

# Influence of product and supplier attributes on hardwood lumber purchase decisions in the furniture industry

---

Craig L. Forbes  
Steven A. Sinclair  
Robert J. Bush  
Philip A. Araman

---

## Abstract

This study determined the influence of product and supplier attributes on hardwood lumber purchases by wood furniture manufacturers and investigated differences across manufacturer type, geographic region, firm size, and kiln ownership. Professional lumber buyers rated the importance and difference across suppliers of various attributes. Purchase influence scores were calculated for each attribute based on importance and difference ratings. MANOVA, Tukey's tests, and Bonferroni t-tests detected if differences existed between purchase influence scores across manufacturer type, geographic region, firm size or kiln ownership. *Load-to-bad Consistency, Accurate Grading, No Warp, Crook and Bow, Accurate Moisture Content, and Quote Competitive Price* were the attributes that most influenced the purchase decisions of respondents. No differences were detected between purchase influence scores across geographic regions. However, differences were detected based on furniture manufacturer type, firm size, and kiln ownership. Manufacturers of wood office and wood household furniture were more influenced by appearance attributes (*No Stain, No Surface Checks, and No Chipped Grain*) than were upholstered furniture manufacturers. Larger firms' purchases were more influenced by attributes related to production scheduling and efficiency (*Correct Tally, Desirable Width Mix, Stacking of*

*Pack, Square End Trimming, Fill Large Orders, and Knowledge of Production*) than were smaller firms. Compared to non-owners, kiln owners were more influenced by attributes affecting kiln scheduling (e.g., *Fill Orders Correctly* and *Ship When Promised*), by *Accurate Grading*, and by *End Coating*. The information gained from this research can be used by suppliers of hardwood lumber to aid in developing more effective marketing strategies.

---

The hardwood lumber market is very competitive. There are numerous firms supplying hardwood lumber and buyers usually have multiple options when choosing a supplier. Prices for hardwood lumber of the same species, origin, grade, thickness, and dryness are published weekly,<sup>1</sup> and are available to buyers and suppliers. The availability of market price information results in similar pricing from most suppliers,

To maintain favorable market positions in a competitive and informed environment, a variety of strategies are employed by firms supplying hardwood lumber. Recent research has indicated a trend toward the adoption of strategies emphasizing differentiation (4). Some firms have indicated intentions to employ a dual differentiation/focus strategy.<sup>2</sup>

---

The authors are, respectively, Graduate Research Assistant, Professor (deceased), and Assistant Professor in the Dept. of Wood Sci. and Forest Prod., Virginia Polytechnic Institute and State University, and Project Leader, USDA Forest Serv., 1650 Ramble Rd., Blacksburg, VA 24061-0503. This research was supported by funds provided by the USDA Forest Serv., Southeastern Forest Expt. Sta., Primary Hardwood Processing and Products Research Unit, Blacksburg, VA, and the Hardwood Manufacturers Association. This paper was received for publication in July 1993.

©Forest Products Society 1994.  
Forest Prod. J. 44(2):51-56.

---

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

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

Understanding the customers and their expectations is necessary for successfully implementing marketing strategies (14, 17). An effectively differentiated product is positioned away from competing products based on attributes perceived by the customer to be important and unique. Awareness of different perceptions across customer segments will aid the supplier in developing successful focus strategies.

The wood furniture industry is the largest domestic user of high grade hardwood lumber, and the second largest user of total hardwood lumber produced (6, 11,12, 15). Thus, awareness of the attributes most influencing the purchase of hardwood lumber by wood furniture manufacturers is important to manufacturers and suppliers of hardwood lumber. In spite of this, little research has been done investigating purchase-influencing attributes of hardwood lumber used by wood furniture manufacturers.<sup>3</sup>

The objectives of this study were to 1) determine the relative influence of various product and supplier attributes on hardwood lumber purchases by wood office, wood household, and upholstered furniture manufacturers; and 2) ascertain if any dissimilarity in perceptions of purchase-influencing attributes exists across manufacturers of different furniture types, geographic regions, firm size, or as a result of kiln ownership.

