

Trends in the US decking market: A national survey of deck and home builders

by Indroneil Ganguly¹ and Ivan L. Eastin²

ABSTRACT

The deck-building industry is going through a period of rapid growth and dramatic change with respect to the types of materials available to build decks. Naturally durable timber species (i.e., redwood, western redcedar, Alaska yellow-cedar and tropical hardwoods) are facing acute competition from engineered decking products, primarily plastic lumber and composite wood products. The results of a 2004 national survey of 156 deck builders and 212 home builders indicate that wood-plastic composites are quickly gaining popularity among deck-building professionals as they increase their market share. This paper investigates deck-building professionals' use and perceptions of the different decking materials. The study also reveals the usage patterns of the various decking materials in the primary end-use applications (substructure, deck surface and deck accessories). Finally, a comparative assessment of the different decking materials relative to a common set of material attributes is presented.

Key words: decking market, deck-building practices, decking material, residential housing, deck builders, homebuilders

RÉSUMÉ

Le secteur de construction de terrasse et de balcon connaît une période de croissance rapide et de changements dramatiques au niveau des types de matériaux disponibles pour ce type de construction. Les espèces de bois à durabilité naturelle élevée (par ex., séquoia, cèdre de l'Ouest, cyprès jaune et bois tropicaux) font face à une vive compétition de la part des bois d'ingénierie conçus pour les terrasses, principalement le bois plastifié et les produits de composites de bois. Les résultats d'une enquête nationale réalisée en 2004 auprès de 156 constructeurs de terrasse et de 212 constructeurs de maison révèlent que le bois plastifié et les composites de bois sont rapidement de plus en plus populaires auprès des professionnels de la construction de terrasse et de balcon, à mesure qu'ils accroissent leur part de marché. Cet article analyse l'utilisation et les perceptions des professionnels en construction de terrasse et balcon relativement aux différents matériaux pour les terrasses. Le sondage indique également les tendances d'utilisation des différents matériaux pour terrasse (charpente, surface de la terrasse et accessoires). Finalement, nous présentons une évaluation comparative des différents matériaux pour terrasse par rapport aux qualités habituelles d'un ensemble de matériaux.

Mots clés : secteur des terrasses et balcon, pratiques de construction de terrasse, matériaux pour terrasse, construction résidentielle, constructeurs de terrasse, constructeurs de maison



Indroneil Ganguly



Ivan L. Eastin

Introduction

The market for residential decking products in North America has become increasingly competitive over the past decade. Moreover, the regulatory constraints on timber harvests from public forests and competition from substitute materials have significantly altered the competitive environment within the deck-building industry (Eastin *et al.* 2005). Wood-plastic composites (WPC) and plastic lumber are increasingly replacing softwood lumber in deck-building applications largely because these products are perceived to have better durability than softwood lumber (Carroll *et al.* 2001). Demand for WPC and plastic lumber in the United States is forecast to expand nearly 12% each year between 2000 and 2010 to reach \$3.9 billion. These substitute decking materials

¹Doctoral Candidate and Research Associate, Center for International Trade in Forest Products, (CINTRAFOR), College of Forest Resources, Box 352100, University of Washington, Seattle, WA 98195, USA. E-mail: indro@u.washington.edu

²Professor and Director, Center for International Trade in Forest Products (CINTRAFOR), College of Forest Resources, Box 352100, University of Washington, Seattle, WA 98195, USA. E-mail: eastin@u.washington.edu

will continue to penetrate deck-building markets which are expected to total \$1.2 billion by 2008 (Bowne 2002). Given the increasing assortment of treated lumber, WPC and plastic decking products available in the market, coupled with the aggressive promotional and product-service campaigns of WPC and plastic lumber manufacturers, the market share for naturally durable lumber is expected to continue to decline.

Decking market in the US

The demand for decking materials in the US is driven by several factors, including the macroeconomic environment, demographics, residential construction starts and repair and remodel (R&R) expenditures. It is estimated that there are approximately 30 million residential decks in the United States (Truini 1996). Of the many factors influencing the demand for decking materials, new residential housing starts and R&R activities are the primary drivers of demand. Approximately 82% of the homes in the US have an outdoor living area which encompasses decks, patios, porches and balconies (US Census 2005). Moreover, of the 6.8 million homes built in the US between 1999 and 2003, 5.9 million were estimated to have an outdoor living area (US Census 2005). Similarly, of the 1.65 million single family houses built in 2006, 421 000 (25%) houses were built with a deck (US Census 2006). Homeowner expenditures in the home improvement market also significantly impact the demand for residential decking materials. Repair and remodel projects constitute approximately 23% of the total revenues of deck builders (George Carter & Affiliates 1989). Moreover, surveys conducted in the past reveal that about 4.2% of all households in the United States add a deck to their existing home each year (George Carter & Affiliates 1989), which results in over 3 million additional new decks per year (Shook and Eastin 2001). The importance of the repair and remodel sector is such that even with a decline in housing starts in 2006 and an increase in mortgage interest rates, the demand for new and replacement decks will likely increase (West 2004). Increasing expenditures in the repair and remodel sector have led industry experts to predict that the deck-building industry will continue to experience growth through 2010 (West 2004) despite the fact that the outlook for housing starts remains uncertain (Seiders 2007).

