C I N T R A F O R

Working Paper
78

A CHARACTERIZATION OF THE RESIDENTIAL DECK MARKET IN THE US

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January 2001

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CINTRAFOR Working PAPER 78

EXAMINATION OF THE RESIDENTIAL DECK MARKET IN THE US

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This material is based upon work supported by the Cooperative State Research Service, US Department of Agriculture, and the State of Washington Department of Community Trade and Economic Development. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not reflect the view of the funding agencies.

Technical Editors: Ed Jenkinson, Kendall Carson, Nicole Stevens

EXECUTIVE SUMMARY*

Approximately 85 percent of all single family homes in the US include a deck or deck-like structure (*e.g.*, patio, porch, or balcony), which is equivalent to roughly 30 million decks. Sixty percent of all new homes are constructed with a deck, while nearly 2.75 million decks are replaced on an annual basis (the average deck has a life expectancy of about eleven years). Furthermore, slightly over 4 percent of all households add a deck to their home on an annual basis, resulting in another 3 million new decks. Collectively, over 6.5 million new decks have been constructed throughout the US on an annual basis since 1995, which represents approximately $3 billion spent annually in deck materials. During the decade of the 1990s, the deck market grew at an average annual rate of 8.1 percent. Assuming a constant rate of growth of 8.1 percent, the deck market in 2010 could be as large as $6.5 billion. Despite the enormous size and healthy growth of the residential deck market in the US, very little research has been conducted evaluating consumer perceptions of the various deck materials available to them in the market. The objective of this study was to review secondary information regarding the residential deck material market in the US. Additionally, a survey of residential homebuilders in the US was conducted to characterize the industry's use of various deck materials, as well as to assess the industry's perceptions of these deck materials.

* **Note:** The use of trade, institution, firm, or corporate names in this publication is for the information and convenience of the reader. Furthermore, such use does not constitute or imply an official endorsement of any product or service by the authors, the Center for International Trade in Forest Products, the University of Washington, or the University of Idaho, to the exclusion of others that may be suitable.

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1 INTRODUCTION AND REVIEW OF THE RESIDENTIAL DECK MARKET

It is estimated that there are approximately 30 million decks in the US (Truini 1996). The demand for residential deck materials is a function of several factors, with new residential home starts being the primary driver of deck material demand. US Department of Commerce data indicate that over 85 percent of new single family homes include an outdoor living area, which encompasses decks, patios, porches, and balconies. The amount of activity occurring in the home improvement market also impacts the demand for residential deck materials. Past survey results indicate that, on an annual basis, about 4.2 percent of all households in the US add a deck to their existing home, which results in over 3 million new decks per year (George Carter & Affiliates 1989b; Home Improvement Research Institute 1993).

The importance of the do-it-yourself market in stimulating deck material demand is evident in the fact that nearly 46 percent of all households have built a deck onto their home as a do-it-yourself project during their tenure as a homeowner (Home Improvement Research Institute 1993). Finally, the rate of deck replacement substantially influences the demand for residential deck materials. The average deck is upgraded, expanded, repaired, or replaced 11 years after installation (Truini 1996). Depending on the source of information, the current market for residential deck materials is estimated to be between $1.9 billion and $3 billion, with an annualized growth rate of 8.1 percent since 1991 (Ghouse 1999; Udelhofen 1998).

1.1 RESIDENTIAL DECK PRODUCTS

Several dozen materials are currently utilized in residential deck construction. Many of these materials, however, are only used in relatively small quantities and within regional markets. For example, cypress deck boards are utilized to some extent in the US South. Black locust deck posts have been used in markets in the Upper Midwest. Four types of materials, however, are used to a much greater extent in deck construction than any others; these materials include untreated solid lumber (*e.g.*, western red cedar and redwood), pressure treated solid lumber, wood-plastic composite lumber, and plastic lumber.

Several factors influence the competitive relationship between the materials used in the residential deck market. The relative difference in material, installation, and maintenance costs between the differing products is the primary basis for differentiation. In addition, product quality factors, such as longevity, durability, and maintenance requirements, are also a basis for product differentiation. Product aesthetics and availability of the material have become increasingly important factors for producers of residential deck materials on which to base competition, especially in the remodeling and renovation market, where homeowners complete the deck project themselves.

This section examines the characteristics of each of the major materials that compete in the residential deck market. Specifically, production and distribution, pricing and demand, and promotional characteristics are examined. These characteristics are followed by product characteristics that are considered to differentiate each deck material from competing deck materials.

1.1.1 Pressure-Treated Lumber

Wood products are frequently treated with chemical preservatives to increase their durability and subsequently prolong the life of the deck. Preservative treatment of lumber also reduces the need for oversize design of structural members to compensate for anticipated deterioration. A wide variety of wood species are treated with chemical preservatives in order to increase their durability and useful lifespan. The most commonly treated softwood species include: Douglas-fir, hemlock, jack pine, lodgepole pine, ponderosa pine, southern yellow pine (SYP), spruce, true firs, western red cedar, and western white pine. Chromated copper arsenate (CCA) is the predominant chemical compound used to treat wood in the US, although ammoniacal copper arsenate (ACA), acid copper chromate (ACC), chromated zinc chloride (CZC), and pentachlorophenol are also used.

A number of large and small treating facilities, most located in the US south, US west, and Canada, produce treated lumber in North America. Nearly every type of lumber distributor and retailer in virtually every market in the US distributes treated wood products. Relative to all other deck materials on the market, treated wood is the most readily available.

The deck and fence markets are the primary drivers of demand for treated wood materials (D. G. Bell & Associates 1986). For instance, treated wood materials were found to be used in eight of every ten residential decks built in the US in 1989 (George Carter & Affiliates 1989b). Although accurate statistics are not available to determine activity in pressure treated lumber deck and fence markets, the general consensus from industry representatives is that they are both growing. ***Figure 1*** displays the national average monthly price of SYP, 5/4" × 6", eight-foot length, treated radius edged decking. The price of SYP treated deck material is much more volatile than western red cedar deck material of equivalent size and surface finish. This is a result of SYP lumber prices being driven more by residential construction activity relative to western red cedar lumber.

For the most part, treated wood is promoted by the Canadian Institute of Treated Lumber, the Western Wood Preservers Institute, and the Southern Pressure Treaters Association. These three organizations aggressively promote treated wood to architects and designers, builders, contractors, and do-it-yourself homeowners. They base a significant amount of their promotional efforts on differentiating their product. For example, treated wood's lifespan characteristics have been heavily promoted at the retail level.

Some treated wood producers have succeeded in developing a branding strategy to differentiate their product from other materials available in the residential deck market. Osmose® and Wolmanized® wood products are highly recognized brands that the treated wood industry promotes directly against western red cedar and redwood residential deck materials. Consumers of treated wood typically receive a 25 to 30 year warranty from the date of purchase and are given detailed product safety information. Additionally, a Southern Pressure Treaters Association representative suggests that the industry has succeeded to some extent in getting distributors and retailers to promote treated wood materials more heavily than substitute materials.

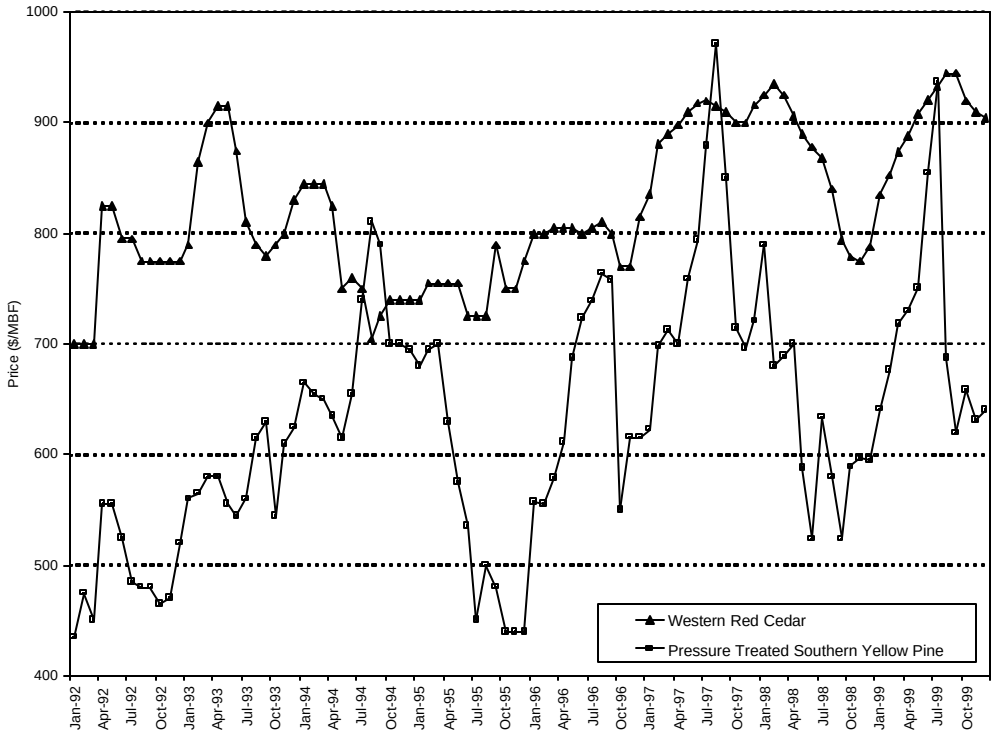

Figure 1. National Average Monthly Price per Thousand Board Foot of 5/4" ´ 6" Western Red Cedar and Southern Yellow Pine Treated Lumber Radius Edged Deck Materials, January 1992 through October 1999.

Note: Western red cedar prices net f.o.b. coastal mill; random length; Architect Knotty® grade. Southern yellow pine prices net f.o.b. treating facility in GA, FL, SC, AL, and MS; waterborne preservatives; quality marked; eight-foot length; wet from cylinder; LP -2 at 0.40 lbs/ft^3.

Sources: Random Lengths [southern yellow pine and western red cedar] and Crows [western red cedar]

Treated lumber also carries some negative perceptions among a significant number of consumers. The perceived health risk associated with using chemically treated wood is one concern that industry promotional efforts have attempted to dispel. One method in reducing risk has been the creation of major brand image and brand loyalty, which are two factors Sinclair and Smith (1990) cite as being vital in relieving consumers' perception of risk of product use. Disposal of treated wood is another major concern to the industry, especially since there has been an increase in the number of municipalities that have banned treated wood from their landfills. For example, data from the 1994 National Association of Home Builders Annual Industry Survey indicates that 8 percent of all builders cannot utilize traditional waste disposal methods for treated lumber. Burning treated wood waste is illegal in nearly all US municipalities since the resulting fumes are toxic.

Consistent product quality can also be a problem with treated lumber. In fact, Dost (1982) states that there is "*...substantial evidence that salt treated wood at retail frequently does not meet the requirements of the AWPA* [American Wood-Preservers' Association] *Standards, especially with respect to penetration* [of the treatment]." Dost makes similar comments about West Coast species of wood in an article published in 1988. He suggests that several factors contribute to the poor consistency of treated wood. These include: differences in permeability between species and races of species, differences in preservative formulations, inadequate drying prior to treatment, excessive decay in the wood to be treated, shortened treatment cycles, and a lack of concern by treaters, distributors, specifiers, and code inspectors. More recent research to determine whether the consistency in wood preservation treatments for deck materials has improved was not found in the literature.

Although treated wood deck materials have several negative perceptions and characteristics, it does not appear to have had a substantial impact on consumer use. As stated in a government report prepared by D.G. Bell & Associates (1986), *"The consumer attitude toward treated lumber has been positive due to merchandising and promotional efforts placed behind the major brands, and although there has been some negative publicity regarding the potential health hazards of the product, no negative sales impact has been apparent*."

1.1.2 Western Red Cedar

Western red cedar is a tree species that grows in significant volumes in the Pacific Northwest, most notably in Washington State and British Columbia. Due to resource location, the majority of western red cedar lumber is produced in these two regions. The producers of western red cedar lumber range from small firms to large corporations. Western red cedar lumber is distributed nationally. A concern in certain US markets, however, is the immediate availability of these materials. A D.G. Bell & Associates report (1986), for instance, suggests that "*cedar producers helped create the treated wood market in this country* [Canada] *because of their pricing policies and the quality and the availability of the product* [cedar] *in the eastern part of the country*."

The demand for western red cedar lumber has remained relatively static in the 1990's. Poor product promotion by western red cedar manufacturers and increased competition from manufacturers of alternative deck materials, especially treated wood, are factors that have created a lagging demand. A survey conducted by George Carter & Affiliates (1989b) found that residential decks constructed of western red cedar utilized significantly less lumber than decks constructed of either redwood or treated wood. Specifically, the results reveal that western red cedar decks are on average constructed with a total of 774 board feet of lumber, whereas treated wood and redwood decks use 1,029 and 991 board feet of lumber, respectively. The survey also found that only 4 percent of all decks in 1987 were constructed of western red cedar lumber.

Figure 1 displays the national average monthly price of western red cedar, 5/4x6, random length, radius edged deck material from January 1992 to September 1999, as well as the national average monthly price of SYP, 5/4x6, eight-foot, treated radius edge deck material. Comparison of these two residential deck materials indicates that the price of western red cedar is considerably more stable than SYP. Specifically, the standard deviations in price for western red cedar and SYP treated wood during the 96 months in the time series are $69.00 and $113.07, respectively. The data indicates that SYP treated wood exhibits a price volatility that is over 60 percent greater than western red cedar. One would expect, however, that the higher price of western red cedar deck materials would make SYP treated wood deck materials more attractive to price sensitive homebuilders.

The Western Red Cedar Lumber Association produces high-quality promotional and technical literature for western red cedar lumber on an industry-wide basis. Promotional materials tend to emphasize the beauty and quality (*i.e.*, image characteristics) of western red cedar lumber relative to other available deck materials, as well as the fact that it is a naturally durable wood. Appearance and natural durability are the primary characteristics that differentiate western red cedar lumber from other residential deck materials. Western red cedar lumber is also competitively priced relative to alternative residential deck materials.

