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Consumer research and attribute elicitation for the development of outdoor wooden decking

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Abstract
Increased concern about the environmental and health effects of wood preservation methods motivate producers to find new wood products for outdoor use that combine durability, environmental friendliness and consumer appeal. Consequently, the industry must improve its ability to elicit key product attributes for the consumers and to transform this knowledge in popular wood products. Different approaches for attribute elicitation and marketing planning for outdoor wood are applied and discussed in this paper. The approaches are sensory analysis, free elicitation, segmentation, and conjoint analysis. The results indicate that all these methods are promising for new product development in the wood industry. The methods have different strengths and weaknesses and their application and successful use for new products also involve the development of new capabilities in the industry.

Keywords: New product development, preserved wood, consumer research.

Introduction

The demand for outdoor wood products is increasing throughout Europe. In the UK, for instance, presentations in magazines and TV-programs have resulted in increased demand for wooden garden furniture and terrace decking (UK Forestry Commission 2004; UK Forestry Commission 2005). At the same time, wood treated with CCA-preservatives (a water-soluble preservative containing copper, chromium and arsenate) and Creosote (a petroleum-based preservative) are being restricted in many countries in Europe, the United States and Australia (Jacobsen and Evans 2002, European Commission 2003, Housenger 2003; Environmental Protection Agency 2005, Australian Pesticides & Veterinary Medicines Authority 2005a; Australian Pesticides & Veterinary Medicines Authority 2005b). Consequently, chemical industries are developing wood products for outdoor use that are environmentally friendly, accepted by public authorities in addition to being competitive with respect to price, durability and aesthetic properties. The alternatives contain less harmful substances, or they are made of naturally resistant wood species.

Although insight about consumers' preferences for different product attributes can provide competitive advantages for wood industries, little research has yet been done in this field. However, innovation and product development in the wood industry is receiving increased attention since the 1990s (see e.g. Cohen and Sinclair 1990, Narver and Slater 1990, West and Sinclair 1991, Lee et al. 1999, Cohen and Kozack 2001, Fell et al. 2002, Schaan and Anderson 2002, Montgomery and Giroux 2002, Schuler and Buehlmann 2002, Korhonen and Niemelä 2003, Van Horne et al. 2004, Hovgaard and Hansen 2004, Välimäki et al. 2004, Rametsteiner et al. 2005, Rametsteiner and Weiss 2005, Bull and Ferguson 2005, Diaz-Balteiro et al. 2005, Nord 2005). The conclusion of the research to date is that innovation is limited in the wood industry, focusing on incremental process innovations. Several industry analyses and industry-wide policy documents therefore warrant increased innovation in the sector (see e.g. "Vision 2030 – Innovative and sustainable use of forest resources, a technology platform initiative by the European forest-based sector").

Knowledge about customers' preferred product attributes is an important factor for competitive advantage, according to the Resource Based View on strategy (Peteraf 1993, Barney 1991, and 2001). Innovativeness is furthermore a means to renew and exploit such

advantages in a dynamic perspective (Eisenhardt and Martin 2000, Stendahl et al. 2006, Danneels 2002), which is important for the firm's profitability and growth (Cho and Puick 2005).

Consumer preferences or and attribute elicitation is one key activity in the early stages of the innovation process (Figure 1). Studies of consumer liking for wood and wood attributes have been presented by Marchal and Mothe (1994), and Broman (2000). Key attributes of wood products were also analysed by Hansen et al. (1996), Hansen and Bush (1999), Weinfurter and Hansen (1999), Ozanne and Smith (1998), Ozanne, *et al*. (1999), Veisten (2002), Hansmann et al. (2004), Bigsby and Ozanne (2002), Anderson and Hansen (2004), Reddy and Bush (1998), Pakarinen (1999), Pakarinen and Asikainen (2001), Bigsby, *et al*. (2005), and Jonsson (2005). Attitudes to treated wood were surveyed by Vlosky and Shupe (2002, and 2004), and for outdoor wood by Donovan (2004). An attempt to link the academic research with the current strategic decision making in the industry was presented by Wagner and Hansen (2004).

