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EXECUTIVE ACADEMY

Consumer Perceptions of Innovative Wood Polymer Composite Decking with a Focus on Environmental Aspects

A Master Thesis submitted for the degree of
"Master of Business Administration"

supervised by
ao.Univ.Prof. Dr. Barbara Stöttinger

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Wien, 13. August 2008

Consumer Perceptions of Innovative Wood Polymer Composite Decking with a Focus on Environmental Aspects

Master Thesis zur Erlangung des akademischen Grades eines
„Master of Business Administration“

eingereicht bei Prof. Barbara Stöttinger

Stefan Weinfurter

Wien, 12. August 2008

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Abstract

The garden market is experiencing a boom not only in Austria. In the last few years garden design has gained popularity and is expected to grow strongly at least in the near future. A large variety of equipment suppliers have significantly enhanced their sales, as well. New services and products are entering the market or increase their rate of application. Among these is the well selling decking that can be of various kind, e.g. wood plastic composites decking (WPC).

Due to the fact that wood-plastic composite decking is unfamiliar to Austrian consumers, a survey was initiated to reveal consumers' perceptions of wood plastic composites decking quality. The method chosen for the survey was product concept testing including conjoint analysis. Personal interviews were carried out with the targeted respondents, single-family home owners and "do-it-yourselfers."

The survey was carried out in the pre-garden season in winter 2006/07. It was repeated in winter 2007/08 with minor changes. Regardless of the survey 06/07 or 07/08 the main results scarcely diverged. Deemed most important by respondents were issues related with durability followed by product handling, environmental concerns and service aspects at last.

Wood-plastic composite decking was perceived more positively by a majority of respondents, across the two surveys. Willingness-to-buy measures of the online survey slightly speak against a "no-go" decision.

The survey of 06/07 included conjoint analysis, revealing that the color and the kind of surface of decking planks are deemed most important for the respondents' purchase decision. Plastics share and plastics type are of less importance and the kind of wood-fiber used is of least importance.

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1 Introduction

In recent years not only Austria's garden sector experienced high growth rates. Furthermore, this development is expected to continue in the near future. Garden design has become very popular. Relevant service provider and equipment manufacturers and dealers are profiting significantly. Services and products are steadily improved, but also new ones are developed. One of these new products is wood-plastic composite decking, that clearly falls into the category of consumer durable goods. In general, decking is one of the fasted growing markets within garden design. Wood-plastic composites also clearly represent a growing market – worldwide. The introduction provides a brief overview of the global wood-plastic composite market.

Two very similar surveys differing only in a few details were carried out, due to the fact that wood-plastic composite decking is unfamiliar to Austrian consumers. The goal of both surveys was to reveal consumers' perceptions of wood plastic composites decking quality. Both surveys targeted single-family home owners and "do-it-yourselfers." The method chosen for the surveys was product concept testing including conjoint analysis.

Product concept testing is not a method per se but a conglomerate of methods. These methods and the scales they are based on are described as well, such as willingness-to-buy measure, a multi-item measure, and a semantic differential. These measures and how a product concept testing can be designed generally, is briefly described in the subsequent chapter. This second chapter also includes a detailed description of how the sample was derived i.e. how the respondents were chosen for the survey. The method of administration was face-to-face, i.e personal interviews.

For better understanding, methodological details are incorporated into the third chapter, the results. Results are presented ranging from simple means such as frequency graphs and nonparametric tests, such as chi-square, Mann-Whitney, and Kruskal-Wallis for investigating group differences, to more sophisticated statistical procedures such factor analysis. For all statistical tests applied, the significance level was set at 0,05. Groups are various segments of respondents. Segments were defined a priori and attempts were made to reveal consumer groups by cluster analysis on an explorative basis.

Chi-square, Mann-Whitney, and Kruskal-Wallis tests were applied here, because they are non-parametric tests, i.e. "non-metric" alternatives to *t* test and analysis of variance (ANOVA). These "alternative" tests to investigate group differences ought to be performed when data are non-metric and when one or both of the following requirements are not met: data are not normally distributed and/or the variances of the two groups can be assumed equal (Churchill, 1995).

Factor analysis was applied to investigate the underlying structure of the construct and to make the initial steps for developing a model of consumer perceptions of innovate wood composite products. Factor analysis is also needed to calculate Cronbach's alpha, a means of testing the reliability of a construct.

Finally, design, method of administration, and results of conjoint analysis are dealt with in the end of the results chapter, before the report closes with a summary. Again method and results are not separated for better understanding and because conjoint analysis is a unique method.

1.1 Brief global wood-polymer composites overview

Wood-plastic composites are a mixture of wood fiber and polymers (Bowyer et al., 2003), either thermoplastic or duroplastic polymers. The terms wood-plastic composites and wood-polymer composites are used interchangeably.

In recent years a global wood-polymer composites (WPC) community came into being and it is further developing constantly. North America was first. That can also be recognized in the birth of the Wood-plastics Composite Conference a decade ago which is held annually in Madison, Wisconsin and hosted by the Forest Product Society.

Europe followed a little later including several annual and bi-annual international conferences. It is worth mentioning that although similar in many regards the European and the North American market differ significantly, may that be the range of wood-polymer composites or the varying recipes differing in kind of and share of raw materials.

The community consists of public but also private research institutions, academia, a large variety of machine tool suppliers, raw material suppliers and finally wood-polymer composite producers. North America is leading in number of producers, but Europe is following. This dominance can be seen in Figure 1.

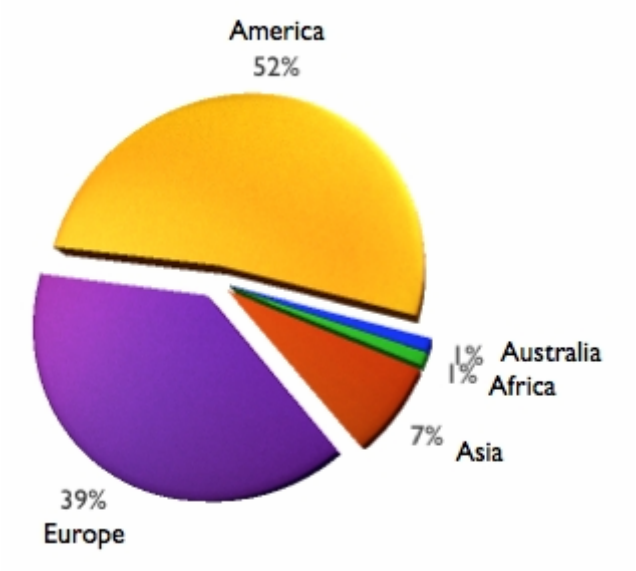


Figure 1: Global distribution of WPC actors in 2007 totaling 199 (Eder, 2007)

An overview of wood-polymer composite applications in the North American Market is given in Figure 2 with decking (planks) clearly dominating the scene.

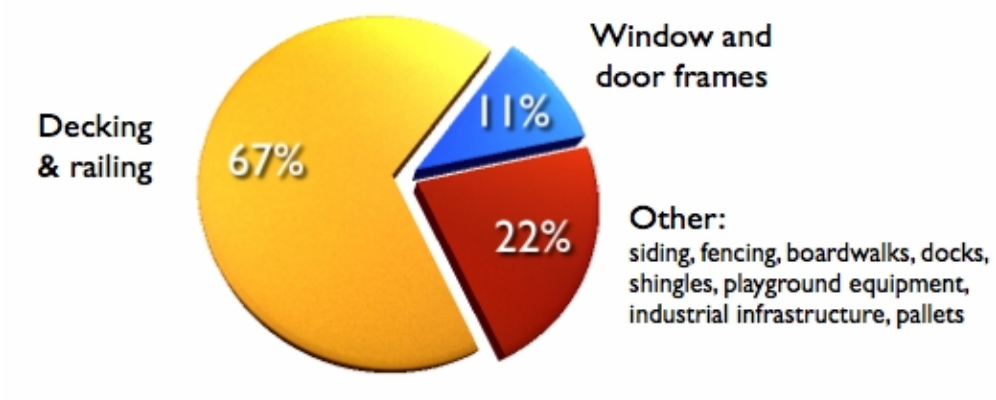


Figure 2: Overview of natural fiber composites uses in North America (Smith and Wolcott, 2006)

The picture is different in Europe: There are not only some other applications, applications do also differ in share in comparison to North America (Figure 3). Furthermore, PVC, recycled plastics and to a certain extent recycled fibers making up comparably cheap products that gained large market shares rapidly e.g. wood-plastic composites decking, dominate the North American WPC market.

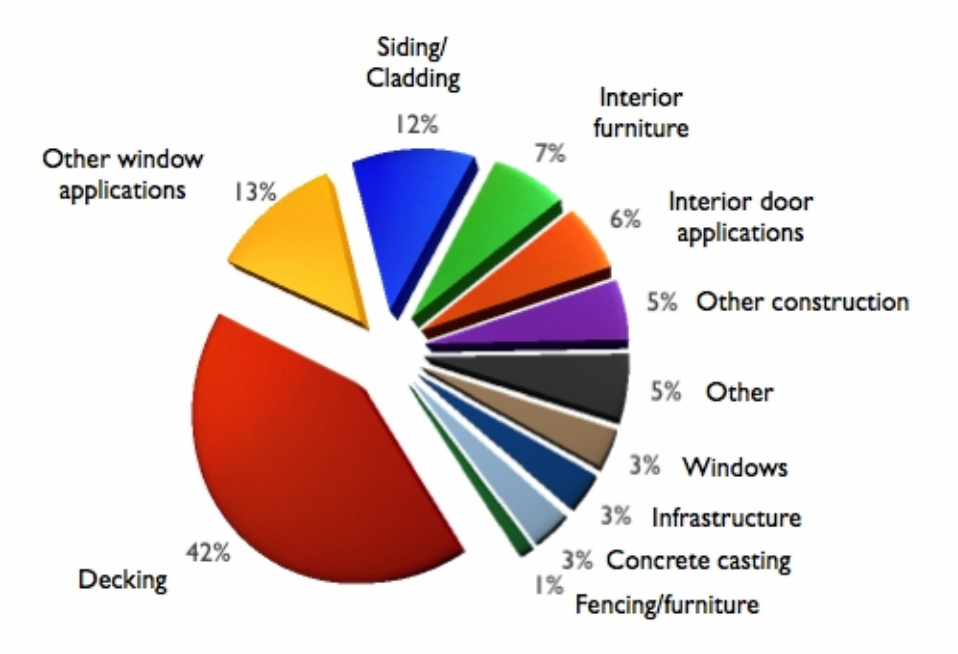


Figure 3: WPC applications in Europe excluding automobile parts in 2005 (Hackwell Group, 2006)

In contrast non PVC polymers such as PP and PE dominate the European market. Virgin fiber is the first choice here. European WPC is characterized by a higher wood fiber content, which causes recipes and production to become more sophisticated.

WPC production is projected to grow significantly on both continents North America and Europe, though at very different levels (Figure 4).