1.1.3 Redwood

Redwood is a tree species that grows in Central and Northern California and in some southern regions of Oregon. Producers of redwood lumber are essentially small- to medium-sized firms, the majority located in California, who distribute redwood lumber nationally. The availability of redwood decking lumber is much greater than redwood siding. According to a representative from the California Redwood Association, the greater availability of redwood decking lumber relative to siding materials is likely due to the fact that the primary market for redwood lumber is the residential deck market.

According to a representative from *Crow's*, the demand and price for redwood lumber has remained fairly stable for the past decade. The price of redwood lumber is not as sensitive to changes in housing starts and timber constraints as are western red cedar and southern yellow pine. Unfortunately, neither *Random Lengths* nor *Crow's* tracks the price of redwood lumber. Industry-wide, the California Redwood Association promotes redwood deck materials and offers some of the best promotional and technical information regarding installation and care of decks in the industry. The California Redwood Association does not archive statistical records on redwood decking production or sales.

Redwood deck lumber is not as available in the national market as western red cedar. Despite this lack of availability, it is reported that 12 percent of all residential decks constructed in 1987 utilized redwood (George Carter & Affiliates 1989b). In other words, for every deck constructed of western red cedar material in 1987, three decks of redwood were built. It should be noted, however, that representatives from both *Random Lengths* and *Crow's* believe that western red cedar holds a competitive advantage over redwood as a residential deck material, especially in southern and eastern US markets, due to its greater availability in these markets.

1.1.4 Untreated Lumber (excluding Western Red Cedar and Redwood)

The use of untreated lumber as a deck material, excluding redwood and western red cedar, is small. Out of 3.7 million board feet of lumber used in deck construction in 1987, only 104 thousand board feet consisted of untreated lumber – again excluding redwood and western red cedar. This represented slightly less than 3 percent of all lumber used in deck construction in 1987. Untreated lumber shares many of the same characteristics as other commonly used solid wood deck material. It is uncertain as to what species of wood are being used to construct decks made of untreated lumber. Obviously, many species of wood are not suitable for long-term outdoor exposure. However, some tropical and native wood species (*e.g.*, azobe, osage orange, black locust) are naturally resistant to decay. It is estimated that the market for untreated lumber for use as a decking material will remain small into the future.

1.1.5 Wood-Plastic Composite Lumber

A relatively new class of residential deck materials to appear in the market are manufactured from a combination of wood fiber and plastic. Raw materials used in the manufacture of this deck product include recycled plastic grocery bags, baling twine, recycled industrial stretch film, sawdust, and recycled wooden pallets. Individually, these materials are broken down into their basic components, mixed together, and then formed into lumber utilizing an extrusion process. Extruded lumber is available in all commonly used dimensions. While wood-plastic composite lumber is not commonly stocked in all sizes at traditional lumber distribution centers, the distribution networks for most manufacturers of this product are extensive enough that delivery is rather quick in nearly all regions of the US. The market for wood-plastic composite lumber is growing rapidly; First Union Capital Markets estimates that this particular segment of the residential deck market is growing at 25 percent annually (Ghouse 1999).

Wood-plastic composite lumber is generally more expensive than treated lumber, averaging 60 to 70 percent more in retail price than pressure treated lumber (Gonzalez 1996). Although overall demand for wood-plastic composite lumber is relatively low, the growth in demand has been tremendous (DeMaster 1998). Many wood-plastic composite lumber manufacturers have found their largest customers among municipalities; the product being used in playground equipment, park structures, and as decking on docks, piers, and walkways.

Wood-plastic composite lumber has several desirable features that their manufacturers heavily promote. Like most composite materials, wood-plastic lumber is extremely consistent relative to solid wood residential deck materials. The material is dimensionally stable, and allegedly does not warp, cup, twist, or loosen fasteners. Finally, the material requires minimal maintenance in order to keep it in good condition.

Wood fiber and plastic composite deck materials do possess some negative characteristics that may hamper penetration into the residential construction market. Most notable are market issues related to price and availability at local distribution centers. In addition, the weight of the composite material is nearly twice that of lumber of equivalent dimension (*e.g.*, one eight-foot 2" × 6" weighs approximately 30 pounds). Hence, it requires more time to handle and install the material, resulting in increased labor costs. Due to its partial plastic composition, the composite is much more flexible (*i.e.*, lower modulus of elasticity) than solid lumber (Youngquist 1995). Therefore, use of the material as columns, beams, joists, stringers, and other primary structural load-bearing members has been minimal. Generally, if the material is to be used as a structural component, then either the distance between spans and columns must be reduced and/or the material dimensions are purposely oversized relative to standard wood deck framing.

1.1.6 Plastic Lumber

Similar to wood-plastic composite lumber, plastic lumber is also a relatively new material to be utilized as a residential deck material. Plastic lumber is manufactured from 100 percent recycled post-consumer high-density polyethylene, or HDPE; the recycled materials typically being milk jugs, shampoo containers, detergent bottles, and other types of containers. Some plastic lumber manufacturers include such additives as fiberglass to enhance product performance as well as additives to produce various colors of products.

Relative to wood-based deck materials, plastic lumber is expensive. The price for plastic lumber currently ranges between 10 to 50 percent more per board foot than treated lumber. However, increasing competition in the plastic lumber industry will likely erode these price premiums. Like wood-plastic composite lumber, many early adopters of plastic lumber were municipalities.

One of the primary consumer benefits of plastic lumber is that it requires little maintenance relatively to wood-based deck materials; painting, staining, or sealing of the material is not necessary (Vlosky 1999). Manufacturers promotional material indicates that plastic deck materials will not shrink, swell, check, crack, split, or rot. Furthermore, manufacturers claim that plastic deck materials are impervious to ultraviolet rays, fungi, mildew, saltwater, and insects.

Plastic lumber possesses several negative attributes relative to wood. Many plastic deck material manufacturers' data sheets suggest that a floating joist system be installed in order to correct for plastic lumber's considerable expansion and contraction properties. The extreme expansion and contraction rate for plastic lumber in the continental US, where temperatures can conceivably range from -20° to 100° Fahrenheit in various regions of the country, is calculated to be 0.3 percent times the length of the product (Eaglebrook 1998; Proulx 1998). Given this information, the maximum expansion-contraction that an eight-foot board could experience is 0.29-inches, and a twelve-foot wide deck could expand-contract by as much as three-eighths of an inch. When screws are used to fasten plastic lumber, it is recommended that the screw holes be pre-drilled and countersunk to prevent the plastic from puckering up around the fastener head. Also, plastic lumber is heavy, thereby increasing labor costs during deck installation (Proulx 1998). Finally, plastic lumber is not designed to be used in structural applications, resulting in discontinuity in finished deck appearance (*i.e.*, differing materials used in the underlying structure, deck surface, railings, and built-ins).

1.1.7 Concrete

Concrete is a material that competes directly with the more conventional wood deck materials. Concrete is most often used in low-cost new home construction, where concrete is poured to form large stoops and/or patio areas. Concrete has several advantages as a deck material in that it is inexpensive and requires virtually no maintenance. Additionally, concrete is a stable material and resistant to rot and insects. However, concrete can become stained or damaged if it comes in contact with strong acids or salt-based compounds. Concrete is not considered an aesthetically pleasing deck material. To counteract the poor appearance of concrete relative to alternative deck materials, many contractors will add aggregate to their concrete mixtures to provide a pebble finish.

1.2 MARKET SHARE OF RESIDENTIAL DECK PRODUCTS

There are currently no reliable measures of market share for residential deck materials and those studies that have been published are contradictory. George Carter & Affiliates conducted a survey in 1987 examining the residential deck market for existing homes in North America. Their survey results indicated that on a board foot basis, pressure treated lumber's market share was over 82 percent, followed by redwood at 11.5 percent, western red cedar at 3.2 percent, and other products at 2.8 percent. In a 1995 study examining deck material market share, the NAHB Research Center estimated that the market share for pressure treated lumber was 54.7 percent, while untreated lumber represented 45.3 percent of the market. The NAHB Research Center study did not report data based on species (*e.g.*, redwood, western red cedar) or alternative materials (*e.g.*, concrete, plastic lumber). Alternatively, Truini (1996) reports that the market share for pressure treated lumber in the residential deck market is about 80 percent.

1.3 CONSUMER PERCEPTIONS OF RESIDENTIAL DECK PRODUCTS

Given the lack of studies regarding residential deck materials, it is nearly impossible to make any reliable conclusions concerning consumer perceptions of the different residential deck materials available. This review of consumers' perceptions of residential deck materials covers factors mentioned in the residential deck literature that are said to affect consumer choice and purchasing decisions. Note that most of these factors are referenced anecdotally in the literature. The literature pertaining to residential deck material was thoroughly examined in order to inventory the factors thought to influence the residential deck planning and purchase process. Factors were categorized into three domains; namely, *product attributes*, *economic attributes*, and *manufacturer/retailer attributes*, as shown in ***Table 1***.

Only a few studies cited in ***Table 1*** have quantitatively measured the relative importance that particular deck material attributes have in consumer decision making, or how the attributes might ultimately impact consumer purchasing behavior. Research by Smith and Sinclair (1989, 1990) and Sinclair and Smith (1990) has explored consumer perceptions of CCA-treated lumber, a product that commands a relatively large market share in the deck material market. Additional research by George Carter & Affiliates (1989a,b) provides some insight into the perceptions that consumers have regarding treated lumber and western red cedar deck materials. None of the studies cited in ***Table 1*** specifically examine consumer perceptions across the complete range of residential deck materials available.

Table 1. Attributes Affecting Consumer Preferences for Residential Deck Materials

Attribute [a]	Reference(s)
Product Attributes	
Chemical retention level	Smith and Sinclair 1989, 1990
Chemically treated	Sinclair and Smith 1990
Durability	George Carter & Affiliates 1989[a]; Ghouse 1999; Sinclair and Smith 1990
Easy disposal of waste material	Sinclair and Smith 1990
Emission of odors	Sinclair and Smith 1990
Environmentally friendly	DeMaster 1998; Gonzalez 1996
Fade resistance	George Carter & Affiliates 1989[a]
Fire resistance	D.G. Bell & Associates 1986; Sinclair and Smith 1990
General product appearance	Smith and Sinclair 1990
Handling safety	Sinclair and Smith 1990
Inhalation of sawdust	Sinclair and Smith 1990
Kiln-dried after chemical treatment	Smith and Sinclair 1989, 1990
Longevity	Gonzalez 1996
Long lengths	George Carter & Affiliates 1989[a]
Low maintenance	DeMaster 1998; Ghouse 1999; Gonzalez 1996; Lowe 1996
Meets building code requirements	D.G. Bell & Associates 1986
Moisture content	Smith and Sinclair 1989, 1990
Natural material	George Carter & Affiliates 1989[a]
Precision end trimmed	George Carter & Affiliates 1989[a]
Product grade consistency	George Carter & Affiliates 1989[a]; Smith and Sinclair 1989
Product overall quality	Gonzalez 1996; Lowe 1996
Product pretreated with sealant	Freeman 1997; George Carter & Affiliates 1989[a]
Product texture	Gonzalez 1996
Quality mark	Smith and Sinclair 1989, 1990
Radius-edged	George Carter & Affiliates 1989[a]
Risk to children in direct contact	Sinclair and Smith 1990
Risk to animals in direct contact	Sinclair and Smith 1990
Safe for outdoor applications	Sinclair and Smith 1990
Straightness	Sinclair and Smith 1990; Smith and Sinclair 1989
Structural properties	George Carter & Affiliates 1989[a]
Surface cleanliness	Smith and Sinclair 1989, 1990
Susceptibility to wear	George Carter & Affiliates 1989[a]
Tight knots	George Carter & Affiliates 1989[a]
Economic Attributes	
Final installed price	D.G. Bell & Associates 1986; DeMaster 1998; Gonzalez 1996; Lowe 1996; Smith and Sinclair 1989
Competitive product price	DeMaster 1998; George Carter & Affiliates 1989a; Ghouse 1999; Lowe 1996
Manufacturer/Retailer Service Attributes	
Availability of accessories	George Carter & Affiliates 1989[a]
Branded product	Freeman 1997; Sinclair and Smith 1990; Smith and Sinclair 1989, 1990
Color variety	D.G. Bell & Associates 1986; DeMaster 1998; Ruderman 1995; Smith and Sinclair 1989
Convenient distribution location	Smith and Sinclair 1989, 1990
Dealer reputation	Smith and Sinclair 1989, 1990
Delivery of material	Smith and Sinclair 1989, 1990
DIY plans	Smith and Sinclair 1989
Knowledgeable salespeople	George Carter & Affiliates 1989[a]; Gonzalez 1996; Lowe 1996; Smith and Sinclair 1989
Manufacturer/retailer service and support	DeMaster 1998; George Carter & Affiliates 1989[a]; Lowe 1996; Smith and Sinclair 1989, 1990
On-time delivery	George Carter & Affiliates 1989[a]
Packaging	George Carter & Affiliates 1989[a]
Price incentives	Smith and Sinclair 1989, 1990
Product availability	D.G. Bell & Associates 1986; George Carter & Affiliates 1989[a]
Product variety	Smith and Sinclair 1989, 1990
Size variety	George Carter & Affiliates 1989[a]
Warranty/guarantee	George Carter & Affiliates 1989[a]; Smith and Sinclair 1989, 1990

[a]Note that consumers of residential deck materials is a generic term and is broadly defined to include builders, contractors, designers, do-it-yourselfers, and home owners.

2 STUDY OBJECTIVES

Given the lack of any existing study analyzing deck materials relative to one another, a study was developed that had the primary objective of surveying residential contractors in order to gather information regarding their use and perceptions of seven different deck materials. These seven deck materials are currently available in nearly every market in the US. A secondary purpose of the study was to characterize the deck material market by profiling the market along several segmentation variables (*e.g.*, firm size).