**Methods**

**Sample frame**

Domestic manufacturers of wood household, upholstered and wood office furniture were the population for this study. A list of firms provided by Dun's Marketing<sup>4</sup> was cross-checked with the FDM 300 published by *Furniture Design and Manufacturing* (8) to develop the sample frame. To maximize coverage of the largest hardwood lumber users, all manufacturers of wood household, upholstered, and wood office furniture on the FDM 300 list and all firms on Dun's list with 100 or more employees were included in the sample. Firms on Dun's list with less than 100 employees were randomly sampled at a 25 percent rate. The sample consisted of 2,184 firms. The final sample by firm size was as follows:

Firm size strata (based on no. of employees)	Number of firms in sample
Firms with 100 or more employees	378
Firms with 10 to 99 employees	730
Firms with <10 employees	1,076
Total	2,184

<sup>3</sup>Bush et al. (3,4) looked at influential attributes of hardwood lumber in the wood household furniture manufacturing industry, along with other hardwood-using industries. The sample used in their study, however, consisted only of the largest manufacturers.

<sup>4</sup>Dun's Marketing Services, Inc., Parsippany, N.J.

**Questionnaire development**

Attribute lists from previous studies (3,5) provided the starting point for this study's attribute list. Personal interviews with industry specialists, including hardwood lumber producers, wholesalers, distributors, and brokers were conducted to evaluate the thoroughness of the attribute list. The attributes were then revised based on these interviews. The questionnaire was reviewed by university personnel (from both marketing and forest products fields of expertise) for face validity and clarity. The revised questionnaire was then pretested by industry experts, including staff members from the Hardwood Manufacturers Association.

**Data collection**

The data were collected via a mail survey. To increase response rates, notification letters were mailed 1 month prior to the mailing of the first wave of surveys. The first survey mailing took place in early March 1991, followed a week later by postcards encouraging response. Approximately 1 month after the first mailing, non-respondents were mailed a second survey, followed once again by a postcard. Firms with 100 or more employees (i.e., the largest hardwood lumber users) were mailed a third survey. Final adjusted response rates for the survey were as follows:

Firm size strata (based on no. of employees)	Response rate
Firms with 100 or more employees	58%
Firms with 10 to 99 employees	25%
Firms with <10 employees	21%
All firms	31%

Respondents who did not answer all questions pertaining to the hardwood lumber attribute analysis (i.e., missing values) were not included in the analysis. To control for differences in perceptions between buyers of kiln-dried lumber versus buyers of green lumber, only those firms who purchase at least 70 percent of their lumber kiln-dried were included in the analyses of differences between manufacturers of different furniture types, geographic region, and firm size. Firms with kilns were then compared to firms without kilns to determine if differences existed between purchasers of kiln-dried lumber and green lumber.

When detecting differences across manufacturers of different furniture types, it was crucial to include only firms with relatively homogeneous product lines. Therefore, only firms with at least 90 percent of their sales in a single type of furniture were included in this analysis. Final sample sizes of groups included in the analysis of differences across type of furniture manufactured, firm size, geographic region, and kiln ownership are shown in Table 1.

**Calculation of purchase influence scores**

Product attribute importance was determined by

TABLE 1. — Sample sizes of groups included in the analysis of differences across type of furniture manufactured, firm size, geographic region, and kiln ownership.

Grouping method	No. of observations per group
By type of furniture manufactured	
Upholstered	34
Wood office	19
Wood household	39
Total	92
By firm size	
100 or more employees	47
10 to 99 employees	58
< 10 employees	68
Total	173
By geographic region	
South	68
Northeast	29
Midwest	28
West	44
Total	169
By kiln ownership	
With kilns	33
Without kilns	173
Total	206

asking hardwood lumber buyers to rate on a scale of 1 (no importance) to 5 (extremely important) how important selected attributes were to their company. To ascertain the degree of difference that buyers perceived among competing suppliers, buyers were asked to rate how attributes differed between suppliers, again on a scale of 1 to 5 (1 - no difference and 5 = big difference). Similar methods have been used in previous studies (1-3,5, 10, 16).

Purchase influence scores<sup>5</sup> were calculated from importance and difference scores using the following formula (derived from Bearden (2)):

$$P_{ij} = I_j Y_{ij}$$

where:

$P_{ij}$  = purchase influence score for attribute  $i$  and respondent  $j$

$I_j$  = importance rating for attribute  $i$  and respondent  $j$

$Y_{ij}$  = difference rating for attribute  $i$  and respondent  $j$

Thus, for any given attribute, a maximum purchase influence score was 25 and a minimum score was 1. Purchase influence scores were calculated in total, by furniture manufacturer type, by geographic region, by firm size, and by kiln ownership.