In addition to macroeconomic factors, demographic trends also influence the demand for residential decks, with a growing population contributing to an increase in housing starts and existing home sales which in turn translates into increased investment in new and replacement decks (Eastin *et al.* 2005). Moreover, the distribution of population cohorts is perhaps more important when considering the impact of demographic trends on the demand for decks and decking materials. In particular, over the next decade the age cohorts comprising people from 45 to 54 years of age and from 55 to 64 years of age will experience growth that is substantially higher than that of most other age cohorts in the US. This older, more affluent segment of the population is not only willing to spend more money on outdoor living amenities (including decks) but they also place a higher value on material attributes such as reduced maintenance, ease of maintenance and material longevity (West 2004, Eastin *et al.* 2005). Year-round outdoor living is no longer a lifestyle that is unique to warmer parts of the country but is an emerging trend in the northern parts of the US (Kirkland 2007). The new emerging trend is to use outdoor living

spaces as an extension of the main house throughout the year by installing fireplaces, covered cooking areas, audio video home entertainment systems and by providing easy access to the main living area of the house. The combination of these factors suggests that the market for decking materials can be expected to increase over the next decade and more (West 2004, Eastin *et al.* 2005).

Residential decking materials in the US

Several factors influence the competitive environment within the residential deck market. The major decking materials used in the US include naturally durable timber species (e.g., western redcedar (WRC), redwood and Alaska yellow-cedar), tropical hardwoods (THW), pressure-treated softwood lumber (PT), wood-plastic composite (WPC) lumber, plastic lumber (PL) as well as untreated lumber (Damery and Fisette 2001, Eastin *et al.* 2005). Material attributes, such as ease of installation and ease of maintenance, provide the main basis for differentiating between the various product offerings in the marketplace. In addition, product attributes such as longevity, durability and beauty are also important considerations for differentiating among deck materials.

Pressure-treated lumber has historically dominated the residential decking market (Damery and Fisette 2001, Shook and Eastin 2001, Eastin *et al.* 2005). However, recent research clearly shows that the rising demand for wood-plastic composite decking materials is supported by growing consumer and builder acceptance of these products, a broadening distribution network and appearance-enhancing product improvements (Bowne 2002). Several factors influence the competitive relationship between the competing materials used in residential decking. Among the decking materials used in the US, pressure-treated lumber dominates to such an extent that an estimated 9 out of every 10 existing residential decks in the northeastern US (Damery and Fisette 2001) and 8 of every 10 existing residential decks in the whole country are made from pressure-treated lumber (George Carter & Affiliates 1989). In 2004, the treated lumber industry voluntarily discontinued the use of chromated copper arsenate (CCA) as a lumber preservative because of health concerns related to the toxicity of the product (Romano 2004). The transition from CCA to alkaline copper quarternary (ACQ) and copper azole (CA-B) preservatives for most residential decking lumber has not resulted in a substantial decline in sales as was initially predicted by industry experts (West 2004). However, pressure-treated lumber has been subject to high price volatility which has caused some builders to consider more price-stable materials (Shook and Eastin 2001).

Among the naturally durable species, western redcedar is reported to have lower maintenance costs, better dimensional stability and to be more aesthetically pleasing than treated lumber. However, the demand for western redcedar lumber has remained relatively constant over the past 20 years, despite its increased availability in the national market (Eastin *et al.* 1996, Shook and Eastin 2001). Heightened competition from substitute materials and lower-cost pressure-treated lumber have both helped to dampen demand. While western redcedar and redwood are close competitors in the decking market, demand for redwood is constrained by its availability in the eastern and the southern regions of the US. Despite its lack of availability, it is reported that 12% of all residential decks built in 1987 utilized redwood and similar results were

obtained by a more recent study that found that 11.1% of all decking materials used during 1997–1998 was redwood (Shook and Eastin 2001). The National Association of Home Builders (NAHB) builder practices survey found that in 2005 redwood registered a market share of just 4.6% (NAHB Research Center 2006). In response to the lack of availability of domestic naturally durable lumber, the usage of tropical hardwoods (THW) as a decking material has gained popularity in the US over last 15 years. Most of the THW lumber imported into the US comes from Brazil, Peru and Malaysia (Duery and Vlosky 2006). With the increased supply of THW lumber and a favourable market perception, THW lumber has been steadily gaining market share in the US decking market. Finally, the use of untreated lumber as a decking material (excluding naturally durable species) is very small. The market share of untreated lumber was estimated to be just 2.6% in 1998 (Shook and Eastin 2001).