3 SURVEY METHODOLOGY

3.1 SAMPLE SELECTION

The population examined in this study was residential construction firms located in the US. Several factors dictated the sample size; these factors included the expected response rate to the mail survey, the data analysis methods utilized in the study, and the number of independent variables employed in the analysis.

The residential construction industry is highly fragmented. Firms operating within the industry can be classified into a myriad of segments, including prefabricated builders, manufactured housing builders, log homebuilders, tract builders, speculation builders, and custom builders. Furthermore, very distinct differences exist between firms within each segment (*e.g.*, number of units built per year, financing arrangements, material acquisition methods). In order to capture the inherent variance between residential builder segments, the sample used in this study was drawn from an industry database utilizing a stratified random sampling technique.

Cahners Direct Marketing Services, located in Des Plaines, Illinois, provided the database used to generate the sample for this study. Specifically, the sample was derived from the controlled circulation database of the trade magazine *Professional Builder*, which contains slightly over 100,000 single family and multi-family construction firms in the US. The sample was stratified along the state that each firm reported as their primary base of operation. Additionally, the US was predefined into four distinct regions; the northeast, southeast, northwest, and southwest (***Figure 2***). Each region received equal representation in the survey sample. Note that California was split into northwest and southwest regions. Given the various database alternatives, this database was chosen due to its overall size, stratification quality, and cost per sample unit.

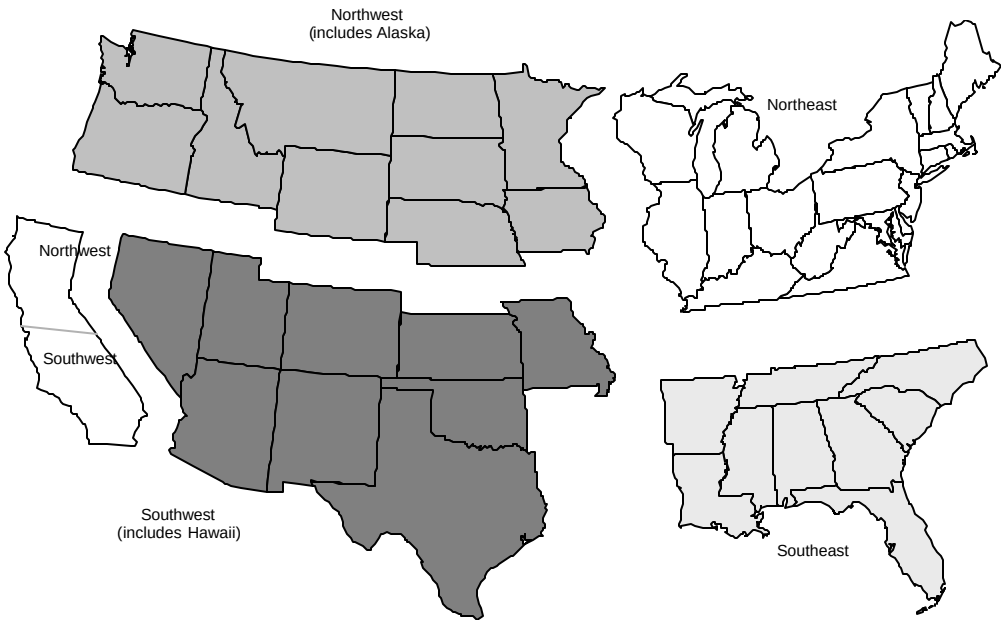

Figure 2. Collapsed Geographical Strata Utilized for Survey Sampling.

A secondary sample was also employed in the study. This secondary sample was used to examine the use and perceptions of residential deck materials among the 100 largest residential construction firms (hereafter referred to as the Builder 100) located in the US in 1997, where "largest" was defined by annual revenue.[1] A list of these 100 firms in the US was obtained from the annual Builder 100 list published in the National Association of Home Builders' magazine, *Builder* (Maynard and DePietropaolo 1998). Collectively in 1997, the Builder 100 firms constructed a total of 263,668 single-family homes (14.8 percent of all new single family housing starts) and had total revenues in excess of $43.2 billion.

3.2 SURVEY SAMPLE SIZE

The calculation of the survey sample size involved several implicit assumptions. First, it was assumed that the residential construction industry in the US was normally distributed and consisted of approximately 200,000 firms, a number based on US Department of Commerce statistics. Second, the error of estimation for the data analyses was bounded at five percent. Third, a 95 percent confidence interval was utilized in the data analyses, which has been standard practice in survey research. Finally, the proportion, *p*, of residential homebuilders familiar with substitute deck materials was conservatively estimated to be at least 75 percent.

[1] Annual revenue was defined as revenue generated from all income-producing sources and not revenue solely generated through homebuilding activities.

Given the assumptions described above, the following equation was used to calculate the survey sample size (Cochran 1977):

$$\text{where, } n = \left[\frac{NPQ}{(N-1)\left(\frac{b^2}{4}\right) + PQ} \right]$$

n	=	sample size
N	=	US single family and multi-family residential homebuilder population size
p	=	proportion of residential homebuilders familiar with substitute deck materials
q	=	$(1 - p)$
b	=	error bound on estimation

Using the equation above, the minimum number of returned surveys required to meet the error estimation bound at the 95 percent confidence level was calculated to be 300. Assuming a survey response rate of approximately 15 percent and a non-deliverable rate of 15 percent, a total of 2,400 surveys were mailed for this study. The inclusion of the Top 100 builders in this study increased the total number of surveys mailed to 2,500. ***Table 2*** provides a summation of the 2,500 sample firms by state and region of operation.

3.3 SURVEY DEVELOPMENT AND EXECUTION

A mail survey was used to collect data regarding residential construction firm use and perceptions of various deck products. Mail surveys typically provide the most efficient means of gathering data from a large population that is geographically dispersed (Dillman 1978). Mail surveys also tend to avoid bias which results from the use of personal interviewers and they allow the respondent to exercise greater care and take more time in completing the survey (Brown 1937; Malhotra 1993; Mangione 1995).

The survey instrument was pre-tested by two groups of individuals. The first pre-test group, used to determine the comprehensiveness of the survey instrument, consisted of industry experts in forest products and residential construction. The second pre-test group consisted of individuals who were generally unfamiliar with both the residential construction market and substitute deck materials. This second group examined the survey instrument for clarity and ease of use. The survey instrument was then revised based on the comments and suggestions from the pre-test participants.

Table 2. Synopsis of Survey Sampling and Response by State and Region

	Number Sampled	Number of Responses
Northeast Region		
Connecticut	22	2
Delaware	5	0
District of Columbia	2	1
Illinois	68	5
Indiana	34	3
Kentucky	15	0
Maine	5	2
Maryland	31	1
Massachusetts	30	5
Michigan	63	4
New Hampshire	8	1
New Jersey	44	6
New York	67	11
Ohio	58	8
Pennsylvania	66	3
Rhode Island	5	1
Vermont	4	1
Virginia	37	5
West Virginia	5	1
Wisconsin	31	5
Regional Subtotal:	*600*	*65*
Southeast		
Alabama	37	1
Arkansas	22	2
Florida	207	17
Georgia	85	7
Louisiana	28	3
Mississippi	15	0
North Carolina	110	14
South Carolina	44	5
Tennessee	52	3
Regional Subtotal:	*600*	*52*
Continued in Next Column		

	Number Sampled	Number of Responses
Northwest Region		
Alaska	14	4
Northern California	139	19
Idaho	31	5
Iowa	60	12
Minnesota	85	10
Montana	26	5
Nebraska	33	6
North Dakota	8	1
Oregon	70	14
South Dakota	14	2
Washington	109	17
Wyoming	11	2
Regional Subtotal:	*600*	*97*
Southwest Region		
Arizona	41	2
Southern California	212	18
Colorado	58	5
Hawaii	9	1
Kansas	23	3
Missouri	45	5
Nevada	18	2
New Mexico	16	3
Oklahoma	22	2
Texas	134	13
Utah	22	5
Regional Subtotal:	*600*	*59*
Unknown	--	11
Builder 100[b]	100	36
GRAND TOTAL	**2,500**	**320**

[a]Data in column was based on the state that the survey participant indicated that their company generated its greatest amount of revenue.

[b]Builder 100 represents the largest 100 residential construction firms located in the US in 1997 (*cf.* Maynard and DePietropaolo 1998).

Dillman's (1978) *Total Design Methodology* was used to design and execute the survey. Each survey participant was mailed an eight-page survey instrument and a self-addressed, postage paid, business reply envelope. A cover letter described the purpose of the survey and ensured confidentiality. As an incentive to reply to the survey, participants were offered a summary report of the research findings. A follow-up mailing containing a cover letter was mailed approximately two weeks following the initial mailing date. Copies of the cover letters and survey instrument are presented in Appendix I.

4 RESULTS

A total of 320 of the 2,500 surveys were completed and returned (***Table 2***). Fifty-three of the 2,500 were undeliverable; three of these undeliverable surveys were addressed to Builder 100 firms. Another three surveys were returned and determined to be unusable. Given these numbers, the overall effective response rate for the survey was 13.1 percent. This response rate is comparable to response rates of other recent mail surveys of firms in the US residential construction industry (Eastin, Shook, and Simon 1999; Shook 1997). The effective response rate among Builder 100 firms was substantially greater, however, with 37.1 percent of these firms responding. By region, the Northwest had the greatest number of returned and usable surveys (16.2 percent), followed by the Northeast (10.8 percent), Southwest (9.8 percent), and Southeast (8.7 percent).

4.1 SURVEY NON-RESPONSE BIAS

In general, higher rates of response to a mail survey imply lower rates of non-response bias (Malhotra 1993). Bias can significantly influence the results and conclusions of a mail survey given the fact that non-respondents can be very different from respondents. As a result, it was essential that the data be evaluated to determine if non-response bias is present.

Bias caused by non-response was evaluated using a test method developed by Armstrong and Overton (1977). This method uses late respondents as a proxy for non-respondents. A statistical test is used to compare the information obtained from late respondents with that of early respondents. If no, or very few, significant differences are found between the two groups, then non-response bias is not considered to influence the results of the survey.

The results of the Armstrong and Overton test method revealed that less than 4 percent of all paired comparisons between early and late survey responses were significantly different. These results suggested that non-response bias was not an important factor influencing the results of the survey and that the significant differences were the result of expected variation contained in the data (Armstrong and Overton 1977).

4.2 RESPONDENT PROFILE

Survey responses were analyzed according to firm size and region of firm's primary operation in order to examine whether group responses based on either of these two variables were significantly different from one another. Since the majority of the Builder 100 firms indicated that they operated within multiple states and regions, they were excluded from the regional analyses. In segmenting by firm size, small firms (n = 159) were defined as having 1997 gross sales revenue of $1 million or less and large firms (n = 58) were defined as having 1997 gross sales revenue greater than $2.5 million. Large firm data excludes Builder 100 firms (n = 36). Firms with 1997 gross sales revenues reported to be between $1 and $2.5 million were excluded from the firm size analysis in order to provide a clear distinction between large and small firms. Note that firm size could have also been measured using annual sales volume (*i.e.*, number of homes sold), total assets, number of employees, or production capacity (Scherer 1965). Kamien and Schwartz (1975), however, indicate that these alternate variables tend to be positively, but not perfectly, correlated. Consequently, empirical results and conclusions could depend to some degree on the variable selected as a proxy for firm size.

Revenue generated from sources unrelated to residential construction activity represented slightly less than 12 percent of responding firms' 1997 gross sales revenue (***Table 3***). Single family construction represented about 53 percent of firms' 1997 gross sales revenue, followed by home improvement and remodeling (23.7 percent), multi-family construction (9.6 percent), and patio and deck construction (2.1 percent). There were no statistically significant differences in sources of income on a regional basis, but there were several significant differences when the source of income data was examined by firm size. Most notable was the fact that large firms were found to generate a much greater percentage of sales revenue, 65.3 percent, from the construction of single family homes than either small firms (44.9 percent) or Builder 100 firms (57.4 percent). Small firms tended to diversify into home improvement and remodeling activity, while Builder 100 firms diversified in multi-family construction activity.

Revenue-generating business activity dedicated solely to residential patio and deck construction was found to be very low, with 2.1 percent of responding firms' 1997 gross sales revenue originating from this activity (***Table 3***). Initially, this low percentage appears to imply that residential deck construction activity is practically nonexistent among surveyed firms. On the contrary, when survey participants were queried as to the percentage of their new homes that included a deck, well over one-half of the new homes built (both spec and custom homes) were built with a deck.

Table 3. Summary of Firms' Sources of 1997 Sales Revenue

	Firms' Sources of 1997 Sales Revenue (%)[a,b]					
	Single Family Construction	**Multi-family Construction**	**Home Improvement & Remodeling**	**Patio & Deck Construction**	**Nonresidential Construction**	**Other**
Region[c]						
Northeast	49.1	5.3	32.5	2.8	8.6	1.9
Southeast	58.5	4.2	27.0	2.3	7.9	0.2
Northwest	53.5	6.8	20.9	2.6	13.6	2.7
Southwest	48.7	6.2	27.5	1.9	13.5	2.2
Firm Size[d]						
Small	44.9[a]	1.0[a]	38.2[a]	4.0[a]	9.3	2.6
Large	65.3[b]	16.3[b]	7.1[b]	0.3[b]	10.0	1.0
Builder 100	57.4[a]	39.4[c]	0.6[b]	0.0[b]	0.6	0.6
All Firms	**52.9**	**9.6**	**23.7**	**2.1**	**9.9**	**1.7**

[a]Due to rounding, percentages across rows may not sum to 100 percent.

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter. The lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.3 DECK CHARACTERISTICS

Table 4 indicates that nearly 60 percent of new spec homes and 68 percent of new custom homes constructed by survey participants included a deck. Builder 100 firms were found to build significantly fewer decks on their new spec and custom homes relative to small and large firms. On a regional basis, new homes in the northwest were more likely to have a deck than homes in the southwest.