### Testing differences in scores across groups

Multivariate analysis of variance (MANOVA) was used to test for differences in purchase influence

<sup>5</sup>Purchase influence scores are also called determinance scores. Attributes most influencing the purchase decision are known as determinant attributes.

TABLE 2. — List of attributes and average purchase influence scores given by respondents.

Attribute	Purchase influence score
Load-to-load consistency	14.42
Accurate grading	13.72
No warp, crook, and bow	13.13
Accurate moisture content	13.09
Quote competitive prices	12.97
Knowledge of lumber	12.97
Fill orders correctly	12.66
Provide rapid delivery	12.60
Ship when promised	12.35
Supplier's candidness	11.90
Fill small orders	11.69
No surface checks	11.68
Quote firm prices	11.31
Supplier's reputation	11.31
Knowledge of production	11.29
Quickly resolve disputes	11.26
Correct tally	11.23
Personal relationship	10.99
No stain	10.88
No wane	10.84
No end splits	10.63
Accurate machining	10.57
Answer questions promptly	10.35
No chipped grain	10.14
Ability to kiln dry	10.13
Desirable width mix	10.01
Ability to arrange shipping	9.87
Species variety	9.87
Supply mixed loads	8.99
Pack cleanliness	8.84
Provide special sorts	8.82
Long-term pricing	8.79
Ability to surface lumber	8.42
Technical information	8.27
Stacking of pack	8.23
Custom grades	8.21
Arrange credit	8.16
Fill large orders	7.83
Protective wrapping	6.87
End coating	6.24
Square edges	5.87
Square end trimming	5.30

scores across manufacturers of different types of furniture, geographic region, and firm size. A full factorial design was used. If differences were detected ( $\alpha = 0.05$ ), Tukey's multiple-range test was used to determine the source of the group differences ( $\alpha = 0.05$ ). Differences between buyers of kiln-dried lumber and green lumber were detected using Bonferroni t-tests ( $\alpha = 0.05$ ).

Tests for violations of assumptions were performed to evaluate if MANOVA was appropriate for this study (9,13). No evidence of violations was detected ( $\alpha = 0.05$ ) by Bartlett's test for sphericity and Box's M ( $\alpha = 0.05$ ). No violations of multivariate normal distribution assumptions were observed by examination of box-plots and normality plots.

### Checks for non-response bias

Based on the assumption that late responders react more like non-responders (7), a comparison of early respondents to late respondents was utilized to test for non-response bias. Data from the surveys received the first week of returns and an equal number of the last surveys received were compared using Chi-square tests ( $\alpha = 0.05$ ) and other nonparametric

tests. Based on firm size, type of furniture manufactured, and location of firm, no evidence of demographic difference between early and late respondents was observed.

Purchase influence scores were also calculated from surveys received the first week of returns and from an equal number of the last surveys received. Bonferroni t-tests on the top five and lowest five purchase influence scores indicated no significant differences between early and late respondents ( $\alpha = 0.05$ ).

### Results

Table 2 lists the attributes included on the questionnaire and the corresponding average purchase influence scores given by the respondents. The attribute that most influenced the purchase of hardwood lumber was *Load-to-Load Consistency* followed by *Accurate Grading: No Warp, Crook, and Bow*; *Accurate Moisture Content*; and *Quote Competitive Prices*. The attributes ranking lowest in purchase influence were *Square End Trimming*, *Square Edges*, *End Coating*, *Protective Wrapping*, and the supplier's ability to *Fill Large Orders*.

Differences in attributes were examined across furniture manufacturer type, firm size, geographic region, and kiln ownership. No differences were detected between purchase influence scores across geographic region. Differences in scores across manufacturers by furniture type, firm size, and kiln ownership are discussed in the following sections.