Recent studies have shown that WPC lumber is rapidly gaining market acceptance (Palmer 2004) to the extent that the WPC industry in North America experienced a 4-fold growth in demand between 1997 and 2000 (Li and Wolcott 2005). WPC meets consumer desire for a low-maintenance, durable product that avoids the use of wood preservatives (Palmer 2004). WPCs tend to be more resistant to moisture absorption and are thus more dimensionally stable than solid wood lumber (Wang and Morrell 2005). WPCs are competitively priced with upscale decking material choices such as WRC and redwood while offering the promise of low maintenance and increased durability. WPCs are primarily used for deck surfaces while deck substructures predominantly utilize pressure-treated lumber for columns and joists (Carey and Carey 2005). Plastic decking lumber, including vinyl and polyethylene (both high and low density), is also steadily gaining acceptance among professional deck builders. Vinyl is the more popular variety of plastic decking material, followed by polyethylene and other plastic-based products (e.g., plastic membrane and polypropylene). NAHB's recent builder survey found that the market share of plastic lumber for decking applications increased from 1.3% in 2000 to 3.7% in 2005 (NAHB Research Center 2006) and is forecast to grow at a steady rate through 2010.

Study Objectives

The deck-building industry is experiencing a period of rapid growth and dramatic change with respect to the types of materials available to build decks. With the dynamic nature of the industry and the technological improvements in the decking products available in the market, it is important for softwood lumber manufacturers to understand material usage patterns and the factors that influence material specification within the deck-building industry. In this research, we consider the residential construction application of 8 nationally available deck-building materials: (i) Alaska yellow-cedar, (ii) western redcedar, (iii) redwood, (iv) treated lumber, (v) untreated lumber, (vi) wood–plastic composites, (vii) tropical hardwoods and (viii) plastic lumber. In this paper we analyze and discuss the following aspects of material use within the US decking industry:

- The current usage of decking materials by homebuilders in new residential construction,
- The current usage of decking materials by deck builders in new, repair and replacement decks,

- Trends in the usage of decking materials during 2003–2004,
- Current material use in different decking end-use applications: substructures, deck surfaces and accessories,
- The importance of various decking material attributes in the purchase decision made by deck builders, and
- A comparative assessment of the different decking materials relative to a common set of material attributes.

Survey Methodology

A survey was used to supplement the secondary data obtained through the literature review and to provide primary data on the decking markets. Two distinct populations were surveyed: residential home builders and deck builders. Based on the time constraints for the project and ensuring the adherence to developing a proper sampling frame, 2 different sample frames and survey methods were adopted for gathering information from these 2 distinct populations.

For the home builders, a telephone survey was determined to be the most efficient way to collect data. The geographic focus of the survey was the US, with an equal number of respondents from both the eastern and western US (as divided by the Mississippi river). A systematic random sampling was undertaken in order to ensure a proper representation of respondents from all the states. The sample frame for the target population was obtained from InfoUSA through a systematic random sampling based on the home builder Standard Industrial Classification (SIC) code. The sampling was done by making the sample size for each state proportional to the ratio of housing starts for that particular state relative to total US housing starts. The total survey sample size was established at 205 respondents. Telephone surveys were conducted and responses were marked on the survey sheet by the interviewer along with relevant comments made by the respondents.

A different survey methodology was adopted for collecting information from the deck builders. Survey questionnaires were distributed as an insert in the May–June 2004 issue of *Professional Deck Builder* magazine. The objective of the research project was introduced on the cover page of the survey along with a request from the Editor of the magazine (in the editorial section) to complete and return the survey. The information requested in the survey was similar to that for the home builder survey, although the structure of the questions was modified slightly to suit the different survey instrument. The sampling frame was decided by the circulation of the magazine. The magazine has 15 000 subscribers who are evenly distributed across the US and the target audience of the magazine is professional deck builders. Surveys were included in half of the magazines mailed out due to budgetary constraints. An e-mail reminder was sent by the Editor of the magazine reminding subscribers to complete and return the survey approximately one month following the publication of the magazine.

Both survey instruments were pre-tested to ensure the comprehensiveness, clarity and ease of use of the survey instruments. The pre-test group consisted of a mix of individuals with varied knowledge of the decking industry. Participants in the pre-test group consisted of industry experts in the forest products and residential construction industries as well as individuals who were unfamiliar with both the residential construction market and substitute decking materials. The

survey instruments were revised based on comments and suggestions received from the pre-test participants to improve the clarity and comprehensives of the surveys.

