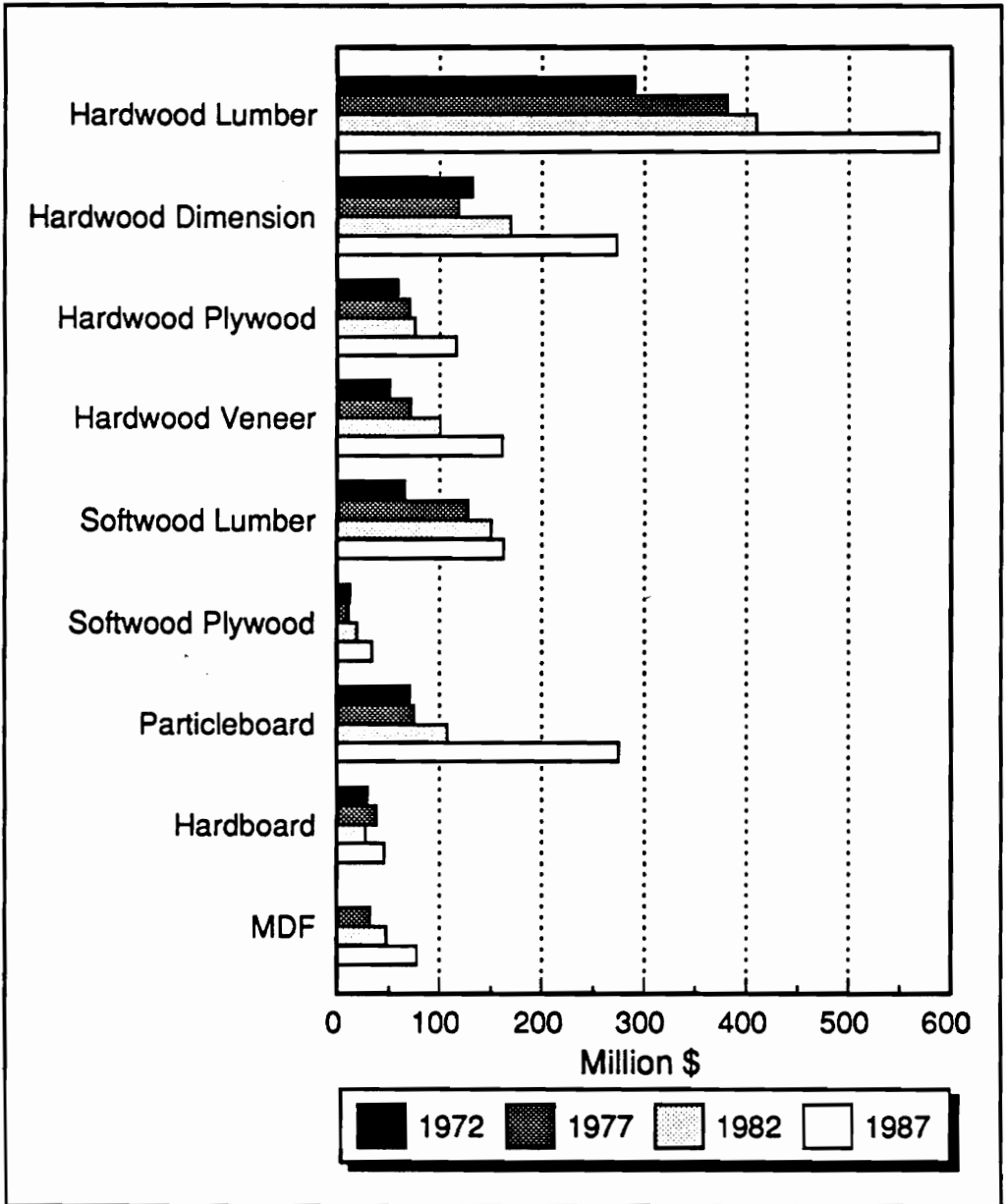


Figure 3. Delivered costs for nine major wood and wood-based materials used to manufacture furniture - 1972 to 1987.

Source: USDC-BOC 1977a, 1977b, 1987a, 1987b

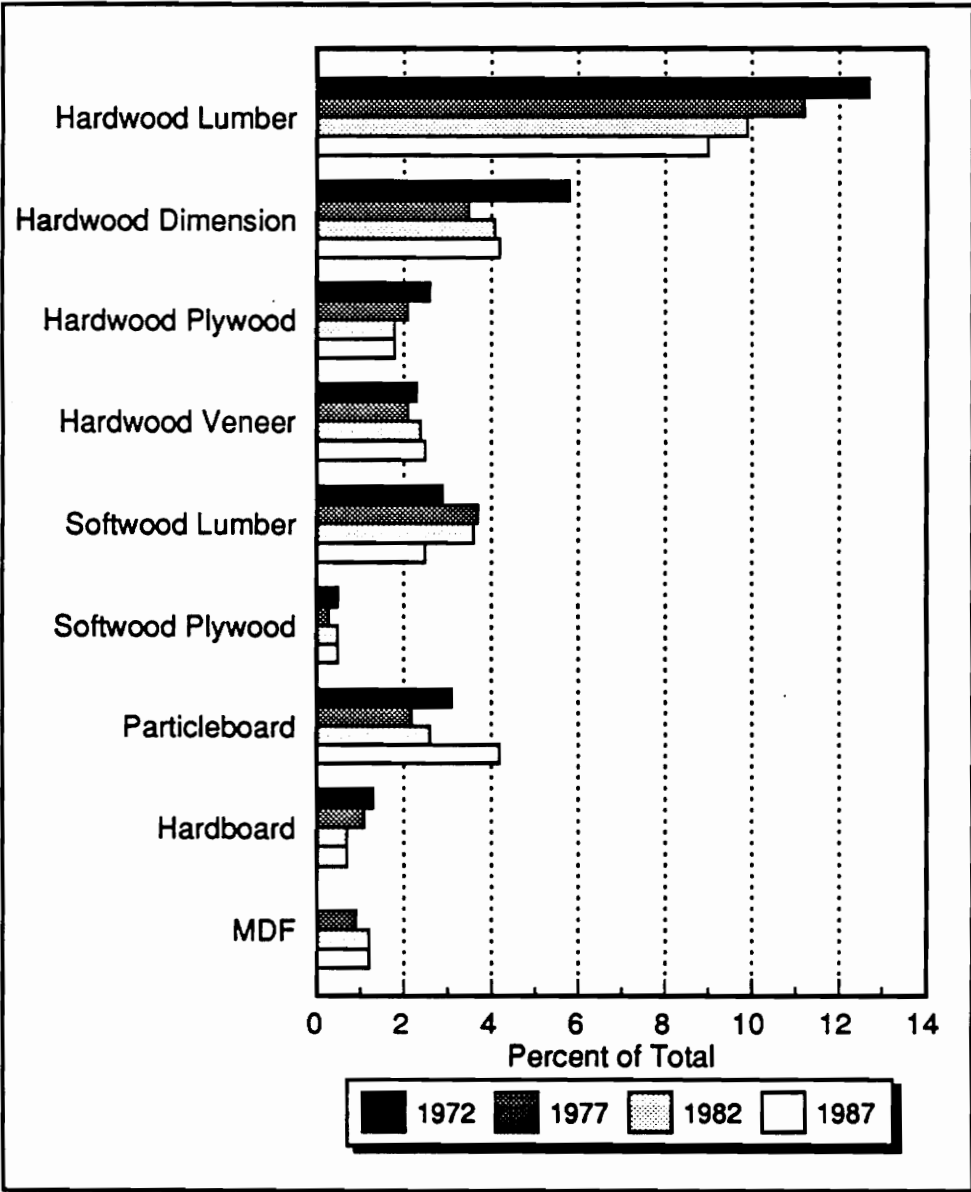


Figure 4. Percentages of total material costs for nine major wood and wood-based materials used to manufacture furniture - 1972 to 1987.

Source: USDC-BOC 1977a, 1977b, 1987a, 1987b

In the commercial and institutional furniture industry, softwood lumber has taken a particularly large share of the market from hardwood lumber. While softwood lumber contributed only 30% of the total lumber used in 1965, usage jumped to nearly 49% by 1982 (McKeever 1985; Haynes 1989). Due to a 127.9% increase in the constant value of commercial and institutional furniture shipments, however, between 1965 and 1986, it was suspected that the loss in market share did not drastically affect the overall consumption rate of hardwood lumber (Haynes 1989).

Figure 5 shows the percentage of dollars spent on various panel products in the wood furniture industry between 1954 and 1982. Hardwood veneer and

(%) 1967 Dollars

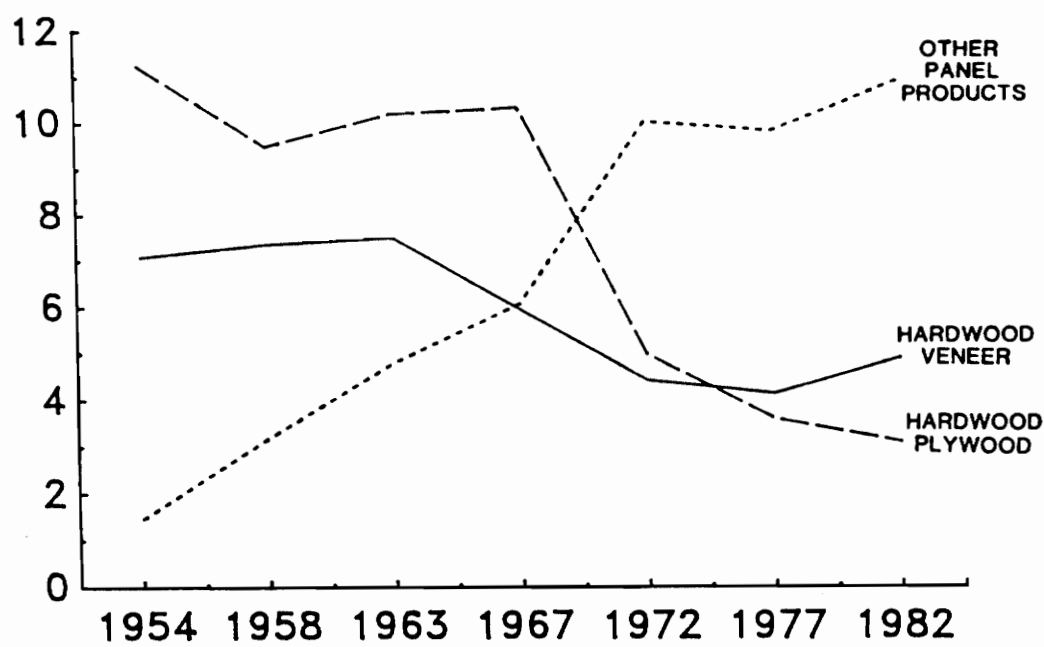


Figure 5. Percent of dollars spent in the wood furniture industry for hardwood veneer, plywood and other panel products over time.

Source: Luppold 1987

plywood accounted for over 18% of the dollars spent in 1954 (in 1967 dollars) but decreased to approximately 8% by 1982. During this same period, the consumption of other panel products increased from about 1% to 11% of the total dollars spent on wood furniture materials.

Spelter, Stone and McKeever (1978) compared material usage factors from 1960 to 1972 using information gathered from USDA Forest Service surveys, Census of Manufacturers and industry data. From 1960 to 1972, the use of hardwood lumber per production index decreased nearly 20%. The index of material usage for hardwood veneer and softwood lumber also decreased approximately 18% and 2% respectively. The only materials whose use factors increased over this period were particleboard (566% increase), hardwood plywood (50% increase), and hardboard (33% increase). Following 1972, Spelter, Stone and McKeever (1978) believed that due to the consumer's preference at the time for traditional wood furniture, additional losses for hardwood lumber use in furniture were not likely. With the lack of up-to-date data on the furniture industry, the extent of the current substitution of wood materials in the manufacture of furniture is still unknown (Luppold 1987).

LITERATURE CITED

1. Balchen, A. S. 1984. Fairchild Fact File: Household Furniture and Bedding (Mattresses and Dual-Purpose Sleep Furniture) Market Research Division. Fairchild Publications, New York.
2. Cardellichio, P. A. and C. S. Binkley 1984. Hardwood Lumber Demand in the United States: 1950 to 1980. *Forest Products Journal* 34(2):15-22.
3. Garet, B. and E. Kaufman 1988. Office Furniture Companies Strong and Self-Assured. *Wood and Wood Products* 93(1):50-53.
4. Haynes, R. W. 1989. An Analysis of the Timber Situation in the United States: 1989-2040. USDA Forest Service. Part I: The Current Resource and Use Situation. p.43.
5. Herman, A. S. 1987. Productivity Gains Continued In Many Industries During 1985. *Monthly Labor Review* 110(4):48-52.
6. Luppold, W. G. 1987. Material Usage Trends in the Wood Household Furniture Industry. USDA Forest Service. Northeastern Forest Experiment Station NE-RP-600.
7. Luppold, W. G. 1988. Material-Use Trends in U.S. Furniture Manufacturing. *Southern Journal of Applied Forestry* 12(2):102-107.
8. Luppold, W. G. 1990. Shifting Demand for Eastern Hardwood Lumber. *Proceedings of Hardwood Forest Products Opportunities: Creating and Expanding Businesses*. Pennsylvania Department of Commerce.
9. McKeever, D. B. 1985. Wood Products Used by U.S. Furniture, Fixtures and Architectural Woodwork Manufacturers. *Furniture Design and Manufacturing* 57(13).
10. Spelter, H., Stone, R. N. and D. B. McKeever 1978. Wood Usage Trends In The Furniture and Fixtures Industry. Research Note FPL-0239. Forest Products Laboratory. USDA Forest Service, Madison, WIS.
11. USDC-BOC. 1977a. Census of Manufacturers. Household Furniture. Industry Series MC77-I-25A. United States Department of Commerce, Bureau of the Census, Washington, D.C.
12. USDC-BOC. 1987a. Census of Manufacturers. Household Furniture. Series MC87-I-25A(P). United States Department of Commerce, Bureau of the Census, Washington, D.C.

13. USDC-BOC. 1977b. Census of Manufacturers. Office, Public Building, and Miscellaneous Furniture; Office and Store Fixtures. Industry Series MC77-I-25b. United States Department of Commerce, Bureau of the Census, Washington, D.C.
14. USDC-BOC. 1987b. Census of Manufacturers. Office, Public Building, and Miscellaneous Furniture; Office and Store Fixtures. Series MC87-I-25b(P). United States Department of Commerce, Bureau of the Census, Washington, D.C.
15. USDC-ITA. 1984. A Competitive Assessment of the U.S. Wood and Upholstered Furniture Industry. International Trade Administration, Washington, D.C.
16. USDC-ITA. 1985. A Competitive Assessment of the U.S. Wood and Upholstered Furniture Industry. International Trade Administration, Washington, D.C.

METHODOLOGY

Literature Review

In order to insure that all previous research had been identified, an extensive literature review was undertaken. The following computerized retrieval systems were used to secure all relevant publications: ABI/INFORM, a business database containing abstracts and indexing to business articles from over 800 business and management journals; AGRICOLA (Agricultural Online Access), an extensive online source of citations to agricultural literature acquired by the National Agricultural Library and cooperating institutions; NTIS (National Technical Information Service), a clearing house for scientific, technical and engineering information within the U.S. Department of Commerce; and InfoTrac, an information database consisting of approximately 1100 general interest and scholarly publications. In addition, prominent trade associations, key government agencies (U.S. Forest Service; U.S. Bureau of the Census), and relevant market research agencies (American Furniture Manufacturers Association; Wheat First Securities) were consulted for pertinent secondary information.

Sample Design

To aid development of the sample design, a preliminary research instrument was first pretested with a group of potential respondents.

Pretest

Following the guidelines proposed by Churchill (1987), two individual pretests were administered. Personal interviews of high level marketing personnel within the furniture industry were first used for pretesting. A small group of

representatives from a subset of wood furniture manufacturers was selected to fill out the questionnaire with an interviewer present. Even though respondents had difficulty culminating a satisfactory amount of the material use data, personal interview results indicated the questionnaire was easy to read and understand.

As a second pretest, a revised mail survey was sent to a random sample of 50 geographically dispersed wood furniture manufacturers. To increase response rates, each potential respondent was contacted by telephone to inform them of the mailing. Follow-up letters were sent approximately one week after the questionnaires were mailed. The final response rate was 62%.

Results from the mail survey pretest indicated, even with improvements in questionnaire design, that marketing personnel were unable to satisfactorily provide material use data. It was equally clear that persons in charge of purchasing would not be able to adequately provide the necessary marketing information, and a few telephone calls to wood furniture raw materials purchasing agents confirmed this. Therefore, to meet the need for both material use and marketing related information, two separate questionnaires were developed.

The first survey was addressed to persons in charge of purchasing wood materials for the manufacture of furniture and the second was addressed to high level marketing representatives within the wood furniture industry. Because of the economics involved in mailing two large national surveys, the second survey was sent to a separate, smaller sample of manufacturers. Sample designs for the two surveys are outlined below.

Material Use

The population for this survey consisted of U.S. manufacturers of wood household, upholstered and wood office furniture (SIC 2511, 2512, 2521). Based on numbers from the 1987 Census of Manufactures there were the following populations of establishments for each segment in 1987.

Wood Household Furniture (SIC 2511)	2,910
Upholstered Household Furniture (SIC 2512)	1,142
Wood Office Furniture (SIC 2521)	<u>640</u>
Total Establishments	4,692

This total is much lower than most commercial mailing lists report. Various mailing list companies cited total populations of 6217 (Zeller), 4789 (American Business Lists), and 9834 (Dun's Marketing).

Discrepancies between the available sources of industry size were based primarily on the method of data collection. The final source chosen for this study was determined by finding the method which included the greatest number of firms and incurred the least amount of bias towards any particular segment of the industry. Both Zeller and American Business Lists were derived from yellow page listings. Yellow page listings tend to be non-inclusive of the entire industry, being biased toward the smaller manufacturers.

Census data, again, does not include the entire industry, being biased towards larger firms. All establishments with greater than 20 employees are mailed report forms from the government, while those with less than 5 employees are generally not included. In industries with a large number of small establishments, such as the furniture industry, abbreviated or "short" forms are sent to many of the

smaller manufacturers. These forms do not include material costs or volumes. Considering that the greatest percentage of U.S. furniture manufacturers have 20 employees or less, a large percentage of the industry is therefore excluded from the census figures.

The most inclusive mailing list attainable was from the Dun's Marketing. This list included firms with one or more employees, including both primary and secondary manufacturers.² For industry representativeness and minimization of bias, Dun's mailing list contained a sample of the population of all three SIC categories.

The mailing list purchased for this sample frame included the 500 largest (by number of employees) furniture manufacturing sites in the U.S. for the three SIC codes. The sample population also included every second manufacturer from the remainder of the total population of 9,834. The final sample consisted of 5167 manufacturing locations.

Once the mailing list was received it was thoroughly checked for errors such as incorrect names and addresses. To further clean the list, phone calls were made to the companies with more than one location listed to check for and eliminate double counting. For those companies found to have a central buying office, all facilities whose materials would be purchased by the central buying office were deleted from the list and only the central buying office was retained. Respondent names and plant addresses were also double checked in a special effort to insure that the proper person at each location was contacted. After the process of cleaning the list

²Primary line of business is that defined by the appropriate SIC code. Secondary manufacturers produce the materials defined by the appropriate SIC code, but their business is defined under a different SIC code.

was completed, 5016 addresses remained.