#### Manufacturer type

Testing for dissimilarities across furniture manufacturer types detected differences in purchase influence scores for several attributes (Fig. 1). Wood office and wood household furniture manufacturers rated *No Surface Checks*, *No Stain*, and *No Chipped Grain* significantly higher in purchase influence than did

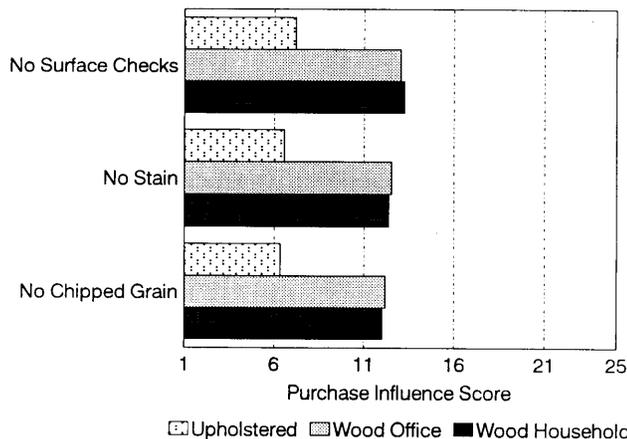


Figure 1. — Attributes with purchase influence scores that were significantly different ( $\alpha = 0.05$ ) across furniture manufacturer type.

upholstered furniture manufacturers. Wood used in upholstered furniture is usually out of view of the consumer, thus appearance attributes are not critical in the lumber purchased by this segment of the furniture industry. Since much of the lumber used by wood household and wood office furniture is exposed, it was expected that they would give significantly higher ratings to appearance-related attributes.

#### Firm size

Figure 2 shows attributes that had significantly different purchase influence scores across manufacturers of different size. Compared to firms with less than 10 employees, firms with 100 or more employees gave significantly higher scores to the following attributes: *Knowledge of (manufacturer's) Production (needs)*, *Correct Tally*, *Desirable Width Mix*, and *Square End Trimming*. Firms with 10 or more employees rated *Stacking of Pack* and supplier's ability to *Fill Large Orders* significantly higher than firms with less than 10 employees. Firms with 10 to 99 employees rated *Provide Rapid Delivery*, *Supplier's Reputation*, and *Long Term Pricing* significantly higher than did firms with less than 10 employees. Firms with 10 to 99 employees rated *Arrange Credit* significantly higher than firms with 100 or more employees.

As inferred from the previous results, the production-oriented nature of larger firms makes planning more crucial. Correct tallies, desirable width mixes, and suppliers' understanding of the firm's production needs were more important to larger firms than smaller firms, as was the ability of a supplier to fill large orders. Neatly stacked packs with square ends

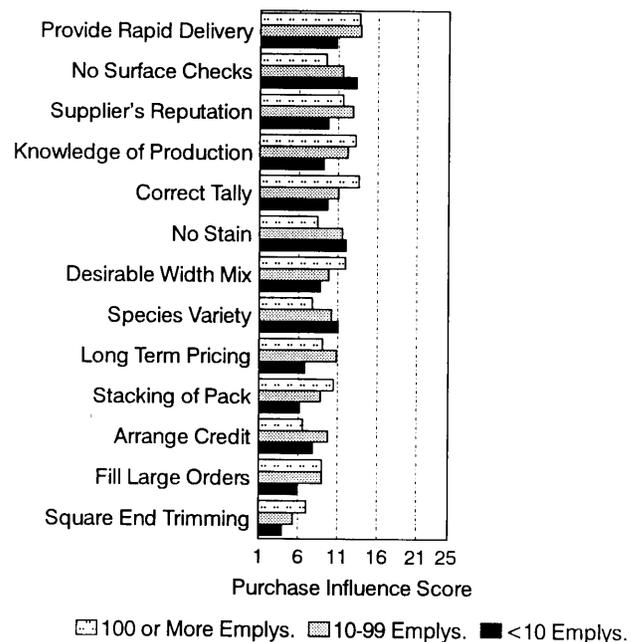


Figure 2. — Attributes with purchase influence scores that were significantly different ( $\alpha = 0.05$ ) across firm size.

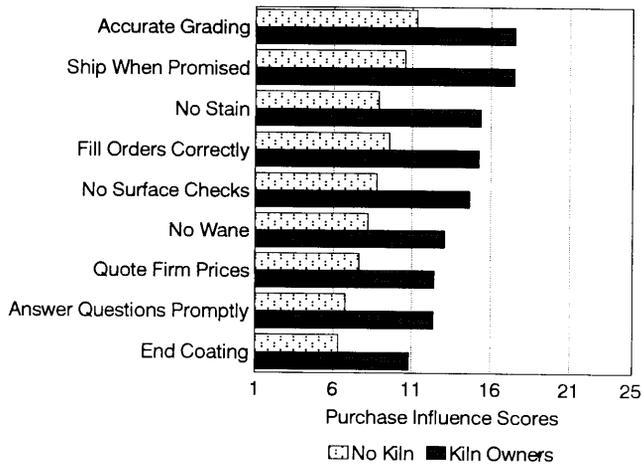


Figure 3. — Attributes with purchase influence scores that were significantly different ( $\alpha = 0.05$ ) between kiln owners and non-owners.

aid in materials handling in the highly automated larger firms. The large volumes of lumber used by the larger firms warrant the need for a trustworthy and reputable supplier.