The surveys collected basic demographic information regarding the respondent's location, geographical area of operation, yearly sales and nature of operations. The survey also inquired about decking material usage (and change) and practices in great detail. All respondents were asked to indicate the percentage of material use in deck substructures, surfaces and accessories in the past year. A section of the survey covered the attitudinal aspects and the perceived importance of the specific product attributes that influence the usage and adoption of various decking materials.

Survey Results and Discussion

A total of 156 professional deck builders and 212 home builders participated in the survey, resulting in a total sample size of 368 respondents, representing all 50 states. In order to capture the national variability in decking practices, the survey included respondents from the eastern states (east of the Mississippi River) and the western states (west of the Mississippi River) equitably. The number of respondents from the eastern states was 188 (100 home builders and 88 deck builders) and from the western states was 180 (112 home builders and 68 deck builders). In order to address the varied deck-building practices of the western states, respondents from the western states were further segmented into 2 geographical regions, "west coast states" consisting of Washington, Oregon and California and "interior west states" comprised of the remaining western states.

Demographic information

The 2003 annual sales revenue reported by the home builders and deck builders are significantly different, primarily as a result of their different scale of operations. The median sales revenue for the home builders was \$1.9 million, whereas the median sales revenue of the deck builders was \$475 000. Moreover, 18.5% of the homebuilders reported annual sales revenue in excess of \$5 million, whereas only 11.7% of the deck builders reported their income to be over \$5 million. Demographic information for the deck builders and home builders, segmented by region, is presented in Tables 1 and 2. The summary information for the home builder and deck builders correspond to the specific nature of activities each of

these groups undertakes. Moreover, the deck builders were asked specific decking-related questions (e.g. the cost distribution across the deck structure, surface and accessories) as they were more conversant with decking applications than were home builders.

The results from the home builder survey reveal some differences and similarities based on geographic location (Table 1). The results reveal that a significantly higher number of spec homes were built by homebuilders on the west coast as compared to the rest of the country. However, the number of custom homes built by homebuilders on the west coast was just half of the national average. The percentage of spec homes built with decks by homebuilders in the eastern US was much higher (63%) compared to the west coast (52%) and interior west (40%). The percentage of custom homes built with decks, however, was similar across all regions of the US, averaging over 70%. While the size of the decks built for spec homes was about the same across all 3 regions, decks built for custom homes on the west coast were almost twice the size of those built in the eastern US.

The total overall cost of decks built on the west coast (both spec and custom) was significantly higher than for decks that were built in the interior west and the eastern US. The average construction cost of spec and custom decks was substantially higher on the west coast as compared to the rest of the country, although the average unit cost for spec decks and custom decks was not found to be significantly different across the 3 regions. Finally, the survey results revealed that, on average, 46% of the decks built on new homes were subcontracted out by home builders. This trend was higher in the eastern US, where more than 50% of new decks were subcontracted out. This suggests that the role of professional deck builders in the total decking market (both the new and R&R sectors) is more prominent than previously thought.

Results obtained from the deck builders' survey clearly show substantial differences in deck characteristics based on geographic location (Table 2). For example, deck builders in the eastern US built more than twice as many decks as deck builders in the interior west and 3 times as many as on the west coast. In addition, the average deck size was significantly higher in the west, although the average construction cost in the interior west was substantially lower compared to the eastern US or the west coast. As a result, there was significant variation in unit construction costs in each region. Unit con-

Table 1. Home builder demographics, by region

	East	Interior West	West Coast	Overall US
Average Number of Spec Homes Built	18.7	40.5	63.5	35.5
Average Number of Custom Homes Built	12.9	16.8	5.3	12.2
Spec Home w/Deck	63.0%	39.6%	51.7%	54.5%
Custom Home w/Deck	75.9%	71.0%	71.8%	73.5%
Size of Spec Deck	345.9 ft ²	383.2 ft ²	362 ft ²	361.2 ft ²
Size of Custom Deck	375.1 ft ²	486.3 ft ²	743 ft ²	490.8 ft ²
Average Cost of Spec Deck	\$3,267	\$3,288	\$6,582	\$3900.2
Average Cost of Custom Deck	\$4,737	\$6,166	\$8,675	\$5984.0
Average construction cost/sq. ft. (Spec Deck)	\$13.8	\$16.8	\$19.8	\$15.8
Average construction cost/sq. ft. (Custom Deck)	\$14.9	\$15.6	\$18.2	\$15.8
Percent Decks Subbed Out	51.2%	42.4%	39.0%	45.8%