Marketing

The population for this survey consisted of U.S. manufacturers of wood household furniture (SIC 2511). One hundred percent of these furniture manufacturers listed in the Miller Freeman 1989 Secondary Wood Products Manufacturers Directory were sampled (Pease 1989). The final sample frame consisted of 347 manufacturers.

Data Collection

Because they are the most efficient and cost effective method of securing data from geographically dispersed populations, mail surveys served as the primary vehicles for data collection (Dillman 1978).

Material Use Survey

The final survey instrument was mailed in April 1990. By this time, the manufacturers had totaled their material use figures from 1989. To eliminate possible duplicates (i.e., double counting of materials used by the same facility), potential respondents were chosen and contacted at the plant level. However, responses for a small number of very large firms were obtained through their central buying offices.

Enclosed with the surveys, addressed to the target person at each location, were a personalized cover letter and a wooden nickel (an added gift to stimulate response). To further stimulate response, the return mailing of the survey instrument was post-paid.

Other efforts were also made to assure high response rates. A follow-up

postcard with a hand-written signature reminding recipients to return their survey was mailed to each manufacturer one week after the initial surveys were mailed. Due to the large number of manufacturers with less than 10 employees responding to the first wave of the mailing, their representation was sufficient to refrain from mailing to them a second time. All facilities with 10 or more employees which did not respond within the first three weeks were mailed a second questionnaire. Approximately one week after the second questionnaires were sent a second wave of reminder postcards was mailed to all nonrespondents.

To assure high response rates among the largest plants, telephone calls were made to nonrespondents within the top 100 largest plants (by number of employees) to personally ask them for the return of their survey. Special efforts were also made to contact persons within each central buying office to assure that they had received a survey and to ask for their response. These calls were made during the week following the second survey mailing. Finally, a third survey and cover letter were sent to the remaining nonrespondents from the largest 500 manufacturing locations approximately three weeks following the second mailing.

Marketing Survey

The marketing survey was also mailed in April 1990. Included in the packets containing the surveys were personalized cover letters and specialized ball point pens. Follow-up postcards were mailed one week after the surveys were sent. In order to further increase the response rate, a second wave of personalized cover letters and surveys was mailed approximately three weeks after the initial mailing. Within a week following this second mail-out of surveys a second follow-up postcard was mailed to those who had not responded by the third week.

Data Analysis

Data from the material use and marketing surveys were coded on a mainframe computer. The data were checked for outliers and inconsistencies, prior to the final analysis, by examining frequencies, means and the actual raw data. Final analyses for both data sets were conducted on mainframe SPSS-X (Statistical Package for the Social Sciences) (SPSS-X 1988).

Literature Cited

1. Churchill, G. A. 1987. Marketing Research Methodological Foundations. Fourth Edition. The Dryden Press.
2. Dillman, D. A. 1978. Mail and Telephone Surveys: The Total Design Method. John Wiley and Sons, New York.
3. Pease, D. A. 1989. 1989 Secondary Wood Products Manufacturers Directory. Miller Freeman Publications, Inc. San Francisco.
4. SPSS-X User's Guide Third Edition. 1988. SPSS, Inc. 444 N. Michigan Avenue, Chicago, IL. 60611

**The U.S. Wood Furniture Industry: An Assessment of
Wood Material Use**

A Manuscript Prepared for Submission to
Forest Products Journal.

Abstract

Wood household (SIC 2511), upholstered household (SIC 2512) and wood office (SIC 2521) furniture manufacturing locations were sampled to provide an assessment of wood materials use within these segments of the U.S. furniture industry. Total hardwood lumber used in 1989 was estimated at over 2.3 billion board feet. The estimated volume of hardwood material used easily exceeded 2.6 billion board feet when including dimension stock. Softwood lumber consumption was estimated at 865 million board feet. Over 1.3 billion square feet of particleboard (3/4" basis) were consumed in 1989 along with another 370 million square feet (3/4" basis) of medium density fiberboard. Additionally, estimates show that 268 million square feet of hardwood plywood (3/8" basis), nearly 193 million square feet of softwood plywood (3/8" basis), 1025 million square feet of veneer and 310 million board feet of dimension stock were consumed in 1989. Among the industry segments sampled, wood household furniture manufacturers consumed over 75% of the softwood lumber, particleboard, medium density fiberboard, dimension stock and veneer. The upholstered furniture segment used nearly 87% of the softwood plywood. By geographic region, the Southeast was the largest consumer of all wood materials, except for hardboard, hardwood plywood and softwood plywood. The most common hardwood species used by the industry segments was red oak, representing 27% of the hardwood used.

Introduction

The U.S. furniture industry is a major end user of many wood products. In fact, nearly 16% of the domestic production of hardwood lumber is consumed by the U.S. wood furniture industry (Luppold 1990). Within the wood household furniture segment alone, over \$226 million worth of particleboard, \$137.5 million worth of softwood lumber and \$109.6 million worth of hardwood veneer were consumed in 1987 (USDC-BOC 1987a). After 1987, however, estimates of the volumes of wood materials used within this major end-use market are unavailable.

Unfortunately, most of what is available on material use by the wood furniture industry is either out of date, disputed by industry experts or both. Census data on material usage is only available in detail every five years and the data is generally not published for at least three years after it is gathered. Even then, researchers spend a great amount of time attempting to interpret and validate the results (Luppold 1990).

Without timely and dependable estimates of current material use within the wood furniture industry, manufacturers of hardwood lumber, dimension parts, veneer, MDF, particleboard and other wood products are limited in their ability to predict the demand for their products within this major end-use market. And, government as well as private land owners and timber growers are limited in their ability to make accurate timber management decisions without information to help generate demand predictions for timber resources (Luppold 1987). In fact, according to the Renewable Natural Resources Planning Act of 1974, the U.S. government is required to have estimates of demand placed on the nation's forest resources.

When the importance of current data on material use to both private and government sectors is considered and the lack of available up-to-date information is noted, the need for gathering current material use data within major end-use industries (particularly wood furniture) is clear.

Material use

Lumber has traditionally been the most important raw material used for the manufacture of furniture. And, from the late 1920's up to 1947, the furniture industry placed increasing importance on the overall and relative use of lumber per unit of production. Between 1928 and 1947 lumber consumption in the total U.S. furniture industry increased from about 0.8 billion board feet to nearly 2.5 billion feet (Robinson 1965). After 1947, however, the use of lumber relative to production began to decrease. By 1960, the average piece of furniture contained only 58% of the lumber used in 1947. Substitute materials and changes in furniture styles were the main causes for decreasing lumber use per piece of furniture (Robinson 1965).

Spelter, Stone and McKeever (1978) compared the volumes of materials used per production index unit (PIU) (1967 = 1.0) from 1960 to 1972. Hardwood lumber use per PIU decreased 20% and hardwood veneer and softwood lumber decreased approximately 18% and 2%, respectively. In contrast, particleboard use per PIU increased 566%. Hardwood plywood and hardboard increased 50% and 33%, respectively. McKeever (1985) noticed shifting trends, however, towards the end of this time period. The use of hardwood lumber per unit of production continued decreasing between 1965 and 1977, but softwood lumber and hardwood veneer were becoming more important. The use of softwood lumber per unit of production

nearly doubled between 1965 and 1977 (McKeever 1985).

Between 1972 and 1987 the material costs for hardwood lumber within the wood household, upholstered and office furniture industries increased 6.1%, in 1972 constant dollars (USDC-BOC 1987a). Total costs for all materials and supplies (excluding materials and supplies, n.s.k)¹ increased 34.6% after inflation.

Census of Manufactures' data show that furniture manufacturers' material costs for six major wood and wood-based materials other than hardwood lumber also increased between 1972 and 1987 (USDC-BOC 1987a). After accounting for inflation, particleboard increased 103.5%, the most of any wood material, followed by hardwood veneer (64.3% increase) and softwood plywood (44.6% increase). Material costs for softwood lumber, hardwood dimension and hardwood plywood increased respectively, 29.4%, 8.5% and 1.7% in constant 1972 dollars. The material cost for hardboard decreased 17.3% after adjusting for inflation.

The unavailability of current and dependable material use data inhibits the reporting of material use estimates after 1987.

Methodology

Sample frame and sampling procedures

The population for this study consisted of individual manufacturing locations for wood household (SIC 2511), upholstered household (SIC 2512) and wood office (SIC 2521) furniture. The majority of commercial mailing lists reviewed were derived from yellow page listings. These lists often fail to include a large percentage of the industry and tend to be biased towards the smaller manufacturers. Numerous sources were researched to find the most comprehensive mailing list with a minimum of bias.

While the 1987 Census of Manufactures only had 4,692 establishments listed under the three industry segments, various commercial mailing lists cited populations of 6,217 (Zeller), 4,789 (American Business Lists), and 9,834 (Dun's Marketing). Zeller and American Business Lists, however, were both derived from yellow page listings, which are known to be biased towards smaller manufacturers. For its comprehensiveness and minimum bias towards manufacturer size, Dun's Marketing was selected to provide the final mailing list.

Manufacturing locations were ranked by number of employees, with the number of employees serving as a surrogate for material use. To assure better representation of larger material users, 100% of the top 500 (by number of employees) furniture manufacturing sites were drawn from the population. Thereafter, every second manufacturing site from the remainder of the total population of 9,834 within the U.S. was drawn from the three industry segments. The 5,164 selected manufacturing locations were thoroughly checked for bad addresses, locations out-of-business and duplicates (multiple manufacturing locations within a company or corporation reporting overlapping material volumes). The final sample frame contained 5,016 manufacturing locations.

Because it is the most efficient and cost effective method of securing data from such a geographically dispersed population as U.S. furniture manufacturers, a mail survey served as the primary data collection vehicle (Dillman 1978). The survey instrument (a questionnaire) was pretested with a select sample of furniture industry representatives. After revisions, additional interviews were conducted and the survey instrument was pilot tested on a random sample of 50 furniture manufacturer representatives. Scientists from the U.S. Forest Service, staff

members from the Hardwood Manufacturers Association and other industry executives also reviewed the questionnaire. The final survey instrument was mailed in April 1990. Various incentives and follow-up mailings were used to stimulate response.

Material volume estimating procedure

All respondents were categorized into one of four response categories based on the extent to which they were subject to repeat mailings, phone calls, etc. All 5,016 locations were arranged by number of employees and subjected to the measures shown below:

Group 1:	(Largest 100 locations)	3 survey mailings and phone calls
Group 2:	(Locations 101 to 500)	3 survey mailings
Group 3:	(Locations 501 to 2215)	2 survey mailings
Group 4:	(Locations 2216 to 5016)	1 survey mailing

A response rate adjusted for bad addresses, out of business firms, etc., was calculated for each category: group 1 (69%), group 2 (48%), group 3 (40%) and group 4 (17%). The volume reported by a manufacturing location in a group was then adjusted using the response rate of the group to reflect the total number of locations on the Dun's Marketing list in that group. For example, for a site in group 1 reporting 25 MMBF of hardwood lumber purchases:

$$25 \text{ MMBF} / .69 = 36.23 \text{ MMBF}$$

This location then represented 39.23 MMBF of the total material use estimate in group 1 (unadjusted for coverage ratio). For groups 3 and 4, where only one half of the sites on the Dun's Marketing list were sampled, the estimates were doubled.

The assumption at this point was that the Dun's Marketing list represented the

entire industry in SIC's 2511, 2512 and 2521. However, even Dun's Marketing recognized that their lists do not cover 100% of the industry. The estimates, therefore, had to be adjusted using an estimated coverage ratio. This was by necessity a judgment call, but based on information supplied by Dun's Marketing, our experience with their list and our knowledge of the industry we estimated a conservative 80% coverage ratio. All estimated volumes were then divided by .8 to reflect this.

Nonresponse bias

In any mail survey where people are free to choose to respond or not to respond, the potential exists for nonresponse bias. That is, those that responded may be different than those that did not respond thus making the data from the responding manufacturing locations not representative of the total industry. This is difficult and time consuming to check. However, it is generally believed that late responders are more like nonresponders, therefore one way to gauge nonresponse bias is to compare early survey responses to those responses that come in last (Fowler 1984). If strong differences are present, then this evidence points to potential nonresponse bias.

Early and late respondents' hardwood species use were compared for each material volume estimation group. Chi-square tests ² at the .05 level revealed no significant differences, which suggests that nonresponse bias was not present. Independent-samples t-tests ³ between early and late respondents' average material volumes for all materials for all four estimation groups were insignificant at the .05 level, again supporting the absence of nonresponse bias.

To provide further insight into uncovering the potential for nonresponse

bias, geographic regions and site sizes (based on the number of employees at each location) of respondents were compared with nonrespondents. No trends in manufacturer size or geographic region were found between respondents and nonrespondents, again providing no evidence of nonresponse bias.

Results

Respondents profile

With a majority of the manufacturing locations in the sample having 5 or fewer employees, it was expected that many of the responses would come from persons such as president or owner. In fact, over 68% of the respondents were either presidents or owners of their company. The remaining respondents had titles such as Plant Manager, General Manager, Purchasing Manager, Purchasing Agent and Vice President of Purchasing.

Six geographic regions, roughly following those used by Census, were utilized to allow for geographic segmentation (Figure 1). The Southeast had over 34% of the respondents and was followed by the Midwest (19.0%) and Northeast (17.3%). Of the remaining respondents, 16.6% were located in the West Coast region, 6.7% in the South Central, and another 6.2% in the West.

Material use estimates

Overall estimates

Table 1 provides 1989 material use estimates for wood household, upholstered household and wood office furniture. Total hardwood lumber purchased in 1989 is estimated at over 2.3 billion board feet. If dimension stock is included the estimated purchase volume exceeds 2.6 billion board feet. Total softwood lumber

consumption was 865 million board feet. In excess of 1.3 billion square feet of particleboard (3/4" basis) were consumed in 1989 along with another 370 million square feet (3/4" basis) of medium density fiberboard (MDF). Large amounts of hardwood plywood, softwood plywood, veneer and dimension stock were also consumed.

Industry segment estimates

Within the three furniture industry segments, wood household furniture accounted for over 75% of the softwood lumber, dimension stock, particleboard, MDF and veneer used (Table 1). The majority of the softwood plywood and oriented strandboard (OSB) was consumed by upholstered furniture manufacturers as frame stock. Compared to the wood household segment, wood office furniture consumed relatively minor quantities of wood materials.

Figure 2 shows that the wood household segment is the largest consumer of hardwood and softwood lumber among the three industry segments, representing nearly 64% of the hardwood lumber and nearly 86% of the softwood lumber. Upholstered furniture manufacturers used close to 30% of the hardwood and 13% of the softwood lumber. Manufacturers of wood office furniture consumed the smallest quantities of both hardwood and softwood lumber.

Geographic segmentation

Comparing material volumes across geographic regions, the Southeast was the largest user of most wood materials (Table 2). Slightly over 1.4 billion board feet of hardwood lumber and 292.5 million board feet of softwood lumber were consumed in 1989. Furniture manufacturers in the Southeast were also the

largest users of veneer (76% of total), particleboard (50% of total), OSB (50% of total), dimension stock (nearly 49% of total) and MDF (over 43% of total).

The Midwest used the largest volumes of hardboard, 61.8 million square feet (1/8" basis), and hardwood plywood, 94.5 million square feet (3/8" basis). The largest volume of softwood plywood, 112.4 million square feet (3/8" basis), was consumed in the South Central region, largely in upholstered furniture production.

Hardwood lumber use by species

Overall estimates

Red oak was the most important hardwood lumber species used in 1989, representing nearly 27% of hardwood lumber consumed within the wood household, upholstered, and office furniture industry segments (Figure 3). Yellow poplar was the second most popular hardwood species used, with a 15.2% share of estimated consumption and white oak followed at 10.6%.

Industry segment estimates

Wood household furniture manufacturers in 1989 consumed the largest volumes of red oak, yellow poplar, hard maple, soft maple, black cherry, ash, hickory (including pecan), beech, mahogany, yellow birch, hackberry and cottonwood (Table 3). Upholstered manufacturers consumed 70% of the alder and over 50% of both the white oak and sapgum used within the three industry segments. Wood office furniture manufacturers consumed the largest percentage of black walnut, 72.4%.

Geographic segmentation

The majority of hardwood species were most heavily consumed in the Southeast. Over 50% of the red oak, white oak, yellow poplar, hard maple, soft

maple, black cherry, black walnut and mahogany were used in the Southeast for the manufacture of wood furniture. A number of other species were important within specific regions. For example, nearly 50% of the sapgum and 56.4% of the elm were consumed in 1989 by firms in the South Central region, while manufacturing locations on the West Coast consumed 80.8% of the alder. Furniture manufacturing locations in the Northeast consumed over 80% of the total estimated volume of yellow birch used in 1989.

Comparison with Census data

Wood material use as estimated from this survey is not directly comparable with data from the Census of Manufactures for several reasons. First, this survey achieved a broader coverage of the industry by capturing a larger number of manufacturing locations in the 3 furniture industry groups than Census reports; second, it captured secondary manufacturers,⁴ firms that produce wood furniture but whose primary business may be in another Census category; and third, it captured the lumber purchased by dimension parts facilities owned by furniture manufacturers which is reported under a different category in the Census data.

Summary

Estimates of 1989 wood materials use were derived from a survey of wood household (SIC 2511), upholstered household (SIC 2512) and wood office furniture (SIC 2521) manufacturers. Including dimension stock, total hardwood lumber purchased in 1989 is estimated at over 2.6 billion board feet. Softwood lumber consumption is estimated at 865 million board feet. Over 1.3 billion square feet of

particleboard (3/4" basis) and 370 million square feet (3/4" basis) of medium density fiberboard were also consumed in 1989. In excess of 268 million square feet of hardwood plywood (3/8" basis), along with 192.9 million square feet of softwood plywood (3/8" basis), 1025.1 million square feet of veneer and over 310 million board feet of dimension stock were consumed in 1989 by the three industry segments.

Red oak was the most important hardwood lumber species used in 1989, representing nearly 27% of the hardwood lumber consumed within the three segments. Yellow poplar and white oak respectively represented 15% and 11% of the estimated volume of hardwood lumber consumed. No other species of hardwood lumber represented greater than 10% of consumption.

Footnotes

1. Total cost of materials for establishments that did not report detailed materials data.
2. The Chi-square test is a statistical procedure designed to detect differences between the frequency distributions of categorical variables (Koopmans 1981).
3. The Independent-Samples t-test is a statistical procedure used in comparing the means of single variables (SPSS Inc. 1988).
4. Primary line of business is that defined by the appropriate SIC code. Secondary manufacturers produce the materials defined by the appropriate SIC code, but their business is defined under a different SIC code.