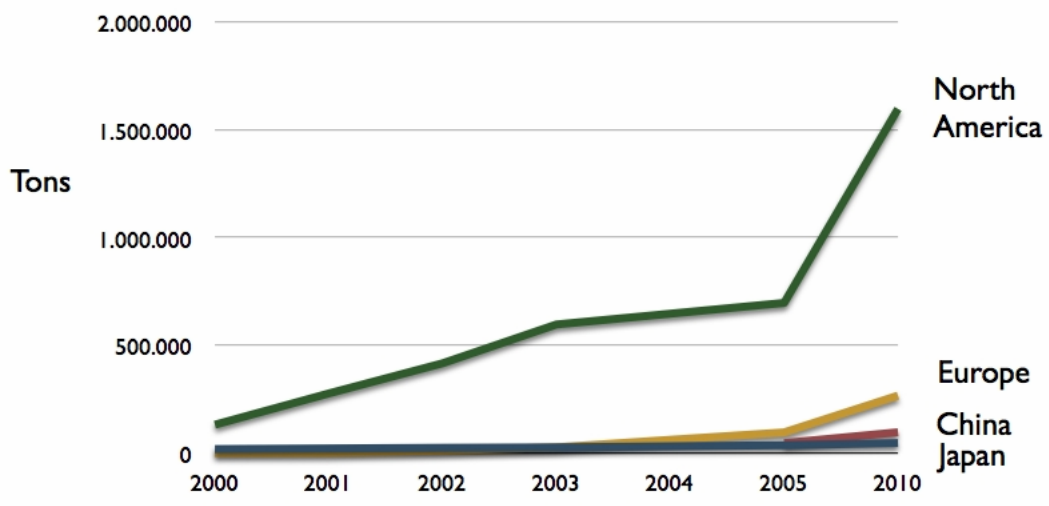


Figure 4: Development of WPC production between 2000 and 2010 (Nova, 2006; Kikuchi, 2005; Hackwell Group, 2006)

2 Methods

Since wood-plastic composites are not familiar to Austrian consumers, the approach chosen for this survey was product concept testing. Personal (=face-to-face) interviews were carried out in winter 2006/07 before the beginning of the garden season in spring. The survey was repeated in winter 2007/08 with minor changes. Both surveys were designed very similarly, including a product concept statement comprised of a verbal and a pictorial product description as well as a questionnaire. Sample pieces of wood-plastic composite decking were not available in the amount needed and thus not included in the survey.

2.1 Product concept testing

A concept test is a means to see what potential users think about the product concept introduced to them. Typically a concept has to be screened before development can be undertaken (Crawford and Di Benedetto, 2003). If consumer reaction to the concept is poor, the product development project may be terminated or earlier stages of the product development cycle have to be repeated. The tests may aim at which out of several concepts to pursue, gathering information of potential consumers in the target market on how to enhance the concept, and getting a feel for the future sales potential (Ulrich and Eppinger, 2004).

A product concept test starts with a concept statement. A concept statement states a difference and how that difference benefits the consumer. Although it can be designed in different formats, the concept should make the new products variation clear. It should list the determinant attributes, specifically the ones making a difference in buying decisions. It should be realistic and credible and it should offer a certain extent of familiarity by appealing to things familiar to the consumer. The latter can hardly be fulfilled if radical new products, respectively new-to-the-world products are of focus. Finally the concept statement should be as short as possible (Crawford and Di Benedetto, 2003). The author strived to meet these requirements for the product concept used in this study (Appendix 1) and deemed the concept for sure not radically new following widespread definitions (Garcia and Calantone, 2002).

As mentioned above, the information of the concept can be presented to potential consumers in one or more than one of several formats: narrative/verbal, pictures, drawing or diagram, a mockup i.e. scale sample, model, a physical sample or prototype, or in virtual reality. For this

study a combination of a verbal and a pictorial description was chosen, because a pictorial depiction has to be accompanied by a narrative statement of the concept (Crawford and Di Benedetto, 2003).

2.1.1 Product concept statement

The product concept statement of this study started on top with the title: "Decking planks made of wood-plastic composite." A list of benefits provided by wood-plastic composite decking succeeded the title. The list of benefits included following wood-polymer composite properties: (1) dimensional stability, (2) durable and weather resistant, (3) non-slippery (4) resistant against insects and fungi, (5) easily repairable, (6) hardly inflammable, (7) no splintering, and (8) recyclable. A few showcase pictures of installed decking including a close-up view of a wood-plastic composite deck followed.

A short comparison of prices and durability of different kinds of decking was provided next. These included wood-plastic composite, Bangkirai, Larch, and Thermowood. Larch is the most durable indigenous Austrian wood species. Nevertheless, it is by far not as durable as Bangkirai. Bangkirai stems from either Malaysia or Indonesia. Due to its outstanding durability and its dark brown color, it rapidly gained popularity as decking planks in the last few years especially in Germany but also in Austria.

After the comparison of price and durability an explanation of the "mixture" of wood and plastics i.e. wood-plastic composite followed. The verbal description of wood-plastic composite was worded as follows: "Wood-plastic composite consists to a large extent of wood (fibers) and a smaller share of plastics, usually PP polypropylene and PE polyethylene. Profiles e.g. decking planks with various cross-cut shapes can be formed by an extruder out of this mixture."

The product concept statement closed with a short series of pictures briefly showing the extrusion process comprising the wood and plastic mixture, an extruder "at work," and various extruded profiles.

2.1.2 Questionnaire design

The questionnaire consisted of a purchase intention scale, succeeded by two open-ended questions asking for the reasons for prospective purchase, respectively non-purchase.

Respondents were then asked which kind of raw material composition they would prefer and which raw material composition would be acceptable for them. After that, respondents had to provide their preference either for solid or hollow profiles. The questionnaire further contained a semantic differential, revealing respondent's first impression of wood-plastic composites decking. Prior knowledge respectively product category expertise was the next issue: When respondents had experience with wooden decks, they were asked how satisfied they were. In two open-ended questions respondents had the opportunity to state why they were or why they were not satisfied with wooden decks. The questionnaire pursued with the core of the questionnaire a multi-item list.

2.1.2.1 Multi-item measure

Within the multi-attribute measure, respondents were asked to rate each item on the basis of its importance to the quality of wood-plastic composite decking on a 4-point Likert-type rating scale ranging from "not important at all" to "very important." The first part of the questionnaire closed with as few as possible sociodemographic questions.

The list of items describing overall product quality represented the first step of developing a model of overall product quality, including product as well as service quality for the application. The factors respectively the dimensions underlying these quality constructs were extracted. Cronbach's Coefficient Alpha calculated for each of these dimensions, shows high reliability of the measurement constructs.

2.1.2.2 Conjoint analysis

Conjoint analysis is commonly used in new products design. It is a method used to detect respondents' preferences for new product features or entire new products. Conjoint analysis can be consulted to identify market segments or optimal product concepts (Lilien and Rangaswamy, 1998b)

A product or service can be viewed as a bundle of attributes. Each attribute has several levels i.e. options. A bundle is a particular product or service composed of attribute levels - one level of each attribute. With conjoint analysis a selection of bundles is presented to respondents and they rate or rank the bundles according to their preference. Respondents must make trade-off judgments during the rating or ranking procedure weighing preferred levels of one attribute against less preferred levels of another attribute. Respondents' overall preferences are then

decomposed into part-worths also called utilities, which are assigned to each attribute level by respondents. Utilities can be calculated for all respondents overall but also for each respondent individually (Lilien and Rangaswamy, 1998a). A bundle of attributes is called a stimulus. In this study stimuli are decking profiles made up by certain attributes with varying attribute levels. For details on conjoint analysis and the way it was performed here, see chapter 3.12.

2.2 Sampling

The samples were chosen in a way expecting they were suited best to serve the research purpose. Thus, single family home owners and do-it-yourselfers were targeted for this survey. It is also believed that they are somewhat representative of the population of interest. A sampling procedure like that is called judgment or purposive sample. There is no need that the sample elements are truly representative but they are supposed to offer the contributions sought for. When searching for ideas and insights the researcher's goal does not lie in sampling a cross section of opinion but rather in sampling the elements deemed being able to offer some perspective of the research question (Churchill, 1991).

3 Results

Results are presented two-fold, namely for the 2006/07 survey and the 2007/08 survey. In some cases, results of the two surveys are presented together in one figure for better comparison. Mostly results of both surveys are separated but immediately following each other for ease of understanding.

3.1 Response rates, method of administration, and sample design

The response rate for both face-to-face surveys was close to 100 percent. Interviews were carried out by students in their personal surroundings resulting in a low number of denials. Altogether 391 interviews were administered in the 2006/07 survey and 546 in the 2007/08 survey.

Interviewers were thoroughly instructed. Instructions were presented to them in person and a written manual was provided. Interviewers were urged to become familiar with the questionnaire by thoroughly going through it several times on their own. They were also advised to let the respondents look at the questionnaire any time to make administration easier for both, the interviewer and the respondent.

Instructions included how to select the targeted respondents. The first sampling criterion was "single-family home owners." Second criterion for whom to choose was "do-it-yourselfer." Amongst consumers, single-family home owners were deemed to be the group for whom decks were most relevant. Since it was expected that not all interviewers have easy access to single-family home owners, they were allowed to consult "do-it-yourselfers" no matter in which kind of home these resided. Being classified as "do-it-yourselfers" depended on the respondents' self-perceptions. When carefully following installation instructions, mounting a simple deck, can be "easily" achieved by "do-it-yourselfers."

Interviewers, students respectively, were allowed to search for their respondents in their personal surroundings. That meant relatives and friends. Each interviewer had to perform four interviews. Out of these four they should try to interview two females and two males. If easily possible interviewers should approach respondents of "significant" different age. Interviewers

were instructed to select their four respondents from different households. Furthermore, not all four respondents should have a close familial relationship.

Although interviews of both surveys 06/07 and 07/08 were carried out by different interviewers and the sample was chosen purposively i.e. judgement sample, results were astonishingly similar among the two surveys. That will be shown later in detail. Furthermore, similar online surveys and personal inquiries were carried out in the recent past. The latter included physical sample pieces of decking planks. Again, results were astonishingly similar to the "present" two surveys (Weinfurter, 2006 and 2007).

3.2 Sociodemographics

To keep the questionnaire short and simple only few sociodemgraphic variables were questioned: (1) sex, (2) year of birth, (3) residence, i.e. province, (4) respondent's origin, i.e. rural or urban, (5) current type of community, i.e. rural or urban, (6) type of residence, and (7) monthly net household income. These sample characteristics of the two surveys 06/07 and 07/08 scarcely diverged (chi-square statistics).

In both surveys slightly more males than females were interviewed (Appendix 2: Figure 28 and 29). Chi-square statistics did not reveal a significant difference for $\alpha \leq 0.05$. The same holds true for the age distribution of both surveys: no significant difference between the two surveys. The shape of both age curves clearly deviates from a normal distribution. Both curves are double-peaked (Appendix 2: Figure 30 and 31). According to the author's previous experience, reason for the two peaks is that both surveys were administered by students. For ease of administration, students were advised to search for respondents in their surroundings. This results in a majority of respondents from the students' own generation and the student's parent generation. Nevertheless, overall results from the present two surveys do not differ from very similar past surveys where age was normally distributed (Weinfurter, 2006 and 2007).

The distributions of respondents across the nine Austrian provinces coincide in both surveys, too. In both surveys a majority of respondents resided in Vienna followed by Lower Austria and Upper Austria (Appendix 2: Figure 32 and 33). The significant difference between the two surveys shown by chi-square statistics might lie in the fact that the number of respondents from Vienna and Lower Austria in the 07/08 survey doubled those from the 06/07 survey.

The samples of the two surveys significantly differ (chi-square statistics) regarding the respondents' origin that can be either urban or rural. In the 06/07 sample a significant higher share of respondents originally stems from a rural community (Appendix 2: Figure 34 and 35). There isn't any significant difference between the two samples concerning the community respondents currently live in, again either urban or rural (Appendix 2: Figure 36 and 37). In both samples about half of the respondents currently live in an urban community and half of the respondents currently live in a rural community.

According to chi-square statistics there is no significant difference between the two surveys according to the type of residence of the respondents. About half of the respondents live in single-family homes, about a quarter in rented apartments, and about a quarter in condominiums, farm houses, row houses, or duplexes (Appendix 2: Figure 38 and 39).

The large share of "top earners" in the 07/08 survey accounts for the significant differences in the chi-square statistics between the 06/07 and the 07/08 survey pertaining to the income distribution (Appendix 2: Figure 40 and 41).

Sociodemographic variables of both surveys 06/07 and 07/08 hardly have any influence on other variables i.e. willingness to buy wood-plastic composite decking, preferred and acceptable raw material composition, preference for full or hollow decking profiles, and the variables of the semantic differential and the multi-item measure.