Table 2. Deck builder demographics, by region

	East	Interior West	West Coast	Overall US
Ave. deck size	395 ft ²	553 ft ²	513 ft ²	455.8 ft ²
Ave. Number of decks built	126	65	42	93
Ave. construction cost	\$5851	\$4524	\$8019	\$6160
Ave. construction cost/sq. ft.	\$14.8	\$8.2	\$15.6	\$13.5
Deck structure	34.2% (\$2,001)	35.0% (\$1,583)	31.7% (\$2,542)	34.2% (\$2,094)
Deck surface	43.9% (\$2,569)	47.4% (\$2,144)	46.6% (\$3,737)	45.1% (\$2,772)
Deck accessories	21.9% (\$1,281)	17.6% (\$796)	21.7% (\$ 1,740)	21.2% (\$1,294)
Decks on existing home	41.6%	43.7%	42.4%	42.2%
Decks built on new home	30.5%	25.5%	11.9%	25.2%
Repair/replacement decks	27.9%	27.0%	45.7%	31.9%

struction costs in the eastern US were \$14.81 per square foot versus \$8.18 in the interior west and \$15.63 on the west coast. The survey data further reveals that approximately 45% of the total deck-building costs (all inclusive) were for deck surfaces, 34% for the deck sub-structure and 21% for the deck accessories (e.g., stairs, railings, seating amenities and storage/planting boxes). Finally, deck builders on the west coast primarily target new deck construction on both new and existing homes with relatively little focus on the repair/replacement sector. In contrast, deck builders in the east and interior west have a more balanced mix of deck-building projects comprising of decks built on existing homes, decks built on new homes and repair and replacement of decks.

Not surprisingly, the survey data also shows that deck builders, on average, build more decks than do home builders. On average, home builders reported that they actually built approximately 17 decks annually (after subtracting out those decks that they subcontracted to deck builders). Deck builders, in contrast, reported that they built more than 90 decks annually. In addition, the per unit cost of decks built by home builders was significantly higher in the western US compared to the decks built by deck builders. The average unit cost of decks built by deck builders in the interior west (\$8.20/sq.ft.) is almost half of the unit cost of decks built by home builders in the same region. It should also be noted that more than 70% of the revenue generated by deck builders was from building new decks on existing houses as well as repair and remodeling of decks, indicating that deck builders are much less vulnerable to downturns in the housing market, which have a much greater impact on home builders.

Material use changes

One objective of this research was to assess how the use of decking materials is changing over time. To evaluate this, respondents were asked to indicate how their use of 8 decking materials has changed over the last 2 years (Table 3). The overall survey results indicate that the use of western redcedar, redwood and treated lumber has declined substantially while WPC, tropical hardwood and plastic lumber use has increased, although it is useful to note that more than 2/3 of the respondents reported that they have never used THW or plastic lumber. Treated lumber is the most commonly used decking material, with more than 93% of the respondents reporting that they have used treated lumber. Interestingly, the percentage of respondents who reported that their usage of treated lumber has declined was matched by the percent-

Table 3. Changing material use in the deck-building market

	Increased	Remained the same	Decreased	Never Used
Total Sample (N = 368)				
Alaska Yellow-cedar	0.8	3.1	4.8	91.2
Western Redcedar	8.1	28.2	25.4	38.3
Redwood	4.6	20.3	22.0	53.1
Treated Lumber	22.1	50.8	20.4	6.7
Untreated Lumber	3.6	16.2	9.6	70.7
Wood-Plastic Composite	57.9	15.2	2.8	24.2
Tropical Hardwood	11.7	13.4	5.2	69.7
Plastic	15.7	7.1	3.3	74.0
Home Builders (N = 212)				
Alaska Yellow-cedar	0.0	1.4	3.3	93.4
Western Redcedar	5.2	28.3	17.5	46.2
Redwood	3.8	22.2	16.0	55.7
Treated Lumber	23.1	59.4	9.0	7.1
Untreated Lumber	2.8	12.3	7.1	67.5
Wood-Plastic Composite	40.1	20.3	2.8	33.0
Tropical Hardwood	1.9	7.1	2.4	81.1
Plastic	6.6	3.8	0.5	80.7
Deck Builders (N = 156)				
Alaska Yellow-cedar	2.1	5.5	6.9	85.5
Western Redcedar	11.8	27.0	35.5	25.7
Redwood	5.6	16.8	30.1	47.6
Treated Lumber	20.1	37.6	36.2	6.0
Untreated Lumber	4.2	19.4	11.8	64.6
Wood-Plastic Composite	79.6	7.2	2.6	10.5
Tropical Hardwood	24.5	21.1	8.8	45.6
Plastic	27.1	11.1	6.9	54.9

age of respondents who reported an increase in their usage of treated lumber, suggesting that treated lumber maintained its market share over the period 2003–2004.