Literature Cited

1. Alvin B. Zeller, Inc. 224 Fifth Avenue, New York, NY 10001
2. American Business Lists. 5711 South 86th Circle, Omaha, NE 68127
3. Cardellichio, P. A., and C. S. 1984. Hardwood Lumber Demand In The United States: 1950 to 1980. *Forest Products Journal* 34(2):15-22.
4. Dillman, D. A. 1978. *Mail and Telephone Surveys: The Total Design Method*. John Wiley and Sons, New York.
5. Dun's Marketing Services, Inc. Three Sylvan Way, Parsippany, NJ 07054
6. Fowler, Jr., F. J. 1984. *Survey Research Methods*. Sage Publications, Inc., Beverly Hills, CA.
7. Koopmans, L. H. 1981. *An Introduction to Contemporary Statistics*. Duxbury Press, Boston, MA.
8. Luppold, W. G. 1987. Material Usage Trends in the Wood Household Furniture Industry. USDA Forest Service Northeastern Forest Experiment Station NE-RP-600.
9. Luppold, W. G. 1988. Material Use Trends in U.S. Furniture Manufacturing. *Southern Journal of Applied Forestry* 12(2):102-107.
10. Luppold, W. G. 1990. Shifting Demand for Eastern Hardwood Lumber. *Proceedings of Hardwood Forest Products Opportunities: Creating and Expanding Businesses*. Pennsylvania Department of Commerce.
11. McKeever, D. B. 1985. Wood Products Used by U.S. Furniture, Fixtures and Architectural Woodwork Manufacturers. *Furniture Design and Manufacturing* 57(13).
12. Robinson, V. L. 1965. A Changing Hardwood Market: The Furniture Industry. *Forest Products Journal* 15(7):277-281.
13. Spelter, H., Stone, R. N. and D. B. McKeever 1978. Wood Usage Trends in the Furniture and Fixtures Industry. Research Note FPL-0239 Forest Products Laboratory. USDA Forest Service, Madison, WIS.
14. SPSS Inc. 1988. *SPSS-X User's Guide*. Third Edition, Chicago, IL.
15. USDC-BOC. 1987a. Census of Manufactures. Household Furniture MC87-I-25A(P). United States Department of Commerce, Bureau of the Census, Washington, D.C.

16. USDC-BOC. 1987b. Census of Manufactures. Office, Public Building, and Miscellaneous Furniture; Office and Store Fixtures. Series MC87- I-25B(P). United States Department of Commerce, Bureau of the Census, Washington, D.C.
17. USDC-ITA. 1985. A Competitive Assessment of the U.S. Wood and Upholstered Furniture Industry. United States Department of Commerce, International Trade Administration, Washington, D.C.

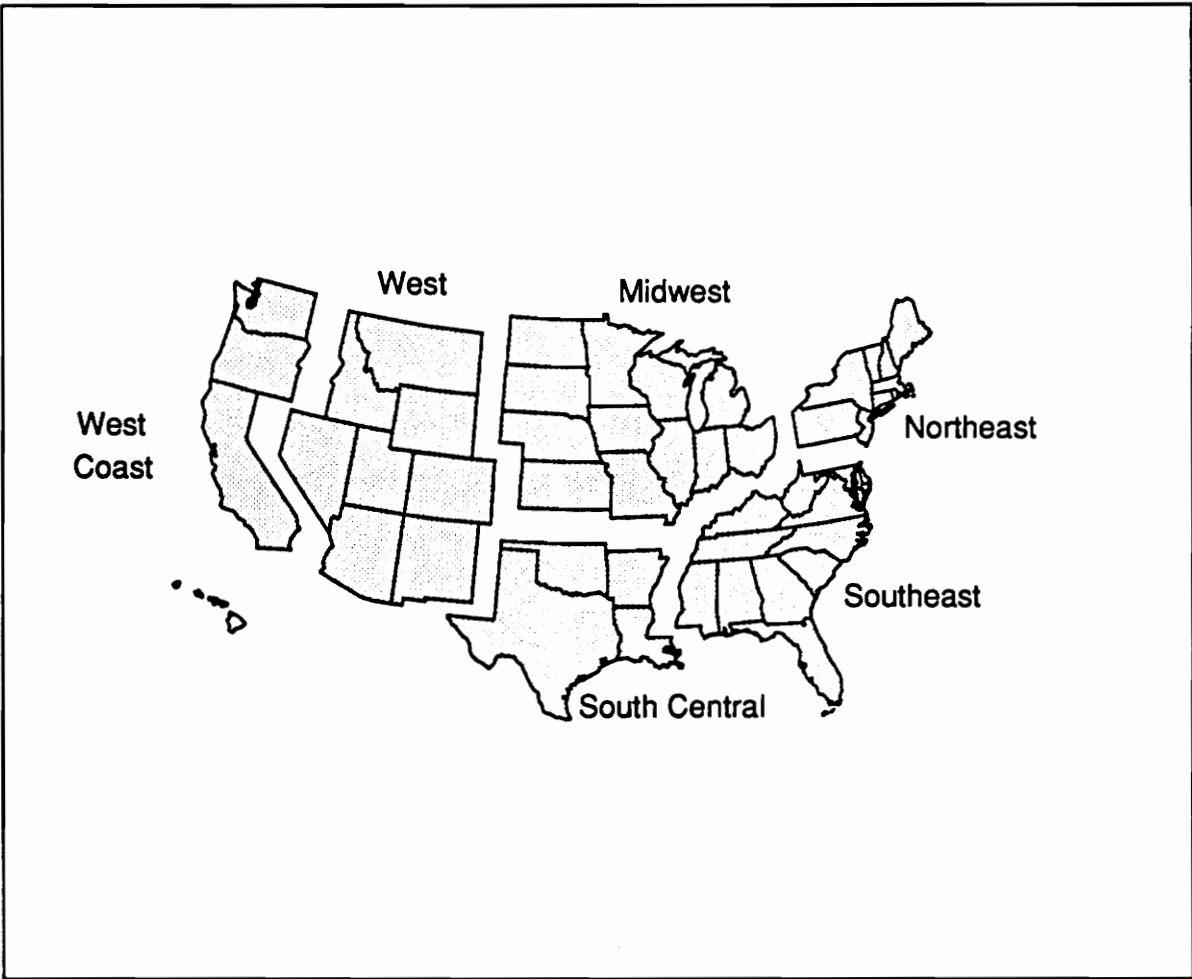
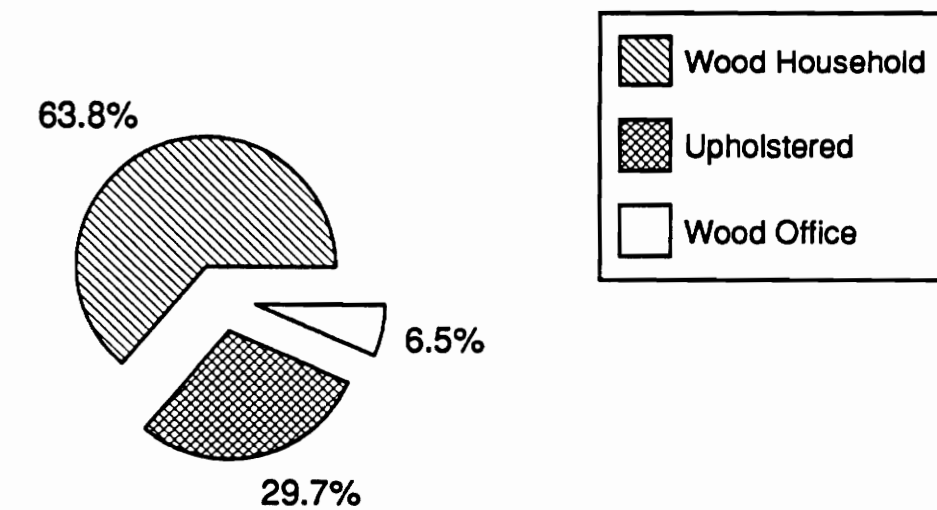
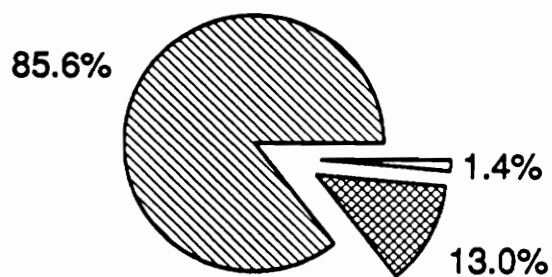


Figure 1. **Geographic breakdown used in analysis.**



Hardwood Lumber



Softwood Lumber

Figure 2. 1989 lumber use by industry category.

Species

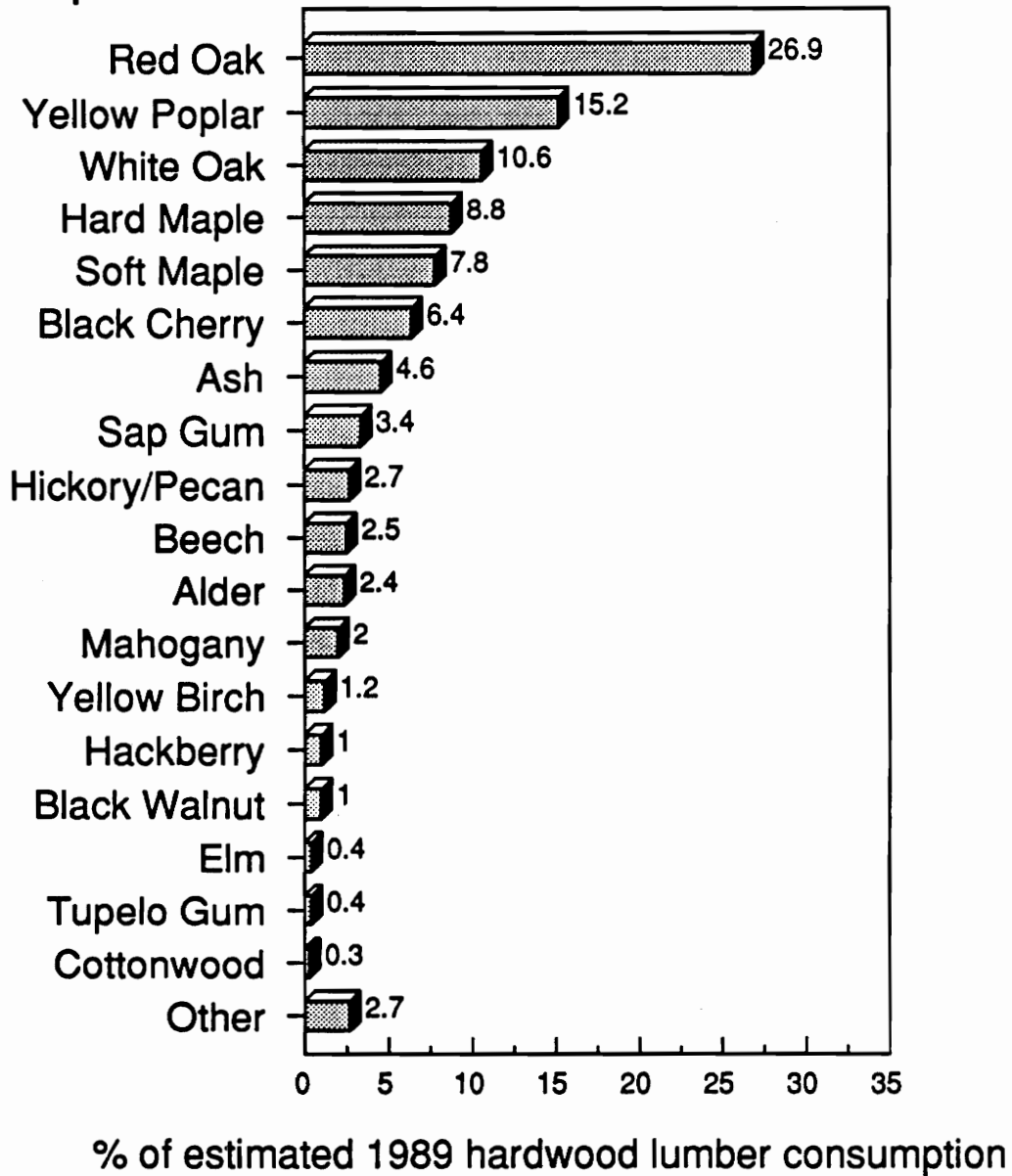


Figure 3. Hardwood species used to manufacture wood household, upholstered and wood office furniture in 1989.

Table 1. 1989 Material use estimates for wood household, upholstered and wood office furniture.

MATERIALS	SIC 2511	SIC 2512	SIC 2521	TOTAL*
	Wood Household	Upholstered	Wood Office	
Hardwood Lumber (MMBF)	1,494.2	696.6	151.8	2,344.2
Softwood Lumber (MMBF)	740.1	112.6	12.4	865.1
Dimension Stock (MMBF)	236.8	24.6	48.8	310.2
Particleboard (MM sqft. 3/4" basis)	1,024.8	30.4	278.5	1,333.7
MDF (MM sqft. 3/4" basis)	286.4	25.1	58.8	370.3
Hardboard (MM sqft. 1/8" basis)	79.1	8.6	57.6	145.3
OSB (MM sqft. 3/8" basis)	6.8	11.2	1.1	19.1
Hardwood Plywood (MM sqft. 3/8" basis)	139.5	50.0	78.6	268.1
Softwood Plywood (MM sqft. 3/8" basis)	15.9	167.2	9.8	192.9
Veneer (MM sqft.)	810.7	2.7	211.7	1,025.1

- * Totals may not equal sum of SIC groups because not all responding locations could be categorized by SIC.

Table 2. 1989 Material use estimates for wood household, upholstered and wood office furniture by geographic region.

Materials	Regions					
	North-east	South-east	South Central	Mid-west	West	West Coast
Hardwood Lumber (MMBF)	254.9	1,440.4	306.6	207.0	22.5	107.9
Softwood Lumber (MMBF)	53.3	292.5	70.1	130.7	153.0	134.5
Dimension Stock (MMBF)	32.8	151.3	12.0	70.3	*	13.6
Particleboard (MM sqft. 3/4" basis)	142.8	660.8	*	224.9	5.0	83.8
MDF (MM sqft. 3/4" basis)	21.6	159.5	65.8	95.3	0.9	26.2
Hardboard (MM sqft. 1/8" basis)	9.1	44.3	12.2	61.8	*	16.9
OSB (MM sqft. 3/8" basis)	*	9.5	2.4	2.4	*	1.4
Hardwood Plywood (MM sqft. 3/8" basis)	44.3	61.0	33.4	94.5	8.7	26.2
Softwood Plywood (MM sqft. 3/8" basis)	3.8	27.5	112.4	21.8	*	25.1
Veneer (MM sqft.)	52.1	783.0	*	110.6	1.2	59.4

Note: Totals are not the same as in Table 1 because a few respondents did not indicate the geographic region of their manufacturing facility.

* Too few respondents to accurately estimate material volumes in these regions.

Table 3. 1989 Hardwood species volume estimates for wood household, upholstered and wood office furniture.

Species	Volume by Industry Segment (MMBF)			Total
	Wood Household	Upholstered	Wood Office	
Red Oak	422.7	175.0	31.4	629.1
Yellow Poplar	207.9	106.3	41.7	355.9
White Oak	110.9	123.6	12.3	246.8
Hard Maple	168.8	28.4	7.5	204.7
Soft Maple	88.6	82.8	10.5	181.9
Black Cherry	141.7	2.7	4.6	149.0
Ash	71.9	31.3	4.2	107.4
Sap Gum	33.1	44.1	2.6	79.8
Hickory/Pecan	42.2	19.6	0.7	62.5
Beech	49.8	7.1	2.1	59.0
Alder	12.7	39.2	2.5	54.4
Mahogany	36.0	3.9	6.0	45.9
Yellow Birch	25.3	0.7	1.0	27.0
Hackberry	15.1	6.6	0.1	21.8
Black Walnut	4.6	0.9	15.6	21.1
Elm	0.6	6.4	3.1	10.1
Tupelo Gum	2.0	6.9	0.5	9.4
Cottonwood	4.8	1.2	0	6.0
Other	51.0	7.7	4.8	63.5
Totals *	1,489.7	694.4	151.2	2335.3

* Totals are not the same as in Table 1 because a few respondents did not provide species information.

**The U.S. Wood Furniture Industry: A Profile of Products and
Channels of Distribution**

**A Manuscript Prepared for Submission to
Forest Products Journal.**

Abstract

A sample of 347 manufacturers from the wood household furniture industry (SIC 2511), was surveyed to study the demand and importance of products and channels of distribution within this industry. Overall, bedroom, dining room and occasional furniture were produced by greater than 50% of the respondents. More than 47% of all respondents manufactured living room furniture and entertainment centers. Between seven common types of furniture construction, solid hardwood furniture was the most frequent type produced. Manufacturers perceived the level of demand for solid hardwood furniture to be increasing at a significantly greater rate than solid softwood furniture. Among various retail outlets, the largest volumes of respondent's sales were through traditional free-standing furniture stores (29.8%) and manufacturer's own stores (23.4%). Over 60% of sales were through manufacturer's representatives to retailers and wholesalers.

Introduction

The types of products manufactured by an industry and the channels of distribution used to transfer these products to the final consumer are two of the most important and fundamental elements of marketing strategy (Bennett 1988). When dealing with industries such as furniture, with a multitude of products and an extremely complex system of distribution (Bennington 1988), it is particularly important to understand these key marketing elements.

Certain trends in product types are commonly found through Census data. For example, in the 1982 Census of Manufactures, 31.9% of the value of shipments for U.S. wood household furniture was for bedroom furniture with another 25% for living room and 20.8% for dining room furniture (USDC-BOC 1987a). Five years later, in 1987, dining room and bedroom furniture production remained fairly stable, while the value of shipments for living room furniture dropped nearly 5%. Limited information is available, however, after 1987 indicating the demand for specific types of wood furniture. And, even less information can be found concerning the volumes handled through each of the many channels of distribution.

With limited information, firms profiting from the sale of wood products to the wood household furniture industry may find it difficult to gauge the importance of various furniture products and subsequent wood products used to manufacture those products. Similarly, firms engaged in the distribution of wood household furniture need information to assess the demand for the types of services they offer, and to help plan for the types of services they should offer in the future. The goal of this paper is to better understand the importance of various products and channels of distribution in the wood household furniture industry.

Methodology

Sample frame and data collection

The population for this survey consisted of manufacturers of wood household furniture (SIC 2511). Miller Freeman's 1989 Secondary Wood Products Manufacturers Directory was used to develop the sample frame (Pease 1989). All manufacturers producing wood household furniture within the continental U.S. were selected from the directory. A total of 347 manufacturers comprised the final sample frame.

Because the firms on the Miller Freeman list were geographically dispersed throughout the United States, a mail survey was the most efficient and cost effective method for gathering data (Dillman 1978). The data collection instrument (a questionnaire) was pretested with representatives from the furniture industry following standard procedures recommended by Churchill (1987). A small group of personal interviews were conducted to resolve problems with question comprehension and survey completion. The survey was revised then pilot tested on a random sample of 50 industry representatives. Various industry and other experts were also consulted to aid questionnaire design.

The final survey was mailed in April 1990. High level marketing personnel within each sample firm were sent a questionnaire along with a personalized cover letter and a gift (as an incentive to increase response). Repeat mailings of personalized cover letters and questionnaires were administered in order to further increase response rate. Once the sample frame was adjusted for bad addresses and out-of-business firms a total of 138 returned usable questionnaires resulted in a final adjusted response rate of 48%.

Nonresponse bias

As in all mail surveys people have a choice to either respond or not respond, creating a potential for nonresponse bias. If nonrespondents are different than respondents, the data from the responding firms is not representative of the population as a whole. Because late respondents are generally believed to more closely resemble nonrespondents, comparisons between early and late respondents may provide evidence for the existence of nonresponse bias (Fowler 1984).

Tests comparing early and late respondents revealed no evidence of nonresponse bias. A chi-square test ¹ between early and late respondent's weighted average sales through various retail distribution outlets indicated no significant difference ($p > .73$). Comparing these same respondents' average weighted sales through a number of other important channels of distribution, there was no evidence to suggest that a difference existed ($p > .47$). Early and late respondents, examined a third time employing the chi-square procedure, were not found to differ in their percentages of the categories of furniture they produced ($p > .44$).