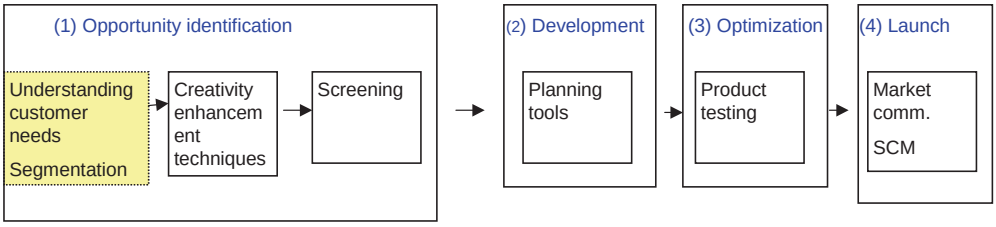

Figure 1. The role of attribute elicitation in the early stages of new product development (van Kleef et al. 2005)

While there is an increasing number of studies on product and service attributes of wood products, applications of well-established elicitation methods is les frequent (Brandt and Shook 2005). Reviews, e.g. van Kleef et al. (2005) and more specifically for the forest industry by Brandt and Shook (2005), show that there is a range of elicitation methods to be applied and in the forest products industries. Sensory analysis **(**Lawless and Heymann 1998**)**, free elicitation, segmenting and conjoint analysis (van Kleef et al. 2005) are examples of such approaches.

The purpose of this study is to apply different consumer research approaches for attribute elicitation and new product development. The methods are applied on real and potential products for outdoor decking. Finally, we briefly discuss the implications for researchers and the industry.

Theory

General model of consumer behavior

We foundation of our study is the general consumer behaviour theory (see e.g. Engel, *et al*. 1986) and the contribution by Lancaster (1966) that consumers demand characteristics of products rather than specific products. Thus, surveying attitudes towards salient product attributes provides information to predict the choice of consumers. Fishbein's Multiattribute Attitude Model (Fishbein 1963) indicates that a consumer's attitude towards a product is influenced by a set of salient product attributes. The consumer evaluates product attributes in a cognitive process influenced by his intention of consumption (Figure 2).

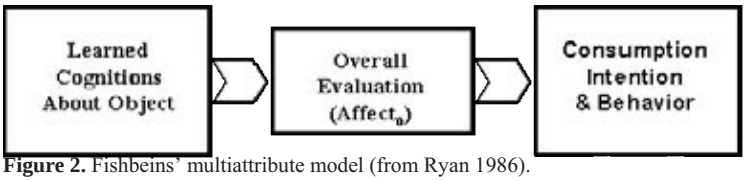

Figure 2. Fishbeins' multiattribute model (from Ryan 1986).

The challenge for the producer, e.g. of wood for outdoor use, is to identify and analyse key attributes that are most appreciated by potential customers and to use this knowledge in the product and marketing processes

Method

Sensory analysis

Sensory analysis is one such method that involves the definition and measurement of product attributes perceived by sight, sound, smell, taste and touch (Lawless and Heymann 1998) The method can be used for descriptive (Lea, *et al*. 1997; Lawless and Heymann 1998), or hedonic purposes (Evin and Siekierski 2002).

Five different terrace decking alternatives were prepared for analytical sensory evaluation and hedonic consumer evaluation by potential consumers (Figure 3 and Table 1). The samples were square modules measuring 100x60 centimetres. All boards were 95 millimetres wide. Four modules were made for each decking. Nine trained assessors agreed upon a consensus list of attributes for profiling the samples using generic terms The analysis respected prescribed standards for panel selection, laboratory design and procedures in sensory analysis (ISO 8586-1 1993, ISO 13299 2003, ISO 8589 1988). In the hedonic exercise 92 non-expert potential consumers rated their preferences for each type of decking.

Figure 3. Five samples of decking used in the study (left to right: Untreated Ipé, Organic biocide treated Pine, Furfuylated Pine, Untreated Russian Larch, Copper treated Pine).