Data concerning the average size and average cost of decks built for newly constructed spec and custom homes are also displayed in ***Table 4***. The average size of decks for new spec and custom homes were calculated to be 252 and 407 square feet, respectively, which corresponds very closely with data reported by Udelhofen (1998). The average cost of a new spec home deck was $2,997, while the average cost for a new custom home deck was $4,293. In other words, the new custom home deck is on average 62 percent larger and 64 percent more costly than a new spec home deck. The difference in the average cost per square foot between new spec and custom home decks was insignificant, however. New spec home decks cost builders an average of $11.89 per square foot to construct compared to $12.09 per square foot for new custom home decks, which represents a 2 percent price differential.

No statistically significant differences existed in the average deck size or cost data when examined by region, although several differences did exist when the data was compared based on firm size. First, Builder 100 firms were found to construct significantly smaller decks on both new spec and custom homes than small or large firms; the average Builder 100 deck was found to be less than one-half the size of small or large firm decks for equivalent new housing types. Second, the average cost of new spec home decks was found to be significantly less for Builder 100 firms than for small or large firms. Initially, this finding appears to be directly related to the fact that the Builder 100 firms construct significantly smaller decks relative to small or large firms – thus the lower total cost. Evaluation of the data based on a square foot basis, however, reveals that deck construction costs are indeed significantly lower for Builder 100 firms than for small or large firms. The average per square foot deck cost for new spec homes was found to be \$12.14, \$14.06, and \$9.48 for small, large, and Builder 100 firms, respectively. Similarly, the average per square foot deck cost for new custom homes was found to be \$12.28, \$13.18, and \$9.17 for small, large, and Builder 100 firms, respectively. Several factors may help to explain the significantly lower per square foot deck costs for Builder 100 firms; these include lower material costs due to greater bargaining power with suppliers, greater control over labor costs, and the use of lower quality and/or lower grade materials.

Table 4. Characteristics of Speculation and Custom Home Decks Constructed by Firms

	New Homes Constructed with Deck (%) [a,b]		Average Size of Deck Constructed by Firms (ft^2)		Average Total Cost of Constructed Deck ($)	
	Spec Homes	**Custom Homes**	**Spec Homes**	**Custom Homes**	**Spec Homes**	**Custom Homes**
Region[c]						
Northeast	64.5[a,b]	76.2[a]	255.6	362.4	3,346	4,171
Southeast	55.0[a,b]	59.4[a,b]	239.1	398.4	2,176	4,388
Northwest	73.2[a]	80.1[a,c]	164.3	436.7	3,291	5,385
Southwest	51.4[b]	56.1[b,c]	306.0	472.5	3,873	6,547
Firm Size[d]						
Small	67.7[a]	73.1[a]	247.9[a]	403.5[a]	3,010[a]	4,953
Large	55.9[a,b]	64.2[a]	288.7[a]	476.7[a]	4,059[a]	6,285
Builder 100	36.4[b]	29.1[b]	107.1[b]	166.8[b]	1,016[b]	1,531
All Firms	**59.8**	**68.0**	**252.0**	**407.2**	**2,997**	**4,923**

[a]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[b]Spec builders build on a speculative basis by purchasing a lot, constructing a home from a house plan, and then offering the home for sale. Custom builders will build from customized plans. In most cases, the custom builder uses a buyer's plans or aids in the design of a buyer's home. Custom homes are usually sold prior to breaking ground.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of \$1 million or less, while large firms had 1997 gross sales revenue greater than \$2.5 million (large firm data excludes Builder 100 firms).

4.4 USE OF VARIOUS DECK MATERIALS

Homebuilders were asked to indicate the volume of materials they used to construct decks on new homes over the past year, November 1997 to October 1998 (***Table 5***). Volume measures included structural elements, deck surface, and accessories such as railings and benches. Survey results revealed that 47.4 percent of all materials used to construct decks on new homes was pressure treated lumber, while western red cedar, concrete, and redwood represented 18.5 percent, 14.1 percent, and 11.1 percent of materials used, respectively. The two relatively new deck materials in the market, plastic lumber and wood-plastic composite lumber represented just under 5 percent of the total volume of deck materials used by responding firms.

Virtually no statistical differences were detected in materials used in new home deck construction when the data was examined by firm size, the exception being the use of untreated lumber (***Table 5***). The survey results indicate that nearly 12 percent of all decks constructed by Builder 100 firms utilized untreated lumber. Although the use of untreated lumber by Builder 100 firms was not found to be statistically different from large firms' use of untreated lumber, it was found to be significantly different than small firms' use of untreated lumber. Again, the use of untreated lumber by Builder 100 firms may partially explain this group of firms' lower average per square foot deck construction cost relative to small and large firms.

As might be expected, several material use differences were found when examining the data by region. Northwest homebuilders, for example, were found to use significantly more western red cedar in new home deck construction than homebuilders located in the other three regions. Similarly, southwest homebuilders were found to use significantly more redwood than homebuilders located in the other three regions. Pressure treated lumber was used twice as much on a volume basis by homebuilders in the eastern regions than their counterparts in the western regions. Statistically identical usage of concrete, wood fiber and plastic composite, untreated lumber, and plastic lumber was found across the four regions.

Homebuilders were asked to indicate their overall use of various materials in building decks on new homes over the period 1996 to 1998 (***Table 6***). Pressure treated lumber was reported to be widely used with 90 percent of respondents indicating that had used this material at some time during the past two years for deck construction. Other materials used by at least one-half of the respondents include western red cedar (67 percent), concrete (62 percent), and redwood (48 percent). Despite their low volume of use, the relatively new deck materials of wood-plastic composite lumber and plastic lumber were used by 37 percent and 25 percent of homebuilders, respectively.

Approximately 32 percent of homebuilders indicated that they had increased their use of pressure treated lumber over the past two years, while slightly over 12 percent had decreased their use. A greater percentage of respondents indicated that their use of western red cedar, redwood, and untreated lumber had decreased relative to those homebuilders that indicated an increase in these three deck materials.

4.5 DECK MATERIAL ATTRIBUTE ANALYSIS

Survey participants were provided a Likert-type scale ranging from 1 (Not Important At All) to 7 (Extremely Important) and were instructed to rate how important each of 11 attributes was to them when building deck surfaces and accessories (***Table 7***). Note that the ratings were made without regard to the type of deck material. Respondents rated the deck material attributes of long life, beautiful/aesthetically pleasing, durability, consistent material quality, and availability the highest. The mean value for each of these five attributes was greater than six. Low material cost was the lowest rated deck material attribute with a 5.3 mean value.

Examination of the attribute importance ratings segmented by region of operation yielded only one statistically significant difference; namely, homebuilders in the northeast and southeast placed significantly more importance on deck material availability than their counterparts in the northwest and southwest. Two statistically significant differences were uncovered when the attribute importance data was segmented and examined based on firm size. First, small firms placed significantly more importance on the beautiful/aesthetically pleasing attribute than Builder 100 firms. Large firms were found to place equivalent importance on this attribute relative to small and Builder 100 firms. Second, both small and large firms were found to place significantly more importance on consistent material quality as compared to Builder 100 firms.

Table 5. Volume of Materials Used by Homebuilders to Construct Decks on New Homes, 1997-1998

	Volume of Materials Used to Construct Decks (%)[a]						
	Pressure Treated Wood	**Western Red Cedar**	**Concrete**	**Redwood**	**Wood-Plastic Composite Lumber**	**Untreated Wood**	**Plastic Lumber**
Region[c]							
Northeast	64.4[a]	17.0[a]	6.9	1.9[a]	3.1	1.2	0.6
Southeast	72.9[a]	3.1[a]	19.5	2.3[a,b]	0.9	0.5	0.7
Northwest	29.9[b]	32.0[b]	13.5	15.5[b]	5.3	2.1	0.8
Southwest	21.6[b]	15.2[a]	18.0	31.3[c]	8.4	3.0	1.0
Firm Size[d]							
Small	46.2	18.5	12.8	14.1	4.6	1.4[a]	1.1
Large	46.6	16.1	15.6	10.1	6.1	3.4[a,b]	0.6
Builder 100	58.5	11.4	16.9	1.1	0.1	11.9[b]	0.0
All Firms	**47.4**	**18.5**	**14.1**	**11.1**	**4.0**	**2.6**	**0.7**

[a]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[b]Percentages across rows do not sum to 100 percent since "other materials" indicated by builders have been excluded in the summary.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

Table 6. Homebuilders' Material Use Patterns in New Home Deck Construction over the Period 1996 to 1998

	Materials Use Patterns in Deck Construction (%)						
Respondents' Use of Material	**Pressure Treated Wood**	**Western Red Cedar**	**Concrete**	**Redwood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**
Increased	31.9	12.7	10.9	5.1	2.2	16.6	3.8
Remained the Same	46.1	33.9	30.6	25.6	11.6	3.8	2.2
Decreased	12.4	20.5	5.6	27.1	14.1	2.8	2.2
Never Used	9.6	32.9	38.4	42.2	52.2	63.1	75.0

Table 7. Importance Ratings for Various Deck Material Attributes when Material is Used as a Deck Surface or Accessory

	Importance of Material Attribute When Used as Deck Surface or Accessory[a,b,c]										
	Long Life	**Beautiful & Aesthetically Pleasing**	**Durability**	**Consistent Material Quality**	**Availability**	**Easy to Maintain**	**High Workability**	**Price Stability**	**High Strength Properties**	**Little Material Waste**	**Low Material Cost**
Region[c]											
Northeast	6.43	6.44	9.32	6.29	6.41a	5.78	6.00	5.94	5.77	5.50	5.31
Southeast	6.23	6.08	6.12	6.02	6.01a	5.86	5.66	5.69	5.77	5.58	5.42
Northwest	6.28	6.35	6.02	6.01	5.88b	5.82	5.60	5.49	5.38	5.21	5.02
Southwest	6.39	6.36	6.03	6.03	5.84b	5.85	5.69	5.66	5.37	5.37	5.39
Firm Size[d]											
Small	6.35	6.35[a]	6.08	6.09[a]	6.01	5.73	5.74	5.54	5.51	5.34	5.06
Large	6.21	6.14[a,b]	6.10	6.06[a]	6.08	5.73	5.69	5.84	5.71	5.47	5.62
Builder 100	6.18	5.75[b]	5.82	5.39[b]	5.68	5.43	5.36	5.54	5.00	4.89	5.79
All Firms	**6.32**	**6.27**	**6.09**	**6.02**	**6.00**	**5.72**	**5.70**	**5.67**	**5.51**	**5.35**	**5.30**

[a]Utilizing a Likert-type scale ranging from 1 (Not Important At All) to 7 (Extremely Important) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for 11 attributes: "How important are the following building material attributes when building deck surfaces and accessories?"

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Deck accessories mentioned in the survey included railings, stair treads, and benches.

[d]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[e]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 fi

4.5.1 Long Life Attribute.

Homebuilders were also asked to rate each of seven deck materials along 11 attributes based on the degree that each material possessed the particular attribute (see ***Table 8*** through ***Table 18***). Homebuilders rated the deck materials using a scale of 1 (Not At All) to 7 (To a High Degree). Results shown in ***Table 8*** reveal that, on average, homebuilders perceive that concrete possesses the long life attribute to a greater degree than any other surveyed deck material; concrete received a mean rating of 6.20 on this particular attribute. Homebuilders also perceived that both plastic lumber and wood-plastic composite lumber possessed the long life attribute to a greater degree than solid wood. However, the mean values for these two products were not significantly different from the mean values for pressure treated lumber, redwood, or western red cedar. Builders perceived that untreated lumber possessed little of the long life attribute, resulting in a mean score of 2.56.

Respondents from the southeast perceived that western red cedar, redwood, untreated lumber, wood fiber and plastic composite, and plastic lumber possessed less of the long life attribute than respondents from the other three regions, especially relative to respondents from the northeast. Conversely, southeast respondents rated pressure treated lumber as possessing the long life attribute to a greater degree than respondents in the other three regions, although this difference was not found to be statistically significant. No statistically significant differences were detected when segmenting responses by firm size.

Table 8. Homebuilders' Ratings for Long Life Attribute of Various Deck Materials

	Degree that Deck Material Possesses Long Life Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	5.53[a]	5.69[a]	5.45	2.20	5.98[a]	6.17[a]	6.32
Southeast	4.40[b]	4.86[b]	5.70	2.30	4.80[b]	5.06[b]	6.19
Northwest	5.44[a]	5.41[a,b]	5.47	2.57	5.52[a,b]	5.58[a,b]	6.18
Southwest	5.31[a]	5.56[a,b]	5.44	2.67	5.56[a,b]	5.44[a,b]	6.13
Firm Size[d]							
Small	5.16	5.40	5.54	2.51	5.67	5.77	6.17
Large	5.15	5.21	5.36	2.48	5.25	5.32	6.22
Builder 100	5.42	5.72	5.14	2.63	5.47	5.71	6.11
All Firms	**5.27**	**5.44**	**5.47**	**2.56**	**5.51**	**5.61**	**6.20**

[a]Utilizing a Likert -type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.2 Beautiful/Aesthetically Pleasing Attribute.

Homebuilder's ratings for the beautiful/aesthetically-pleasing attribute are presented in ***Table 9***. Clearly, redwood and western red cedar, with mean ratings of 6.25 and 6.12, respectively, were perceived by homebuilders as possessing the greatest degree of beauty and aesthetics than any of the other five deck materials surveyed. Interestingly, concrete, with a mean rating of 4.48, was rated third behind redwood and western red cedar. The two deck materials receiving the lowest rating along the beautiful/aesthetically-pleasing attribute were plastic lumber (3.91) and untreated lumber (3.03).

On a product-by-product basis, no significant statistical differences existed in the beautiful/aesthetically pleasing attribute ratings between small, large, and Builder 100 firms. On a regional basis, homebuilders located in the southeast rated western red cedar as possessing significantly less of the beautiful/aesthetically-pleasing attribute than their counterparts in the other three surveyed regions. Conversely, homebuilders located in the southeast region rated pressure treated lumber as possessing a significantly greater degree of the beautiful/aesthetically-pleasing attribute than homebuilders in the other three regions.