Respondents

Distinct personnel were targeted within each sampled firm who could most accurately provide the desired marketing information. As a result, over 37% of the respondents were presidents or owners of their company. Another 20% of the respondents were either the Vice President of Sales and Marketing or the Executive Vice President. Respondents averaged 210 full-time production employees and 255 full-time employees of all types. Average 1989 sales for the

responding firms was \$26,228,977. This figure represents average sales for individual companies. For large corporations such as Interco, individual companies like Lane are treated as separate companies in this average.

Respondents were geographically categorized using the four major census regions (Figure 1). The greatest percentage of firms (39%) had the majority of their manufacturing facilities in the South. The Midwest and Northeast regions followed with 25.5% and 19.1%, respectively.

Nearly 67% of the respondents were a single company with only one manufacturing facility. Slightly over 23% of the responding firms had furniture manufacturing facilities at multiple locations within a single company, and approximately 8% had plants at multiple locations within a division of a larger corporation. All respondents indicated on the survey that they produced wood household furniture.

Respondent company sizes were compared with the breakdown of establishment sizes listed in the 1987 Census of Manufactures. Census data shows that 29% of U.S. wood household furniture manufacturers had 20 or more employees in 1987, however, 69% of the firms responding to the survey had 20 or more employees. The respondents in this study are clearly more representative of the larger firms in the industry and the results should be viewed with this in mind.

Product Profile

Respondents were asked to indicate the categories of furniture they manufactured along with the percentages of their production represented by seven major types of furniture construction. Data for furniture categories are presented

as percentages of the number of firms producing each category. Data for construction types are unweighted average percentages of production on a per firm basis.

Furniture categories

The product mix of the responding firms was examined to gain an understanding of the categories of wood household furniture produced in 1989 (Table 1). Overall, more than 66% of the 138 respondents most commonly produced bedroom, dining room (65.2%) and occasional furniture (53.6%). Nearly 48% produced entertainment centers and slightly over 47% of the respondents produced living room furniture.

The frequency of occurrence for bedroom, dining room and living room furniture manufacturing was similar to the 1987 Census of Manufactures ranking of the value of shipments for these categories (USDC-BOC 1987a). A fairly large percentage of firms (35.5%), however, also produced kitchen furniture and a much smaller percentage of manufacturers (15.2%) produced juvenile/infants furniture.

As the size of the responding firms increased the subsequent number of furniture categories produced per firm decreased (Table 1). At least 50% of the respondents with less than \$1 million in 1989 sales were manufacturing 8 out of the 10 furniture categories on the survey. Only three furniture categories, bedroom, dining room and occasional furniture were produced by more than 50% of respondents with between \$1-10 million in sales and with greater than \$10 million in sales.

The product categories manufactured differed across geographic regions. More than 90% of the wood household furniture manufacturers in the Northeast

produced dining room furniture and over 76% manufactured occasional furniture. Seventy percent of the manufacturers in the Northeast produced living room furniture, followed by only 47.1% in the West. Home office furniture production occurred most frequently among the manufacturers in the West (52.9%). Ready-to-assemble furniture was most common in the Midwest region with over 21% of the respondents producing this category versus 14.3% in the Northeast and less than 12% in the remaining regions. Computer furniture was produced by less than 6% of the firms in every region.

Furniture construction types

Respondents were asked to indicate the types of wood furniture construction they used and the percentage of sales each construction type represented (Table 2). Respondent's 1989 sales of wood household furniture consisted of 44.9% solid hardwood construction, 25.9% artificial laminates over composites and 11.3% hardwood veneers over composites. Solid softwood furniture accounted for 8.4% of sales. Less than 6% of 1989 sales were hardwood veneers over solids and only 4.2% were in other variations of construction types.

For each company size category solid hardwood furniture was the dominant furniture construction type (Table 2). Firms with greater than \$10 million in sales produced the largest relative volume of artificial laminates over composites and hardwood veneers over solid wood.

Differences across regions were apparent between the use of solid hardwood and artificial laminates over composites. Firms in the Northeast region manufactured the largest relative volume of solid hardwood furniture. Slightly under 66% of sales were in solid hardwoods. Solid hardwoods represented less

than 50% of sales in all other regions. Artificial laminates over wood composites were produced most often among the firms in the Midwest region. Close to 40% of the manufacturers' sales in the Midwest region, followed by 11.0% in the South and 10.4% in the West, consisted of artificial laminates over composites.

Analysis of Demand for furniture construction types

Surveyed manufacturers were asked to indicate their perceptions of the trend(s) in demand for the type(s) of furniture construction they manufactured. Mean scores shown in Figure 2 are the ratings of each construction type on a scale of 1-strongly decreasing to 5-strongly increasing. Respondents perceived slightly increasing levels of demand for solid hardwood furniture, artificial laminates over composites/or solids, hardwood veneers over composites and hardwood veneers over solid wood. Respondents producing solid softwood furniture perceived a stable demand for this type of construction.

Secondary products

Respondents reported only minor quantities of secondary products being produced. Only 5.3% of the respondents produced upholstered furniture with solid hardwood frames. Less than 1% of the respondents produced other types of furniture construction.

Minor variation was also found in secondary products manufacturing across geographic regions. Upholstered furniture with solid wood frames was produced by over 7% of the manufacturers in the South and less than 3% in all other regions.

Channels of distribution

All respondents were asked to provide their percentage of sales through various channels of distribution along with their volume of 1989 sales. The figures presented are weighted by respondent's sales, meaning they should be interpreted as the average volume of respondent's sales which passed through each channel.

Distribution outlets

The largest percentage of wood household furniture sales for the responding firms (29.8%) was to traditional free-standing furniture stores (Figure 3). Manufacturer's own showrooms were the second overall most important outlet of distribution, representing 23.4% of respondent's 1989 sales.

Variations in company sizes had differing effects on the type of distribution outlets used to move wood household furniture to the final consumer (Table 3). Large firms distributed the greatest percentage of their sales through traditional free-standing furniture stores and through their own showrooms. Mid-size firms (firms with between \$1-10 million in sales) shipped a much smaller volume of wood household furniture through their own showroom, but over 47% of sales were through traditional free-standing furniture stores. Ten percent of the sales of the mid-sized firms were through both designers/design centers and small furniture specialty/lifestyle stores. Small furniture specialty/lifestyle stores were the most important outlet of distribution for small manufacturers (19.3% of 1989 sales).

Additional trends were also apparent across company size categories. As company size increased, conventional department stores, warehouse clubs, home improvement centers and catalog showrooms became increasingly important.

Small furniture specialty/lifestyle stores became increasingly important as company sizes decreased.

Across geographic segments, firms in the Midwest region shipped a larger relative volume to their own showrooms than any other region (44.8%). Close to 40% of the firms in the West were responsible for shipping the largest relative volume of furniture through small furniture specialty/lifestyle stores. Conventional department stores were more important to Southern manufacturers than manufacturers in other regions.

Channel intermediaries

Consistent with the large volume of furniture handled through independent channels of distribution, the largest overall volume of sales (44.9%), was channeled through manufacturer's representatives to retailers (Figure 4). The next most important channel was direct to the company's own store (32.2%), followed by manufacturer's representatives to wholesalers (15.2% of 1989 sales) (Table 4).

Figure 5 provides a visual representation of respondent's furniture sales by channel of distribution. Direct sales to independent retailers accounted for over 50% of respondent's sales. With 16.5% of sales through wholesaler's to independent retailers, over 66% of respondent's furniture eventually passed through independent retailers. Over 32% of the manufacturer's sales of wood household furniture were channeled through manufacturer owned stores or galleries.

The larger manufacturers maintained the greatest relative volume of sales through manufacturer's representatives to retailers and through manufacturer's representatives to wholesalers (Table 4). Only 1% of sales among the firms with

less than \$1 million in 1989 sales were through manufacturer's representatives to retailers. Similarly, no small manufacturers shipped through manufacturer's representatives to wholesalers. The most important channel of distribution among the small manufacturers was their own sales staff to retailers. Manufacturer's own sales staffs to retailers became less important with each increasing increment in company size.

Excluding the Midwest region, wood household furniture was most heavily distributed through manufacturer's representatives to retailers in every geographic segment. In the West over 69% of sales were handled through this channel, followed by 64.8% in the South and 58.6% in the Northeast and only 15.2% in the Midwest region.

Firms in the Midwest region shipped almost 52% of their furniture direct to their own stores, followed by the South shipping 11.3% of their wood household furniture direct to their own stores.

Summary

This study examined the importance of a number of products, types of furniture construction and channels of distribution used for wood household furniture (SIC 2511). The most frequent categories of wood household furniture produced were bedroom and dining room furniture. Responding firms with more than \$10 million in 1989 sales produced fewer categories of furniture while firms with less than \$1 million in sales more frequently produced a variety of furniture categories. Dining room, living room and occasional furniture were most frequently produced by firms in the Northeast. Respondents in the Midwest region were the most frequent

producers of ready-to-assemble (RTA) furniture.

From a group of seven common construction types, solid hardwood furniture was the most common type produced among all company sizes and in all geographic regions. Manufacturers also perceived the demand for solid hardwood furniture to be increasing at a significantly greater rate than solid softwood furniture. The demand for the majority of wood furniture construction types was perceived to be increasing slightly.

The largest percentage of overall respondent's sales (29.8%) were to traditional free-standing furniture stores and to their own showrooms (23.4%). Large firms placed similar emphasis on these two channels while mid-size firms deemphasized distribution to their own showroom, placing more emphasis on designers/design centers and small furniture specialty/lifestyle stores. Small firms had the largest percentage of their sales (19.3%) to small furniture specialty/lifestyle stores. Traditional free-standing furniture stores were most important to producers in the Northeast and the South. Small furniture specialty/lifestyle stores were most important to producers in the West; and in the Midwest region, manufacturer's own showrooms were the most important distribution outlet.

Among the channel intermediaries examined, manufacturer's representatives to retailers accounted for nearly 45% of respondent's sales. Thirty two percent of respondent's sales were through manufacturer's own stores. Small manufacturers shipped only 1% of their sales through manufactures' representatives to retailers but 52.9% through their own sales staff to retailers. Manufacturer's representatives to retailers was the most important channel of distribution in every geographic segment except for the Midwest region. Firms in the Midwest and

South regions shipped the largest relative volumes of their furniture through manufacturer's representatives to wholesalers. Direct sales to manufacturer's own stores accounted for nearly 52% of sales in the Midwest region, but only 11.3% in the South and less than 5% in all other regions.

As shown in this data, there are a number of differences between the types of products, types of furniture construction and channels of distribution used in the wood household furniture industry. Firms engaged in the sale of wood materials targeted at this market and in the transfer of finished furniture to the final consumer can use this information to gain a better understanding of the importance of various end products and channels of distribution used in the U.S. wood household furniture industry.

Footnotes

1. The Chi-square test is a statistical procedure designed to detect differences between the frequency distributions of categorical variables (Koopmans 1981).

Literature Cited

1. Bennett, P. D. 1988. *Marketing*. McGraw-Hill Company, New York, N.Y.
2. Bennington, R. R. 1985. *Furniture Marketing*. Fairchild Publications. New York, N.Y.
3. Churchill, G. A., Jr. 1987. *Marketing Research, Methodological Foundations*. Fourth Edition. The Dryden Press, New York, N.Y.
4. Corey, R. F., F. V. Cespedes, and V. K. Rangan. 1989. *Going to Market: Distribution Systems for Industrial Goods*. Harvard Business School Press, Boston, Mass.
5. Dillman, D. A. 1978. *Mail and Telephone Surveys: The Total Design Method*. John Wiley and Sons, New York.
6. Fowler, Jr., F. J. 1984. *Survey Research Methods*. Sage Publications, Inc., Beverly Hills, CA.
7. Koopmans, L. H. 1981. *An Introduction to Contemporary Statistics*. Duxbury Press, Boston, MA.
8. Pease, D. A. 1989. *1989 Secondary Wood Products Manufacturers Directory*. Miller Freeman Publications, Inc. San Fransisco.
9. SPSS Inc. 1988. *SPSS-X User's Guide*. Third edition. Chicago, ILL.
10. USDC-BOC. 1987a. *Census of Manufactures. Household Furniture Series MC87-I-25A(P)*. United States Department of Commerce, Bureau of the Census, Washington, D.C.
11. USDC-BOC. 1987b. *Census of Manufactures. Office, Public Building, and Miscellaneous Furniture; Office and Store Fixtures Series MC87- I-25B(P)*. United States Department of Commerce, Bureau of the Census, Washington, D.C.

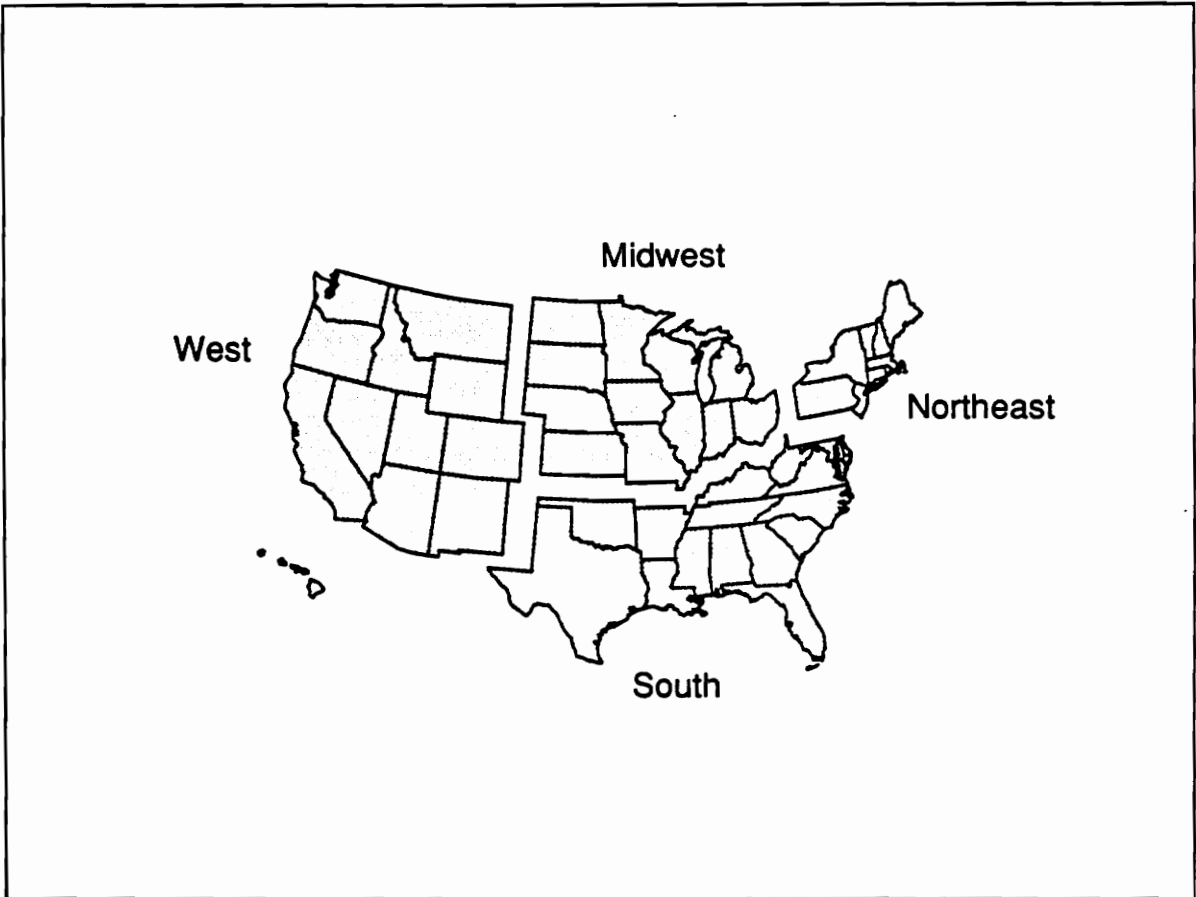


Figure 1. Four regional segments used in the analysis.

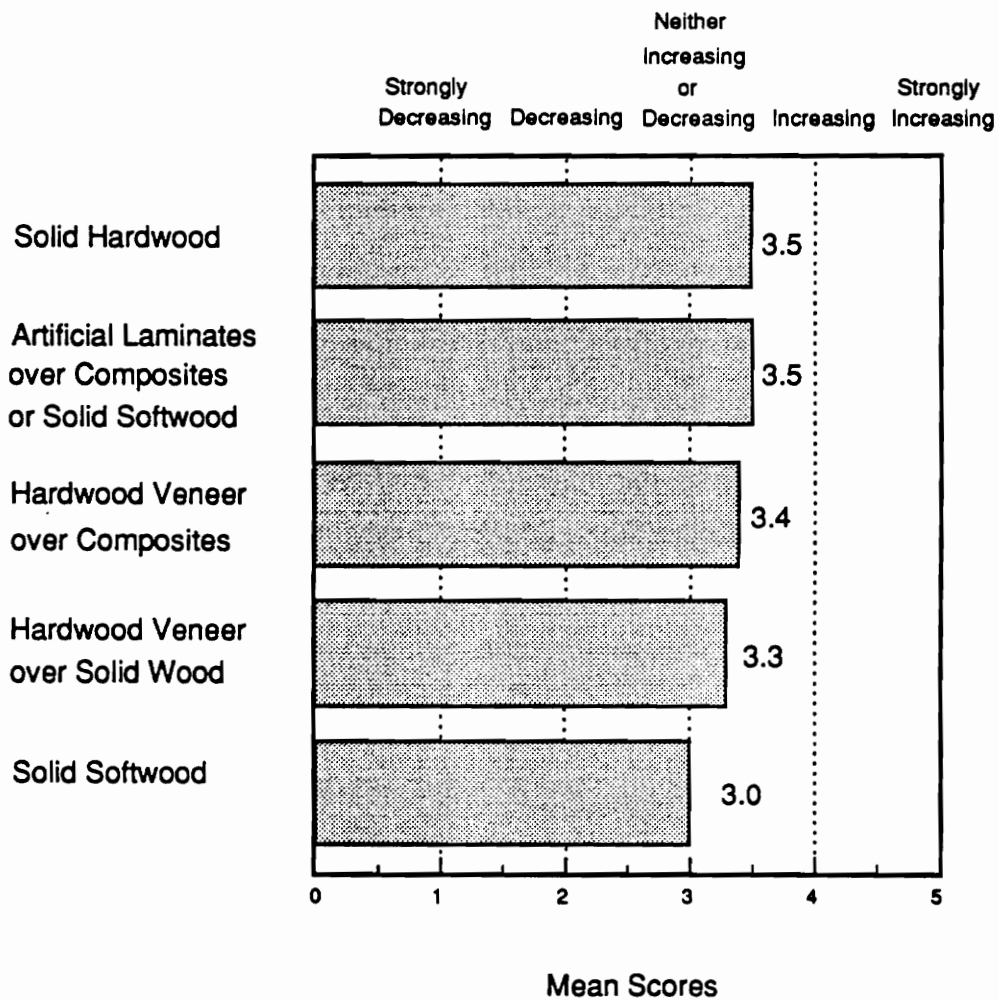


Figure 2. Furniture manufacturer's perceptions of the direction of demand for various types of furniture construction.