3.3 Reliability

Testing reliability of a measurement construct (scale) is a very important issue to consider. High reliability has a positive impact on the validity of the interpretation of data analysis results and the conclusions drawn from them.

As mentioned before, testing reliability was achieved in two ways: Firstly, by using the split-half method (DeVellis, 2003; Netemeyer et al., 2003) and secondly by calculating Cronbach's alpha (Cronbach, 1951). Please see chapter 3.10.1 for more details on reliability in general and regarding the present surveys.

3.4 Willingness-to-buy and reasons for purchase / non-purchase

Although it might be a "crude" measure and its results have to be interpreted with care, the willingness-to-buy question appears in almost every concept test (Crawford and Di Benedetto, 2003). A four-point buying intention scale was used for this study, ranging from "I would definitely not buy" to "I would definitely buy" with the intervening points "I would probably buy" and "I would probably not buy."

Results of willingness-to-buy measures (Figures 5 and 6) must be treated carefully and must not be over-interpreted. Nevertheless they provide the researcher with a direction of the respondents' preferences and support for "go – no-go" decisions. Both surveys hint at a "go"-decision requiring a greater amount of consumer input for product design that is provided by subsequent questions and later conjoint analysis.

Referring to Mann-Whitney test results, willingness-to-buy measures of the 06/07 and the 07/08 survey do not differ significantly from each other. The author suspects that part of the slightly positive willingness-to-buy measure in both surveys might lie in the curiosity of respondents towards new products and that no physical decking samples were provided. Thus by only presenting small pictures that will not expose all the details, the latter are left to the imagination of the respondents.

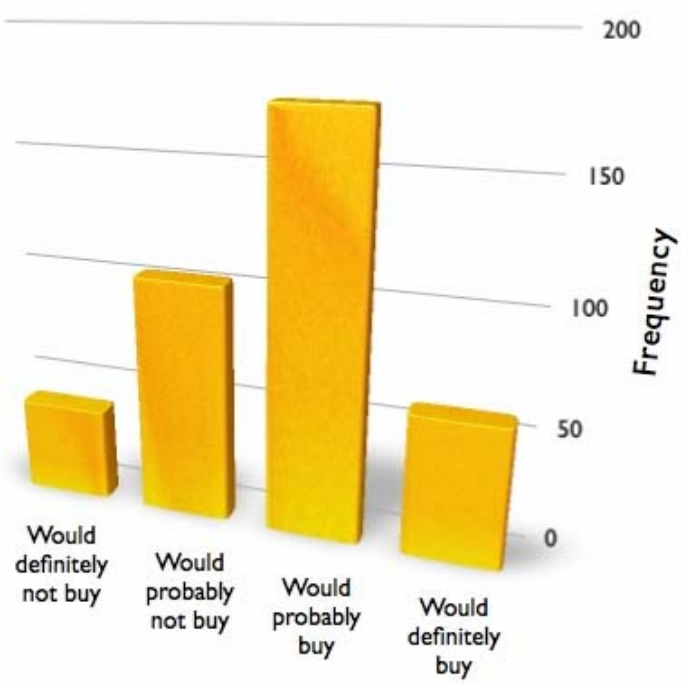


Figure 5: Respondents' willingness to buy wood-plastic composite decking (survey 06/07, n = 382)

In the 2006/07 survey respondents named following reasons why they would by wood-plastic composite decking: Durability and appearance that were stated most often. Next but far less often appeared low- maintenance, followed by price, natural/recyclable, and no splintering.

Reasons, why respondents would not buy wood-plastic composite decking, most often were the preference for wood or other materials and the "artificial" component of the material, namely plastics. Next but less often mentioned were the price and lack of knowledge caused by the newness of the material.

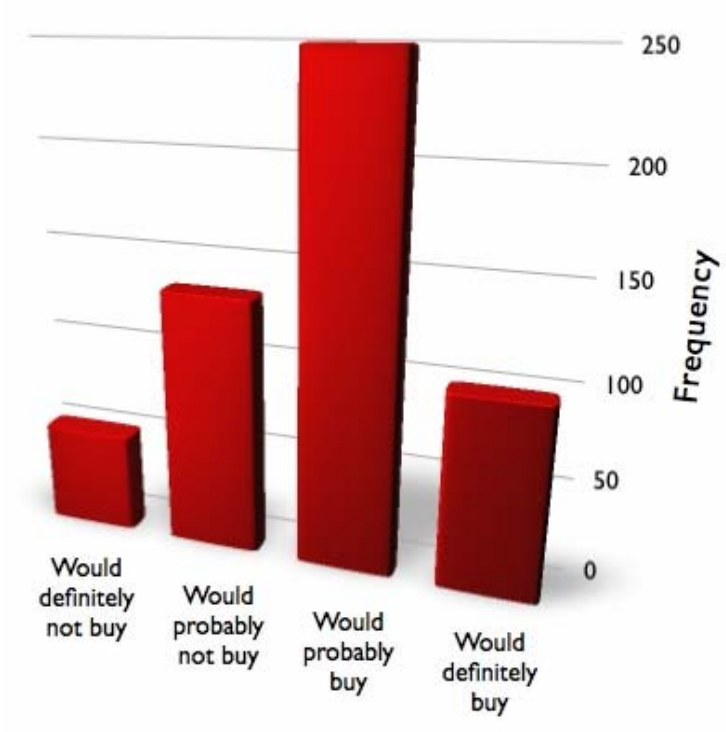


Figure 6: Respondents' willingness to buy wood-plastic composite decking (survey 07/08, n = 542)

In the 2007/08 survey, reasons in favor of buying wood-plastic composite decking, were: Durability, and appearance that were given most often. Next but less often listed were low-maintenance, recyclable, wood-like, non-slippery, and no splintering

Reasons for denying wood-plastic composite decking purchase were that respondents prefer wood primarily or other materials. That was followed by the price, specifically the purchasing costs. The artificial component, the plastics share was given next as “would not buy” reason. Appearance was named next, but far less often.

It can be easily recognized that the reasons provided by the respondents in both surveys 06/07 and 07/08 either in favor of buying wood-plastic composite decking or against it, are very similar.

3.5 Raw material composition

The ingredients of wood-plastic are of two-fold importance. From a technological point of view the type of raw materials and their shares are of particular interest for wood-plastic compound producers and for suppliers of equipment such as extruders and injection molding machines. A vast variety of different wood-plastic compound recipes have been tested and developed globally with North America and Europe dominating. The compounds’ raw materials were investigated as well as their behavior in extruding and injection molding machines. Finally the wood-plastic compounds are tested for strength, weathering, fungi resistance, and UV stability. Intensive research is still going on and will continue in the future. That is the technological view of raw material composition in brief.

There is still an important view missing: the consumers’ view of raw material composition. Therefore, respondents were asked for their preferred and the raw material composition they were willing to accept. In order not to ask too much from respondents recipes were simplified in that they were reduced to two or three main components: wood(fibers), plastics, and a specialty, namely corn starch. Corn starch was included in the first survey, because at time of the first survey the only Austrian wood-plastic compound producer used corn starch in addition to wood.

In the first survey 06/07, respondents were allowed to choose from plastic shares ranging from 10 to 50 percent, wood shares from 50 to 80 percent respectively, and two specialties, 10 and 20 percent corn starch. As can be seen in Figure 7, respondents clearly prefer plastics shares as low as possible and wood (corn) shares as high as possible.

This picture is of even more clarity in Figure 8. It depicts the respondents’ preferred raw material composition of the second survey 08/07. The results from both surveys are very

similar though the possible plastic ranged from 10 to 90 percent and the wood share from 90 to 10 percent respectively in the second survey 08/07 in contrast to the 06/07 explained in the paragraph above.

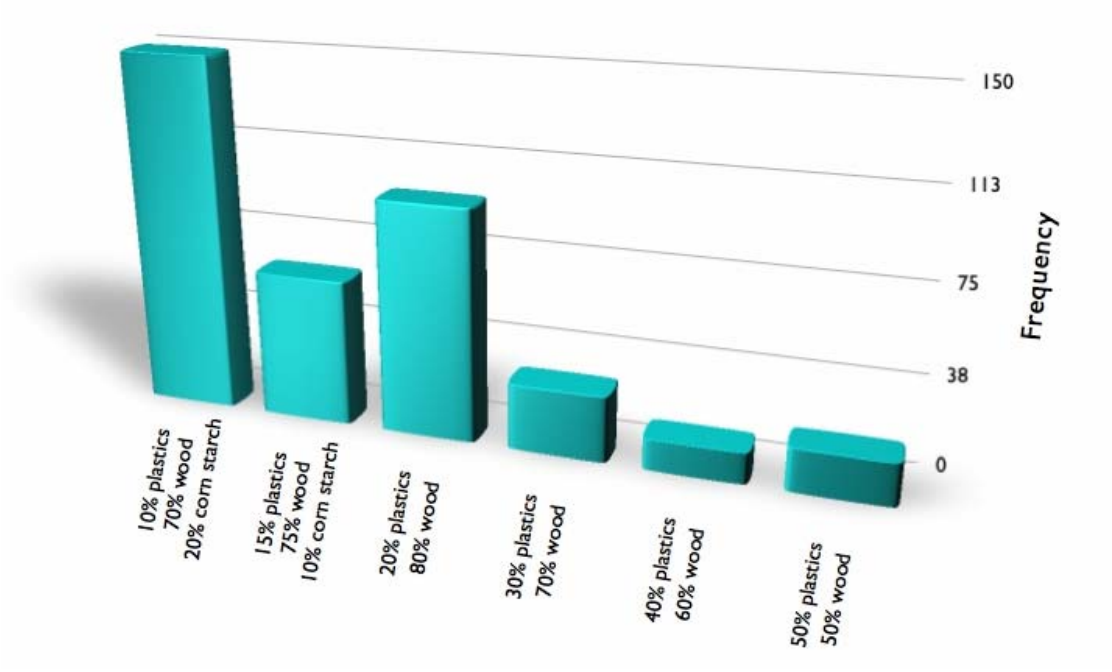


Figure 7: Respondents' preferred raw material composition (survey 06/07, n = 372)

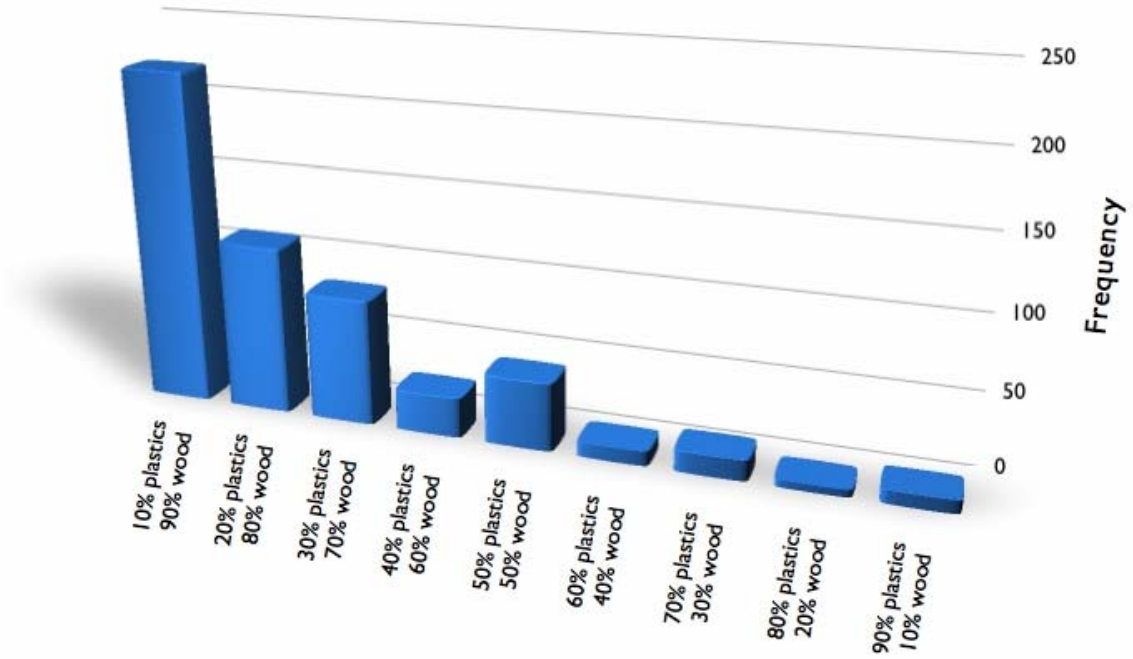


Figure 8: Respondents' preferred raw material composition (survey 07/08, n = 531)

Results of the "acceptable plastics share"-question are more ambiguous, though still clear in the 06/07 survey (Figure 9). There is no doubt that for a distinct majority of respondents, a plastics share of 30 percent is still acceptable. Remember, a maximum plastics share of 50 percent and minimum wood share of 50 percent were provided in the questionnaire.