Firms with less than 10 employees rated *Species Variety*, *No Surface Checks*, and *No Stain* higher than did firms with 100 or more employees. The higher rating of these attributes by smaller firms maybe the result of the distribution of manufacturer types by firm size. Less than 9 percent of the responding firms with less than 10 employees were upholstered furniture manufacturers, while nearly 40 percent of the firms with greater than 10 employees were upholstered furniture manufacturers. Since the firms with less than 10 employees contain a higher proportion of wood office and wood household furniture manufacturers, this group is more influenced by appearance-related attributes.

### Kiln ownership

Figure 3 shows differences in purchase influence scores between firms with kilns and those without. Compared to firms without kilns, firms with kilns were influenced more by the following attributes: *Accurate Grading*, *Fill Orders Correctly*, *Ship When Promised*, *No Surface Checks*, *Quote Firm Prices*, *No Stain*, *No Wane*, *Answer Questions Promptly*, and *End Coating*. The higher ratings of these attributes by firms with kilns were a result of a combination of dry-kiln scheduling needs and the type of furniture manufactured by kiln owners.

When a kiln is not in use it is not making money. When green lumber is waiting to be kiln-dried it is prone to defects (checks, stain, and decay). A kiln must be fully loaded to insure proper airflow and drying, and to maximize efficiency. A kiln charge should be composed of lumber of the same thickness and of species with similar drying characteristics. Considering all

this, it is clear why kiln owners were more influenced by attributes that may affect scheduling, e.g., *Fill Orders Correctly* and *Ship When Promised*.

Nearly 90 percent of the responding firms with kilns were manufacturers of wood household or wood office furniture. Since wood household and office furniture designs utilize a considerable amount of exposed wood, it is clear why kiln owners are interested in purchasing lumber that is free of stain and checks. Since end coating reduces checks in drying lumber, it is obvious why kiln owners rated this attribute higher in purchase influence than did non-owners.

### Summary

Hardwood lumber and supplier attributes were ranked in order of their mean purchase influence as perceived by hardwood lumber buyers for domestic wood office, wood household, and upholstered furniture manufacturers. The following attributes were perceived by the respondents to most influence their purchase decision: *Load-to-Load Consistency*; *Accurate Grading*; *No Warp, Crook, and Bow*; *Accurate Moisture Content*; and *Quote Competitive Price*. Least influential were *Square End Trimming*, *Square Edges*, *End Coating*, *Protective Wrapping*, and the supplier's ability to *Fill Large Orders*.

No differences were detected between purchase influence scores across geographic region. However, differences in the level of purchase influence of attributes were detected across furniture manufacturer type, firm size, and between buyers of kiln-dried and green lumber.

Manufacturers of wood office and wood household furniture were more influenced by appearance attributes, such as *No Stain*, *No Surface Checks*, and *No Chipped Grain* than were upholstered furniture manufacturers. This was expected since upholstered furniture has relatively less wood exposed and appearance defects are not a problem.

Attributes that related to efficient production, such as *Correct Tally*, *Desirable Width Mix*, *Stacking of Pack*, *Square End Trimming*, and supplier's *Knowledge of Production (needs)* were more important to larger firms than to smaller firms. The ability of a supplier to *Fill Large Orders* and the *Supplier's Reputation* were also more influential to purchase decisions of larger firms.

Kiln owners were more influenced by attributes that may affect scheduling such as *Fill Orders Correctly* and *Ship When Promised* than were non-owners. The presence of *End Coating* also contributed more to the purchase decision of kiln owners.

### Discussion

The information gained from this research can be used by suppliers of hardwood lumber to aid in developing more effective marketing strategies. If the attributes perceived by lumber buyers in the U.S. wood furniture industry to be the most influential in the purchase decision are incorporated into the hard-

wood lumber suppliers' marketing strategies, they will aid in achieving a superior market position.