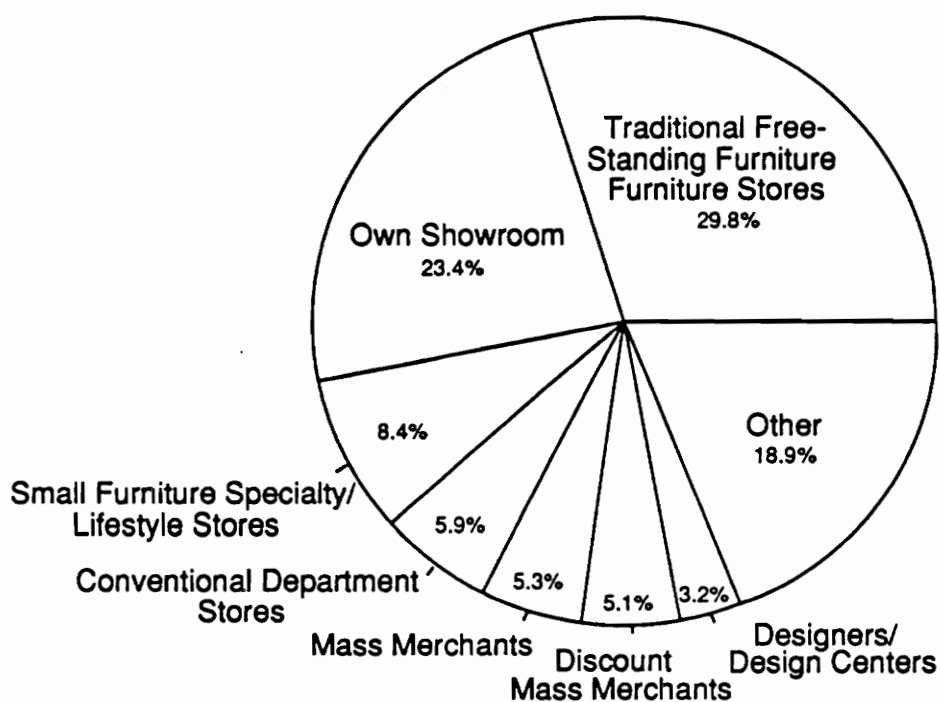


Figure 3. Retail outlets of distribution and percent of sales through each outlet.

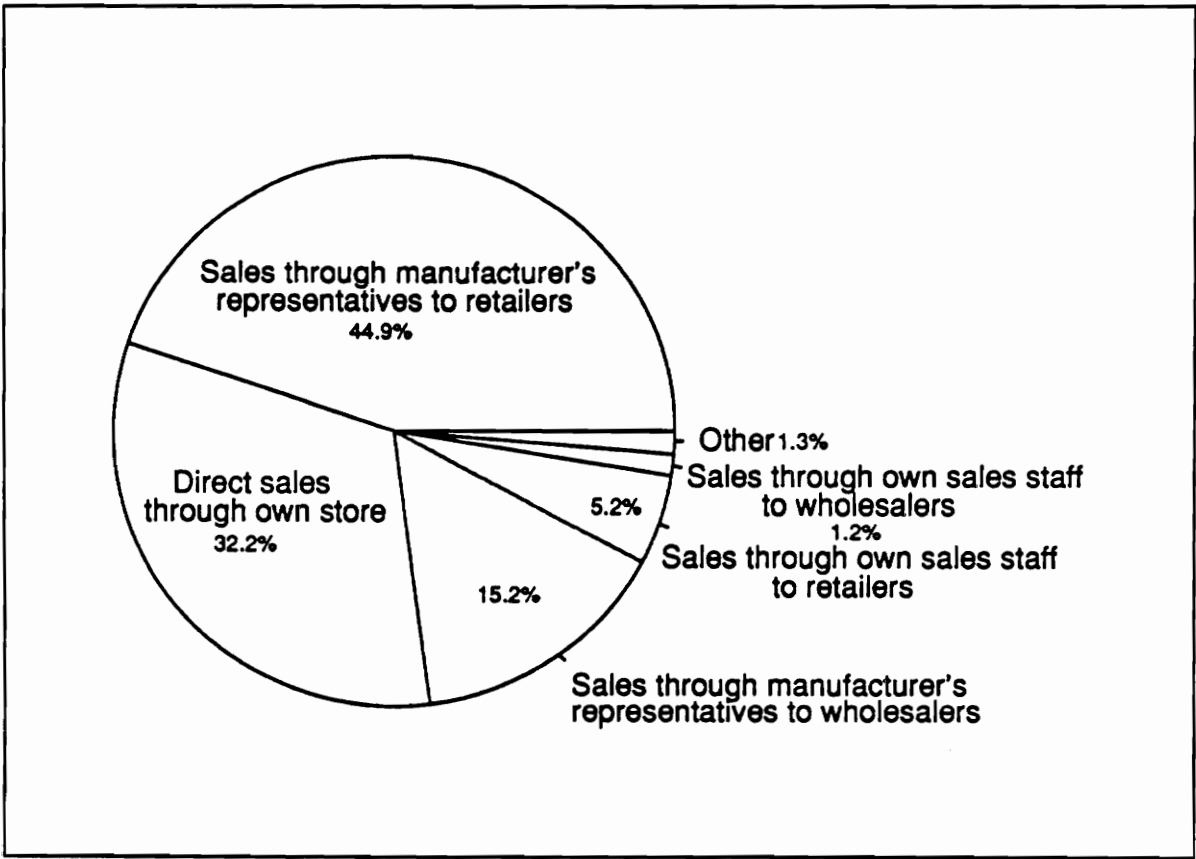


Figure 4. Percent of respondent's furniture sales through channel intermediaries.

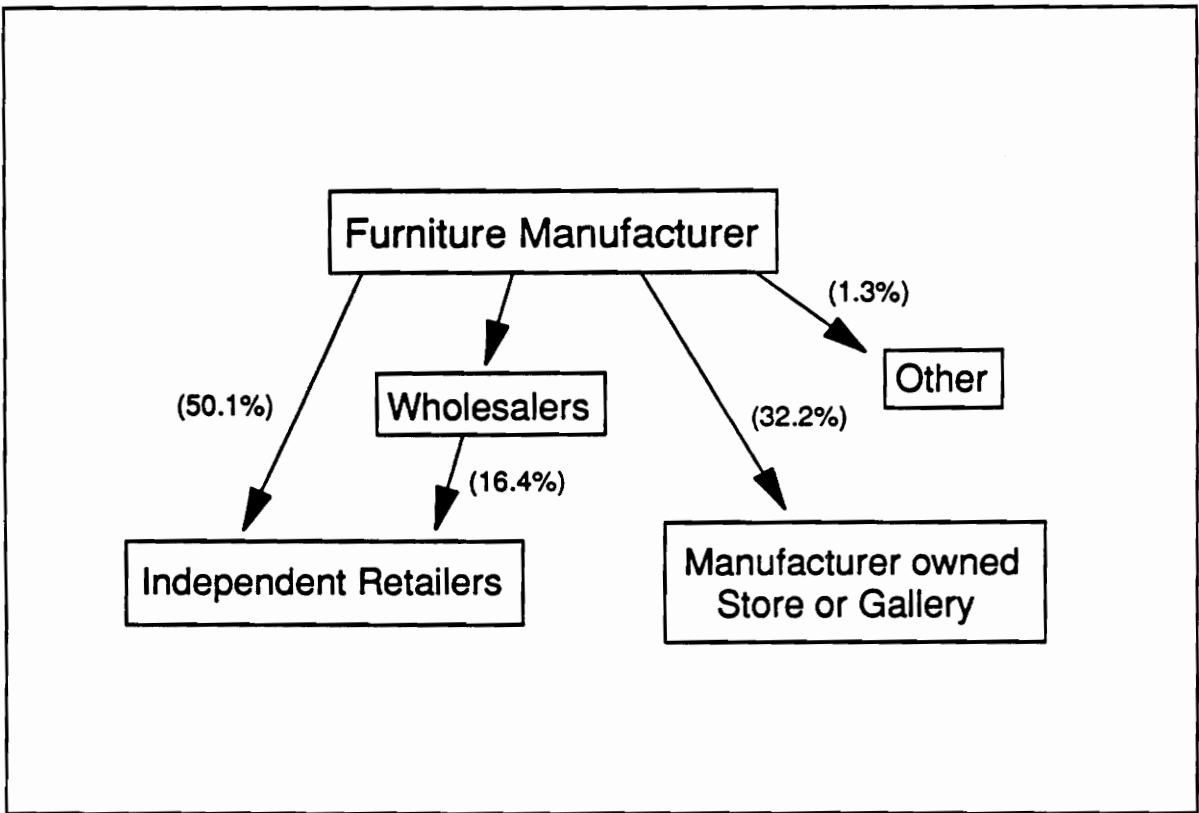


Figure 5. Simplified system of distribution for respondent's furniture, showing percent of sales through each channel.

Table 1. Categories of furniture manufactured by respondents by company size.

Furniture Category	Percentage Manufacturing *			
	< \$1 mill. Sales	\$1-10 mill. Sales	> \$10 mill. Sales	Overall
Bedroom	75.0	63.6	70.6	66.7
Dining Room	68.8	67.0	58.8	65.2
Occasional	56.3	52.3	55.9	53.6
Entertainment Centers	56.3	48.9	41.2	47.8
Living Room	62.5	48.9	35.3	47.1
Home Office	50.0	37.5	32.4	37.7
Kitchen	62.5	34.1	26.5	35.5
Juvenile/Infants	25.0	12.5	17.6	15.2
Computer	0.0	1.1	0.0	0.7
Other	0.0	10.2	8.8	8.7

* Total will be greater than 100% due to multiple responses.

Table 2. Weighted percent of respondent's sales by type of furniture construction and company size.

Construction Type	Percent of Sales			
	< \$1 mill. Sales	\$1-10 mill. Sales	> \$10 mill. Sales	Overall
Solid Hardwood	59.2	57.2	43.9	44.7
Artificial Laminates over Composites	9.0	10.8	26.9	25.9
Hardwood Veneers over Composites	16.5	15.0	11.0	11.3
Solid Softwood	12.3	2.3	8.8	8.4
Hardwood Veneers over Solids	1.8	4.5	5.6	5.5
Other	1.2	10.2	3.8	4.2
Total	100 %	100 %	100 %	100 %

Table 3. Weighted percent of respondent's furniture sales by retail outlet and company size.

Outlet of Distribution	Percent			
	< \$1 mill. Sales	\$1-10 mill. Sales	> \$10 mill. Sales	Overall
Traditional Free-Standing Furniture Stores	18.3	47.7	28.6	29.8
Own Showroom	12.7	2.5	24.8	23.4
Small Furniture Specialty/ Lifestyle Stores	19.3	10.8	8.2	8.4
Conventional Department Stores	0.5	2.4	6.1	5.9
Mass Merchants	0.0	7.6	5.1	5.3
Discount Mass Merchants	0.0	0.0	5.5	5.1
Designers/Design Centers	2.4	10.0	2.8	3.2
Warehouse Clubs	0.0	0.4	2.3	2.2
Home Improvement Centers	0.0	0.4	2.0	1.9
Catalog Showrooms	0.0	1.0	1.5	1.4
Mail Order/Catalog Retailers	6.1	0.9	1.4	1.4
Rental customers	0.0	1.1	0.3	0.3
Outlet Retailers/Discounters	0.0	1.6	0.1	0.2
Other	40.7	13.6	11.3	11.5
Total	100 %	100 %	100 %	100 %

Table 4. Weighted percent of respondent's furniture sales by channel intermediary and company size.

Channel Intermediary	Percent			
	< \$1 mill. Sales	\$1-10 mill. Sales	> \$1 mill. Sales	Overall
Sales through manufacturer's reps to retailers	1.0	55.9	44.3	44.9
Direct sales to own store	37.1	4.3	34.0	32.2
Sales through manufacturer's reps to wholesalers	0.0	0.9	16.1	15.2
Sales through own sales staff to retailers	52.9	20.2	4.1	5.2
Sales through own sales staff to wholesalers	2.9	10.8	0.6	1.2
Other	6.1	7.9	0.9	1.3
Total	100 %	100 %	100 %	100 %

CONCLUSIONS

To give the reader an idea of the type of information that lies within this research effort, highlights of the results are provided below. For the sake of brevity, the term *wood furniture industry* will be used to mean the U.S. wood household, upholstered and wood office furniture industries.

Material Use Survey

1. In 1989, the wood furniture industry consumed an estimated 2.3 million board feet of hardwood lumber.
2. The wood furniture industry consumed the following estimated volumes of wood materials in 1989:

Softwood lumber	865.1	million board feet
Dimension Parts	310.2	million board feet
Particleboard	1,333.7	million square feet (3/4" basis)
Medium Density Fiberboard	370.3	million square feet (3/4" basis)
Hardboard	145.3	million square feet (1/8" basis)
Oriented Strandboard	19.1	million square feet (3/8" basis)
Hardwood Plywood	268.1	million square feet (3/8" basis)
Softwood Plywood	192.9	million square feet (3/8" basis)
Veneer	1,025.1	million square feet

3. Within the wood furniture industry, in 1989 wood household furniture manufacturers used over 75% of the softwood lumber, dimension stock, particleboard, medium density fiberboard and veneer consumed.
4. The largest volume of softwood plywood was consumed in the South Central region, hardboard and hardwood plywood in the Midwest and all other wood materials in the Southeast region.
5. Red oak was the most common hardwood species used for the manufacture of wood furniture in 1989; yellow poplar the second most common hardwood species used.

Marketing Survey

1. Over 65% of the responding wood household furniture manufacturers produced dining room furniture.
2. Nearly 45% of the furniture production consisted of solid hardwood construction.
3. Respondents perceived a slightly increasing level of demand for most types of wood furniture, especially furniture constructed with solid hardwoods.
4. The largest percentage of sales of wood household furniture (29.8%) passed through traditional free-standing furniture stores.
5. Slightly under 45% of respondent's sales were handled through manufacturer's representatives to retailers.
6. Thirty-two percent of the wood household furniture manufacturer's sales were channeled to the company's own stores.

RECOMMENDATIONS FOR FUTURE RESEARCH

The author offers the following suggestions for enhancement of ongoing research.

1. Given the timeliness of this study, continued research in material use, products and distribution should be undertaken. Future studies should focus on gathering long-range predictions to help better anticipate changes in demand for wood products and the industries manufacturing them (Material use predictions gathered in this study were collected before the Middle East crisis and were therefore not reported in the articles, however, for the interested reader these predictions are provided in the tables in Appendix B).
2. The Marketing survey could be enhanced by asking furniture manufacturers to rate the importance of channel intermediary attributes. Incorporated with rating scores of the differences between channel intermediaries, these importance scores could be utilized to produce a determinant attribute analysis. Determinant attribute analysis results could be used by channel intermediaries to improve their competitiveness in the market place.
3. Future investigations of wood materials use could be enhanced by employing a determinant attribute analysis on wood household, upholstered and wood office furniture manufacturer supplier and material attributes. This type of information would be beneficial for furniture raw material suppliers concerned about gaining a competitive advantage in the market place.
4. With a smaller sample size, future efforts to estimate material consumption from a large population of manufacturers could be employed in preferably a more timely and less costly manner. Because of the extreme variation in material use within the top 500 manufacturing locations these locations should all remain on the list. The sample of every other location (50% sample) after the top 500, however, could be reduced to every fourth location (25% sample). This would have to be accounted for in the estimation procedure by multiplying the estimates for this group by four instead of two. The sample size reduction could further serve to improve the quality of future research by allowing, financially, for an additional survey mailing to the 25% sample to increase the response rate.

APPENDIX A

Research Instruments

Material Use Survey

Directed to U.S. manufacturing locations of wood household,
upholstered and wood office furniture.

Distributed in
April/May 1990

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 WOOD MATERIALS please give this questionnaire to the person responsible for WOOD MATERIALS at your facility. Thank you!

1. Does the manufacturing facility you are located at produce wood furniture or wood-framed upholstered furniture? (Please check one box)

☐

No



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

☐

Yes



2. For how many plants, do you personally order/purchase furniture materials? (Please circle the proper number)

1 2 3 4 5 6 7 8 9 10 more than 10

If you are responsible for materials at several plants within the company, please answer the remainder of the questionnaire for ONLY THE PLANT AT WHICH YOU ARE LOCATED.

3. Please indicate the types of furniture manufactured at your location. (Check all that apply)

☐

Wood Household

☐

Wood Office

☐

Wood-Framed Upholstered

☐

Institutional/Contract (wood)

☐

Church (wood)

☐

Other, Please Specify: _____

4. Please give us your title or position: _____

5. Does your company have a rough mill at this location?

☐ No

☐ Yes

6. Please indicate which categories of furniture are manufactured at your location.
(Check all that apply)

☐ Bedroom

☐ Dining Room

☐ Living Room

☐ Kitchen

☐ Occasional

☐ RTA

☐ Home Office

☐ Commercial Office

☐ Juvenile and Infant's

☐ Entertainment centers

☐ Other, Please Specify: _____

7. Please indicate what percentage of your total hardwood lumber consumption (in MBF) is represented by each of the following species. (If you don't use hardwood lumber, please go to the next question.)

_____% Red Oak

_____% White Oak

_____% Ash

_____% Black Cherry

_____% Yellow Birch

_____% Hard Maple

_____% Soft Maple

_____% Black Walnut

_____% Mahogany

_____% Yellow Poplar

_____% Alder

_____% Beech

_____% Sap Gum

_____% Hackberry

_____% Tupelo Gum

_____% Elm

_____% Hickory/Pecan

_____% Other: _____

_____% Other: _____

_____% Other: _____

100% Total

8. Please specify the percent of your volume usage for each material below which comes from foreign suppliers.

_____% Lumber
 _____% Rough wood parts
 _____% Semi-Finished wood parts
 _____% Wood-based composite panels and other raw materials
 _____% Finished parts
 _____% Finished furniture

9. Please do your best to estimate the volumes of the following materials used at your plant for the manufacture of furniture in 1989 and the approximate volumes you plan to use over the next three years. (If you do not have this data at your fingertips, would you please contact the person within your firm that can provide an estimate of this information. This data is very important to me and the successful completion of my degree. Thank you!)

Material	Do Not Use	1989	1990	1991	1992	Please circle or write in which units you use.
Hardwood Lumber	<input type="checkbox"/>	_____	_____	_____	_____	(bdft.)
Softwood Lumber	<input type="checkbox"/>	_____	_____	_____	_____	(bdft.)
Particleboard	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 3/4" basis)
Medium Density Fiberboard (MDF)	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 3/4" basis)
Hardboard	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 1/8" basis)
Oriented Strandboard	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 3/8" basis)
Hardwood Plywood	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 3/8" basis)
Softwood Plywood	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft. 3/8" basis)
Wood Parts/ Dimension Parts	<input type="checkbox"/>	_____	_____	_____	_____	(by bdft. or piece)
Veneer	<input type="checkbox"/>	_____	_____	_____	_____	(sq. ft.)
Other: _____		_____	_____	_____	_____	(units: _____)

There are often differences between the definitions people give to various types of wood furniture. To be consistent, please use the following two definitions for answering questions 10 - 10c. Thank you!



Solid Wood

Each exposed furniture part is made of solid lumber.



Hardwood Veneers over Solids

Thin slices of hardwoods bonded to solid wood.

10. Are either solid hardwood or hardwood veneered furniture produced at your plant?

☐

No

☐

Yes



10a: If yes, please indicate the *approximate volume* of hardwood lumber used for solid wood and/or veneered furniture in 1989.

Solid Hardwood Furniture _____ (bdf.)

Hardwood Veneered Furniture _____ (bdf.)

10b: Please indicate the *approximate percentages of your total furniture production* represented by solid hardwood and hardwood veneered furniture in 1989.

Solid Hardwood Furniture _____ %

Hardwood Veneered Furniture _____ %

10c: Hardwood lumber represents approximately what *percentage of your total manufacturing costs* for solid hardwood and/or hardwood veneered furniture?