Table 9. Homebuilders' Ratings for Beautiful/Aesthetically Pleasing Attribute of Various Deck Materials

	Degree that Deck Material Possesses Beautiful & Aesthetically Pleasing Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	6.37[a]	6.28	3.85[a]	3.04	4.22	4.12	4.33
Southeast	5.73[b]	6.10	4.71[b]	2.51	3.89	3.81	4.44
Northwest	6.16[a,b]	6.18	3.91[a]	3.09	4.14	3.74	4.55
Southwest	6.02[a,b]	6.38	3.61[a]	3.11	4.34	3.93	4.69
Firm Size[d]							
Small	6.13	6.24	4.01	3.19	4.28	4.05	4.40
Large	5.87	6.02	3.86	2.76	3.97	3.64	4.49
Builder 100	6.26	6.50	4.24	3.67	4.53	4.14	4.18
All Firms	**6.12**	**6.25**	**3.99**	**3.03**	**4.18**	**3.91**	**4.48**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.3 Durability Attribute

Homebuilders' perceptions with regard to the degree that various deck materials possess the durability attribute are displayed in ***Table 10***. Concrete, with a mean of 6.25, was rated as possessing the highest level of durability, followed by plastic lumber (5.43), wood-plastic composite lumber (5.43), and pressure treated lumber (5.00). Untreated lumber, with a mean of 2.93, was perceived to possess the lowest level of durability.

Examination of the homebuilder perceptions of the durability attribute segmented by firm size indicated that Builder 100 firms perceived that western red cedar was significantly more durable than large firms. Also, small firms were found to perceive that redwood was significantly more durable than large firms. No statistical differences were found between small, large, and Builder 100 firms with regard to durability perceptions for the other five deck materials. On a regional basis, homebuilders in the southeast were found to perceive that pressure treated lumber was significantly more durable than firms located in the northwest. There were no significant differences in perceptions of durability on a regional basis for the remaining six deck materials.

Table 10. Homebuilders' Ratings for Durability Attribute of Various Deck Materials

	Degree that Deck Material Possesses Durability Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.97	5.15	5.18[a,b]	2.73	5.33	5.54	6.35
Southeast	4.40	4.83	5.46[a]	2.69	5.15	5.03	6.17
Northwest	4.59	4.66	4.71[b]	2.87	5.33	5.36	6.24
Southwest	4.69	4.91	4.90[a,b]	3.26	5.75	5.60	6.24
Firm Size[d]							
Small	4.81[a,b]	5.05[a]	5.14	3.12	5.64	5.66	6.28
Large	4.27[a]	4.36[b]	4.80	2.39	5.00	4.94	5.90
Builder 100	5.65[b]	5.21[a,b]	4.86	3.33	5.93	5.73	6.21
All Firms	**4.76**	**4.90**	**5.00**	**2.93**	**5.43**	**5.43**	**6.25**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.4 Consistent Material Quality Attribute

Wood-plastic composite lumber was perceived by homebuilders to possess the greatest degree of consistent material quality, with a mean rating of 5.71 (***Table 11***). Plastic lumber and concrete, both with means greater than 5.50, also were perceived as possessing relatively high degrees of consistent material quality. Pressure treated lumber (mean = 4.22) and untreated lumber (mean = 3.50) were rated by respondents as being the least consistent deck materials. No significant differences were found when examining the consistent material quality attribute data by region for each deck material, and only one statistically significant difference was uncovered in the analysis when examining the attribute by firm size. Specifically, small homebuilders perceive that redwood deck materials possess a greater degree of consistent quality than do large homebuilders. Builder 100 firms were found to be statistically equivalent to small and large firms in their rating of redwood lumber's quality.

Table 11. Homebuilders' Ratings for Consistent Material Quality Attribute of Various Deck Materials

	Degree that Deck Material Possesses Consistent Material Quality Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.89	4.98	3.96	3.69	5.84	5.92	5.48
Southeast	4.70	5.00	4.63	3.34	5.23	5.09	5.76
Northwest	4.44	4.53	4.13	3.38	5.70	5.64	5.65
Southwest	4.35	4.50	4.34	3.45	5.89	5.75	5.53
Firm Size[d]							
Small	4.74	4.94[a]	4.26	3.78	5.89	5.87	5.67
Large	4.25	4.21[b]	4.11	3.00	5.59	5.44	5.34
Builder 100	4.50	4.95[a,b]	4.36	3.89	5.94	6.13	5.47
All Firms	**4.58**	**4.74**	**4.22**	**3.50**	**5.71**	**5.68**	**5.59**

[a]Utilizing a Likert -type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.5 Availability Attribute

Pressure treated lumber, untreated lumber, and concrete were perceived by homebuilders as possessing the greatest degree of availability (***Table 12***), with means of 6.03, 5.93, and 5.77, respectively. Plastic lumber (mean = 3.77) was perceived as possessing the lowest degree of availability. Several significant differences existed in homebuilders' perceptions of deck material availability on a regional basis. First, homebuilders in the Southeast rated the availability of western red cedar significantly lower than homebuilders in the other three regions. Second, homebuilders in the eastern regions rated the availability of redwood significantly lower than homebuilders located in western regions. Finally, homebuilders in the western regions rated the availability of pressure treated lumber significantly lower than homebuilders located in the eastern regions.

Analysis of the availability attribute based firm size indicated that small firms perceived significantly greater availability of untreated lumber than large builders. Builder 100 firms had statistically identical availability perceptions for untreated lumber as small and large builders. Relative to large builders, Builder 100 firms perceived a greater availability of plastic lumber. Small builders' perception of the availability of plastic lumber was statistically equivalent to that of large and Builder 100 firms.

Table 12. Homebuilders' Ratings for Availability Attribute of Various Deck Materials

	Degree that Deck Material Possesses Availability Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.78[a]	3.90[a]	6.40[a]	6.12	4.23	3.68	5.80
Southeast	3.51[b]	3.07[a]	6.42[a]	5.65	3.93	3.51	5.79
Northwest	4.81[a]	4.75[b]	5.73[b]	5.93	4.28	3.70	5.66
Southwest	4.65[a]	5.19[b]	5.66[b]	5.91	4.62	3.83	5.76
Firm Size[d]							
Small	4.59	4.48	6.12	6.15[a]	4.32	3.79[a,b]	5.88
Large	4.20	3.84	6.04	5.41[b]	4.27	3.33[a]	5.29
Builder 100	4.25	3.68	6.00	6.00[a,b]	4.81	4.75[b]	6.16
All Firms	**4.51**	**4.28**	**6.03**	**5.93**	**4.30**	**3.77**	**5.77**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.6 Easy-to-Maintain Attribute

Homebuilder ratings indicated that concrete was perceived as being the easiest deck material to maintain (mean = 5.93). Plastic lumber, wood-plastic composite lumber, and pressure treated lumber followed the perceptual rating for concrete, with means of 5.59, 5.47, and 4.43, respectively. Untreated lumber received the lowest easy to maintain rating (mean = 2.23) and was substantially lower than any other residential deck material that was evaluated. When the region and firm size factors were used to segment and analyze the easy to maintain attribute data, no significant differences were uncovered (***Table 13***).

Table 13. Homebuilders' Ratings for Easy to Maintain Attribute of Various Deck Materials

	Degree that Deck Material Possesses Easy to Maintain Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.20	4.22	4.35	2.02	5.52	5.78	5.91
Southeast	4.05	4.20	4.72	2.17	4.97	4.91	5.88
Northwest	4.15	4.19	4.31	2.36	5.56	5.64	5.94
Southwest	4.31	4.50	4.57	2.42	5.45	5.68	6.05
Firm Size[d]							
Small	4.32	4.44	4.54	2.44	5.66	5.74	5.96
Large	3.84	3.88	4.52	2.00	5.24	5.38	5.70
Builder 100	3.90	4.32	4.27	2.00	6.06	6.00	5.83
All Firms	**4.16**	**4.27**	**4.43**	**2.23**	**5.47**	**5.59**	**5.93**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.7 High Workability Attribute

In general, homebuilders perceived that all the residential deck materials surveyed possessed a fair degree of high workability (***Table 14***). Western red cedar and redwood received the highest high workability rating; their mean ratings were nearly identical at 5.98 and 5.97, respectively. These two deck materials were followed by pressure treated lumber and untreated lumber. On average, all solid wood products received ratings on the high workability attribute that were greater than those for substitute deck materials.

Few differences were found between the four regions with regard to the high workability attribute. Homebuilders in the southeast were found to rate the high workability attribute of western red cedar and redwood significantly lower than their counterparts in the northeast and southwest. Northwest homebuilders were found to be statistically similar in their rating of the high workability attribute for western red cedar and redwood relative to the homebuilders in the other three regions. No statistically significant differences were detected among the deck materials along the high workability attribute when segmented by firm size.

Table 14. Homebuilders' Ratings for High Workability Attribute of Various Deck Materials

	Degree that Deck Material Possesses High Workability Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	6.20[a]	6.15[a]	5.47	5.35	4.74	4.53	3.98
Southeast	5.51[b]	5.45[b]	5.65	4.46	4.65	4.59	4.69
Northwest	6.00[a,b]	6.04[a,b]	5.37	5.17	4.45	4.32	4.42
Southwest	6.17a	6.12[a]	5.61	5.33	5.21	4.89	4.43
Firm Size[d]							
Small	6.09	6.08	5.53	5.27	4.76	4.58	4.28
Large	5.66	5.62	5.39	4.92	4.79	4.48	4.20
Builder 100	5.65	5.79	5.64	5.94	4.56	4.87	4.63
All Firms	**5.98**	**5.97**	**5.51**	**5.19**	**4.71**	**4.57**	**4.39**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.8 Price Stability Attribute

The price stability of various products was perceived as being markedly different amongst the survey respondents (***Table 15***). On an aggregate response basis, homebuilders indicated concrete exhibited the greatest price stability, followed by pressure treated lumber, wood-plastic composite lumber, and untreated lumber, with means of 5.13, 4.51, 4.37, and 4.25, respectively. Homebuilders perceived that western red cedar and redwood had unstable prices. Note that when deck materials are rated by their overall mean score on the price stability attribute, pressure treated lumber rates second, while western red cedar rates sixth out of the seven materials evaluated. This result is interesting since data presented in ***Figure 1*** clearly shows that pressure treated lumber is more price volatile than western red cedar. In fact, the average month-to-month price variation for pressure treated deck material between January 1992 and December 1999 was 63 percent greater than that for western red cedar. Narrowing the price volatility analysis to the year just prior to the survey's execution (December 1997 to November 1998), a period where homebuilders' recall knowledge should be more accurate and relevant, reveals that pressure treated lumber deck material was 40 percent more price volatile on a month-to-month basis than western red cedar. This result suggests that price magnitude may also be a factor when homebuilders assess the price stability attribute.

Analysis of the price stability attribute by region detected only one difference among homebuilders; namely, survey participants in the southwest rated the price stability of wood-plastic composite lumber significantly higher than homebuilders in the southeast. No significant differences were detected when the price stability attribute was segmented and analyzed by firm size.

Table 15. Homebuilders' Ratings for Price Stability Attribute of Various Deck Materials

	Degree that Deck Material Possesses Price Stability Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	3.78	3.43	4.59	4.47	4.46[a,b]	4.22	5.20
Southeast	3.38	3.43	4.82	4.19	3.67[a]	3.76	5.66
Northwest	3.71	3.57	4.31	4.08	4.33[a,b]	4.20	4.92
Southwest	4.02	4.02	4.69	4.57	4.72[b]	4.45	5.11
Firm Size[d]							
Small	3.91	3.79	4.59	4.56	4.42	4.27	5.29
Large	3.29	3.14	4.49	3.85	4.06	3.91	4.83
Builder 100	3.58	3.56	3.95	3.65	4.76	4.88	4.59
All Firms	**3.72**	**3.60**	**4.51**	**4.25**	**4.37**	**4.24**	**5.13**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.9 High Strength Properties Attribute

Concrete, with an overall mean rating of 6.27, was perceived to possess the greatest degree of high strength properties relative to all other deck materials evaluated in the survey (***Table 16***). Pressure treated lumber was the second highest rated deck material on the high strength properties attribute. Note that homebuilders indicated that they perceived that pressure treated lumber possessed higher strength properties than untreated lumber. Information published in the *Wood Handbook* states that pressure treatment of wood with salt-based compounds will generally weaken the wood's strength properties, although the magnitude of the effect is minimal (Forest Products Laboratory 1999). Survey participants may be evaluating the high strength properties attribute based on the long-term performance of the material, where pressure treated lumber would clearly outperform untreated lumber. They may also be referring to the fact that most pressure treated lumber is southern pine which has high strength properties that are roughly equivalent to Douglas-fir.

Segmentation and analysis of the high strength properties attribute on a regional basis revealed that homebuilders in the southeast rated pressure treated lumber significantly higher than their counterparts in the northwest. Only one statistically significant difference was detected on the high strength attribute when data was analyzed by firm size. Small firms perceived that untreated lumber exhibited significantly higher strength properties than large firms, while there were no significant differences between Builder 100 firms and the small or large firms.

Table 16. Homebuilders' Ratings for High Strength Properties Attribute of Various Deck Materials

	Degree that Deck Material Possesses High Strength Properties Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.13	4.98	5.31[a,b]	4.60	4.29	4.23	6.42
Southeast	3.82	4.13	5.50[a]	4.12	4.16	3.94	6.21
Northwest	4.13	4.08	4.81[b]	4.28	4.24	3.86	6.17
Southwest	4.17	4.33	4.87[a,b]	4.67	4.53	4.44	6.22
Firm Size[d]							
Small	4.13	4.57	5.02	4.69[a]	4.34	4.19	6.34
Large	3.98	4.07	5.26	3.84[b]	4.21	3.91	5.93
Builder 100	4.10	4.53	5.43	4.68[a,b]	5.13	4.63	6.53
All Firms	**4.08**	**4.40**	**5.11**	**4.44**	**4.37**	**4.14**	**6.27**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.5.10 Little Material Waste Attribute

Survey respondents perceived that concrete generated the least material waste relative to all other deck materials evaluated in the study (***Table 17***). The remaining deck materials had very similar ratings. Homebuilders in the northeast, however, perceived that western red cedar and redwood deck materials resulted in significantly more waste than homebuilders located in the southeast. Numerous statistically significant differences in the little material waste attribute were found when data was segmented and analyzed by firm size. Large and Builder 100 firms perceived that western red cedar resulted in more material waste in deck construction relative to small firms. A significant difference was also found between small and large firms in their perceptions of material waste for redwood, pressure treated lumber, and untreated lumber, with small firms rating each of these three deck materials as generating less waste relative to large firms.