This picture is less distinct in the 07/08 survey, where a range from 10 to 90 percent in plastics share and a range from 90 to 10 percent respectively were offered in the questionnaire. Here 50 percent plastics and 50 percent wood are an acceptable option for a majority of respondents besides 30 percent plastics and 70 percent wood (Figure 10).

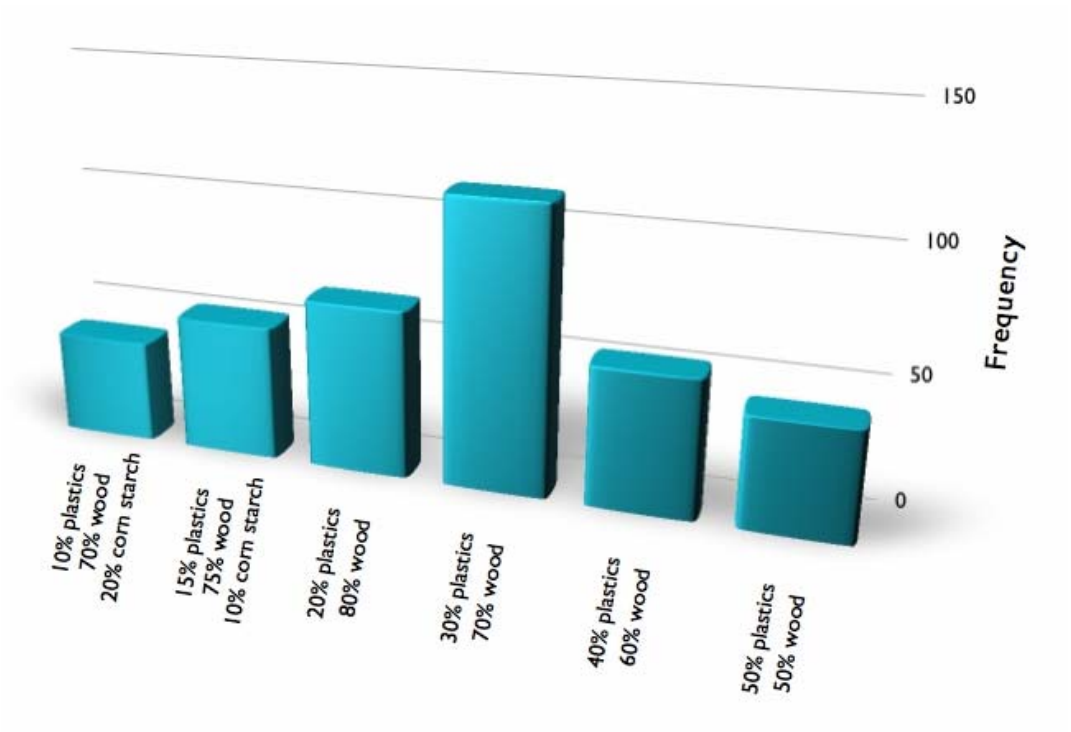


Figure 9: Acceptable raw material composition for the respondents (survey 06/07, n = 374)

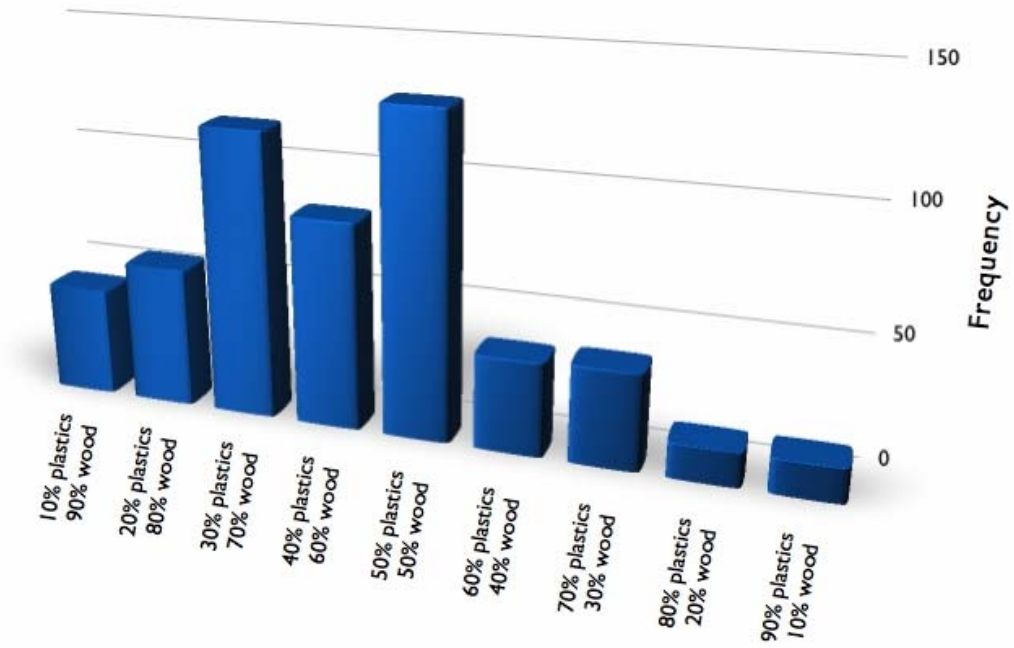


Figure 10: Acceptable raw material composition for the respondents (survey 07/08, n = 536)

Summing up, it can be said that in both surveys a clear majority of respondents prefers a low plastics share in the compound. That is 10 percent. In both surveys a large fraction of respondents stated that a 30 percent plastics content would still be acceptable for them. What respondents do not know, in real world a plastics share of at least 20 percent, better 30 percent, are technically necessary to provide the prior benefit of wood-plastic composites, namely the extended lifetime.

It seems that respondents understand this and other benefits provided by the mixture of wood particles and plastics. Interviewers reported that respondents understood the concept of wood-plastic composites without difficulties. Results of the semantic differential (chapter 3.8) show that respondents do believe the prior benefit, higher durability. Nevertheless respondents prefer a low plastics content, 10 percent, that cannot be realized for outdoor wood-plastic composite applications such a decking providing competitive durability in the near future. This will be a major issue for marketing communication.

3.6 Preferred cross-section

In general, there are two ways of how to extrude a decking plank, with hollow spaces or without. This either results in solid profiles or hollow profiles. Though often perceived by consumers, hollow profiles are not less stable than solid profiles regarding decking. The advantages of hollow profiles are the lower weight and that fewer raw material needed. The disadvantage may be the aesthetics often calling for caps i.e. end covers.

In both surveys 06/07 and 07/08, respondents were asked if they prefer solid profiles or hollow profiles. For easier understanding sketches were provided for respondents, one showing a solid cross section of a decking plank and one showing a hollow cross-section.

In the survey of 06/07 the sketch of the hollow cross-section was put left and the sketch of the solid cross-section was put right. A slight majority of respondents preferred a solid cross-section (Figure 11). In the survey of 07/08 the sketch of the solid cross-section was put left and the sketch of the hollow cross-section was put right. This time, a clear majority of respondents preferred a solid cross-section (Figure 12). Chi-square statistics backs the significant difference between the two surveys regarding cross-section preference. Considering these results, the author cannot rule out an influence of the order of the sketches. Reading habits, from left to right, may cause the respondents to choose alternatives printed on

the left prior to those printed on the right (Schwarzbauer, 1996). Nevertheless, there seems to be a slight preference for solid cross-sections.

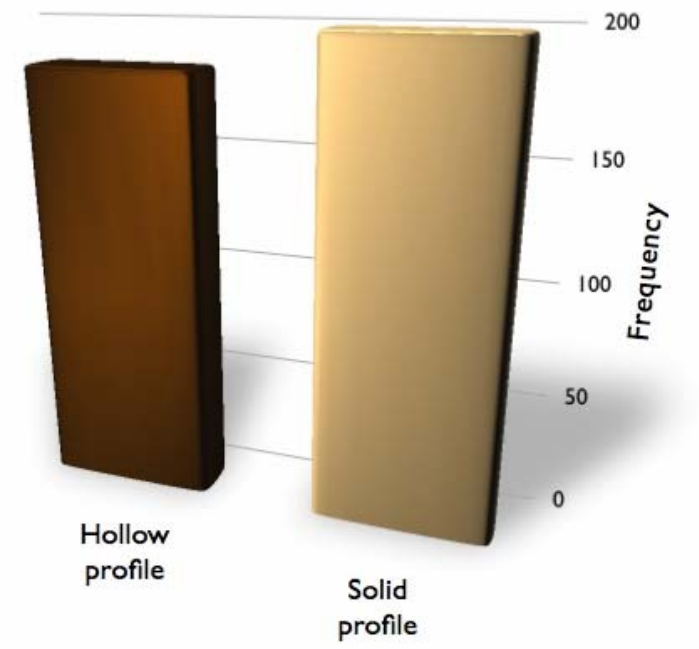


Figure 11: Respondents' "cross-section" preference (survey 06/07, n = 380)

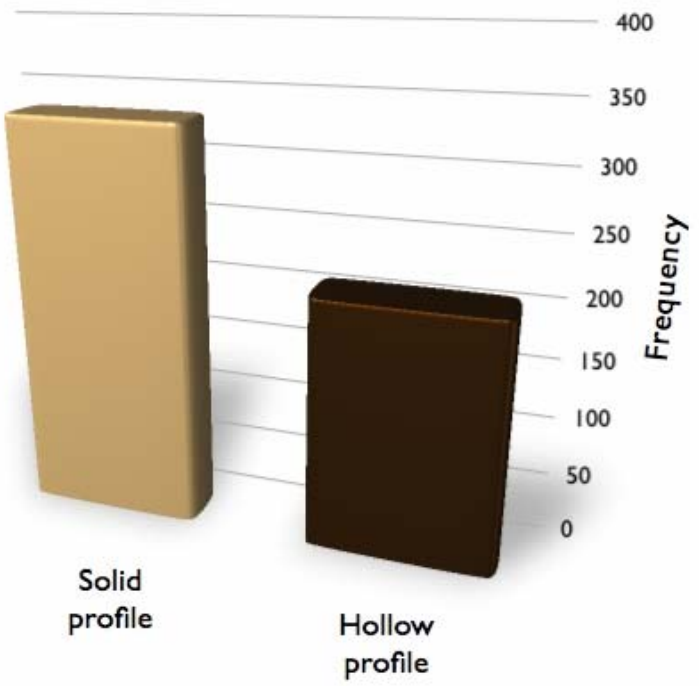


Figure 12: Respondents' "cross-section" preference (survey 07/08, n = 538)

3.7 Prior knowledge – product category expertise

Product category expertise or prior knowledge stands for various levels of "experience" with a certain product. If the product is new to consumers it refers to the product category. The product category is clear here, it is decking. Defining the product category may not be as easy as in this case. Prior knowledge is supposed to influence respondents' perceptions. Ratings of respondents with low prior knowledge might differ from those with much prior knowledge in how they perceive wood-plastic composite decking (semantic differential) or in the items' importance ratings. De Bont and Schoormans (1995) suggest involving only consumers in a new product concept test who have at least some product expertise. Therefore, the two samples 06/07 and 07/08 were investigated utilizing Mann-Whitney tests. Test results show that having experience in the product category or not hardly has any significant influence on other variables.