Solid Hardwood Furniture _____ %

Hardwood Veneered Furniture _____ %

11. In which state is your plant located?

12. What was the average number of people employed at your plant in 1989? (Answer this question for furniture only, if your plant manufactures other products)

_____ Full-time employees (all types)

_____ Full-time production employees

PLEASE RETURN THE QUESTIONNAIRE, by FOLDING ONCE and STAPLING so that the return address is showing. POSTAGE IS PREPAID!

THANK YOU!

VPI&SU - WOOD SCIENCE & FOREST PRODUCTS
THOMAS M. BROOKS FOREST PRODUCTS CENTER
ATTN.: C.M. MEYER
P O BOX 850
BLACKSBURG VA 24063-9985

FOLD ALONG DOTTED LINE...

...then STAPLE OR SEAL HERE

Marketing Survey

Directed to U.S. manufacturers of wood household furniture.

Distributed in
April/May 1990

Virginia Tech

Wood Furniture Manufacturer Marketing Survey

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

☐ No —————→

Please return questionnaire in the
postpaid envelope so we can remove
your name from our mailing list.
Thank you!

☐ Yes



2. Please indicate which of the following types of furniture your company produces.
(Check all that apply)

- ☐ Wood Household
- ☐ Wood Office
- ☐ Wood-Framed Upholstered
- ☐ Institutional/Contract (wood)
- ☐ Church (wood)
- ☐ Other, Please Specify: _____

3. What categories of furniture does your company manufacture? (Check all that apply)

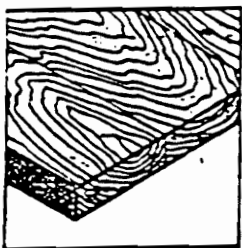
- | | |
|--------------------------------------|--|
| <input type="checkbox"/> Bedroom | <input type="checkbox"/> Home Office |
| <input type="checkbox"/> Dining Room | <input type="checkbox"/> Commercial Office |
| <input type="checkbox"/> Living Room | <input type="checkbox"/> Juvenile and Infants |
| <input type="checkbox"/> Kitchen | <input type="checkbox"/> Entertainment centers |
| <input type="checkbox"/> Occasional | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> RTA | |

4. Please give us your title or position: _____

5. Please indicate which best describes your company's situation.
(Please check only one box)

- ☐ Single plant, single company
- ☐ Plants at multiple locations, single company
- ☐ Plants at multiple locations, multiple companies within the corporation
- ☐ Other, Please Specify: _____

There are often differences between the definitions people give to various types of wood furniture. To be consistent, please use the following four definitions of wood furniture construction for answering the remainder of the questionnaire. Thank you!



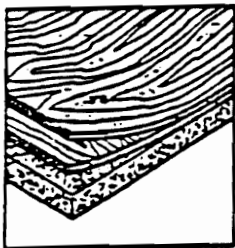
Solid Wood

Each exposed furniture part is made of solid lumber.



Hardwood Veneers over Solids

Thin slices of hardwoods bonded to solid wood.



Hardwood Veneers over Composites

Thin slices of hardwoods bonded to particleboard, plywood, medium density fiberboard, or any other type of composite wood material.



Artificial Laminates over Composites

A layer of paper, plastic, or foil similar in appearance to natural wood is bonded to the surface of particleboard, plywood, medium density fiberboard or any other type of composite wood material.

6. Please indicate the approximate percentages of your total furniture production represented by each of the following construction types. (Refer back to the definitions if necessary)

<u>Types of Furniture Construction</u>	<u>Percentage of Total Furniture Production</u>
Solid Wood (Hardwood)	_____ %
Solid Wood (Softwood)	_____ %
Hardwood Veneers over solids	_____ %
Hardwood Veneers over composites	_____ %
Artificial Laminates over composites	_____ %
Upholstered with solid hardwood frame	_____ %
Upholstered with composite or softwood frame	_____ %
Other, Please specify: _____	_____ %
	100% Total

7. Please estimate the division of your furniture dollar sales (by %) between the following distribution outlets.

_____ % Traditional Free-Standing Furniture Stores	_____ % Home Improvement Center
_____ % Department Store	_____ % Garden Center
_____ % Mass Merchant (such as Sears)	_____ % Warehouse Club
_____ % TV/Electronics Store	_____ % Mail Order/Catalog Retailers
_____ % Small Furniture Specialty/ Lifestyle Stores	_____ % Rental customers
_____ % Discount Mass Merchant (such as K-Mart)	_____ % Wholesaler/Broker
_____ % Designers/Design Centers	_____ % Outlet Retailer/Discounter
_____ % Commercial (office)	_____ % Other, Please Specify: _____
_____ % Catalog Showroom	100% Total

8. Please divide your furniture dollar sales (by %) among the following categories.

_____ % Sales through own sales staff to retailers	_____ % Direct sales to customer (mail order)
_____ % Sales through own sales staff to wholesalers	_____ % Direct sales through own store
_____ % Sales through manufacturer's reps to retailers	_____ % Other, Please Specify: _____
_____ % Sales through manufacturer's reps to wholesalers	_____ %
	100% Total

9. Please divide your furniture sales (by %) among independent outlets and company controlled/franchised galleries/dealers.

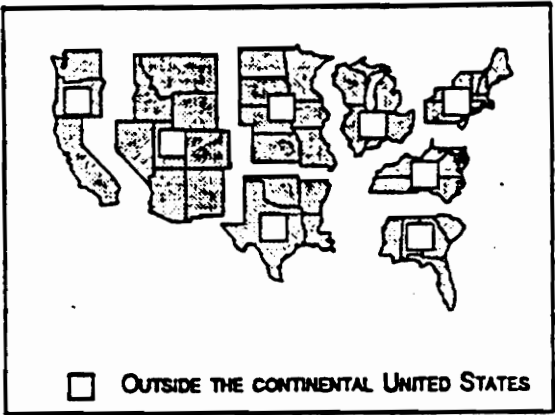
_____ % Independent Outlets
_____ % Company controlled/franchised Galleries/Dealers
100% Total

10. Please place a check in the boxes next to the type(s) of furniture your firm produces, then indicate (by circling the appropriate number) the state of the demand for the type(s) you produce.

Types of Furniture	Strongly Decreasing	Decreasing	Stable	Increasing	Strongly Increasing
<input type="checkbox"/> Solid Wood (Hardwood)	1	2	3	4	5
<input type="checkbox"/> Solid Wood (Softwood)	1	2	3	4	5
<input type="checkbox"/> Hardwood Veneer over solids	1	2	3	4	5
<input type="checkbox"/> Hardwood Veneer over composites	1	2	3	4	5
<input type="checkbox"/> Artificial Laminates over composites	1	2	3	4	5
<input type="checkbox"/> Upholstered, with solid hardwood frame	1	2	3	4	5
<input type="checkbox"/> Upholstered, with composite or softwood frame	1	2	3	4	5

If you are one of many companies within a corporation, please answer the next three questions as pertaining ONLY to your company.

11. Please indicate the major region where your furniture manufacturing facilities are located. (Check the box that applies)



12. What were your company's total sales in furniture in 1989?
(Individual company, NOT total corporation)

\$ _____

13. What was the average number of people employed by your company (not corporation) in 1989?
(Answer this question for furniture only, if your company manufactures other products)

_____ Full-time employees (all types)

_____ Full-time production employees

PLEASE RETURN THE QUESTIONNAIRE IN THE POSTAGE-PAID ENVELOPE

THANK YOU!

APPENDIX B

Material Use Estimates

(Final Material Volumes)

Table 1. Total Industry Material Usage -- SIC 2511, Wood Household Furniture;
SIC 2512, Upholstered Furniture; SIC 2521, Wood Office Furniture.

Material	1989	1990	1991	1992
Hardwood Lumber (MMBF)	2,344.2	2,588.3	2,881.9	3,108.2
Softwood Lumber (MMBF)	865.1	917.3	1,006.9	1,115.8
Particleboard (MM sq ft)	1,333.7	1,376.3	1,486.6	1,617.1
MDF (MM sq ft)	370.3	412.2	463.5	517.6
Hardboard (MM sq ft)	145.3	155.8	187.4	198.8
OSB (MM sq ft)	19.1	22.3	26.7	31.1
Hardwood Plywood (MM sq ft)	268.1	301.1	351.8	389.1
Softwood Plywood (MM sq ft)	192.9	209.2	224.7	241.0
Dimension Parts (MMBF)	206.1	230.2	246.7	264.6
Dimension Pieces (MM pieces)	34.7	39.3	48.3	56.4
Veneer (MM sq ft)	1,025.0	1,030.6	1,138.9	1,220.6

Table 2. Total Material Usage -- SIC 2511, Wood Household Furniture.

Material	1989	1990	1991	1992
Hardwood Lumber (MMBF)	1,494.2	1,627.3	1,762.9	1,886.7
Softwood Lumber (MMBF)	740.1	773.7	848.6	941.0
Particleboard (MM sq ft)	1,024.8	995.4	1,097.1	1,179.1
MDF (MM sq ft)	286.4	314.9	348.3	384.3
Hardboard (MM sq ft)	79.1	84.1	90.1	97.5
OSB (MM sq ft)	6.8	5.3	5.9	6.4
Hardwood Plywood (MM sq ft)	139.5	160.0	185.0	203.3
Softwood Plywood (MM sq ft)	15.9	16.8	18.0	18.2
Dimension Parts (MMBF)	153.4	173.2	181.8	193.1
Dimension Pieces (MM pieces)	27.8	31.6	39.9	47.4
Veneer (MM sq ft)	810.7	832.2	885.3	942.2

Table 3. Total Material Usage -- SIC 2512, Upholstered Furniture.

Material	1989	1990	1991	1992
Hardwood Lumber (MMBF)	696.6	796.4	927.3	1,011.2
Softwood Lumber (MMBF)	112.6	130.6	142.6	157.7
Particleboard (MM sq ft)	30.4	34.8	39.5	44.3
MDF (MM sq ft)	25.1	26.5	29.9	33.4
Hardboard (MM sq ft)	8.6	9.4	10.3	11.0
OSB (MM sq ft)	11.2	15.9	19.9	23.6
Hardwood Plywood (MM sq ft)	50.0	50.4	60.2	67.1
Softwood Plywood (MM sq ft)	167.2	182.2	195.7	210.9
Dimension Parts (MMBF)	17.4	19.2	20.9	21.7
Dimension Pieces (MM pieces)	2.4	2.9	3.2	3.4
Veneer (MM sq ft)	2.7	3.0	3.4	3.8

Table 4. Total Material Usage -- SIC 2521, Wood Office Furniture.

Material	1989	1990	1991	1992
Hardwood Lumber (MMBF)	151.8	162.5	189.7	208.2
Softwood Lumber (MMBF)	12.4	13.0	15.6	17.1
Particleboard (MM sq ft)	278.5	346.1	350.0	393.6
MDF (MM sq ft)	58.8	70.8	85.3	99.9
Hardboard (MM sq ft)	57.6	62.3	86.9	90.3
OSB (MM sq ft)	1.1	1.1	.9	1.1
Hardwood Plywood (MM sq ft)	78.6	90.7	106.6	118.6
Softwood Plywood (MM sq ft)	9.8	10.2	10.9	11.8
Dimension Parts (MMBF)	35.3	37.8	43.9	49.8
Dimension Pieces (MM pieces)	4.5	4.8	5.2	5.6
Veneer (MM sq ft)	211.7	195.4	250.2	274.6

Table 5. 1989 Material Usage by SIC Category.

MATERIALS	SIC 2511	SIC 2512	SIC 2521	TOTAL*
	Wood Household	Upholstered	Wood Office	
Hardwood Lumber (MMBF)	1,494.2	696.6	151.8	2,342.6
Softwood Lumber (MMBF)	740.1	112.6	12.4	865.1
Particleboard (MM sq ft)	1,024.8	30.4	278.5	1,333.7
MDF (MM sq ft)	286.4	25.1	58.8	370.3
Hardboard (MM sq ft)	79.1	8.6	57.6	145.3
OSB (MM sq ft)	6.8	11.2	1.1	19.1
Hardwood Plywood (MM sq ft)	139.5	50.0	78.6	268.1
Softwood Plywood (MM sq ft)	15.9	167.2	9.8	192.9
Dimension Parts (MMBF)	153.4	17.4	35.3	206.1
Dimension Pieces (MM Pieces)	27.8	2.4	4.5	34.7
Veneer (MM sq ft)	810.7	2.7	211.7	1,025.1
* Totals may be less than totals in Table 1 because not all responding firms could be categorized by SIC category.				

Table 6a. Material Usage by Respondent Firm Size.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Top 100 Respondents*	1,283.0	1,369.9	1,475.6	1,549.0
Top 500 Respondents	2,245.9	2,456.2	2,731.4	2,937.4
All Respondents	2,344.2	2,588.3	2,881.9	3,108.2
Softwood Lumber (MMBF)				
Top 100 Respondents	233.8	259.8	286.1	305.6
Top 500 Respondents	748.6	791.5	871.7	998.6
All Respondents	865.1	917.3	1,006.9	1,115.8
Particleboard (MM sq ft)				
Top 100 Respondents	713.7	624.7	710.7	769.1
Top 500 Respondents	1,264.9	1,301.8	1,395.1	1,506.2
All Respondents	1,333.7	1,376.3	1,486.6	1,617.1
MDF (MM sq ft)				
Top 100 Respondents	173.4	176.5	200.4	220.9
Top 500 Respondents	350.1	391.2	435.2	480.6
All Respondents	370.3	412.2	463.5	517.6
Hardboard (MM sq ft)				
Top 100 Respondents	84.6	86.9	113.6	120.2
Top 500 Respondents	133.6	143.4	175.1	186.9
All Respondents	145.3	155.8	187.4	198.8
OSB (MM sq ft)				
Top 100 Respondents	6.8	6.9	7.4	8.1
Top 500 Respondents	12.8	17.5	21.5	25.3
All Respondents	19.6	22.3	26.7	31.1

Table 6b. Material Usage by Respondent Firm Size.

MATERIAL	1989	1990	1991	1992
Hardwood Plywood (MM sq ft)				
Top 100 Respondents	97.9	105.9	117.8	129.0
Top 500 Respondents	216.3	242.1	284.0	311.9
All Respondents	268.1	301.1	351.8	389.1
Softwood Plywood (MM sq ft)				
Top 100 Respondents	129.0	138.8	147.2	156.6
Top 500 Respondents	177.9	191.2	209.9	223.7
All Respondents	192.9	209.2	224.7	241.0
Dimension Parts (MMBF)				
Top 100 Respondents	40.4	42.0	45.9	50.7
Top 500 Respondents	193.9	219.1	236.7	253.8
All Respondents	208.1	230.2	246.7	266.0
Dimension Pieces (MM pieces)				
Top 100 Respondents	6.0	6.5	6.8	7.0
Top 500 Respondents	32.6	35.7	43.4	50.3
All Respondents	33.7	39.3	48.3	56.4
Veneer (MM sq ft)				
Top 100 Respondents	779.8	761.0	807.2	831.9
Top 500 Respondents	1,008.2	1,006.0	1,103.8	1,172.8
All Respondents	1,025.0	1,030.6	1,138.9	1,220.6

* The top 100 respondents (by number of employees) to the survey represented this volume of material used in the final estimates.

Table 7a. Material Usage for Northeast Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	220.91	234.24	246.26	258.61
Upholstered	18.03	24.80	29.42	32.43
Wood Office	15.92	13.70	15.81	16.93
Total	254.86	272.74	291.49	307.97
Softwood Lumber (MMBF)				
Wood Household	50.87	37.12	40.89	44.32
Upholstered	1.78	2.30	2.65	2.92
Wood Office	.62	.42	.49	.51
Total	53.27	39.84	44.03	47.75
Particleboard (MM sq ft)				
Wood Household	109.30	124.33	147.77	175.38
Upholstered	3.27	3.87	4.17	4.48
Wood Office	30.18	28.92	30.53	32.69
Total	142.75	157.12	182.47	212.55
MDF (MM sq ft)				
Wood Household	19.74	20.87	25.24	27.58
Upholstered	.44	.40	.48	.54
Wood Office	1.40	1.74	1.98	2.22
Total	21.58	23.01	27.70	30.34
Hardboard (MM sq ft)				
Wood Household	4.82	4.23	4.41	4.52
Upholstered	.01	.01	.01	.01
Wood Office	4.27	1.27	1.25	1.26
Total	9.10	5.51	5.67	5.79

Table 7b. Material Usage for Northeast Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	2,363.2	*	*	*
Upholstered	95.80	88.13	113.46	144.92
Wood Office	*	*	*	*
Total	*	*	*	*
Hardwood Plywood (MM sq ft)				
Wood Household	39.49	50.86	57.47	63.43
Upholstered	1.61	2.12	2.68	3.14
Wood Office	3.18	3.54	3.96	4.51
Total	44.28	56.52	64.11	71.08
Softwood Plywood (MM sq ft)				
Wood Household	1.21	.85	.93	.99
Upholstered	1.50	1.93	1.99	2.07
Wood Office	1.06	1.51	1.56	1.60
Total	3.77	4.29	4.48	4.66
Dimension Parts (MMBF)				
Wood Household	12.20	11.75	12.96	14.38
Upholstered	.01	.01	.03	.03
Wood Office	7.78	8.71	9.75	10.89
Total	19.99	20.47	22.74	25.30
Dimension Pieces (MM pieces)				
Wood Household	3.35	3.34	3.44	3.36
Upholstered	.10	.11	.15	.19
Wood Office	.82	.85	.88	.91
Total	4.27	4.30	4.47	4.46

Table 7c. Material Usage for Northeast Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	8.13	7.27	8.06	8.51
Upholstered	.13	.16	.17	.18
Wood Office	43.87	51.46	99.53	117.9
Total	52.13	58.89	107.76	126.59

* Too few respondents for a meaningful estimate

Table 8a. Material Usage for Southeast Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	1,011.65	1,106.05	1,183.26	1,260.04
Upholstered	344.32	394.08	455.73	496.05
Wood Office	84.42	90.14	109.59	120.77
Total	1,440.39	1,590.27	1,748.58	1,876.86
Softwood Lumber (MMBF)				
Wood Household	270.06	283.07	300.59	320.02
Upholstered	19.72	22.66	25.56	30.24
Wood Office	2.71	4.22	5.71	5.87
Total	292.49	309.95	331.86	356.13
Particleboard (MM sq ft)				
Wood Household	532.19	598.68	638.82	670.24
Upholstered	15.49	18.14	20.82	23.53
Wood Office	113.10	118.98	145.40	163.03
Total	660.78	735.80	805.05	856.80
MDF (MM sq ft)				
Wood Household	130.67	149.82	169.28	191.95
Upholstered	2.17	2.84	3.39	4.03
Wood Office	26.67	28.21	37.56	46.45
Total	159.51	180.87	210.23	242.43
Hardboard (MM sq ft)				
Wood Household	27.76	30.22	30.94	32.94
Upholstered	2.16	2.35	2.53	2.68
Wood Office	14.41	15.21	19.59	19.98
Total	44.33	47.78	53.06	55.60