Table 17. Homebuilders' Ratings for Little Material Waste Attribute of Various Deck Materials

	Degree that Deck Material Possesses Little Material Waste Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	4.97[a]	4.88[a]	5.04	4.98	4.96	4.96	5.67
Southeast	4.22[b]	4.18[b]	4.83	4.24	4.62	4.58	5.48
Northwest	4.64[a,b]	4.74[a,b]	4.58	4.44	4.64	4.58	5.44
Southwest	4.54[a,b]	4.59[a,b]	4.67	4.60	4.87	4.73	5.62
Firm Size[d]							
Small	4.80[a]	4.85[a]	4.90[a]	4.70[a]	4.88	4.91	5.75
Large	4.00[b]	3.86[b]	4.32[b]	3.89[b]	4.34	4.18	5.13
Builder 100	4.11[a,b]	4.22[a,b]	4.24[a,b]	3.89[a,b]	4.69	4.56	5.83
All Firms	**4.60**	**4.61**	**4.72**	**4.52**	**4.76**	**4.70**	**5.57**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

Low Material Cost Attribute.

Recall that homebuilders indicated that the low material cost attribute was the least important of eleven attributes when determining what material to use when building deck surfaces and accessories (***Table 7***). Homebuilders' responses, as displayed in ***Table 18***, indicated that most deck materials were not perceived as exhibiting low cost; the exceptions being untreated and pressure treated lumber. Of the seven deck materials evaluated, redwood was perceived as exhibiting the least degree of being a low cost material (mean = 2.80), followed by western red cedar, plastic lumber, and wood-plastic composite lumber. Collectively, these results suggest that new homebuilders may not be as sensitive to the price when choosing a deck material. Instead, other deck attributes take precedence over price.

Several statistically significant differences were found when the low material cost attribute data was segmented and analyzed by region and firm size. Homebuilders in the northwest and southwest perceived that western red cedar and redwood possessed a greater degree of the low material cost attribute than their counterparts in the southeast. This difference can likely be attributed to supply factors; namely, western red cedar and redwood are not as widely distributed in the southeastern markets relative to other North American market areas. Homebuilders in the southeast perceived that pressure treated lumber possessed a greater degree of the low material cost attribute than homebuilders in the northwest. Also, homebuilders in the southwest perceived that wood-plastic composite lumber possessed a greater degree of the low material cost attribute than homebuilders in the southeast. On a firm size basis, small firms perceived that both western red cedar and redwood possessed a greater degree of the low material cost attribute than large firm. Finally, small firms and Builder 100 firms perceived that untreated lumber possessed a greater degree of the low material cost attribute than large firms.

Table 18. Homebuilders' Ratings for Low Material Cost Attribute of Various Deck Materials

	Degree that Deck Material Possesses Low Material Cost Attribute[a,b]						
	Western Red Cedar	**Redwood**	**Pressure Treated Wood**	**Untreated Wood**	**Wood-Plastic Composite Lumber**	**Plastic Lumber**	**Concrete**
Region[c]							
Northeast	3.11[a,b]	2.55[a,b]	4.60[a,b]	4.72	3.27[a,b]	3.23	4.09
Southeast	2.40[a]	2.18[a]	5.13[a]	4.09	2.80[a]	2.91	4.46
Northwest	3.46[b]	3.25[b]	4.14[b]	4.47	3.12[a,b]	3.01	4.24
Southwest	3.57[b]	3.23[b]	4.43[a,b]	4.76	3.91[b]	3.98	4.41
Firm Size[d]							
Small	3.43[a]	3.09[a]	4.56	4.80[a]	3.18	3.16	4.36
Large	2.64[b]	2.28[b]	4.60	3.74[b]	3.33	3.44	4.24
Builder 100	2.55[a,b]	1.95[b]	4.45	5.47[a]	3.19	2.80	3.44
All Firms	**3.15**	**2.80**	**4.51**	**4.61**	**3.27**	**3.22**	**4.22**

[a]Utilizing a Likert-type scale ranging from 1 (Not At All) to 7 (To a High Degree) and containing a midrange value of 4 (Neutral), survey participants were asked to answer the following question for seven deck materials: "Indicate the degree to which the material possesses the stated attribute."

[b]Comparison of means across subgroups (*i.e.*, column data) is represented by alphabetic notations (Scheffe's contrast test, 0.05 α-level). Subgroups with statistically identical means share the same letter; the lack of alphabetic notations indicates that the means were statistically similar across all subgroups.

[c]Builder 100 firms were excluded from the regional summary since most reported operating within multiple states and regions.

[d]Small firms were defined as having 1997 gross sales revenue of $1 million or less, while large firms had 1997 gross sales revenue greater than $2.5 million (large firm data excludes Builder 100 firms).

4.6 MODELS OF PRODUCT AND ATTRIBUTE PERCEPTIONS

In order to make strategic decisions, marketing managers often desire to have information regarding how consumers perceive their company's product relative to competing products (*i.e.*, product substitutes). A common method to assess the relative differences between competing products is to assess the products based on their tangible and intangible attributes. When properly executed, attribute analysis allows managers to identify those product attributes that distinguish their product from competitors' products. Armed with this type of information, the manager can adjust existing marketing strategies and tactics to more effectively and efficiently compete with substitute products.

The term "market position" is a rather abstract concept; we can imagine a product's market position by utilizing a spatial metaphor. Specifically, two points in space can represent various products. The distance between the points corresponds directly to the similarity between the products. Using a two-stage process of collecting data about the perceived similarities between products and representing these similarities in a two-dimensional or three-dimensional spatial model, the construction of a market position for a product can be created. This technique is called perceptual mapping.

In this study, perceptual mapping is used to investigate homebuilder perceptions of the similarities and differences that exist between the different types of materials within a single class of products – deck surfaces and accessories. The results obtained from this analysis can be used to obtain the information necessary to compete more intensely with rivals, reduce competitive rivalry, or uncover feasible niches in the market that have yet to be exploited by competitors' products.

This study utilized the compositional approach to perceptual mapping. This approach to perceptual mapping derives preference evaluations from a series of separate evaluations by each of the survey respondents. The individual evaluations were combined using a multivariate statistical technique called multiple discriminant analysis (MDA) to form an overall evaluation. MDA provides an advantage in that it allows for the identification of differences among two or more market segments.

Eleven deck material attributes were used as the independent (predictor) variables in this study, while seven deck materials were represented as dependent variables. The eleven deck material attributes included: availability, beautiful/aesthetically pleasing, consistent material quality, durability, easy to maintain, high strength properties, high workability, little product waste, long life, low material costs, and price stability.

4.7 RESULTS OF PERCEPTUAL MAPPING ANALYSIS

A total of 233 homebuilders rated all the deck materials along all eleven deck material attributes. A multiple discriminant analysis (MDA) was performed on the data to determine which of the eleven attributes differentiated best between the various deck materials. A varimax rotation was used in the MDA procedure to enhance the interpretability of the results. The MDA and varimax rotation procedure resulted in six canonical discriminant functions. Four of the canonical discriminant functions were found to be statistically significant. The matrix for the rotated discriminant function loadings along each product attribute is displayed in ***Table 19***. This table also indicates the amount of variance that is accounted by each of the six functions. Functions I and II were found to be the most influential with regard to discriminating between the various deck materials, accounting for 55.0 and 34.2 percent of the total explained variance in the data, respectively. Collectively, the four significant discriminant functions accounted for 99.7 percent of the variation in the data. The associated eigenvalue's for Functions III and IV were much less than one, indicating that the use of these functions in making statistical and objective conclusions would not be practical.

The MDA reduced the eleven deck material attributes to six dimensions. Each of the dimensions can be described by a function that represents those attributes in which the deck materials differ the most. Each discriminant function represents a linear combination in which a discriminant score can be calculated for each of the respondents, which is very similar to a regression analysis. Examination of each of the attributes having the highest attribute loadings on a function allows for the interpretation and labeling of each of the functions.

Referring to ***Table 19***, each loading represents the amount of correlation between each deck material attribute and the discriminant dimension. The correlation between easy to maintain and Function I, for instance, was .678. This means that 67.8 percent of the variance in the deck material attribute of easy to maintain was accounted for in Function I. Examination of attributes that loaded highly on the same functions allows for the grouping of attributes that discriminate between the deck materials similarly. The MDA revealed that the easy to maintain attribute loaded highly on Function I, while the attributes availability, low material cost, and price stability loaded highly on Function II. Function II was labeled as consistent supply and pricing given the three variables that loaded highest on it. Interestingly, the beautiful/aesthetically-pleasing attribute did not load highly on any of the six functions, suggesting that it does not effectively discriminate between the deck materials.

Table 19. Rotated Discriminant Function Loadings (Correlations) between Deck Material Attributes and Discriminant Dimensions

Deck Material Attributes	Rotated Discriminant Function Loadings[a]					
	Function I	Function II	Function III	Function IV	Function V	Function VI
Easy to Maintain	***.678***	.083	.379	-.190	.159	.069
Availability	-.255	***.607***	.336	-.049	.549	.329
Low Material Cost	-.153	***.463***	-.070	-.391	-.142	.153
Price Stability	.128	***.366***	-.053	-.060	.275	.228
Durability	.534	.096	***.634***	.025	.183	.274
High Workability	-.266	-.322	***.545***	-.033	.312	.229
High Strength Properties	.114	.400	.408	***.537***	.010	-.378
Consistent Material Quality	.495	-.049	-.033	.219	***.656***	.175
Little Product Waste	.144	.182	.135	.462	***-.721***	.421
Long Life	.185	-.311	.209	-.008	.492	***-.587***
Beautiful/Aesthetically Pleasing	.246	.201	-.129	.188	.018	.242
Eigenvalue	1.081[b]	.672[b]	.165[b]	.041[b]	.003	.002
Percent of Variation Explained	55.0%	34.2%	8.4%	2.1%	.2%	.1%
Cumulative Variance Explained	55.0	89.2	97.6	99.7	99.9	100.0

[a]Factors were rotated using a varimax rotation. Function loadings represent the pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions.

[b]Function significant as determined by Wilks' lambda test of significance.

The mean discriminant scores, or group centroids, for each of the eleven deck materials are displayed in ***Table 20***. The discriminant scores in this table are standardized. As a result, the group centroids can be interpreted to be the number of standard deviations for each deck material from the average of all deck materials on each function. Graphically plotting these scores in a multidimensional space (*e.g.*, two dimensions) allows for a comparison of the deck materials relative to one another along the attributes that were determined to be statistically significant.

Table 20. Mean Discriminant Scores (Group Centroids) for Deck Materials

Deck Material	Rotated Discriminant Function Centroids[a]					
	Function I	Function II	Function III	Function IV	Function V	Function VI
Western Red Cedar	-.419	-.859	.228	-.013	-.003	.096
Redwood	-.254	-1.010	.295	.232	-.008	-.070
Pressure treated lumber	-.566	.699	.489	-.320	.006	-.029
Untreated lumber	-1.899	.598	-.634	.093	-.006	-.002
Wood Fiber/Plastic Composite	1.029	-.242	-.395	-.072	.129	-.008
Plastic Lumber	1.256	-.419	-.479	-.194	-.102	-.014
Concrete	1.117	1.306	.207	.261	-.016	.023

[a]Factors were rotated using a varimax rotation.

The solution to the MDA can be plotted in a six-dimensional space. Only a single two-dimensional plot representing Function I and II was constructed in this study; the remaining four functions were not plotted due to the low percentage of variation that each of them accounted for in the MDA results. ***Figure 3*** plots each of the seven deck materials evaluated in this study along Function I (easy to maintain) and Function II (consistent supply and pricing).

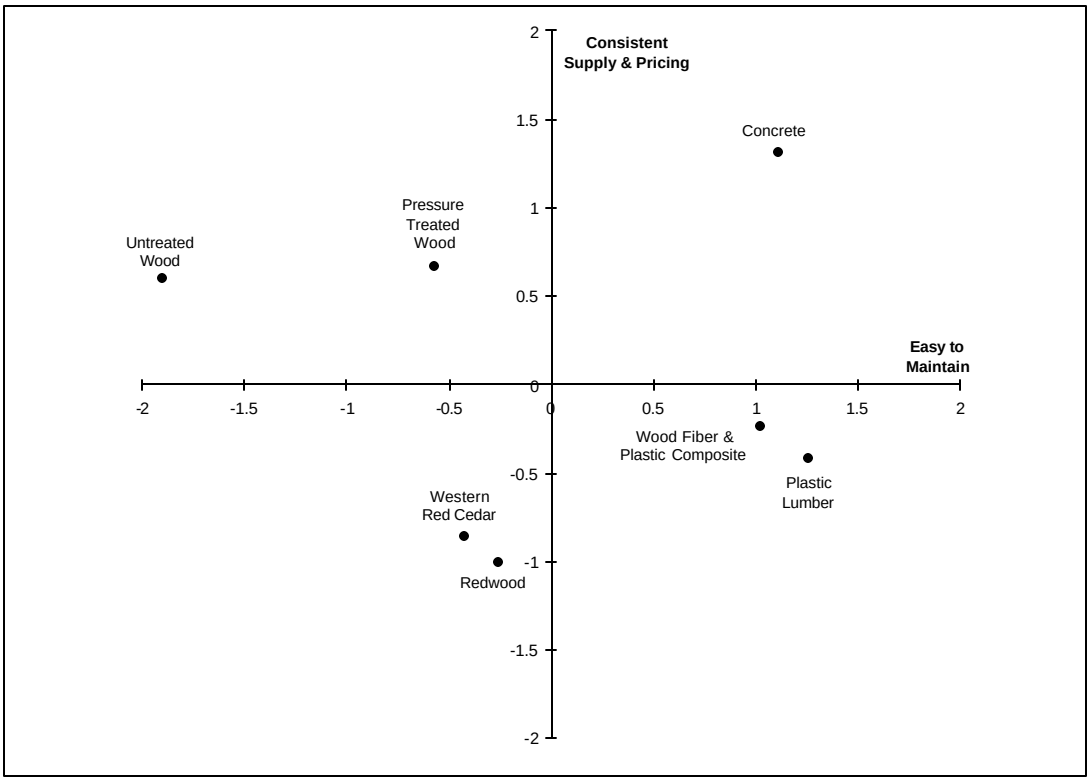

Figure 3. Discriminant Function Analysis Results of Homebuilders' Perceptions of Various Deck Materials Along the Attribute Dimensions of *Easy-To-Maintain* and *Consistent Supply and Pricing*.
Note: Data points represent group centroids.