Prior knowledge was measured the following way in both surveys: Respondents were asked if they have experience with wooden decking. If yes, they were further asked for their satisfaction with wooden decking on a four-pint Likert-type scale ranging from "very satisfied" to "not satisfied" with the two intervening points "rather satisfied" and "rather unsatisfied."

In both surveys half of the respondents stated to have at least some experience with wooden decks. Only a fourth to a fifth of these was not or rather not satisfied with their wooden deck experience. A clear majority, about half of these respondents, was rather satisfied (Figure 13 und 14). Results of both surveys coincide well.

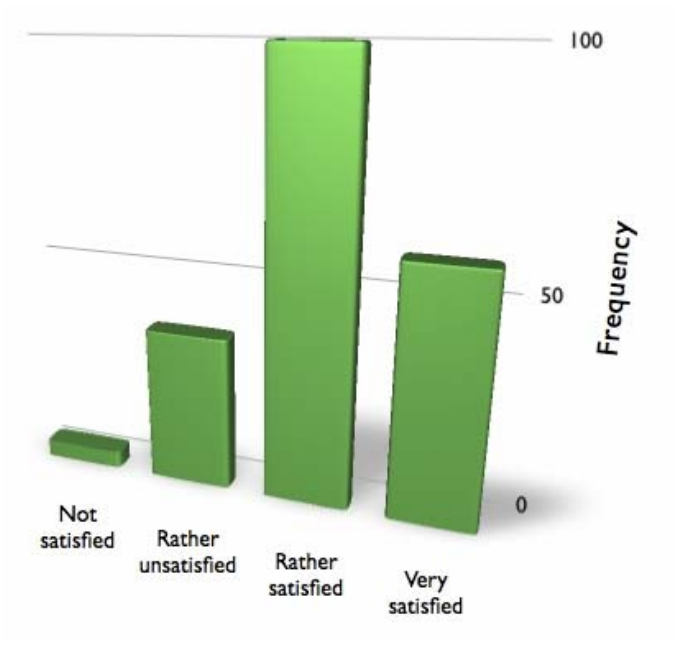


Figure 13: Respondents' satisfaction/experience with wooden decking (survey 06/07, n = 202)

The closed question in form of a satisfaction rating, was complemented by two open-ended questions. The first was "why were/are you satisfied with wooden decking (planks)?" and "why were/are you not satisfied with wooden decking (planks)?"

In the 06/07 survey, respondents listed following factors: The appearance of wooden decking had the largest number of entries, followed by workability and ease of repair. These were succeeded by "naturalness" and durability. Haptics and comfort followed next with significantly fewer entries.

In contrast to that lack of durability was named most often, when respondents were asked for the reasons of dissatisfaction with wooden decking, why they were/are not satisfied, followed by extensive maintenance work. Clearly less often but named next, were splintering, greying i.e. discoloration, and slippery.

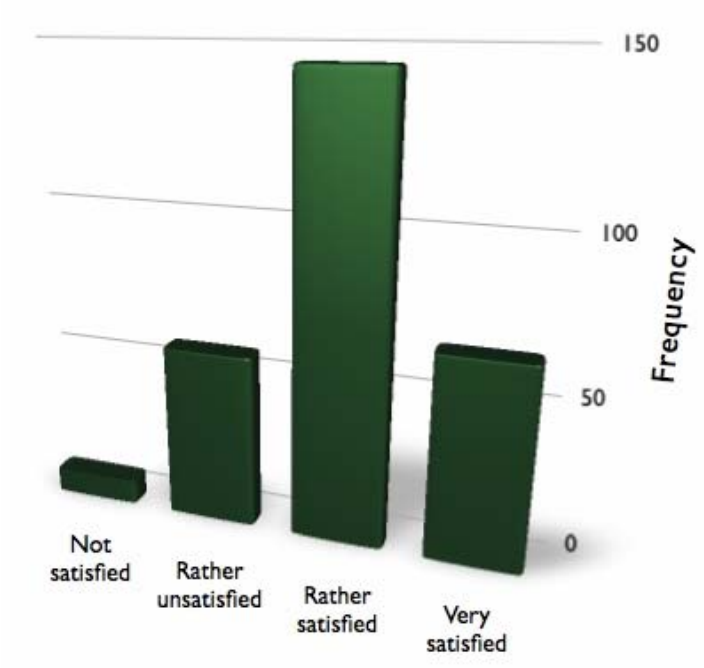


Figure 14: Respondents' satisfaction/experience with wooden decking (survey 07/08, n = 278)

Reasons given for satisfaction in the 07/08 survey were in descending number of entries: Appearance, comfort, naturalness, durability, workability, low price, and simple availability. Reasons provided by respondents for dissatisfaction were: lack of durability, maintenance work, warp, changing color, and splintering and cracks.

Again, results of the two surveys were similar. Problems to the most important drawbacks of wooden decks stated by the respondents are directly addressed by wood-plastic composite decking. Durability is enhanced by adding plastics for instance. That reduces maintenance work. The compound also prevents the creation of splinters and cracks and warping. UV-stabilizers can be added to the recipe to alleviate greying.

Applying Kruskal-Wallis test to the samples of both surveys supports that respondents (rather) satisfied with wooden decks perceived wood-plastic composite decking significantly less positive than respondents (rather) unsatisfied with wooden decks. Vice versa, (rather) unsatisfied respondents perceived wood-plastic composite decking significantly more positively (semantic differential, chapter 3.9).

In addition, willingness-to-buy wood-plastic composites decking of respondents (rather) unsatisfied with wooden decks was significantly higher than that of respondents (rather) satisfied with wooden decks (Kruskal-Wallis test).

Furthermore, respondents (rather) unsatisfied with wooden decks prefer and accept significantly higher plastics share in wood-plastics composite decking compounds than (rather) satisfied respondents (Kruskal-Wallis test).

3.8 Multi-item measure

"Multi-item" paraphrases a "simple" list of attributes "independently" evaluated by the respondents. Developing the multi-item list of this study was far from simple. It is based on a large number of studies concerning forest products including decking. Most of these studies either deal with b-to-b or b-to-c customer perceptions (e.g. Shook and Eastin, 2001). A large number of marketing scientists and practitioners was consulted to adopt the list and to ensure completeness of the measure. The practitioners comprised wood-plastic composite experts and wholesalers and retailers of forest products and outdoor (garden) applications of wood.

The goal was to design a multi-item measure of overall wood-plastic composite decking quality. According to Garvin et al. (1984) this instrument ought to circumvent sufficient aspects of product and service quality. Respondents had to rate the items of the measure on importance.

3.8.1 Likert scale

In a Likert scale the respondent indicates how strongly he or she agrees or disagrees with each listed item (Fishbein, 1967). In the case of this study the 4-point scale ranged from “very important” to “not important at all” (Figure 15). The items respectively attributes covered technical product features comprising several items associated with durability and materials handling. Other attributes covered information, service, and ecology.

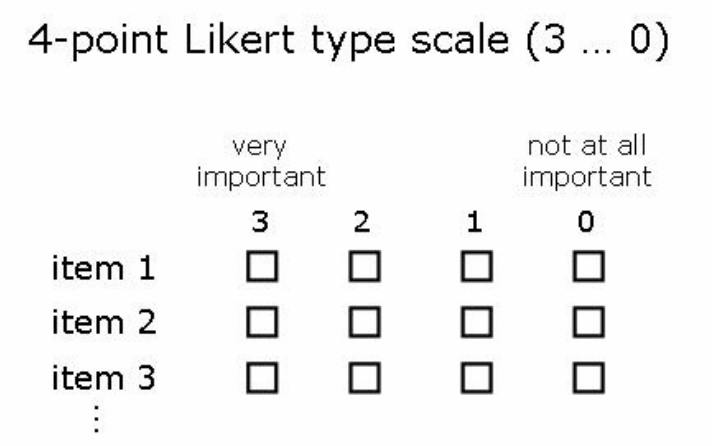


Figure 15: Multi-item measure

3.8.2 Comparison of item-importance ratings

Once again results of the survey 06/07 and the survey of 07/08 nearly were the same (Figure 16). Significant differences with regard to the importance ratings of the two surveys were only found for less than a handful of items. One should not be misguided by these significant differences revealed by statistical tests such as Mann-Whitney-U statistics and Kolmogorov-Smirnov test. They are very likely caused by large samples. These few differences, though statistical significant, must not be over-interpreted and are thus not given in Figure 16.

Mann-Whitney-U statistics and Kolmogorov-Smirnov tests are non-parametric alternatives to the t-test which was not allowed to be applied here. The reasons for being forced to use Mann-Whitney-U statistics and Kolmogorov-Smirnov tests lie in the preconditions that have to be met for t-tests, namely normal distribution of the data and the equivalence of the compared sample's variances. At least one precondition was not fulfilled when comparing the item-importance rating of both surveys (Norusis, 2000).

In both surveys items associated with durability were rated most important followed by ease of product handling and finally service. Price and environmental issues are found in the midfield and the lower midfield, respectively.

Again, results of the two present surveys and results from similar online surveys and personal inquiries from the recent past are alike. The latter included physical sample pieces of decking

planks (Weinfurter 2006 and 2007). This finding resembles the findings of an experiment of Dahan and Srinivasan (2000) with coinciding results from online personal surveys.

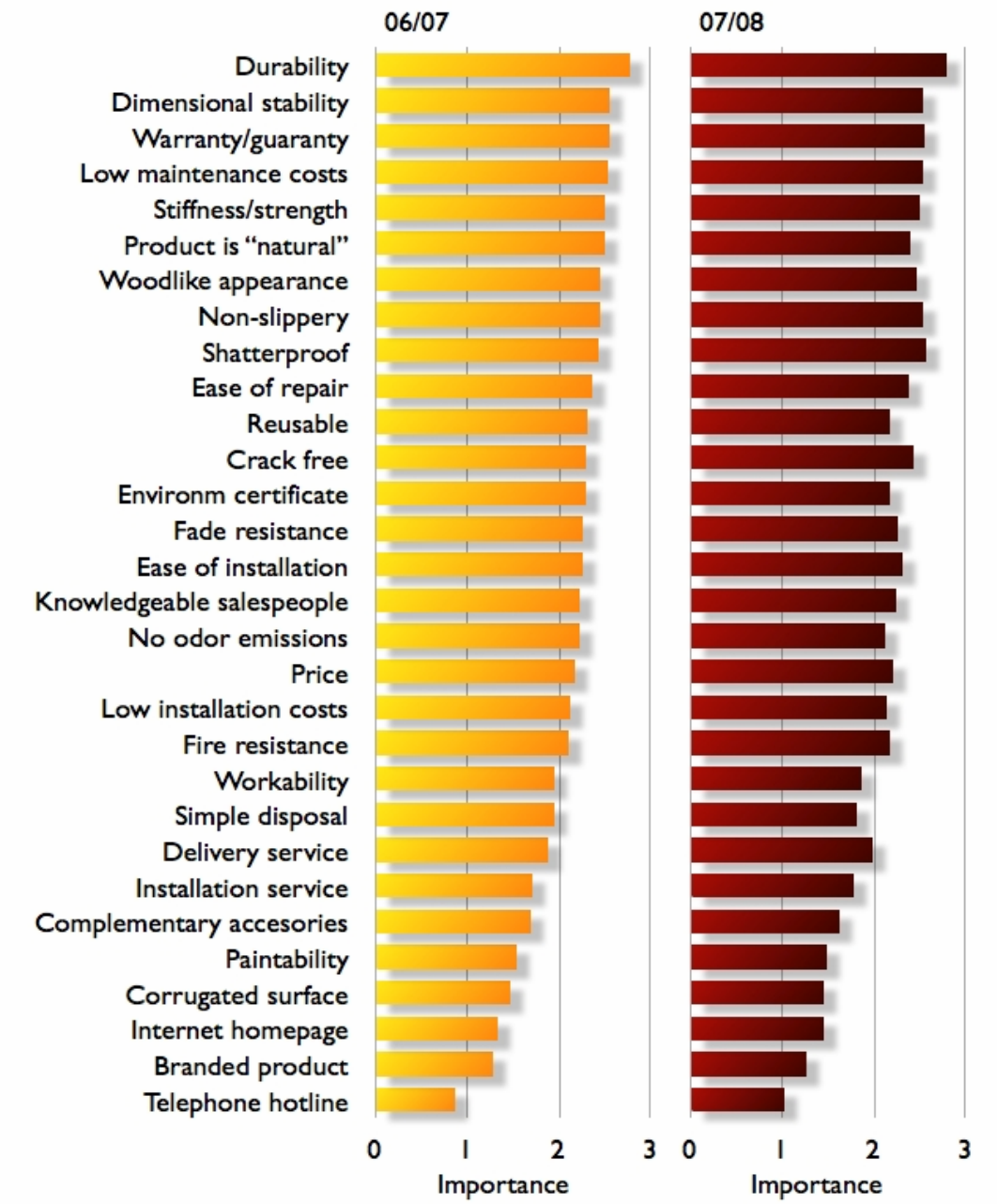


Figure 16: Comparison of mean importance ratings of the 06/07 and the 07/08 survey regarding the importance of attributes describing product and service quality of wood-plastic composite decking (n = 380 / 538)