Table 8b. Material Usage for Southeast Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	2.85	3.10	3.36	3.62
Upholstered	6.60	8.50	11.28	14.35
Wood Office	.07	.08	.06	.06
Total	9.52	11.68	14.70	18.03
Hardwood Plywood (MM sq ft)				
Wood Household	33.75	31.79	35.04	38.74
Upholstered	16.17	16.82	19.12	22.61
Wood Office	11.08	13.10	17.50	19.37
Total	61.00	61.71	71.66	80.72
Softwood Plywood (MM sq ft)				
Wood Household	5.29	4.65	5.25	6.39
Upholstered	19.92	23.52	26.47	33.03
Wood Office	2.26	2.41	2.49	2.58
Total	27.47	30.58	34.21	42.00
Dimension Parts (MMBF)				
Wood Household	53.68	48.99	55.10	61.73
Upholstered	14.98	16.15	17.25	17.52
Wood Office	23.65	24.84	29.27	33.23
Total	92.31	89.98	101.62	112.48
Dimension Pieces (MM pieces)				
Wood Household	16.52	20.22	27.18	33.01
Upholstered	1.29	1.34	1.13	1.18
Wood Office	1.84	1.92	2.01	2.16
Total	19.65	23.48	30.32	36.35

Table 8c. Material Usage for Southeast Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	707.33	729.72	772.01	798.57
Upholstered	1.16	1.29	1.39	1.52
Wood Office	74.47	47.97	52.16	55.02
Total	782.96	778.98	825.56	855.11

Table 9a. Material Usage for South Central Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	60.71	70.48	76.77	84.72
Upholstered	245.81	278.63	323.04	351.52
Wood Office	.04	.04	.05	.05
Total	306.56	349.15	399.86	436.29
Softwood Lumber (MMBF)				
Wood Household	54.37	65.92	67.21	77.52
Upholstered	15.70	17.60	17.89	19.58
Wood Office	.01	.01	.01	.01
Total	70.08	83.53	85.11	97.11
Particleboard (MM sq ft)				
Wood Household	*	*	*	*
Upholstered	5.02	5.11	5.44	5.52
Wood Office	.08	.05	.05	.05
Total	*	*	*	*
MDF (MM sq ft)				
Wood Household	65.10	62.32	63.72	65.57
Upholstered	.39	.75	.94	1.12
Wood Office	.29	.01	.01	.01
Total	65.78	63.08	64.67	66.70
Hardboard (MM sq ft)				
Wood Household	12.22	11.18	11.83	12.07
Upholstered	0	0	0	0
Wood Office	.01	.01	.01	.01
Total	12.23	11.19	11.84	12.08

Table 9b. Material Usage for South Central Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	0	0	0	0
Upholstered	2.41	2.45	2.50	2.53
Wood Office	0	0	0	0
Total	2.41	2.45	2.50	2.53
Hardwood Plywood (MM sq ft)				
Wood Household	5.63	6.42	7.80	8.82
Upholstered	27.71	26.45	32.48	34.59
Wood Office	.04	.04	.04	.04
Total	33.38	32.91	40.32	43.45
Softwood Plywood (MM sq ft)				
Wood Household	.90	.85	.94	.98
Upholstered	111.50	118.64	126.69	134.13
Wood Office	.02	.02	.02	.02
Total	112.42	119.51	127.65	153.13
Dimension Parts (MMBF)				
Wood Household	11.32	12.45	13.37	15.11
Upholstered	.65	.71	.78	.86
Wood Office	0	0	0	0
Total	11.97	13.16	14.15	15.97
Dimension Pieces (MM pieces)				
Wood Household	.85	*	*	*
Upholstered	0	0	0	0
Wood Office	*	*	*	*
Total	*	*	*	*

Table 9c. Material Usage for South Central Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	17.03	17.42	14.27	14.23
Upholstered	.13	.22	.26	.33
Wood Office	*	*	*	*
Total	*	*	*	*

* Too few respondents for a meaningful estimate

Table 10a. Material Usage for the Midwest Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	125.73	135.76	163.46	178.42
Upholstered	44.05	52.73	62.42	66.78
Wood Office	37.19	40.18	45.62	49.63
Total	206.97	228.67	271.50	294.83
Softwood Lumber (MMBF)				
Wood Household	107.16	132.82	160.08	185.05
Upholstered	15.59	16.23	17.99	20.17
Wood Office	7.97	7.16	8.10	9.13
Total	130.72	156.21	186.17	214.35
Particleboard (MM sq ft)				
Wood Household	115.19	132.80	147.50	143.29
Upholstered	2.57	2.97	3.31	3.79
Wood Office	107.17	113.82	134.23	153.99
Total	224.93	249.59	285.04	301.07
MDF (MM sq ft)				
Wood Household	46.87	52.25	57.30	63.10
Upholstered	21.09	21.54	23.85	26.34
Wood Office	27.32	37.95	42.33	47.39
Total	95.28	111.74	123.48	136.83
Hardboard (MM sq ft)				
Wood Household	22.98	25.84	29.71	33.39
Upholstered	2.02	2.05	2.34	2.57
Wood Office	36.79	43.61	63.77	68.06
Total	61.79	71.50	95.82	104.02

Table 10b. Material Usage for the Midwest Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	.96	.94	1.01	1.01
Upholstered	.74	.77	.86	.94
Wood Office	.74	.72	.66	.80
Total	2.44	2.43	2.53	2.75
Hardwood Plywood (MM sq ft)				
Wood Household	33.28	39.69	44.76	48.02
Upholstered	2.29	2.47	2.91	3.00
Wood Office	58.97	67.39	76.99	85.14
Total	94.54	109.55	124.66	136.16
Softwood Plywood (MM sq ft)				
Wood Household	4.56	6.16	7.44	5.96
Upholstered	12.48	16.34	18.27	18.32
Wood Office	4.74	4.12	4.34	4.51
Total	21.78	26.62	30.05	28.79
Dimension Parts (MMBF)				
Wood Household	48.15	54.58	51.57	54.90
Upholstered	.02	.39	*	*
Wood Office	3.52	3.76	4.34	4.90
Total	51.69	58.73	*	*
Dimension Pieces (MM pieces)				
Wood Household	4.29	4.67	5.32	6.30
Upholstered	.21	.59	1.04	1.05
Wood Office	1.70	1.85	2.06	2.20
Total	6.20	7.11	8.42	9.55

Table 10c. Material Usage for the Midwest Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	42.56	34.47	40.94	45.49
Upholstered	.50	.53	.61	.65
Wood Office	67.50	56.13	61.88	63.72
Total	110.56	91.13	103.43	109.86

* Too few respondents for a meaningful estimate

Table 11a. Material Usage for West Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	16.42	16.52	17.92	19.71
Upholstered	4.78	4.66	5.46	6.33
Wood Office	1.34	1.17	1.26	1.37
Total	22.54	22.35	24.64	27.41
Softwood Lumber (MMBF)				
Wood Household	145.02	175.49	196.00	214.33
Upholstered	7.98	11.13	13.12	13.46
Wood Office	.03	.03	.03	.03
Total	153.03	186.65	209.15	227.82
Particleboard (MM sq ft)				
Wood Household	3.61	3.60	4.67	4.97
Upholstered	.01	.01	.01	.01
Wood Office	1.41	.70	.77	.84
Total	5.03	4.31	5.45	5.82
MDF (MM sq ft)				
Wood Household	.55	.57	.69	.77
Upholstered	.01	.01	.01	.01
Wood Office	.29	.27	.29	.33
Total	.85	.85	.99	1.11
Hardboard (MM sq ft)				
Wood Household	.65	.66	.76	.79
Upholstered	.01	.01	.01	.01
Wood Office	*	*	*	*
Total	*	*	*	*

Table 11b. Material Usage for West Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	.64	.64	.83	1.02
Upholstered	*	*	*	*
Wood Office	*	*	*	*
Total	*	*	*	*
Hardwood Plywood (MM sq ft)				
Wood Household	7.55	8.69	10.43	11.74
Upholstered	.14	.08	.17	.25
Wood Office	.99	1.04	1.04	1.14
Total	8.68	9.81	11.64	13.13
Softwood Plywood (MM sq ft)				
Wood Household	921.42	*	*	*
Upholstered	*	*	*	*
Wood Office	.04	*	*	*
Total	*	*	*	*
Dimension Parts (MMBF)				
Wood Household	.03	*	*	*
Upholstered	*	*	*	*
Wood Office	*	*	*	*
Total	*	*	*	*
Dimension Pieces (MM pieces)				
Wood Household	1.12	1.25	1.56	1.88
Upholstered	.01	.01	.01	.01
Wood Office	*	*	*	*
Total	*	*	*	*

Table 11c. Material Usage for West Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	1.07	*	*	*
Upholstered	.05	.03	.02	.02
Wood Office	.05	.03	.02	.02
Total	1.17	*	*	*

* Too few respondents for a meaningful estimate

Table 12a. Material Usage for West Coast Region.

MATERIAL	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Wood Household	58.17	63.56	74.35	84.09
Upholstered	37.28	41.62	35.21	41.13
Wood Office	12.45	17.25	17.40	19.45
Total	107.90	122.43	126.96	144.67
Softwood Lumber (MMBF)				
Wood Household	81.65	79.26	83.86	99.79
Upholstered	51.86	60.64	65.42	71.36
Wood Office	1.02	1.19	1.32	1.57
Total	134.53	141.09	150.60	172.72
Particleboard (MM sq ft)				
Wood Household	53.21	61.23	74.51	90.52
Upholstered	3.97	4.71	5.53	6.76
Wood Office	26.58	83.63	38.99	43.02
Total	83.76	149.57	119.03	140.30
MDF (MM sq ft)				
Wood Household	22.38	27.64	30.35	33.25
Upholstered	.99	.99	1.20	1.33
Wood Office	2.79	2.62	3.09	3.50
Total	26.16	31.25	34.64	38.08
Hardboard (MM sq ft)				
Wood Household	10.58	11.99	12.50	13.81
Upholstered	4.42	4.94	5.45	5.72
Wood Office	1.91	2.18	2.30	1.01
Total	16.91	19.11	20.25	20.54

Table 12b. Material Usage for West Coast Region.

MATERIAL	1989	1990	1991	1992
OSB (MM sq ft)				
Wood Household	.01	*	*	*
Upholstered	1.23	1.57	1.64	1.79
Wood Office	.14	.16	.18	.20
Total	1.38	*	*	*
Hardwood Plywood (MM sq ft)				
Wood Household	19.76	22.52	29.51	32.55
Upholstered	2.11	2.42	2.88	2.54
Wood Office	4.36	5.65	7.06	8.44
Total	26.23	30.59	39.45	43.53
Softwood Plywood (MM sq ft)				
Wood Household	3.07	3.61	3.14	3.52
Upholstered	20.38	21.54	22.04	23.19
Wood Office	1.64	2.13	2.54	3.13
Total	25.09	27.28	27.72	29.84
Dimension Parts (MMBF)				
Wood Household	3.52	6.16	7.35	7.33
Upholstered	1.76	2.36	2.82	3.28
Wood Office	.37	.45	.62	.75
Total	5.65	8.97	10.79	11.36
Dimension Pieces (MM pieces)				
Wood Household	1.70	2.12	2.38	2.90
Upholstered	.82	.86	.92	.98
Wood Office	.14	.18	.22	.29
Total	2.66	3.16	3.52	4.17

Table 12c. Material Usage for West Coast Region.

MATERIAL	1989	1990	1991	1992
Veneer (MM sq ft)				
Wood Household	32.92	38.01	47.36	71.92
Upholstered	.70	.79	.93	1.07
Wood Office	25.81	39.84	36.59	37.99
Total	59.43	78.64	84.88	110.98

* Too few respondents for a meaningful estimate

Table 13. 1989 Hardwood Species Use.

Species	MMBF Used	% of Total
Red Oak	628.9	26.92
Yellow Poplar	355.8	15.23
White Oak	246.7	10.56
Hard Maple	204.9	8.77
Soft Maple	182.0	7.79
Black Cherry	149.0	6.38
Ash	107.4	4.60
Sap Gum	79.8	3.42
Hickory/Pecan	62.4	2.67
Beech	59.0	2.53
Alder	55.7	2.38
Mahogany	45.6	1.95
Yellow Birch	27.0	1.16
Hackberry	21.7	.93
Black Walnut	21.6	.92
Elm	10.1	.43
Tupelo Gum	9.3	.40
Cottonwood	6.1	.26
Other	63.3	2.70
Totals*	2,336.3	100.00

* Total will be less than total in Table 1 because a few respondents did not provide a species breakdown.

Table 14. 1989 Hardwood Species Use by Region.

Species	Totals	Volume by Region (MMBF)					
		North-east	South-east	South Central	Mid-west	West	West Coast
Red Oak	628.9	60.0	349.8	111.3	51.3	11.9	44.6
Yellow Poplar	355.8	2.3	300.1	34.4	17.6	.7	.7
White Oak	246.7	4.7	183.7	40.2	8.8	.1	9.2
Hard Maple	204.9	37.4	123.4	1.8	40.0	.4	1.9
Soft Maple	182.0	15.1	114.3	23.4	28.4	.1	.7
Black Cherry	149.0	55.5	81.1	2.9	6.8	1.8	.9
Ash	107.4	20.1	50.8	16.2	19.6	.1	.6
Sap Gum	79.8	0	37.2	39.5	3.1	0	0
Hickory/Pecan	62.4	1.3	48.1	11.5	1.1	.4	0
Beech	59.0	22.7	25.3	.1	10.7	.1	.1
Alder	55.7	.1	1.2	.8	3.9	4.7	45.0
Mahogany	45.6	2.7	36.7	.5	3.9	.7	1.1
Yellow Birch	27.0	21.8	3.2	.5	.8	.6	.1
Hackberry	21.7	2.0	14.0	5.0	.7	0	0
Black Walnut	21.6	1.8	10.5	.4	5.1	.9	2.9
Elm	10.1	0	3.6	5.7	.8	0	0
Tupelo Gum	9.3	1.9	5.6	1.4	.4	0	0
Cottonwood	6.1	0	4.0	1.5	.6	0	0
Other	63.3	7.4	43.9	8.4	2.1	.2	1.3
Totals*	2,336.3	256.8	1,436.5	305.5	205.7	22.7	109.1

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

Table 15a. Volumes of Materials Used by Firms Producing Solid Hardwood or Hardwood Veneered Furniture at Their Location versus Those Who Do Not.

MATERIALS	1989	1990	1991	1992
Hardwood Lumber (MMBF)				
Produce	1,572.3	1,726.2	1,905.3	2,046.3
Don't Produce	770.9	861.6	976.2	1,061.3
Softwood Lumber (MMBF)				
Produce	200.7	207.9	218.3	274.1
Don't Produce	663.7	708.5	787.6	873.8
Particleboard (MM sq ft)				
Produce	296.1	355.8	339.2	374.7
Don't Produce	1,024.7	1,007.2	1,133.7	1,228.6
MDF (MM sq ft)				
Produce	129.1	153.1	173.3	200.9
Don't Produce	241.1	259.1	290.1	316.5
Hardboard (MM sq ft)				
Produce	75.6	71.0	74.2	77.5
Don't Produce	69.6	84.8	113.2	121.3
OSB (MM sq ft)				
Produce	2.7	2.9	3.1	3.5
Don't Produce	16.4	19.4	23.6	27.6
Hardwood Plywood (MM sq ft)				
Produce	195.8	219.2	251.9	276.1
Don't Produce	72.3	81.8	99.8	112.9

Table 15b. Volumes of Materials Used by Firms Producing Solid Hardwood or Hardwood Veneered Furniture at Their Location versus Those Who Do Not.

MATERIALS	1989	1990	1991	1992
Softwood Plywood (MM sq ft)				
Produce	58.2	66.5	73.9	80.8
Don't Produce	134.6	142.6	150.8	160.2
Dimension Parts (MM sq ft)				
Produce	145.8	161.4	171.3	183.2
Don't Produce	62.3	68.7	75.3	82.8
Dimension Pieces (MMBF)				
Produce	27.6	32.9	41.7	49.7
Don't Produce	7.2	6.4	6.6	6.8
Veneer (MM pieces)				
Produce	846.2	831.9	912.6	961.6
Don't Produce	178.8	198.7	226.2	259.0

(Material Volumes By Estimation Group)

Table 16. Material Use Estimates For Wood Household (SIC 2511), Upholstered (SIC 2512) and Wood Office Furniture (SIC 2521) By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	828.9	848.4	453.3	213.6
Softwood Lumber (MMBF)	101.8	198.4	468.5	96.4
Particleboard (MM sq.ft.)	491.4	277.0	428.6	136.7
MDF (MM sq.ft.)	84.4	77.0	147.9	61.0
Hardboard (MM sq.ft.)	43.2	51.5	26.3	24.3
OSB (MM sq.ft.)	0.1	10.1	5.3	3.6
Hardwood Plywood (MM sq.ft.)	26.3	56.9	77.9	107.0
Softwood Plywood (MM sq.ft.)	30.2	110.8	39.3	12.6
Dimension Parts (MMBF)	6.5	67.1	74.5	58.0
Dimension Pieces (MM pieces)	3.8	6.0	24.0	0.9
Veneer (MM sq.ft.)	617.3	215.2	177.0	15.5

Table 17. Material Use Estimates For Wood Household Furniture By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	710.7	440.5	247.3	95.7
Softwood Lumber (MMBF)	98.4	164.3	385.1	92.3
Particleboard (MM sq.ft.)	414.0	220.0	344.7	46.1
MDF (MM sq.ft.)	83.3	60.5	120.0	22.6
Hardboard (MM sq.ft.)	22.3	38.9	13.2	4.7
OSB (MM sq.ft.)	0	2.9	1.2	2.7
Hardwood Plywood (MM sq.ft.)	16.2	22.0	51.8	49.5
Softwood Plywood (MM sq.ft.)	0.2	2.8	7.0	5.9
Dimension Parts (MMBF)	6.5	42.3	64.5	40.1
Dimension Pieces (MM pieces)	2.3	3.7	20.9	0.9
Veneer (MM sq.ft.)	567.8	128.1	106.9	7.9

Table 18. Material Use Estimates For Upholstered Household Furniture By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	113.2	363.7	169.3	50.4
Softwood Lumber (MMBF)	2.8	31.8	74.8	3.2
Particleboard (MM sq.ft.)	3.8	9.5	14.0	3.1
MDF (MM sq.ft.)	0.7	1.2	22.7	0.5
Hardboard (MM sq.ft.)	0	0.2	4.3	4.1
OSB (MM sq.ft.)	0	7.3	3.9	0
Hardwood Plywood (MM sq.ft.)	8.5	23.5	14.1	3.9
Softwood Plywood (MM sq.ft.)	28.5	105.7	29.0	4.0
Dimension Parts (MMBF)	0	12.6	4.8	0
Dimension Pieces (MM pieces)	0.1	1.5	0.8	0
Veneer (MM sq.ft.)	0	1.3	0.5	0.8

Table 19. Material Use Estimates For Wood Office Furniture By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	4.9	44.2	35.3	67.4
Softwood Lumber (MMBF)	0.6	2.3	8.7	0.8
Particleboard (MM sq.ft.)	73.7	47.5	69.8	87.5
MDF (MM sq.ft.)	0.5	15.3	5.1	37.9
Hardboard (MM sq.ft.)	20.9	12.4	8.8	15.5
OSB (MM sq.ft.)	0.1	0	0.2	0.8
Hardwood Plywood (MM sq.ft.)	1.6	11.3	12.1	53.6
Softwood Plywood (MM sq.ft.)	1.5	2.3	3.3	2.7
Dimension Parts (MMBF)	0	12.2	5.1	18.0
Dimension Pieces (MM pieces)	1.4	0.9	2.2	0
Veneer (MM sq.ft.)	49.4	85.8	69.7	6.8