4.8 INTERPRETATION OF PERCEPTUAL MAP OF DECK MATERIALS

The perceptual map displayed in Figure 3 can be used to evaluate each of the seven deck materials relative to one another. The distance between any two deck materials can be considered as a measure of the substitutability between the two deck materials along the attribute dimensions. In other words, two deck materials located next to one another in the perceptual map are considered to be substitutes by the homebuilders in this study as dictated by the attributes in the perceptual map. Theoretically, a deck material exhibiting average measures of the easy to maintain and consistent supply and pricing dimensions would be located at the very center of the perceptual map (*i.e.*, cardinal coordinates 0,0).

Figure 3 clearly indicates that concrete was perceived by homebuilders to exhibit the greatest degree of consistent supply and pricing, followed by pressure treated lumber and untreated lumber. Redwood and western red cedar were perceived by homebuilders as exhibiting the lowest degree of consistent supply and pricing among the seven deck materials evaluated in the study. Along the easy to maintain dimension, plastic lumber, concrete, and wood-plastic composite lumber were rated the highest among homebuilders, whereas untreated lumber was rated the lowest.

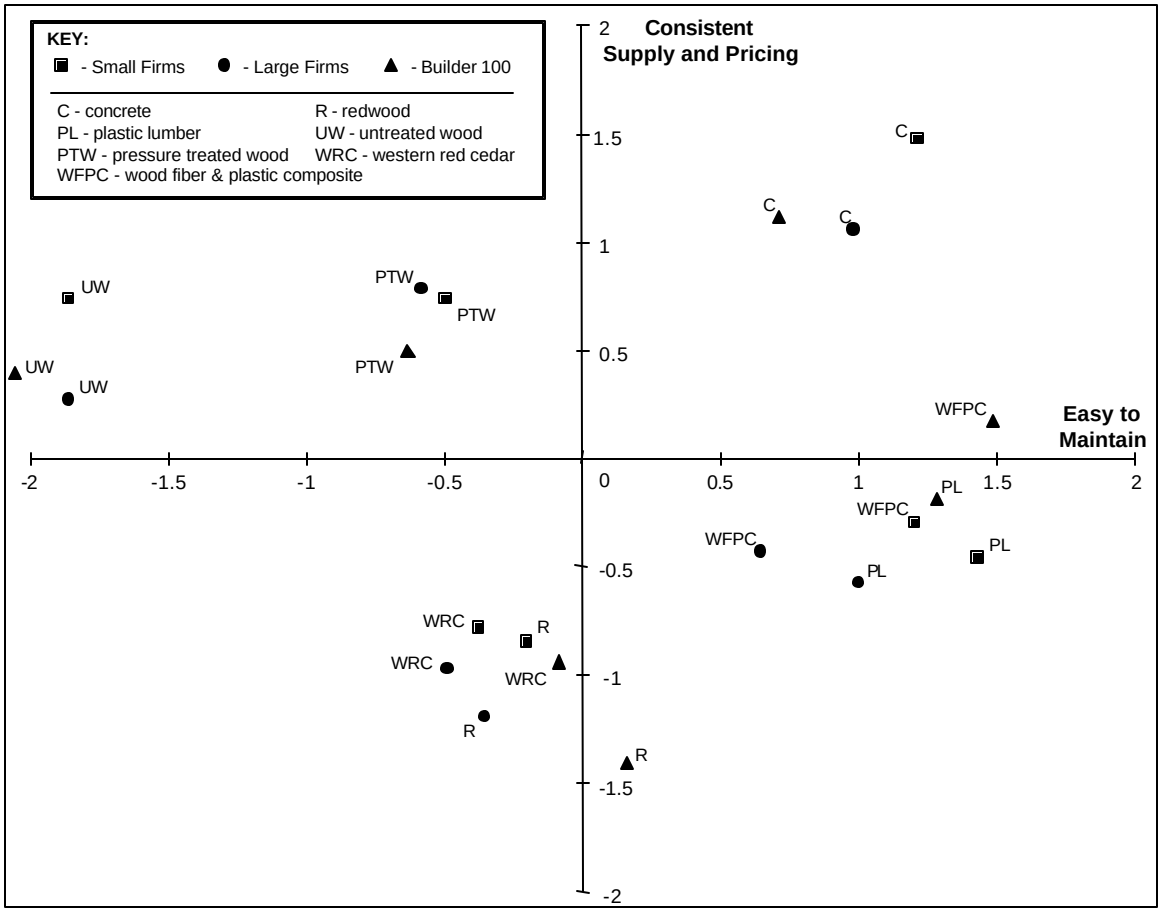

Figure 4. Discriminant Function Analysis Results of Homebuilders' Perceptions of Various Deck Materials Along the Attribute Dimensions of *Easy to Maintain* and *Consistent Supply and Pricing*, Segmented by Firm Size.
Notes: Data from large firms excludes Builder 100 responses. Data points represent group centroids.

Figure 4 is identical to ***Figure 3*** except that each deck material has been segmented by firm size. In segmenting by firm size, small firms were defined as having 1997 gross sales revenue of $1 million or less and large firms were defined as having 1997 gross sales revenue greater than $2.5 million. Large firm data excludes Builder 100 firms. Firms with 1997 gross sales revenues reported to be between $1 and $2.5 million were excluded from the firm size analysis in order to provide a clear demarcation between large and small firms. Visual inspection of

Figure 4 reveals that homebuilders, when segmented by firm size, had somewhat differing perceptions of the deck materials along the dimensions of easy to maintain and consistent supply and pricing. For instance, the difference between Builder 100 and large firms on wood-plastic composite lumber's easy to maintain dimension appears to be quite large.[2] However, the differences in the means for each product analyzed by firm size indicates that no significant differences exist along the easy to maintain and consistent supply and pricing dimensions.

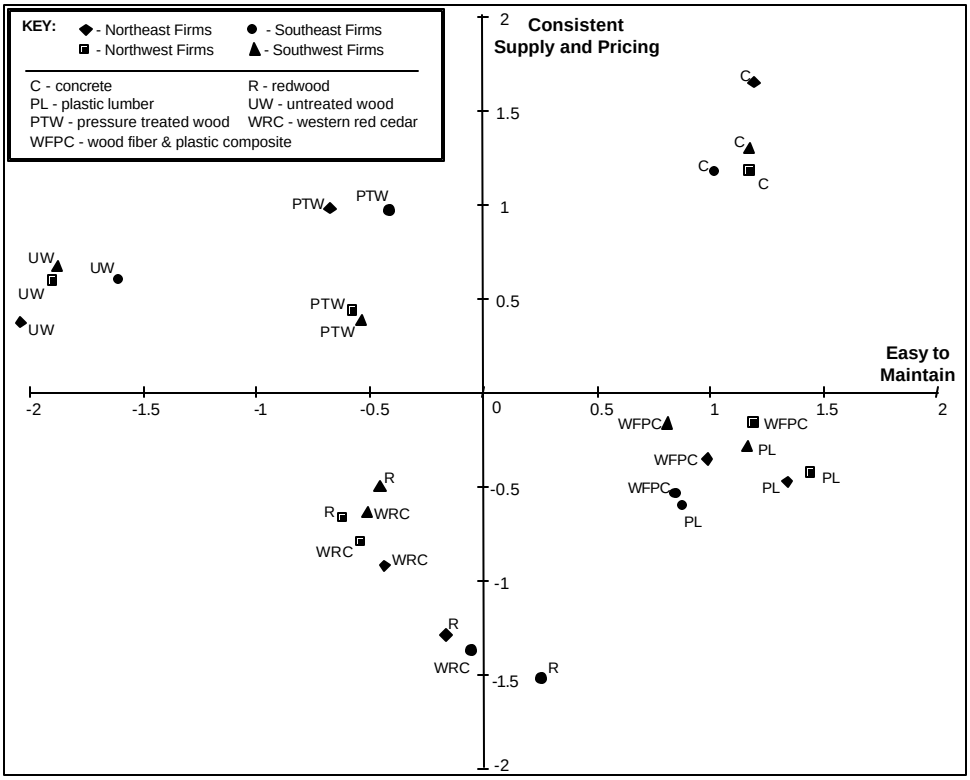

Figure 5. Discriminant Function Analysis Results of Homebuilders' Perceptions of Various Deck Materials along the Attribute Dimensions of *Easy to Maintain* and *Consistent Supply and Pricing*, Segmented by Region of Operation.

Notes: Builder 100 firms were excluded from the regional analysis since most reported operating within multiple states and regions. Data points represent group centroids.

Figure 5 is similar to ***Figure 4*** in interpretation; however, the data has been segmented by region of operation rather than by firm size. A few statistically significant differences were uncovered for western red cedar and redwood when segmented by firm size. First, homebuilders in the southeast perceived that western red cedar deck material was significantly easier to maintain but significantly less consistent in supply and price than their counterparts in the northwest. Second, homebuilders in the southeast perceived that redwood deck material was significantly easier to maintain than homebuilders in the northwest and southwest. The remaining deck materials were perceived as statistically equivalent along the two attribute dimensions when the data was segmented by region of operation, despite what appear to be visually significant differences in ***Figure 5***.

[2] Numerically, the difference in this case is nearly one standard deviation.

5 CONCLUSIONS

Approximately 85 percent of all single-family homes in the US include a deck or deck-like structure (*e.g.*, patio, porch, or balcony), which is equivalent to roughly 30 million decks. Sixty percent of all new homes are constructed with a deck, while nearly 2.75 million decks are replaced on annual basis (the average deck has a life expectancy of about eleven years). Furthermore, slightly over 4 percent of all households add a deck to their home on an annual basis, resulting in another 3 million new decks. Collectively, over 6.5 million new decks have been built annually in the US since 1995, which represents a market of approximately $3 billion in deck materials annually During the decade of the 1990s, the deck market grew at an average annual rate of 8.1 percent. Assuming a constant rate of growth of 8.1 percent, the deck market in 2010 could be as large as $6.5 billion. Despite the enormous size and healthy growth of the residential deck market in the US, very little research has been conducted evaluating consumer perceptions of various deck materials available to them in the market. The objective of this study was to review secondary information regarding the residential deck material market in the US. Additionally, a survey of residential homebuilders in the US was conducted to characterize the industry's use of various deck materials, as well as to assess the industry's perceptions of these deck materials.

Surveyed homebuilders indicated that about 60 percent of new speculation homes and 68 percent of custom homes are constructed with decks. The average deck size for new speculation homes was reported to be 252 square feet, substantially smaller than the 407 square feet reported for new custom homes. The average total cost for new speculation and custom home decks was calculated to be $2,997 and $4,923, respectively. On a per square foot cost basis, there is essentially no difference the cost of new speculation ($11.89) and new custom ($12.09) home decks.

A review of the current market information indicated that seven different materials are used on a rather consistent and measurable basis in the construction of residential decks in the US. These seven materials include western red cedar, redwood, pressure treated lumber, untreated lumber, wood-plastic composite lumber, plastic lumber, and concrete. Published market share reports for the various deck materials are inconsistent and vary dramatically between sources. To illustrate, estimates of pressure treated lumber market share (volume basis) in the residential deck market ranges from 54.7 to 82 percent. National survey data collected for this study indicated that, for new homes, pressure treated lumber captured 47.4 percent of the market (volume basis), followed by western red cedar (18.5 percent), concrete (14.1 percent), and redwood (11.1). Market shares for the various deck materials, however, differed significantly from one region to another.

Surveyed homebuilders were queried as to how their general use of various deck materials had changed between November 1996 and October 1998. Seventy-eight percent of the respondents indicated that their use of pressure treated lumber had either increased or remained the same; this was followed by western red cedar (46.6 percent), concrete (41.5 percent), and redwood (30.7 percent). Over 27 percent of the homebuilders indicated that their use of redwood deck materials had declined in the two year time span, followed by western red cedar (20.5 percent), untreated lumber (14.1 percent), and pressure treated lumber (12.4 percent). Three-quarters of the respondents indicated that they had never used plastic lumber for new deck construction; while over one-half of the homebuilders indicated that they had never used untreated lumber or wood-plastic composite lumber.

Survey participants were asked to rate seven deck materials along eleven different product attributes. Specifically, homebuilders were asked to rate the importance of the attributes when the particular material was to be used as a deck surface or accessory. The attributes of long life, beautiful/aesthetically pleasing, durability, and consistent material quality rated the most important product attributes for deck surfaces and accessories. The four lowest rated product attributes, based on importance, were price stability, high strength properties, little material waste, and low cost material. This result suggests that price is not the dominant factor in homebuilder choice for deck materials. It also suggests that homebuilders perceive significant differentiation between the various deck materials available to them in the market.