0 = not important, 3 = very important

3.9 Semantic differentials

The semantic differential (Osgood et al., 1957) is one of the most widely applied techniques to examine users' perceptions of product forms. This procedure investigating product semantics uses a bipolar Likert scale for quantifying the subjects' perceptions of new products, for example (Hsu et al., 2000). Either end of the scale is labelled with a contrasting pair of adjectives.

The semantic differentials of the present surveys support the overall positive perception of respondents regarding wood-plastic composite decking. In both surveys wood-plastic composite decking was perceived to be innovative and durable. Both are important attributes that do not have to be additionally transported by marketing activities, because they are already well communicated by the concept itself (figures 17 – 18).

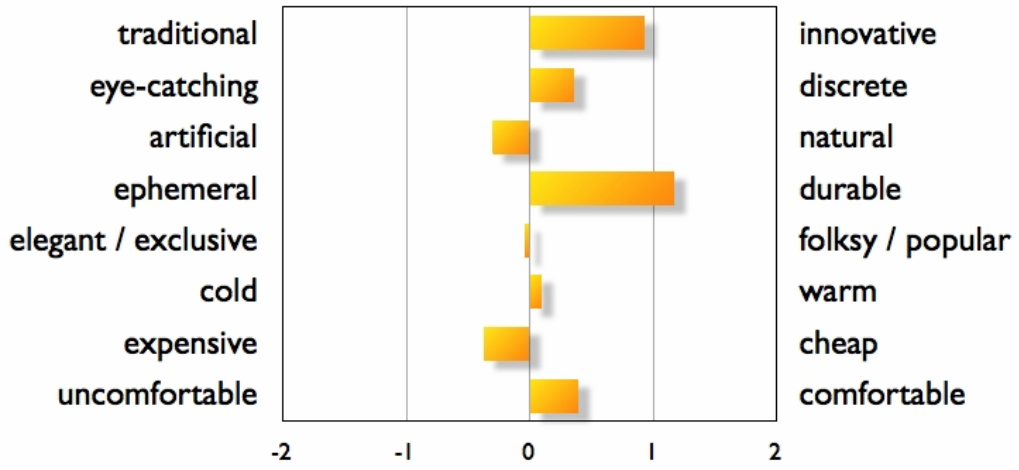


Figure 17: Semantic differential; respondents' mean perceptions of wood-plastic composite decking (survey 06/07, n = 381)

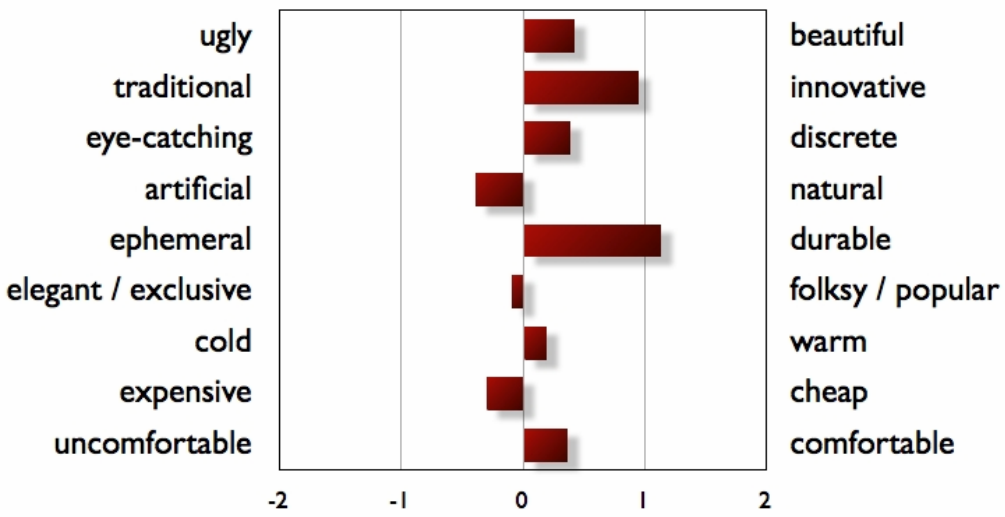


Figure 18: Semantic differential; respondents' mean perceptions of wood-plastic composite decking (survey 07/08, n = 540)

When splitting the sample of both surveys a priori in two subgroups, (1) respondents that would definitely or probably buy wood-plastic composite decking and (2) respondents that would probably not or definitely not buy wood-plastic composite decking, significant differences were revealed as follows with Mann-Whitney tests: "Non-buyers" perceive wood-plastic composite decking in a more negative way e.g. less innovative, less durable, less natural, colder, and more expensive. The same counts for respondents satisfied with wooden decks. They perceive wood-plastic composite decking more negatively, too (chapter 3.7). All this can be considered valuable information for marketing communication.

3.10 Modelling

Besides surveys on fire retardant interior paneling, melamine-treated veneer flooring, and wood-plastic composite fencing, the present surveys on wood-plastic composite decking represents the first step towards developing a model for innovative wood (composite) products' quality.

3.10.1 Testing the model – reliability

More reliable constructs (scales, measures) benefit the researcher with an increase in reliability for a certain sample size given. Subsequently, more reliable scales allow smaller sample sizes to achieve equivalent statistical power. Like a larger sample, a more reliable construct contributes less error to statistical analysis (DeVellis, 2003). Several procedures are

available to test reliability. Another hint for reliability are the concurrent results of the 06/07 and 07/08 survey.

3.10.1.1 Alternative-form reliability, parallel test

A sample of the respondents fills out two rigorously comparable tests which measure the same attributes but use different instruments. Reliability depends directly on the correlation of the results of both tests (Netemeyer et al., 2003). A general problem with alternative-form is that it is nearly impossible to design two versions of a scale that strictly meet the assumptions of parallel test (DeVellis, 2003). This test could not be used for this research, due to the problem of designing two rigorously comparable tests.

3.10.1.2 Test-Retest reliability

The test-retest is a method of determining the stability of a measure. Respondents fill out the same questionnaire twice. Measuring time stability is the specific objective of this test. Time between the two tests should be as short as possible, but the learning-effect between the two tests has to be taken into account. Variation may not only refer to low reliability, but also to changes within respondents (Schwarzbauer, 1996). Due to the time consuming and difficult administration, it was not possible to apply this technique to the current dataset.

3.10.1.3 Equivalence

The equivalence measure of reliability focuses on the internal consistency or internal homogeneity of the set of items forming the scale (Churchill, 1991). Consistency analysis reveals if responses of an individual are logically incompatible. Incompatibility can be caused by both insufficiencies of the instrument and respondents (Schwarzbauer, 1996).

3.10.1.3.1 Split-half reliability

A set of items making up a single measurement construct (scale) is randomly divided into two subsets. These subsets are then correlated to assess reliability (DeVellis, 2003). Split-half reliability was calculated for the scales of the two studies using the respective SPSS® routine, resulting in high reliability for the multi-attribute measure that was equally used in both surveys. Computing Guttman Split-half Coefficients resulted in a value of 0,776 for the 2006/07 survey and 0,805 for the 2007/08 survey indicating high reliability of the construct (scale).

One can imagine that a large number of different split-halfs can be formed. The correlation for each split is likely to be different (Netemeyer et al., 2003). Cronbach (1951) found that the mean correlation between all possible split-halfs equals coefficient alpha, i.e, Cronbach's alpha.

3.10.1.3.2 Coefficient Alpha, Cronbach's alpha (α)

Coefficient alpha is a widely used measure of reliability in marketing (Bruner and Hensel, 1992; Bearden and Netemeyer, 1999; DeVellis, 2003). Cronbach (1951) showed that the average correlation of all possible splits equals coefficient alpha (Netemeyer et al., 2003). Cronbach's (1951) coefficient alpha is a measurement of internal consistency. It should be the first measure to assess the quality of an instrument (Churchill, 1991). The square root of coefficient alpha is the estimated correlation of the k-item test with errorless true scores. Thus, a low coefficient alpha indicates the sample of items performs poorly in capturing the construct which motivated the measure. Conversely, a large alpha indicates that the k-item test correlates well with true scores (Churchill, 1991).

Coefficient alpha provides a summary measure of the intercorrelations that exist among a set of items designed to measure a single construct. If all the items of a measure are derived from the domain of a single construct, responses to those items should be highly intercorrelated. Low inter-item correlations, in contrast, indicate that some items are not drawn from the appropriate domain and are producing error and low reliability (Churchill, 1991).

The statistical data structure is case-by-variable where cases are the respondents and variables are the items. This measure of internal consistency provides an index of the homogeneity of responses to the unidimensional construct underlying the variables (MacLennan, 1993). Coefficient alpha has to be calculated for all the single dimensions of the construct (Hair, 1995). These dimensions (factors) are detected with the means of factor analysis.

Coefficient alpha was obtained from the RELIABILITY program of SPSS. The measurement scales proofed highly reliable. Coefficient alpha was high for the scales of all three dimensions of both surveys (Table 1 and 2) ranging from 0.667 to 0.787.

3.10.2 Factor analysis

While cases (individuals) are typically grouped with cluster analysis, factor analysis is typically used to group variables. Allocation of a variable to a group (factor, dimension) depends on the correlation between the variables. Variables within a group feature high similarity. Similarity between groups shall be as low as possible (Rodeghier, 1997).

As can be seen in Tables 1 and 2, for both surveys, meaningful factors respectively dimensions that make sense were extracted. The factors computed for both surveys only differ marginally. Only three items were assigned to different factors. Those are colored differently and have arrows attached. Most items clearly loaded highly on one factor. Improvements in reliability (Cronbach's Alpha) by deleting single items were minimal.

These Factor Analysis results are a promising initial step towards developing a model of service and product quality of wood-plastic composite decking. The three factors extracted were named (1) "product and handling", (2) "service", and (3) "ecology".

Marketing implications are quite obvious. Considered most important by respondents was the first factor "product and handling". That is durability and associated attributes and ease of handling the product e.g. assembling and maintenance. These are the product characteristics that have to be met first and best.

Less important but not to be neglected is the factor "ecology" with "wood-like appearance" and "product is natural" as the foremost attributes. Decking still seems to be strongly associated with wood. That constrains the theoretically unlimited variety of compounds, shapes, and colors of wood-plastic composites.