Among home builders, both treated lumber and wood-plastic composite lumber recorded large increases in usage. In contrast, WRC and RW recorded large declines in usage. More than 2/3 of home builders indicated that they have never used AYC, untreated lumber, THW or plastic lumber

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while almost half reported that they have never used WRC or RW. The data suggest that home builders have been reducing their use of naturally durable wood species in favour of treated lumber and WPC. While only 20% of home builders reported using plastic lumber, almost 95% of those who had used it reported that their use was either increasing or remaining the same, suggesting that they were satisfied with the performance of plastic lumber. While home builders appear to favour a limited selection of decking products (primarily treated lumber and WPC), the survey data suggest that deck builders use a much broader array of decking products. For example, the percentage of deck builders who reported to have never used each of the decking materials included in the survey was substantially lower than that observed within the home builder sector. Deck builders registered their largest increases in material use for WPC, plastic lumber and THW. Interestingly, while 20% of deck builders reported increasing their use of treated lumber, almost twice as many (36.2%) indicated that their use had declined. The data suggest that many deck builders are reducing their use of WRC, RW and treated lumber in favour of WPC, tropical hardwoods and plastic lumber.

Material use in decking end-use applications

Understanding the differences in material usage within the 3 primary decking end-use applications was another objective of this study. The survey data shows that treated lumber is the dominant material used in deck substructures with an overall market share of 81.2% (Table 4). Approximately $\frac{3}{4}$ of the decks built by home builders used treated lumber for the substructure while the remaining materials used were distributed fairly evenly between RW, untreated lumber and WPC. Material use by deck builders for deck substructures was dominated by treated lumber with a market share of over 90%. Treated lumber and WPC each represented about $\frac{1}{3}$ of the deck surface market while WRC and RW together comprised another 22%. Treated lumber had a 34% share of the accessories market while WRC and RW together represented another 30% followed by WPC with 22% of the overall market.

An analysis of the material usage data indicates some important differences between home builders and deck builders in their use of different decking materials within the different end-use applications (Table 4). The data shows that whereas deck builders almost exclusively used treated lumber for deck substructures, home builders were more likely to use naturally durable wood species as well as WPC lumber in this application. Given the fact that few WPC products are manufactured in cross-sectional sizes that would be appropriate for support beams or primary posts (and few WPC manufacturers recommend the use of their products in these applications), it is likely that home builders are beginning to use WPC lumber as joists and perhaps intermediate support posts. Interestingly, deck builders, who might be assumed to be more knowledgeable of deck construction details and material specification, used virtually no WPC lumber in building deck substructures. This difference suggests that either home builders are ahead of the curve in terms of using WPC as a structural material in deck substructures or else they may be incorrectly specifying WPC for an application where its use is not intended. The survey data further reveal that deck builders used a substantially higher proportion of

Table 4. Material use in different end-use applications in deck-building in 2003

Total Sample	Substructure (%)	Surface (%)	Accessories (%)
Alaska Yellow-cedar	0.4	0.5	0.4
Western Redcedar	2.3	12.2	17.4
Redwood	3.1	9.6	11.5
Treated Lumber	81.2	34.3	34.0
Untreated Lumber	5.9	0.8	2.3
Wood-Plastic Composite	4.5	32.7	21.6
Tropical Hardwood	0.3	3.2	2.4
Plastic	0.1	2.1	2.8
Other	2.2	4.3	7.2
Home Builders			
Alaska Yellow-cedar	0.7	0.2	0.1
Western Redcedar	3.4	13.1	17.4
Redwood	5.3	12.5	14.3
Treated Lumber	74.3	38.4	37.5
Untreated Lumber	5.8	0.2	2.6
Wood-Plastic Composite	7.1	27.9	17.2
Tropical Hardwood	0.0	1.4	1.2
Plastic	0.2	0.6	1.6
Other	3.2	4.9	8.1
Deck Builders			
Alaska Yellow-cedar	0.0	0.9	0.9
Western Redcedar	0.7	10.8	17.5
Redwood	0.0	5.3	6.6
Treated Lumber	91.2	28.3	27.8
Untreated Lumber	6.0	1.5	1.8
Wood-Plastic Composite	0.6	39.6	29.5
Tropical Hardwood	0.7	5.8	4.4
Plastic	0.0	4.2	4.8
Other	0.8	3.5	5.6

WPC for both deck surfaces and accessories than did home builders. In contrast, home builders tended to specify treated lumber, western redcedar and redwood more often than deck builders in these applications. Deck builders also appear to have specified plastic decking and THW more often than home builders.