A specialized multivariate statistical analysis was conducted on the data to construct perceptual maps of homebuilder perceptions of deck materials. The results of this analysis indicated that ease of maintenance, price, and consistent supply of material attributes were the most important when homebuilders formed perceptions of deck materials. Obvious differences between the seven deck materials evaluated were uncovered in the perceptual mapping analysis. Manufacturers, wholesalers, and retailers of deck materials can exploit the perceptual differences uncovered in this study to develop more effective and efficient marketing strategies. Furthermore, the perceptual differences can also be used in further differentiating one deck material from competing deck materials.

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APPENDICES

APPENDIX I

COVER LETTER EXAMPLE

Dear FIRSTNAME LASTNAME HERE:

The successful introduction of new building materials and technologies into the U.S. residential construction market presents numerous challenges. Unfortunately, very little research has been conducted to identify builders' perceptions of the wide range of building materials available in the residential construction industry. Understanding your perceptions is critical since they affect how products are developed and introduced to the market.

Your company is one of a small number of residential construction companies being asked to provide their opinions regarding a variety of wood and non-wood residential construction materials used in structural end-use applications. Your company was selected through a random sampling of residential construction companies located throughout the U.S. In order for the results to truly represent the opinions of the residential construction industry, it is important for each survey to be completed and returned. Therefore, the answers that your company provides will be of significant importance to the success and accuracy of this research project.

I hope that you can spare about 10 minutes to help with this project by completing the enclosed survey. I ask that it be completed by the person in your firm most involved in decisions relating to the purchase and use of building materials.

You can be assured of complete confidentiality. All information that you provide will be held in the strictest confidence and will only be reported in combination with the information provided by other residential construction companies. You will notice an identification number on the front page of your survey. This number is for mailing purposes only. It provides me with a means of removing your name from the mailing list once your completed survey has been returned. If you are interested in receiving a summary of results, please print your name and address on the last page of your survey or, if you prefer, request the information in a separate letter.

Again, your participation is very important to the success and reliability of this project. I would be more than happy to answer any questions you might have. Please call or write. Thank you for your assistance.

Sincerely,

Ivan L. Eastin
Telephone: (206) 543-1918
Fax: (206) 685-0790
Email: eastin@u.washington.edu

APPENDIX II

SURVEY INSTRUMENT

SURVEY INSTRUMENT

1) Approximately what percentage of your company's 1997 sales revenue was generated from the following activities?

Single Family Construction	_____%
Multi-family Construction	_____%
Home Improvement /Remodeling	_____%
Patio/Deck Construction	_____%
Nonresidential Construction	_____%
Other (please specify below)	_____%

_____

Total = 100%

2) How would you describe the area that your company conducts most of its business? (*please only check on box*)

- ❑ URBAN/SUBURBAN: A city or group of contiguous communities with a population greater than 50,000.
- ❑ SMALL TOWN: A city or town that is generally isolated from a major urban area with a population less than 50,000.
- ❑ RURAL: Low density population scattered over a wide area

3) Does your company conduct business in multiple states? ❑ YES ❑ NO
If YES, how many states? _____

4) In which state does your company generate its greatest amount of revenue? _____

5) For each of the following products used in structural applications, please indicate whether your company's use of the product over the past two years has *Increased*, *Remained the Same*, or *Decreased*. Also indicate the year that your company first used each of the products. If your company has never used the product, then simply check the *My Company Has Never Used this Product* box. (*please provide a response for each product listed*)

Structural Product	**Over Past Two Years, My Company's Use of Structural Product Has…..** **Increased**	**Remained the Same**	**Decreased**	**My Company Has Never Used this Product**	**Year First Used (if applicable)**
Finger-jointed Studs	❑	❑	❑	❑	_____
Steel Framing	❑	❑	❑	❑	_____
Fiber/Plastic Lumber Composite	❑	❑	❑	❑	_____
Reinforced Concrete	❑	❑	❑	❑	_____
Plastic Studs	❑	❑	❑	❑	_____
Wall Panel Systems	❑	❑	❑	❑	_____
Wood I-joists	❑	❑	❑	❑	_____
Wood/Steel I-beams	❑	❑	❑	❑	_____
Laminated Veneer Lumber (LVL)	❑	❑	❑	❑	_____
Laminated Strand Lumber (LSL)	❑	❑	❑	❑	_____
Parallam™ Beams and Headers	❑	❑	❑	❑	_____
Glue Laminated Beams (Glulam)	❑	❑	❑	❑	_____
Solid Wood Lumber	❑	❑	❑	❑	_____

6) Please indicate how the amount of solid wood used as a structural material in your company changed over the past two years? (*Please circle one number on the scale*)

THE AMOUNT OF SOLID WOOD USED BY MY COMPANY HAS NOT CHANGED AT ALL		THE AMOUNT OF SOLID WOOD USED BY MY COMPANY HAS CHANGED MODERATELY			THE AMOUNT OF SOLID WOOD USED BY MY COMPANY HAS CHANGED SIGNIFICANTLY	
1	2	3	4	5	6	7

7) For each of the building applications listed below, please estimate the percentage of each type of structural material used during the past year by your company. (*Write the approximate PERCENTAGE in the appropriate category for each building application*)

	¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ **Structural Materials** ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾ ¾							
Building Application	**Solid Wood Lumber**	**Wood Trusses**	**Finger-Jointed Studs**	**Wood I-joists**	**Laminated Veneer Lumber**	**Steel Framing**	**Other (specify)** _____	**Total**
Wall Studs								100%
Floor Joists								100%
Roofs								100%

8) In your opinion, how do each of the following materials compare to solid wood with respect to their impact on the environment? (*Please rate each product on a scale of 1 = LESS FAVORABLE to 7 = MORE FAVORABLE by circling the appropriate number*)

PRODUCTS	**LESS FAVORABLE**			**SAME**			**MORE FAVORABLE**
Steel Framing	1	2	3	4	5	6	7
Plastic Studs	1	2	3	4	5	6	7
Finger-jointed Studs	1	2	3	4	5	6	7
Reinforced Concrete	1	2	3	4	5	6	7
Concrete Blocks	1	2	3	4	5	6	7
Panelized Wall Systems	1	2	3	4	5	6	7
Wood I-joists	1	2	3	4	5	6	7
Wood/Steel Floor Trusses	1	2	3	4	5	6	7
Laminated Veneer Lumber (LVL)	1	2	3	4	5	6	7
TimberStrand Lumber (Parallam™)	1	2	3	4	5	6	7
Glue Laminated Beams (Glulam)	1	2	3	4	5	6	7
Fiber Reinforced Plastic Lumber	1	2	3	4	5	6	7

9A) When purchasing structural materials (**INCLUDING WOOD AND NONWOOD**), how important are the following product attributes? (*Please rate each attribute on a scale of 1 = NOT IMPORTANT to 7 = VERY IMPORTANT by circling the appropriate number*)

PRODUCT ATTRIBUTES	NOT IMPORTANT AT ALL			NEUTRAL			EXTREMELY IMPORTANT
Strength	1	2	3	4	5	6	7
Straightness	1	2	3	4	5	6	7
Reduced Environmental Impact	1	2	3	4	5	6	7
Availability	1	2	3	4	5	6	7
Price Stability	1	2	3	4	5	6	7
Overall Price	1	2	3	4	5	6	7
Availability of Longer Lengths	1	2	3	4	5	6	7
Energy Efficiency	1	2	3	4	5	6	7
Ease of Use	1	2	3	4	5	6	7
Technical/Engineering Support	1	2	3	4	5	6	7
Lack of Defects	1	2	3	4	5	6	7
Appearance	1	2	3	4	5	6	7
Little Product Waste	1	2	3	4	5	6	7
Other (please specify)_____	1	2	3	4	5	6	7

9B) Using the product attributes listed above (Question 9A), please indicate the three *most important attributes* that you are concerned with when purchasing structural materials:

Most Important Product Attribute _____
Second Most Important Product Attribute _____
Third Most Important Product Attribute _____

10) When purchasing **SOLID LUMBER**, how satisfied are you with the following attributes. (*Please rate each statement on a scale of 1 = NOT SATISFIED to 7 = VERY SATISFIED by circling the appropriate number*)

SOLID LUMBER PRODUCT ATTRIBUTES	NOT SATISFIED AT ALL			NEITHER SATISFIED NOR UNSATISFIED			EXTREMELY SATISFIED
Strength	1	2	3	4	5	6	7
Straightness	1	2	3	4	5	6	7
Reduced Environmental Impact	1	2	3	4	5	6	7
Availability	1	2	3	4	5	6	7
Price Stability	1	2	3	4	5	6	7
Overall Price	1	2	3	4	5	6	7
Availability of Longer Lengths	1	2	3	4	5	6	7
Energy Efficiency	1	2	3	4	5	6	7
Ease of Use	1	2	3	4	5	6	7
Technical/Engineering Support	1	2	3	4	5	6	7
Lack of Defects	1	2	3	4	5	6	7
Appearance	1	2	3	4	5	6	7
Little Product Waste	1	2	3	4	5	6	7
Other (please specify)_____	1	2	3	4	5	6	7

11) Approximately what percentage of spec and custom family homes that your company builds have decks?

Percent of spec homes built with deck _____ percent

Percent of custom homes built with deck _____ percent

12) What is the *average size* of decks that your company builds?

Average size of spec home decks _____ square feet

Average size of custom home decks _____ square feet

13) What is the *average cost* of decks that your company builds?

Average cost of spec home decks $_____

Average cost of custom home decks $_____

14) Using the list of building materials below, please indicate whether your company's use of the deck material over the past two years has *Increased*, *Remained the Same*, or *Decreased*. Also indicate the year that your company first used each of the products. If your company has never used the product, then simply check the *Has Never Used* box. (*please provide a response for each product listed*). If your company has used the material in the past year, then please indicate the percentage of decks that were built with the material.

Deck/Porch Structural Material	**Over Past Two Years, My Company's Use of Deck/Porch Material Has…..**			**My Company Has Never Used This Product**	**Percent of Decks Built with Material in Past Year**	**Year First Used (if applicable)**
	Increased	**Remained the Same**	**Decreased**			
Solid Cedar	❑	❑	❑	❑	____%	_____
Solid Redwood	❑	❑	❑	❑	____%	_____
Pressure treated lumber	❑	❑	❑	❑	____%	_____
Untreated lumber (excluding cedar/redwood)	❑	❑	❑	❑	____%	_____
Wood Fiber & Plastic Composite (e.g., Trex™)	❑	❑	❑	❑	____%	_____
Plastic Lumber (100% plastic)	❑	❑	❑	❑	____%	_____
Concrete (excluding footing/piers)	❑	❑	❑	❑	____%	_____
Other _____	❑	❑	❑	❑	____%	_____
					Total=100%	

15) How important are the following building material attributes when building deck surfaces and accessories (surface, stair treads, benches, railings)?

Material Attributes	**NOT IMPORTANT AT ALL**			**NEUTRAL**			**EXTREMELY IMPORTANT**
Long Life	1	2	3	4	5	6	7
Beautiful & Aesthetically Pleasing	1	2	3	4	5	6	7
Low Material Costs	1	2	3	4	5	6	7
Easy to Maintain	1	2	3	4	5	6	7
High Workability	1	2	3	4	5	6	7
Consistent Material Quality	1	2	3	4	5	6	7
Availability	1	2	3	4	5	6	7
Price Stability	1	2	3	4	5	6	7
High Strength Properties	1	2	3	4	5	6	7
Durability	1	2	3	4	5	6	7
Little Product Waste	1	2	3	4	5	6	7
Appearance	1	2	3	4	5	6	7
Little Product Waste	1	2	3	4	5	6	7
Other (please specify)_____	1	2	3	4	5	6	7

16) The following questions refer to your company's use of various building materials in the construction of **decks**. For each of the building materials listed below, please indicate the degree to which the material possesses the following attributes.

Deck Material Attribute	. The material possesses the stated attribute …						
	Not At All						To a High Degree
➢ **Long Life**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Beautiful & Aesthetically Pleasing**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Low Material Cost**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Easy to Maintain**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **High Workability**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Consistent Material Quality**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7

16)*Continued*……..

Deck Material Attribute	. The material possesses the stated attribute … Not At All						To a High Degree
➢ **Availability**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Price Stability**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **High Strength Properties**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Durability**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7
➢ **Little Product Waste**							
Solid Cedar	1	2	3	4	5	6	7
Solid Redwood	1	2	3	4	5	6	7
Pressure treated lumber	1	2	3	4	5	6	7
Untreated lumber (excluding cedar/redwood)	1	2	3	4	5	6	7
Wood Fiber & Plastic Composite (e.g., Trex™)	1	2	3	4	5	6	7
Plastic Lumber (100% plastic)	1	2	3	4	5	6	7
Concrete (excluding footings/piers)	1	2	3	4	5	6	7

Finally, we would like some information about you and your company for statistical purposes.
★ *ALL SURVEY INFORMATION IS KEPT STRICTLY CONFIDENTIAL* ★
All identifying information (personal names, company names, and locations) is removed from the data

17) What is your position/title?

_____

18) How long have you been with the company?

_____ years

19) Approximately what was your firm's total sales in 1997. *(please check only one)*

- ❑ 0 - $500,000
- ❑ $500,001 to $1,000,000
- ❑ $1,000,001 to $2,500,000
- ❑ $2,500,001 to $5,000,000
- ❑ $5,000,001 to $10,000,000
- ❑ $10,000,001 to $20,000,000
- ❑ Over $20,000,000

20) Approximately how many of the following types of structures did your company complete in 1997?

_____ single family homes

_____ multi-family homes

_____ nonresidential structures

21) If your company built single family homes in 1997, how many of these homes were of the following type?

_____ number of spec home

_____ number of custom homes

❑ Did not build any single family homes in 1997

22) On average, what percentage of your company's framing costs is subcontracted to other companies?

_____ percent

23) Approximately how many years has your company been involved in the residential construction industry? _____ years

Thank you for your time and cooperation in completing this survey. Please return the survey in the pre-addressed stamped envelope provided. If you would like a summary of the final report please include your name and address below.

Name: _____

Address: _____

_____