The attributes that most influenced hardwood lumber purchases were *Load-to-Load Consistency*; *Accurate Grading*; *No Warp, Crook, and Bow*; and *Accurate Moisture Content*. Price ranked fifth in purchase influence. This suggests that a low price strategy may not be as effective as a supplier's commitment to consistent quality.

Many of the attributes that ranked highly in purchase influence scores were drying related (*No Warp, Crook, and Bow*; *Accurate Moisture Content*; *No Surface Checks*; and *No End Splits*). Manufacturers and suppliers with kiln-drying facilities may capitalize on these attributes by promoting properly dried lumber.

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

Likewise, a manufacturer or supplier may not find all influential attributes achievable or practical when budgets are considered. A supplier who receives complaints of surface checks may simply not have the funds available to invest in the necessary equipment to remedy drying problems. This supplier could target products to a different market where surface checks are not a problem (e.g., upholstered furniture) and develop and/or emphasize attributes that are influential to the buyer's purchase yet affordable for the supplier.

It should also be mentioned that even if an attribute is not rated as highly influential to the customer's purchase decision, it may still offer benefits significant to the supplier. For example, a distinguishable color end coating may provide firm recognition for the supplier offering a favorable product or service. Even though such an attribute may, in general, provide little

influence on a buyer's purchase decision, it can reinforce the supplier's name or offer a distinct association between the supplier and the product.

The analyses performed in this study can be a valuable marketing and managerial tool in the wood products industry. Lumber buyers from different furniture manufacturer types have their own perceptions of what is most influential in their lumber purchases. Manufacturers and suppliers can use this analysis to help design their marketing program to better fit customers in different market segments.

#### Literature cited

1. Alpert, M.I. 1971. Identification of determinant attributes: a comparison of methods. *J. of Marketing Research* 8(2):184-191.
2. Bearden, W.O. 1977. Determinant attributes of store patronage: downtown versus outlying shopping centers. *J. of Retailing* 53(2):15-22.
3. Bush, R.J., S.A. Sinclair, and P.A. Araman. 1990. Match your hardwood lumber to current market needs. *Southern Lumberman* 251(7):24-25.
4. \_\_\_\_\_ and \_\_\_\_\_. 1991. A multi-variate model and analysis of competitive strategy in the U.S. hardwood lumber industry. *Forest Sci.* 37(2):481-499.
5. \_\_\_\_\_, \_\_\_\_\_, and P.A. Araman. 1991. Determinant product and supplier attributes in domestic markets for hardwood lumber. *Forest Prod. J.* 41(1):33-40.
6. Cardellichio, P.A. and C.S. Binkley. 1984. Hardwood lumber demand in the United States: 1950 to 1980. *Forest Prod. J.* 34(2):15-22.
7. Fowler, Jr., F.J. 1984. *Survey Research Methods*. Sage Publications, Inc., Beverly Hills, Calif.
8. *Furniture Design and Manufacturing*. 1990. The FDM 300. 62(2):21-168.
9. Hair, J. F., R.E. Anderson, R.L. Tatham, and W.C. Black. 1992. *Multivariate Data Analysis with Readings*. 3rd ed. Macmillan Publishing Co. pp. 153-180.
10. Lumpkin, J.R., B.A. Greenberg, and J.L. Goldstucker. 1985. Marketplace needs of the elderly: determinant attributes and store choice. *J. of Retailing* 61(2):75-105.
11. Luppold, W.G. 1987. Material usage trends in the wood household furniture industry. NE-RP-600. USDA Forest Serv. Northeastern Forest Expt. Sta.
12. \_\_\_\_\_. 1988. Material-use trends in U.S. furniture manufacturing. *Southern J. of Applied Forestry* 12(2):102-107.
13. Norusis, M.J. 1990. *SPSS. Advanced Student Guide*. SPSS, Inc. Chicago, Ill. pp. 211-260.
14. Schofield, M. and D. Arnold. 1988. Strategies for mature businesses. *Long Range Planning* 21(5):69-76.
15. Sinclair, S.A. 1992. *Forest Products Marketing*. McGraw-Hill, Inc., N.Y.
16. \_\_\_\_\_ and E.C. Stalling. 1990. How to identify differences between market segments with attribute analysis. *Industrial Marketing Management* 19(2):31-40.
17. Webster, Jr., F.E. 1979. *Industrial Marketing Strategy*. John Wiley & Sons. New York.