Table 1. Descriptive information about decking samples

Tree species	Sample	Commercial name	Treatment	Origin	Price (NOK/m^3)
Tabebuia spp	I	Ipé	Untreated tropical hardwood	Brazil	620
Pinus silvestris	II	TMF	Pressure treatment, organic biocides	Norway	136
Pinus silvestris	III	Kebony	Pressure treatment and curing, Furfuryl-alcohol	Norway	150
Larix sibirica	IV	Russian Larch	Untreated heartwood from larch	Russia	208
Pinus silvestris	V	Wolmanit	Pressure treatment, Copper	Norway	93

Both the descriptive and hedonic sensory procedures used 7 graded rating scales. Principal Component Analysis and Partial Least Squares (PLS) (Abdi 2003) together with the Tukey HSD All-Pairwise Comparisons Test were used to analyse the data.

Free elicitation

In the hedonic study respondents were also asked to briefly reveal why they liked or disliked a specific product. In this analysis, these comments were recorded for the individual's most liked, or disliked alternative, yielding the reasons or motives for 'strong' positive or negative preferences (van Kleef et al. 2005).

Segmentation

Market segmentation is widely used to distinguish separate consumer groups with similar attributes and preferences. The approach can be used to target specific groups of customers, for product development or for differentiation (Grant 2003). Clustering techniques are often used for segmentation. In our study, an explorative hierarchical clustering study was carried out, using the Ward clustering method. Preference ratings were used as clustering variables (Green 1977).

Conjoint analysis

Sample II, III and V in the sensory analysis were finally selected for a conjoint analysis study among visitors to a large garden fair in the Oslo area. In the conjoint research approach several attributes are evaluated jointly, to mimic a real choice situation (Green and Srinivasan 1978, Green and Krieger 1991). In addition to the display of samples for inspection, we incorporated price, environmental labelling, augmented product and service as factors in the study. Factors and levels are presented in table 2.

Table 2. Conjoint analysis

Factor	Levels	Number of levels
Photo and product	TMF, Kebony, Wolmanit	3
Price	P1 (lowest), P2 P3 (highest)	3
Environmentally certified	Yes, No	2
Service	Yes, No	2
Ready to assemble box	Yes, No	2

Results

Sensory study

Eighteen relevant attributes were successfully identified and measured in the analytical sensory analysis. Principal component analysis (PCA) revealed that the variation between the samples could be described according the main dimensions, PC1, representing mainly surface texture, explaining 64% of the variation in the sensory data, and PC2, representing brightness of colour with *whiteness* as one important characteristic of the samples opposite to *colour hue* (case yellowish-red), explaining 21% of the variation (Figure 6). Additional principal components did not contribute substantially to describing the data material.

Ipé, copper treated Pine and untreated Larch presented extreme values on the sensory scores. Pine treated with copper appeared to be the most green/yellow and intense in colour. Organic biocides treatment exhibited less red colours than the furfurylated Pine. The amount of surplus colour was less visible for wood treated with organic biocides compared to the two other treatments. The samples of Copper treated wood had more and bigger knots as well as more distinct growth rings than the other Pine samples, but this relates to wood properties rather than method of treatment (the copper impregnated wood was bought in a builders' store, whereas the other samples were procured from the factories).

The decking from untreated Ipé and Larch were most liked by the customers (Figure 5). The two samples from pressure treated wood (copper and organic biocides) achieved low average scores. Consumer acceptance for pressure treated pine was significantly lower than the other samples.