Table 20. Material Use Estimates For Northeast Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	44.6	98.6	81.7	32.4
Softwood Lumber (MMBF)	1.7	20.9	11.4	19.3
Particleboard (MM sq.ft.)	109.6	4.7	15.3	13.1
MDF (MM sq.ft.)	7.6	6.6	3.0	4.4
Hardboard (MM sq.ft.)	0.3	3.4	4.2	1.2
OSB (MM sq.ft.)	0	0	0.3	2.2
Hardwood Plywood (MM sq.ft.)	2.9	2.5	9.3	29.6
Softwood Plywood (MM sq.ft.)	0.2	0.6	2.0	0.9
Dimension Parts (MMBF)	1.0	12.4	4.0	2.5
Dimension Pieces (MM pieces)	2.1	0.1	1.6	0.5
Veneer (MM sq.ft.)	12.7	4.5	30.7	4.2

Table 21. Material Use Estimates For Southeast Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	659.1	445.4	223.2	113.1
Softwood Lumber (MMBF)	50.0	61.0	170.5	11.0
Particleboard (MM sq.ft.)	104.6	176.6	316.5	63.1
MDF (MM sq.ft.)	23.4	28.5	75.2	32.4
Hardboard (MM sq.ft.)	13.8	11.8	6.2	12.5
OSB (MM sq.ft.)	0.1	6.4	3.0	0
Hardwood Plywood (MM sq.ft.)	9.9	25.5	15.4	10.2
Softwood Plywood (MM sq.ft.)	12.3	7.7	3.3	4.1
Dimension Parts (MMBF)	2.3	42.3	29.6	18.1
Dimension Pieces (MM pieces)	1.6	2.3	15.4	0.4
Veneer (MM sq.ft.)	561.7	139.1	77.5	4.6

Table 22. Material Use Estimates For South Central Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	65.6	186.8	45.9	8.2
Softwood Lumber (MMBF)	2.8	17.0	20.6	29.6
Particleboard (MM sq.ft.)	185.1	16.6	14.6	0.1
MDF (MM sq.ft.)	15.3	9.3	35.2	6.0
Hardboard (MM sq.ft.)	1.9	10.1	0.2	0
OSB (MM sq.ft.)	0	2.4	0	0
Hardwood Plywood (MM sq.ft.)	2.1	15.8	12.7	2.7
Softwood Plywood (MM sq.ft.)	10.2	87.6	14.2	0.4
Dimension Parts (MMBF)	0	0.6	11.3	0
Dimension Pieces (MM pieces)	0	0.9	0	0
Veneer (MM sq.ft.)	0	13.9	3.3	0

Table 23. Material Use Estimates For Midwest Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	59.6	81.2	54.6	11.6
Softwood Lumber (MMBF)	2.0	46.9	56.0	25.8
Particleboard (MM sq.ft.)	92.1	46.1	52.6	34.1
MDF (MM sq.ft.)	38.2	12.2	28.8	16.1
Hardboard (MM sq.ft.)	27.1	21.4	8.8	4.5
OSB (MM sq.ft.)	0	0	1.7	0.7
Hardwood Plywood (MM sq.ft.)	11.5	12.3	16.6	54.1
Softwood Plywood (MM sq.ft.)	7.4	4.2	6.2	4.0
Dimension Parts (MMBF)	3.0	10.0	1.2	37.4
Dimension Pieces (MM pieces)	0.1	1.1	5.0	0
Veneer (MM sq.ft.)	42.8	43.7	21.4	2.6

Table 24. Material Use Estimates For West Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	0	0	12.7	9.8
Softwood Lumber (MMBF)	0	0	148.1	4.9
Particleboard (MM sq.ft.)	0	0	2.3	2.7
MDF (MM sq.ft.)	0	0	0.4	0.4
Hardboard (MM sq.ft.)	0	0	0.6	0.3
OSB (MM sq.ft.)	0	0	0.2	0.6
Hardwood Plywood (MM sq.ft.)	0	0	7.3	1.3
Softwood Plywood (MM sq.ft.)	0	0	1.6	0.7
Dimension Parts (MMBF)	0	0	0	0
Dimension Pieces (MM pieces)	0	0	1.1	0
Veneer (MM sq.ft.)	0	0	0.3	0.9

Table 25. Material Use Estimates For West Coast Region By Estimation Group.

Material	Group 1	Group 2	Group 3	Group 4
Hardwood Lumber (MMBF)	0	36.5	34.5	38.5
Softwood Lumber (MMBF)	45.3	21.5	62.0	5.7
Particleboard (MM sq.ft.)	0	33.0	27.2	23.6
MDF (MM sq.ft.)	0	20.5	4.2	1.5
Hardboard (MM sq.ft.)	0	4.9	6.3	5.7
OSB (MM sq.ft.)	0	1.2	0.1	0
Hardwood Plywood (MM sq.ft.)	0	0.8	16.4	9.0
Softwood Plywood (MM sq.ft.)	0	10.6	12.0	2.4
Dimension Parts (MMBF)	0	1.8	3.8	0.1
Dimension Pieces (MM pieces)	0	1.7	0.9	0
Veneer (MM sq.ft.)	0	14.0	42.3	3.1

(Error Estimates)

Using typical sample size calculations, the sample size is large enough to give a high level of precision (i.e., ± 1 to 2% at the 95% confidence level). Unfortunately, traditional estimates of the precision of a total derived from a sample are driven by the size of the standard deviation about the volume estimates and with this sample the standard deviation for most estimates is very large. This is a result of the enormous variation in manufacturer sizes within the furniture industry. Therefore, any estimates of the precision of these data are so varied that interpretation of these estimates may not be very meaningful.

Error estimates were performed on mainframe SPSS. The equation used to calculate standard deviations about the material volumes is described below:

$$S.D. (\hat{\epsilon}) = \left[\sum_{i=1}^4 \frac{N_i^2}{n_i^2} n_i s_i^2 \frac{(N_i - n_i)^2}{N_i} \right]^{1/2} \quad (1.0)$$

where,

S.D. ($\hat{\epsilon}$) = Standard deviation for a material volume estimate
N_i = Number of manufacturing locations in a group
n_i = Number of good responses in a group

$$s_i^2 = \sum_{j=1}^{n_i} \frac{(X_{ij} - \bar{X}_i)^2}{n_i - 1} \quad (1.5)$$

where,

$\frac{X_{ij}}{\bar{X}_i}$ = Material volume for observation j within group i
= Average material volume within group i

Source: William G. Cochran 1977. Sampling Techniques. Third Edition. John Wiley & Sons.

Notice equation 1.0 includes a summation across four groups. Error estimates for each estimation group were therefore derived using equation 1.0 minus the

summation.

Ninety-five percent confidence intervals were derived from the standard deviations for the final volume estimates and for the 1989 estimates by estimation group. The equation for calculating the confidence intervals is described below:

$$C.I. = Vol \pm 1.96 [S.D. (\hat{\tau})] \quad (2.0)$$

where,

C.V. = Confidence interval
Vol = Material volume estimate

For the interested reader, the following tables provide a summary of the error estimates for the material use data.

Table 26. 95% Confidence Intervals for 1989 Wood Household, Upholstered and Wood Office Furniture Material use Estimates and for the Total Use Estimates for All Three Industry Segments.

MATERIALS	SIC 2511	SIC 2512	SIC 2521	All Three SIC's Combined (+/-)
	Wood Household (+/-)	Upholstered (+/-)	Wood Office (+/-)	
Hardwood Lumber (MMBF)	486.4	359.5	293.6	450.6
Softwood Lumber (MMBF)	492.7	136.7	17.3	354.8
Particleboard (MM sq.ft.)	641.5	25.2	298.6	487.5
MDF (MM sq.ft.)	153.9	60.8	136.2	133.0
Hardboard (MM sq.ft.)	60.4	17.1	127.7	70.9
OSB (MM sq.ft.)	8.8	16.0	3.5	11.3
Hardwood Plywood (MM sq.ft.)	68.8	44.6	231.4	106.1
Softwood Plywood (MM sq.ft.)	7.2	231.4	14.2	138.1
Dimension Parts (MMBF)	122.1	39.9	108.6	110.0
Dimension Pieces (MM Pieces)	30.6	5.1	8.3	22.6
Veneer (MM sq.ft.)	548.6	5.3	229.4	446.7

Table 27. 95% Confidence Intervals for 1989 Material Use Estimates by Geographic Region.

MATERIALS	Regions					
	North-east (+/-)	South-east (+/-)	South Central (+/-)	Mid-west (+/-)	West (+/-)	West Coast (+/-)
Hardwood Lumber (MMBF)	237.2	587.6	302.1	168.1	47.9	124.4
Softwood Lumber (MMBF)	74.9	230.3	381.9	337.1	793.2	116.5
Particleboard (MM sq.ft.)	400.8	663.6	630.3	264.1	10.3	107.4
MDF (MM sq. ft.)	45.6	142.5	230.6	168.7	1.6	107.6
Hardboard (MM sq.ft.)	17.9	44.8	47.7	124.4	1.9	22.9
OSB (MM sq.ft.)	7.6	14.5	11.5	5.1	3.6	6.6
Hardwood Plywood (MM sq.ft.)	102.5	36.8	61.3	189.4	31.3	38.8
Softwood Plywood (MM sq.ft.)	6.1	35.7	315.7	34.9	7.6	45.6
Dimension Parts (MMBF)	67.1	97.5	66.7	149.5	0.2	15.5
Dimension Pieces (MM Pieces)	10.3	36.4	4.0	12.8	6.4	9.5
Veneer (MM sq.ft.)	89.6	588.0	65.7	186.8	14.5	96.3

Table 28. 95 % Confidence Intervals For Wood Household (SIC 2511), Upholstered (SIC 2512) and Wood Office (SIC 2521) By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	335.9	246.6	122.2	120.3
Softwood Lumber (MMBF)	82.4	233.7	246.9	59.1
Particleboard (MM sq.ft.)	278.9	169.1	346.1	107.2
MDF (MM sq.ft.)	59.9	58.8	90.1	50.3
Hardboard (MM sq.ft.)	34.7	57.2	9.6	21.5
OSB (MM sq.ft.)	0.1	9.5	4.9	3.7
Hardwood Plywood (MM sq.ft.)	18.0	36.1	25.9	94.6
Softwood Plywood (MM sq.ft.)	26.3	134.1	19.2	5.2
Dimension Parts (MMBF)	4.7	65.6	47.0	74.3
Dimension Pieces (MM pieces)	4.0	6.1	21.4	1.0
Veneer (MM sq.ft.)	408.0	154.0	96.3	8.7

Table 29. 95 % Confidence Intervals for Wood Household Furniture (SIC 2511) By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	403.5	217.5	152.5	56.5
Softwood Lumber (MMBF)	102.0	334.1	340.4	69.7
Particleboard (MM sq.ft.)	341.3	242.8	483.9	44.1
MDF (MM sq.ft.)	73.3	63.2	117.5	22.9
Hardboard (MM sq.ft.)	17.9	56.9	9.0	3.8
OSB (MM sq.ft.)	0	7.5	2.1	4.2
Hardwood Plywood (MM sq.ft.)	21.2	23.5	30.8	52.8
Softwood Plywood (MM sq.ft.)	0.2	4.2	5.3	2.6
Dimension Parts (MMBF)	2.7	66.9	64.5	79.2
Dimension Pieces (MM pieces)	4.2	6.1	29.7	1.1
Veneer (MM sq.ft.)	504.7	179.4	118.2	6.0

Table 30. 95% Confidence Intervals For Upholstered Household Furniture (SIC 2512) By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	97.3	319.4	99.7	88.3
Softwood Lumber (MMBF)	8.5	115.2	72.6	8.2
Particleboard (MM sq.ft.)	6.5	16.2	17.0	6.5
MDF (MM sq.ft.)	1.8	2.4	60.7	1.0
Hardboard (MM sq.ft.)	0	0.5	7.6	15.3
OSB (MM sq.ft.)	0	13.4	8.7	0.2
Hardwood Plywood (MM sq.ft.)	12.7	37.2	19.5	8.2
Softwood Plywood (MM sq.ft.)	50.4	223.1	34.3	6.4
Dimension Parts (MMBF)	0	37.7	13.0	0
Dimension Pieces (MM pieces)	0.3	4.8	1.7	0
Veneer (MM sq.ft.)	0	4.6	0.7	2.6

Table 31. 95 % Confidence Intervals for Wood Office Furniture (SIC 2521) By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	16.4	55.6	30.6	286.2
Softwood Lumber (MMBF)	2.0	7.2	15.6	1.1
Particleboard (MM sq.ft.)	77.7	68.6	61.5	273.2
MDF (MM sq.ft.)	1.0	50.5	4.2	126.4
Hardboard (MM sq.ft.)	90.0	70.3	13.4	55.6
OSB (MM sq.ft.)	0.2	0.1	0.5	3.5
Hardwood Plywood (MM sq.ft.)	6.0	38.4	19.5	227.3
Softwood Plywood (MM sq.ft.)	5.6	6.1	4.4	10.7
Dimension Parts (MMBF)	0	59.7	10.5	90.1
Dimension Pieces (MM pieces)	6.3	3.2	4.3	0.1
Veneer (MM sq.ft.)	108.5	173.2	102.5	18.9

Table 32. 95 % Confidence Intervals For Northeast Region By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	81.8	186.0	97.6	73.7
Softwood Lumber (MMBF)	7.7	59.9	16.0	41.4
Particleboard (MM sq.ft.)	398.9	13.8	18.4	31.1
MDF (MM sq.ft.)	32.6	29.1	5.7	11.8
Hardboard (MM sq.ft.)	1.1	12.1	12.6	3.6
OSB (MM sq.ft.)	0.1	0	0.8	7.6
Hardwood Plywood (MM sq.ft.)	6.9	8.2	18.9	100.2
Softwood Plywood (MM sq.ft.)	1.1	3.2	4.7	1.9
Dimension Parts (MMBF)	2.8	66.2	8.3	6.3
Dimension Pieces (MM pieces)	9.6	0.3	3.4	1.6
Veneer (MM sq.ft.)	40.6	11.9	78.0	12.3

Table 33. 95 % Confidence Intervals for Southeast Region By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	430.0	283.9	180.6	217.2
Softwood Lumber (MMBF)	54.8	105.9	196.7	10.8
Particleboard (MM sq.ft.)	71.0	221.0	598.4	168.5
MDF (MM sq.ft.)	21.3	25.6	112.9	80.3
Hardboard (MM sq.ft.)	17.8	16.1	7.2	37.1
OSB (MM sq.ft.)	0.1	12.2	7.9	0
Hardwood Plywood (MM sq.ft.)	11.3	28.4	18.3	9.2
Softwood Plywood (MM sq.ft.)	23.6	26.3	3.6	3.9
Dimension Parts (MMBF)	3.0	64.3	38.8	62.1
Dimension Pieces (MM pieces)	3.0	5.3	35.9	1.2
Veneer (MM sq.ft.)	536.7	197.1	136.8	9.3

Table 34. 95 % Confidence Intervals for South Central Region By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group4 + -
Hardwood Lumber (MMBF)	104.5	234.7	138.6	77.2
Softwood Lumber (MMBF)	11.0	216.4	63.0	308.1
Particleboard (MM sq.ft.)	624.6	62.2	57.0	0.7
MDF (MM sq.ft.)	66.7	43.8	207.5	61.4
Hardboard (MM sq.ft.)	8.0	47.0	0.9	0.1
OSB (MM sq.ft.)	0	11.5	0	0
Hardwood Plywood (MM sq.ft.)	6.2	40.1	39.9	22.9
Softwood Plywood (MM sq.ft.)	46.6	306.9	57.2	3.0
Dimension Parts (MMBF)	0	3.0	66.5	0
Dimension Pieces (MM pieces)	0	4.0	0	0
Veneer (MM sq.ft.)	0	62.8	19.2	0.1

Table 35. 95% Confidence Intervals For Midwest Region By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	100.6	110.6	76.2	10.7
Softwood Lumber (MMBF)	7.2	323.3	85.2	42.4
Particleboard (MM sq.ft.)	184.9	131.2	78.5	110.4
MDF (MM sq.ft.)	127.9	52.6	79.5	54.8
Hardboard (MM sq.ft.)	75.8	96.6	14.0	13.9
OSB (MM sq.ft.)	0	0.1	4.3	2.7
Hardwood Plywood (MM sq.ft.)	38.6	43.3	20.3	179.1
Softwood Plywood (MM sq.ft.)	28.7	15.3	8.8	9.1
Dimension Parts (MMBF)	10.0	42.9	2.7	142.8
Dimension Pieces (MM pieces)	0.4	3.9	12.2	0.1
Veneer (MM sq.ft.)	110.6	133.2	69.7	6.8

Table 36. 95% Confidence Intervals For West By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	0	0	31.0	36.5
Softwood Lumber (MMBF)	0	0	792.9	22.3
Particleboard (MM sq.ft.)	0	0	4.7	9.2
MDF (MM sq.ft.)	0	0	1.4	0.7
Hardboard (MM sq.ft.)	0	0	1.9	1
OSB (MM sq.ft.)	0	0	0.6	3.5
Hardwood Plywood (MM sq.ft.)	0	0	31.2	2.8
Softwood Plywood (MM sq.ft.)	0	0	6.6	3.7
Dimension Parts (MMBF)	0	0	0	0.2
Dimension Pieces (MM pieces)	0	0	6.4	0
Veneer (MM sq.ft.)	0	0	1.0	4.4

Table 37. 95 % Confidence Intervals for West Coast By Estimation Group.

Material	Group 1 + -	Group 2 + -	Group 3 + -	Group 4 + -
Hardwood Lumber (MMBF)	0	109.3	25.0	54.0
Softwood Lumber (MMBF)	0	87.5	76.4	8.8
Particleboard (MM sq.ft.)	0	76.9	29.5	69.0
MDF (MM sq.ft.)	0	107.4	6.6	2.0
Hardboard (MM sq.ft.)	0	15.9	7.9	14.5
OSB (MM sq.ft.)	0	6.6	0.5	0
Hardwood Plywood (MM sq.ft.)	0	7.5	37.4	7.1
Softwood Plywood (MM sq.ft.)	0	37.2	26.2	3.5
Dimension Parts (MMBF)	0	10.1	11.7	0.2
Dimension Pieces (MM pieces)	0	9.2	2.2	0.1
Veneer (MM sq.ft.)	0	52.1	80.6	7.5

APPENDIX C

Response Rate Calculations

(Material Use Survey)

	Group 1	Group 2	Group 3	Group 4
Number of addresses	100	533	1582	2801
Bad addresses, duplicates and those not manufacturing wood or upholstered furniture . .	29	122	406	542
Adjusted sample size	71	411	1176	2259
Number of usable returned surveys	49	199	472	395
Adjusted response rate	69%	48%	40%	17%
Number of plants represented in usable returned surveys (plants) .	167	380	771	623
Adjusted sample size (plants)*	242	785	1923	3560

- * These numbers were estimated by dividing the number of plants accounted for by returned surveys for a group by the response rate for that group.

Response Rate Calculations

(Marketing Survey)

Number of addresses	347
Bad Addresses and those not manufacturing wood household furniture	61
Adjusted sample size	286
Number of usable returned surveys	138
Adjusted response rate	48%

VITA

Christopher John Meyer, son of John and Elinor Meyer, was born in Pittsburgh, Pennsylvania on May 5, 1966. Mr. Meyer received a Bachelor of Science Degree in Forest Products from the Pennsylvania State University in 1988. The following two years were spent at Virginia Polytechnic institute and State University where he was employed part-time as a graduate research assistant. Mr. Meyer will receive a Master of Science Degree in Forest Products during May 1991.

A handwritten signature in cursive script that reads "Christopher Meyer". The signature is written in dark ink and is positioned centrally below the biographical text.