Least important is the factor "service", diminishing the opportunity for producers to distinguish their products by the accompanying service. Furthermore, neither a priori groupings of the two samples nor cluster analysis revealed two consumer segments, one "everything doing-it-yourself" and one requiring services such as delivery and assembling.

Table 1: Factors/dimensions extracted from the 06/07 survey amongst consumers and calculated Cronbach's alpha

Factors _ survey 06/07

1 Product & Handling	2 Service	3 Ecology	Factor loadings*		
	Branded Product			0,28	-0,26
Warranty/guaranty			0,42	0,22	
		Cert. of environ. Friendliness		0,21	0,59
Knowledgeable Salespeople			0,40	0,39	
No Odor Emissions			0,27	0,24	
Ease of installation			0,42	0,29	0,22
Durability			0,65		
Fade resistance			0,49	0,21	-0,39
Fire resistance			0,52	0,32	
Stiffnes/Strength			0,57		
Dimensional stability			0,65		
Price			0,32	0,27	
		Simple Disposal of Waste		0,36	0,71
	Installation service			0,65	
	Workability		0,29	0,41	0,22
	Paintability			0,53	
	Complementary Accesories		0,39	0,53	
Ease of repair			0,55	0,36	
		Product is "natural"			0,61
	Telephone hotline			0,72	
	Internet homepage			0,56	
	Delivery service			0,68	
	Corrugated surface			0,24	
		Woodlike appearance			0,24
Low maintenance costs			0,49		0,29
		Recyclable		0,22	0,79
No splintering			0,56	0,26	0,21
Non-slippery			0,64		
Absence of cracks			0,63		
	Low installation costs		0,35	0,50	
0,767	0,722	0,677			
	Cronbach's Alpha				

* loadings < 0,2 or > -0,2 not shown

Table 2: Factors/dimensions extracted from the 07/08 survey amongst consumers and calculated Cronbach's alpha

Factors _ survey 07/08

1 Product & Handling	2 Service	3 Ecology	Factor loadings*		
	Branded Product			-0,48	-0,26
	< Warranty/guaranty		0,31	-0,45	
		Cert. of environ. Friendliness		-0,26	0,61
	< Knowledgeable Salespeople			-0,46	0,22
No Odor Emissions			0,41	-0,28	
Ease of installation			0,41		0,25
Durability			0,58		
Fade resistance			0,48	-0,29	-0,24
Fire resistance			0,49	-0,30	
Stiffnes/Strength			0,60	-0,31	
Dimensional stability			0,66	-0,36	
Price			0,38		0,33
		Simple Disposal of Waste		-0,29	0,70
	Installation service			-0,57	
	Workability		0,27	-0,34	0,27
	Paintability			-0,38	
	Complementary Accesories		0,24	-0,55	
Ease of repair			0,41	-0,30	
		Product is "natural"			0,61
	Telephone hotline		0,20	-0,68	
	Internet homepage			-0,52	
	Delivery service		0,23	-0,56	
	Corrugated surface			-0,23	
		Woodlike appearance			0,33
Low maintenance costs			0,60		0,31
		Recyclable		-0,24	0,74
No splintering			0,55		
Non-slippery			0,58	-0,20	
Absence of cracks			0,66	-0,23	
Low installation costs >			0,53		0,27
0,787	0,703	0,701			
	Cronbach's Alpha				

* loadings < 0,2 or > -0,2 not shown

3.11 Consumer segmentation

Out of three multivariate statistical tools recommended for marketing management by Nairn et al. (2004), cluster analysis was chosen for this study. Cluster analysis is a powerful tool to divide a sample of individuals into meaningful segments. These segments should be mutually exclusive subgroups based on similarities between the individuals within the respective subgroup. Subgroups shall be as dissimilar as possible (Backhaus et al., 2000). The subgroups are not predefined a priori. Cluster analysis is a tool to identify groups. After detecting the number of groups and assigning each individual into a group, mutual characteristics of individuals within a group have to be revealed by subsequent statistical tests to discriminate them against individuals of other groups. This can be done by discriminant analysis. Chi-square statistic was used here, because at least one assumption for discriminant analysis was not met, namely normality if the independent variables (Hair et al., 1995). No meaningful clusters were found for the present two samples with cluster analysis.

The same counts for segments defined a priori by the researcher. In the present study respondents were segmented by sociodemographic and a few other variables. Again, no meaningful clusters were found, except when splitting the sample into following two subgroups, (1) respondents that would definitely or probably buy wood-plastic composite decking and (2) respondents that would probably not or definitely not buy wood-plastic composite decking.

“Non-buyers” significantly perceive wood-plastic composite decking in a more negative way e.g. less innovative, less durable, less natural, colder, and more expensive. Furthermore, it is obvious that “non-buyers” perceive many of the product and service attributes of the multi-item list significantly less important. All this could be valuable information for communicating wood-plastic composite decking to consumers not yet willing to buy.

The author suspects that the absence of consumer segments in the present samples might lie in the lack of respondents’ experience with the product concept introduced.

3.12 Conjoint analysis

In addition to the core of the first part of the questionnaire, namely the multi-item measure, conjoint analysis, making up part two of the questionnaire, was tested in the 06/07 survey.

Conjoint analysis is a so called multiattribute approach. Multiattribute research is used in marketing to get a better understanding of the structure of customer decisions regarding the market offerings of a company. This shall help the company to improve evaluation and/or design of its offerings and to better achieve profitability and customer satisfaction. Multiattribute research is also used in concept generation and new product evaluation (Shocker, 1979).

Conjoint analysis is a decompositional method. The researcher asks each respondent to give his or her overall preference for a set of potential products i.e. attribute combinations. Conjoint analysis decomposes the overall preference to reveal the utility or value of each attribute. In contrast, compositional models such as many regression applications and discriminant analysis, first collect respondents' ratings of single product attributes. Then the researcher calculates in some way an overall preference based on the single attribute ratings (Hair et al., 1995).

Conjoint analysis is very well suited for understanding consumers' evaluations of and reactions to predetermined attribute combinations that depict potential services or products. The researcher gains insight into the composition of consumers' preferences. Conjoint analysis is based on the assumption that consumers evaluate the utility or value of a product (concept) by combining the utilities contributed by each attribute. The (hypothetical) products are presented to the respondents thus simulating a more realistic purchase situation where consumer have to choose among a set of products but not rate single product attributes e.g. on importance. In conjoint analysis the importance of each product attribute and each utility of each attribute are calculated from respondents' overall product ratings according to their preference. A respondent's overall preference for a product can be called the "total worth" of the product. It can be understood as the sum of the part-worths of each level (Hair et al., 1995).

3.12.1 Attributes, levels, and stimuli

Possible values for each attribute are called attribute levels. Each product (idea) presented to the respondents is called treatment or stimulus. It is made up by combinations of attribute levels (Hair et al., 1995). The attributes and their levels used for the present survey are given in Figure 19. In contrast to past surveys including conjoint analysis (Weinfurter 2006 and 2007), conjoint analysis of this survey also focuses on environmental issues.

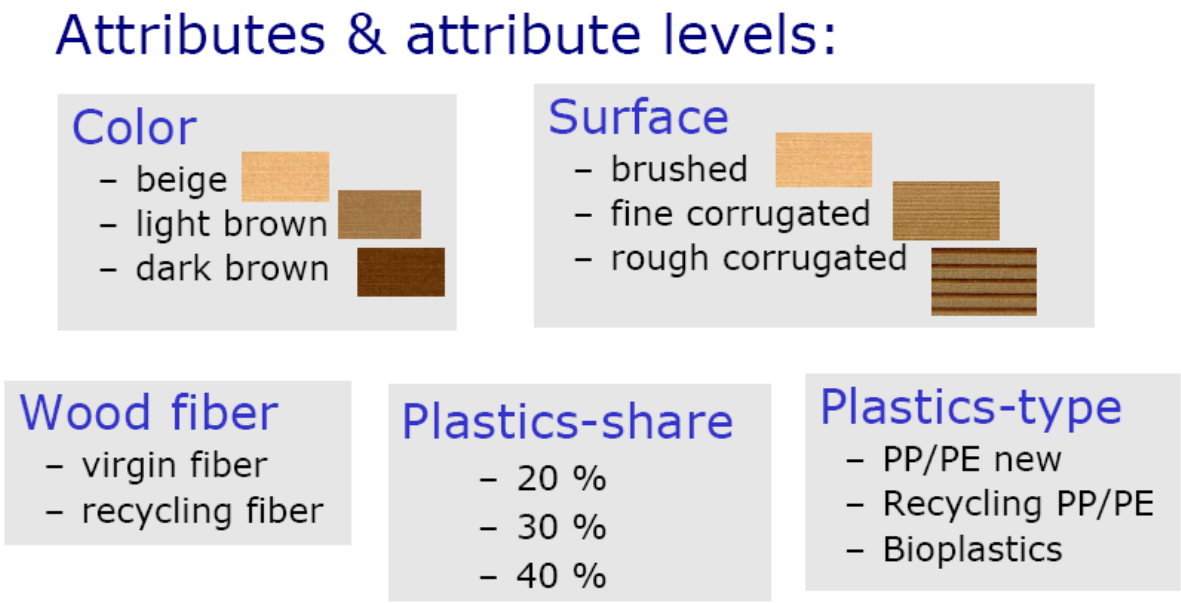


Figure 19: Conjoint attributes and attribute levels (surveys 06/07)

The attributes and attribute levels were carefully chosen based on scarce secondary data and large number of practitioners. The latter were wood-plastic composite experts and wholesalers and retailers of forest products and outdoor (garden) applications of wood, including decking. Wholesalers and retailers had extensive knowledge on consumer behavior in the relevant fields of interest.

The selection of attributes and attribute levels should obey a couple of rules (Backhaus et al., 2000, Hair et al., 1995): (1) Selected attributes should be relevant. That was ensured by consulting above mentioned practitioners. (2) Attributes should be realizable by producers. The author must confess that wood-**bio**plastic composites are under way. (3) Attributes should be independent. Absolutely meeting this requirement is nearly impossible. (4) The number of

levels should be similar across the attributes used. Most of the attributes in this survey had three levels, one had two. It has been found that the relative importance of an attribute increases with the number of levels provided. It is presumed that a large number of attribute levels attracts respondents' attention and they assign a higher importance to the respective attribute. This should not be the case in this survey. (5) The number of attributes and attribute levels should be kept to minimum. According to the author and the practitioners', inputs as few as possible and as "many" as necessary attributes and levels were used. Nevertheless, interviewers reported difficulties of respondents after ranking approximately half of the provided stimuli. Thus results of the present conjoint analysis have to be interpreted with care, although they offer valuable insights.

All possible combinations of the attribute levels given in Figure 19 would result in hundreds of (hypothetical) products i.e. stimuli to be presented to and evaluated by respondents. Such a factorial design is rather impractical. Therefore a fractional factorial design was used. This reduced design was generated using the ORTHOPLAN procedure of SPSS®. The stimuli used in the survey were created running the SPSS® PLANCARDS routine that uses the results of the ORTHOPLAN procedure. That resulted in sixteen stimuli (appendix 1), still a challenging task for respondents.

3.12.2 Results of full-profile ratings-based conjoint analysis (survey 06/07)

For several reasons, ease of design, administration, and data analysis a full-profile ratings-based conjoint method was selected. Full-profile means that each stimulus incorporates a level of each (of the five) attributes. The full-profile method allows the use of fractional factorial design described above. Ratings-based means that respondents had to rank-order the 16 stimuli from the most to the least preferred. The full profile method is used most often in comparison to others such as trade off and pairwise comparison methods, because it offers to reduce the number of comparisons by fractional factorial design (Hair et al., 1995).

In this survey, significant Kendall's tau and Pearson's R values close to one indicate that empirically derived data is well represented by conjoint results.

On one hand, conjoint analysis results provide the part-worths (utilities) of all attribute levels and the importance of all attributes for each respondent. That is called disaggregate analysis. On the other hand, results of conjoint analysis provide the levels' utilities and the attributes'

importance aggregated for all respondents (Hair et al., 1995). The results of aggregate analysis are shown in Figure 20 to 25 and Appendix 3.