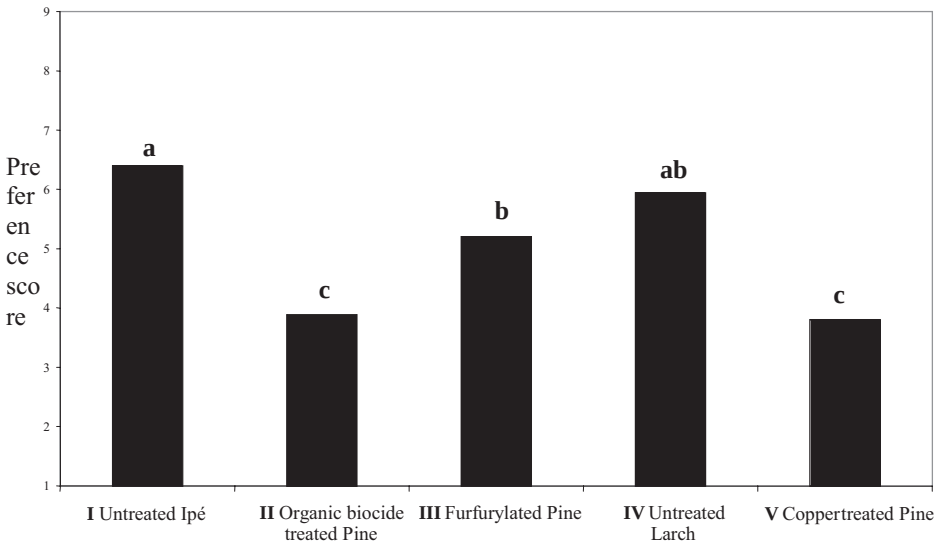

Figure 5. Consumer acceptance of the different types of decking. Average rating of 92 consumers. Samples with identical index letters are not significantly different (Tukey HSD All-pairwise comparison test).

Using the results from the Partial Least Squares (PLS) analysis, the sensory and consumer acceptance data were mapped according to the dominant principal components loadings, PC1 and PC2 (Figure 6). Consumer response is clustered in the right end of PC1, which suggests

that most consumers prefer decking with corresponding characteristics (evenness, high growth ring density etc.).

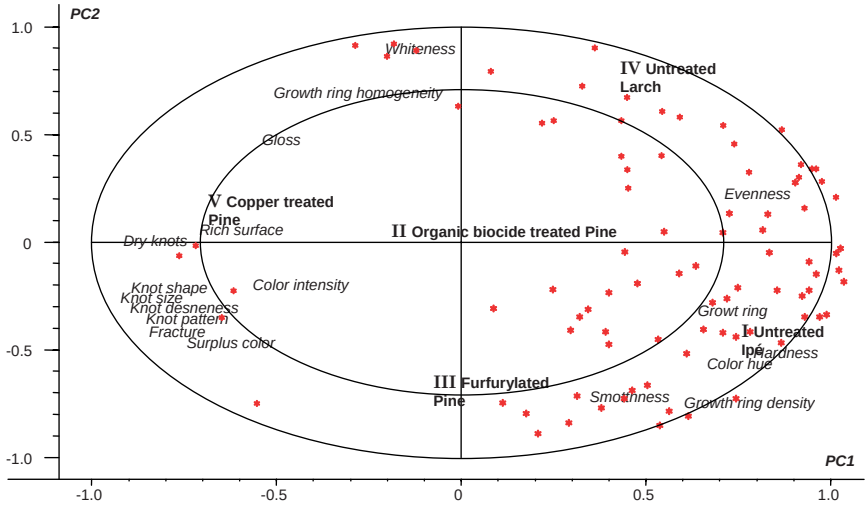

Figure 6. Preference map, plotting product attributes (*italics*), individual consumers (asterisks ∗) and the five samples of wooden decking (numbered I through V).

Free elicitation

The elicited reasons for most pronounced liking or disliking each of the samples are presented in Table 3. Some adjectives were mentioned by two or more respondents. For natural reasons the most liked products (Ipe and Larch) showed most positive comments, while the least liked decking had more negative observations.

Table 3. Free alicitation results

Sample	Reasons to prefer	Reasons not to prefer
Ipe	Suits the colour of my house Nice colour Solid impression Looks exclusive Trendy colour Nice dark colour Tough colour, resistant Doesn't need treatment Would be nice in my garden Few knots Seems resistant Will last over years	Too dark Deforestation? Rainforest species? I don't like dark Uneven colours
TMF	Looks real Colour Light and nice Inviting Light and pleasant	Pink colour? Reddish colour – seems unnatural Too light red – unpractical, doesn't fit anywhere
Kebony	Nice colour Conforms to the colour of my house OK colour Dark and even colour Gives a solid impression Like a roof of a cabin	Too dark! This type of colour is not trendy Looks dirty
Untreated heartwood from larch	Light, pleasant colour Aesthetically appealing wood Looks natural Neutral and nice colour Looks like good quality wood	Gets easily stained Needs regular treatment Too much patterns Too light
Wolmanit	Nice colour Green is a known colour for preserved wood	Don't like the colour! Associated with pressure treatment Too green Looks poisonous Low quality wood! Uneven colour

The comments give substance to some of the sensory analysis of e.g. Ipe and Larch, and Wolmanit. The comments also bring other associations and reactions – e.g. environmental properties - to the surface.