Attribute importance in material specification

The importance ratings reported by deck builders and home builders for different material attributes is useful in understanding the relationship between material attributes and their influence on the material specification process. They also provide insight for understanding how specific material attributes might be effective in differentiating between competing products. Survey respondents were asked to rate the importance of a set of material attributes on their specification of decking materials using a Likert-like scale ranging from 1 to 7 (where an importance rating of 1 meant that the material attribute was not important at all and an importance rating of 7 meant that the attribute was very important). The attributes rated as most important in the specification of decking materials were long life (durability), material quality, beauty and availability (Table 5). Among the remaining attributes, natural decay resistance, ease of maintenance and price stability were also rated to be moderately important. It

Table 5. Importance ratings for material attributes of decking materials

Importance Rank	Material Attribute	Composite Scores ^a		
		Total Sample	Home Builders	Deck Builders
1 st	Long Life	6.28	6.23	6.35
2 nd	Consistent Material Quality	6.23	6.28	6.17
3 rd	Beautiful and Aesthetically Pleasing	6.14	6.02	6.29
4 th	Availability	6.07	6.29 ^b	5.76 ^b
5 th	Naturally Decay Resistant	5.87	5.99	5.71
6 th	Ease of Maintenance	5.69	5.69	5.68
7 th	Price Stability	5.67	5.91 ^b	5.34 ^b
8 th	High Workability/Ease of Use	5.41	5.49	5.30
9 th	High Strength Properties	5.27	5.41	5.08
10 th	Resistance to Splintering	5.16	4.81 ^b	5.63 ^b
11 th	Low Material Cost	5.09	5.53 ^b	4.49 ^b
12 th	Little Product Waste	5.06	5.25 ^b	4.80 ^b
13 th	Low Heat Retention in Service	4.01	3.66 ^b	4.50 ^b

^aComposite scores are calculated by using the attribute importance ratings from a 7-point Likert-type scale

^bStatistically significant differences (95%) in the ratings between the homebuilders and deckbuilders

should be noted that while price stability was rated to be moderately important, the actual price of the decking material was rated to be substantially less important. The 4 highest material attributes for both home builders and deck builders were the same with one big difference: the most important attribute (and rated significantly higher) for home builders was product availability whereas this attribute was only the fourth most important product attribute for deck builders. Another important difference between these groups was that low material cost was given the lowest importance by deck builders while it was rated as being significantly more important by home builders. These results show that deck builders view price and availability to be significantly less important in the specification of decking materials than homebuilders. Further, this suggests that the customers of deck builders are less price-sensitive, preferring high quality, durability and ease of maintenance over low price.

The 3 most import decking material attributes—long life, consistent material quality and aesthetic appeal—were con-

sistent across both deck builders and home builders. However, product availability, price stability, low material cost and minimal product waste were all rated as playing a significantly more important role in the material specification decision for home builders than for deck builders. This suggests that homebuilders, all things being equal, tend to give preference to decking materials that are readily available with low cost and stable pricing as compared to deck builders.

Perceptions of relative material attributes

Respondents were also asked to indicate the degree to which they perceived that the different decking materials possessed each of the material attributes, using a Likert-like scale where a rating of 1 meant that they perceived that the material did not possess the attribute at all and a rating of 7 meant that they perceived that the material possessed the attribute to a high degree. In discussing the results presented in Table 6, we will first compare the mean score that each of the decking materials received for each attribute (e.g., the mean score for WRC on the long life attribute was 4.46) and compare them to the scores received by the other decking materials as well as to the mean score calculated for each attribute (e.g., the mean score for the long life attribute was 5.02). In addition, we will compare the aggregate attribute score for each decking material, which was calculated by summing up the average score that each decking material received for each attribute (e.g., the aggregate attribute score for WRC was 28.96).

With respect to the individual attributes, WPC lumber received a substantially higher score on the long life attribute than any other product. Other decking materials that received scores above the mean score (5.02) included (in decreasing order): THW, treated lumber, plastic lumber, redwood and WRC. Only 2 products (AYC and untreated lumber) scored below the average attribute score. In terms of beauty, redwood was the highest-rated product with a rating of 6.10, which was substantially higher than the scores received by the other decking materials. Other decking materials that scored above the mean included: THW, WRC, WPC and AYC. The only products to score below the mean were plastic lumber, treated lumber and untreated lumber. WPC was widely perceived to be the easiest decking material to maintain, receiving a substantially higher rating than all of the other decking materials. Plastic lumber, THW and redwood were the only other materials to score above the mean while treated lumber, WRC, AYC and untreated lumber all scored below the mean. Treated lumber, WPC and untreated lumber were all consid-

Table 6. Composite scores^a of decking materials with respect to specific material attributes

Material Attribute	AYC	WRC	RW	Treated Lumber	Untreated Lumber	WPC	THW	PL	Mean Score
Long Life	4.46	5.17	5.44	5.53	2.30	6.19	5.55	5.52	5.02
Beauty	5.06	5.85	6.10	4.05	3.01	5.33	5.88	4.34	4.95
Ease of Maintenance	4.08	4.50	4.72	4.58	2.37	6.24	4.90	5.72	4.64
Availability	2.67	5.30	4.84	6.56	6.24	6.37	4.70	5.30	5.25
High Strength	4.45	5.00	5.15	5.97	4.88	4.87	5.93	4.35	5.08
Low Cost	3.45	4.12	3.69	5.32	5.07	3.94	3.55	3.93	4.13
Natural Decay Resistance	4.79	5.17	5.42	5.62	1.93	6.42	5.60	6.34	5.16
Aggregate Attribute Score	28.96	35.11	35.36	37.63	25.80	39.36	36.11	35.5	34.23

^aComposite scores are calculated by using the attribute importance ratings from a 7-point Likert-type scale

ered to be widely available while WRC and plastic lumber also scored above the mean. The materials considered to have the highest mechanical strength were treated lumber, THW and redwood. All other materials scored below the mean in terms of strength. Respondents indicated that the lowest-cost decking materials were treated and untreated lumber while WRC received the mean score. All other decking materials received scores below the mean. The materials perceived to have the highest level of natural decay resistance were WPC and plastic lumber, which received scores that were substantially higher than the other decking materials. Other materials whose scores were above the mean included treated lumber, THW, redwood and WRC.

To consider the extent to which each of the decking materials incorporate the various material attributes, we can total the individual attribute scores received by each decking material to obtain an aggregate attribute score (bottom row of Table 6). Based on the composite attribute score, the highest-rated decking material was WPC with an aggregate attribute score of 39.36. WPC received the highest attribute ratings for long life, ease of maintenance and natural decay resistance. In addition, WPC received the second-highest rating for availability and the fourth-highest score for beauty and low cost. The second rated decking material was treated lumber with an aggregate attribute score of 37.63. Treated lumber received the highest attribute score for availability, high strength and low cost. In addition, it received the third-highest score in long life and natural decay resistance and the fourth-highest score for ease of maintenance. The decking material with the third-highest aggregate attribute score (36.11) was THW which received the second-highest scores in long life, beauty and high strength, the third-highest score in ease of maintenance and the fourth-highest score in natural decay resistance.

Conclusions

This research indicates that home builders play a relatively less important role in the US decking market relative to professional deck builders. Almost half of the decks built on new homes are subcontracted out to deck builders. However, only a quarter of the revenue earned by deck builders is derived from decks built on new homes, whereas their remaining revenues are derived from new decks built on existing homes as well as from repair and remodelling of decks on existing homes.

Among all the decking materials used, WPC seems to be favoured by both deck builders and home builders. About 80% of the surveyed deck builders and 40% of the surveyed home builders reported that they have increased their usage of WPC. The results also reveal that both deck builders and home builders have reported an increase in the usage of plastic lumber. However, while deck builders reported a net increase in the usage of THW lumber, few home builders reported having any experience in using THW. Treated lumber, which is clearly the current leader in the decking market, seems to have been able to maintain its market share. The domestic naturally durable species, AYC, WRC and RW, registered a net decrease in usage both by deck builders and homebuilders.

Significant differences exist in the usage of the various decking materials between homebuilders and deck builders. Home builders tend to favour using a limited number of decking materials, with treated lumber and WPC being their

decking materials of choice. In contrast, deck builders are more diversified in their choice of decking materials. However, the overall trend among deck builders and home builders appears to be reducing their use of naturally durable species (i.e., WRC, AYC and redwood) in favour of WPC and plastic lumber. The survey data on material usage in specific decking end-use applications found that both home builders and deck builders primarily use treated lumber for building decking substructures. Treated lumber represents about 40% of the deck surface market with WPC having a 28% market share and WRC and redwood each having a 13% market share. Treated lumber also has the dominant market share in deck accessories with a 38% market share followed by WRC, redwood and WPC, each with a market share ranging between 14% and 17%.

While identifying the importance of various materials attributes in specifying the decking materials, some similarities were observed between the responses of deck builders and homebuilders. Longevity, beauty, consistent material quality and availability of decking materials were rated as being the most important product attributes by both deck builders and homebuilders. The major dissimilarity between homebuilders and deck builders was the importance of low price. Low price was found to be of least importance to deck builders, whereas homebuilders rated low material price to be of much higher importance.

Finally, the study provides clear indication that innovative and engineered decking materials (such as WPC and plastic lumber) are steadily gaining acceptance with home builders and deck builders and that they are gaining market share primarily at the expense of WRC and redwood lumber. While these naturally durable species still retain a niche market, particularly in the decking surface and accessory segments of the market, it is clear that the manufacturers of these products must do a better job of communicating their competitive advantage in terms of natural decay resistance, longevity and availability within regional markets. This will be particularly important as the baby boomers continue to emphasize low-maintenance products that combine long life and beauty for their decking and outdoor lifestyle projects.

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