Cluster analysis

The hierarchical cluster analysis results are shown in table 4, which also presents approximate labels and most distinguishing features of each cluster.

Table 4. Cluster analysis results

Cluster No	N	Likes	Dislikes	Comments
1	15	(Kebony, Larch)	Wolmanit*, TMF	Young
2	13	Ipe	TMF, (Larch*)	
3	18	Larch*, (TMF*)	(Wolmanit, Ipe*, Kebony*)	Old
4	22	Kebony, (TMF*)		
5	5	Ipe	Kebony*, TMF	

* significant cluster property, in brackers: not very extreme rating

Unfortunately, the clusters were not distinct in terms of internal homogeneity and external differences. Moreover, additional descriptive data that might had confirmed and supported our cluster solution, were not available.

Conjoint analysis

The preliminary conjoint analysis results on a section (200 observations out of 296) of the data are shown in the summary Table 5.

Table 5. Conjoint results

Label	**Utility**	**Importance** (% Utility range)
Intercept		4
Wolmanit	-0.4	17
TMF	0.2	
Kebony	0.2	
P1	0.5	24
P2	0.0	
P3	-0.5	
Certified	0.9	48
Not certified	-0.9	
Service	0.1	3
No service	-0.1	
Box	-0.2	8
No box	0.2	

Respondents rated the treatment, price and environmental attributes as the most important aspects for their purchase. As in the sensory analysis, the green wolmanite-treated wood was least preferred. Improved service and advice, or ready-to-assemble box features were not important product attributes.

Discussion

The aim of this study was to apply and compare different methods for attribute elicitation for consumer-led product development. For the sake of realism we provided wood for outdoor decking as examples. The methods used were sensory analysis, free elicitation, segmentation, and conjoint analysis. Our main impression of this example is that all methods yield important information for marketing planning. However, the methods vary in focus and application. The methods could be used individually or in conjunction to provide different types of answers to the product developer. Sensory analysis gives a basis for exploratory innovation and a general indication of the direction of the product development. In some cases the sensory analysis results could be complemented by free elicitation or, when different segments can be expected, by segmentation studies. Conjoint analysis can provide important input when product concepts designed.

An assessment of the different methods and their application in product development is shown in Table 6. However, it must be stated that each of the approaches can be further refined to answer to more precise market planning questions. The methods are mainly a sample from a larger toolbox of for marketing research. This means that there is a great challenge ahead to use established marketing research methods in the forest products industry.

Table 6. Evaluation of elicitation methods

Method	Main results	Applications	Resources needed
Analytic sensory analysis	Yields a high amount of attributes Objective measures of sensory attributes Provide main dimensions based on attributes	First stage in NPD Map similarities and differences between products based on objective sensory attributes	Requires resources, e.g. a sensory panel and trained analysts that are rare in forest products research
Hedonic sensory analysis	Associates attributes with preferences Distinguishes attributes with negative, neutral or positive impact on preference	Indicate directions product development based on attributes. Useful for product placement and differentiation	Requires resources and skills (see above). I also entails new competences to use the information productively for new product development
Free elicitation	Seeks the individual's own reason for likes/dislikes. Considers the respondent's own vocabulary	Provides advice on further improvements. Indicates possible content in marketing communication	Simple method. Fewer requirements on the user. Easy to apply and analyse although it benefits from experienced and trained project team
Segmentation	Identifies consumer segments for product development and differentiation	Can indicate potential products for different segments. The method is less powerful when background data about	Easy to apply and interpret. Trained assessors are needed for a realistic approach in the application

		the segment is scarce	
Conjoint analysis	Identifies important attributes for consumer preferences Reveals preferred properties Resembles a typical choice situation	Powerful tool in product design – at different stages of the product development process Good basis for segmentation	Analytical skills Statistical skills and software.

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