In Figure 20, it can be easily recognized that the attributes most important to respondents are the wood-plastics composite deck's color and its surface. So, appearance seems to be the major purchase criterion followed by the plastics share and plastics type.

Having a closer look at the attribute levels, a fine-corrugated surface seems to provide the highest utility to the respondents followed by a brushed surface. Rough surface had the lowest utility value (Figure 21). It is also quite obvious that respondents prefer light brown colored decks most followed by dark brown and beige at least (Figure 22).

Respondents clearly prefer bioplastics and recycled plastics in contrast to new polypropylene and new polyethylene (Figure 23). Care has to be taken when interpreting the utilities for plastics type because they might not be based on true behavior but socially desired behavior (Schwarzbauer, 1996). Furthermore, the development of wood-**bio**plastics composites are just under way.

The respondents' preference for a low plastics share (Figure 24) corresponds with the results of the first part of the questionnaire (Chapter 3.5). At last it doesn't seem to matter to respondents if either virgin fiber or recycled fiber is used in the wood plastics composite compound (Figure 25).

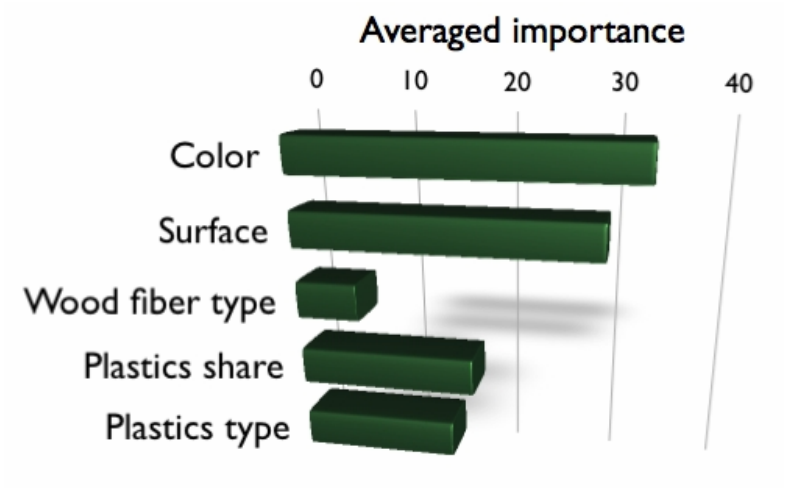


Figure 20: Conjoint analysis – attribute importance (survey 06/07, n = 374)

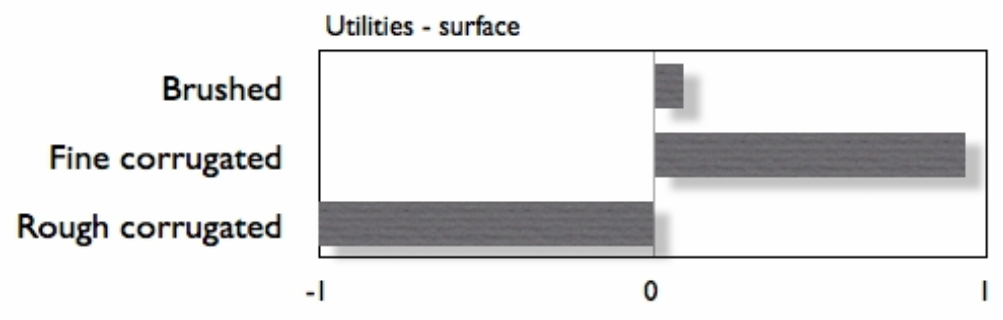


Figure 21: Conjoint analysis – utilities surface (survey 06/07, n = 374)

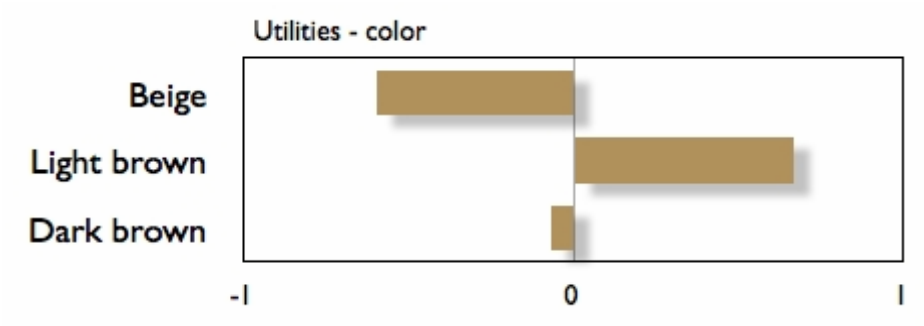


Figure 22: Conjoint analysis – utilities color (survey 06/07, n = 374)

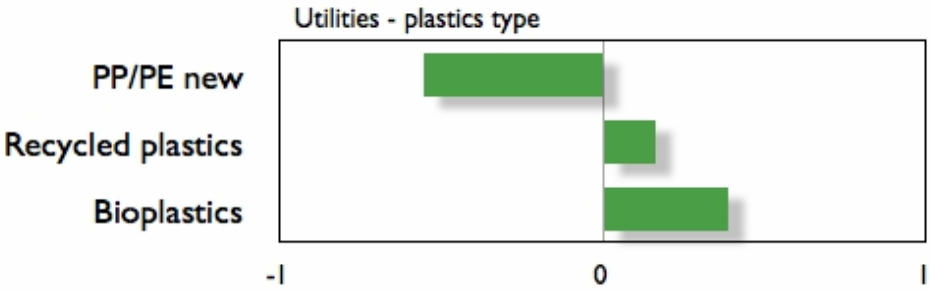


Figure 23: Conjoint analysis – utilities plastics type (survey 06/07, n = 374)

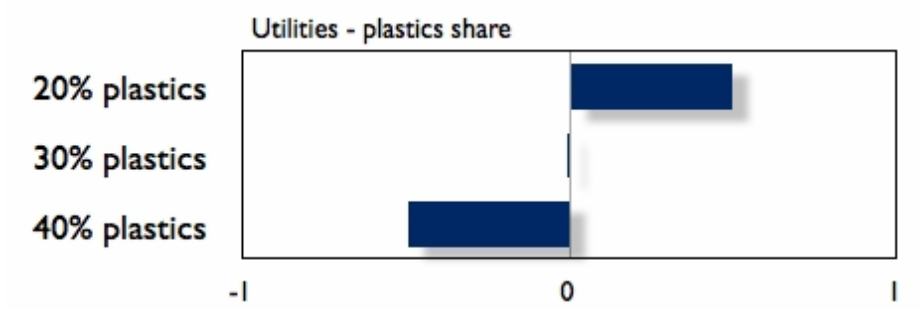


Figure 24: Conjoint analysis – utilities plastics share (survey 06/07, n = 374)

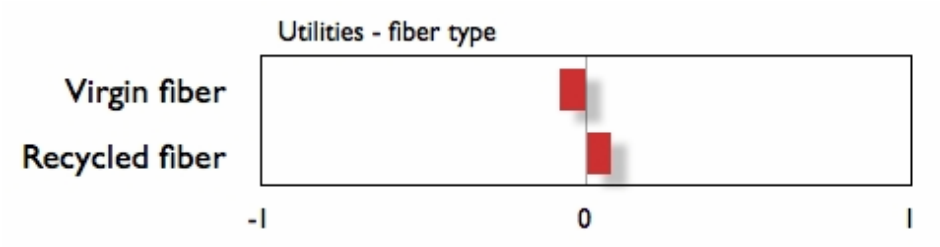


Figure 25: Conjoint analysis – utilities fiber type (survey 06/07, n = 374)

For making it easier for respondents in the 07/08 survey, respondents did not have to rank-order all 16 stimuli, but just to choose the one stimulus they prefer most. Thus calculating part-worths (utilities, importance) was not possible as in survey 06/07. Nevertheless both samples 06/07 and 07/08 do not differ significantly regarding their first-choice deck i.e. stimuli (Figure 26 and 27).

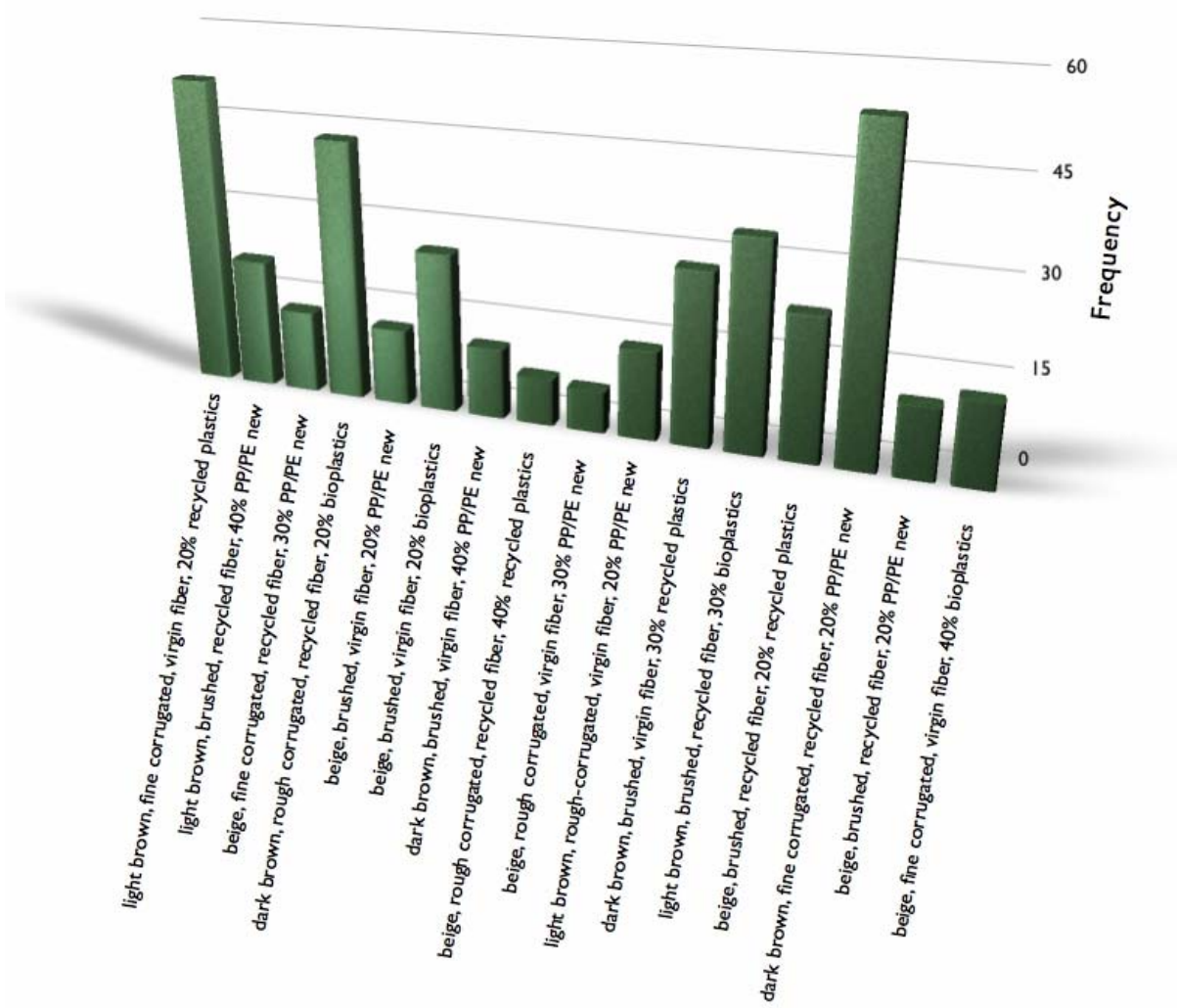


Figure 26: Conjoint stimuli – first choice (survey 06/07, n = 374)

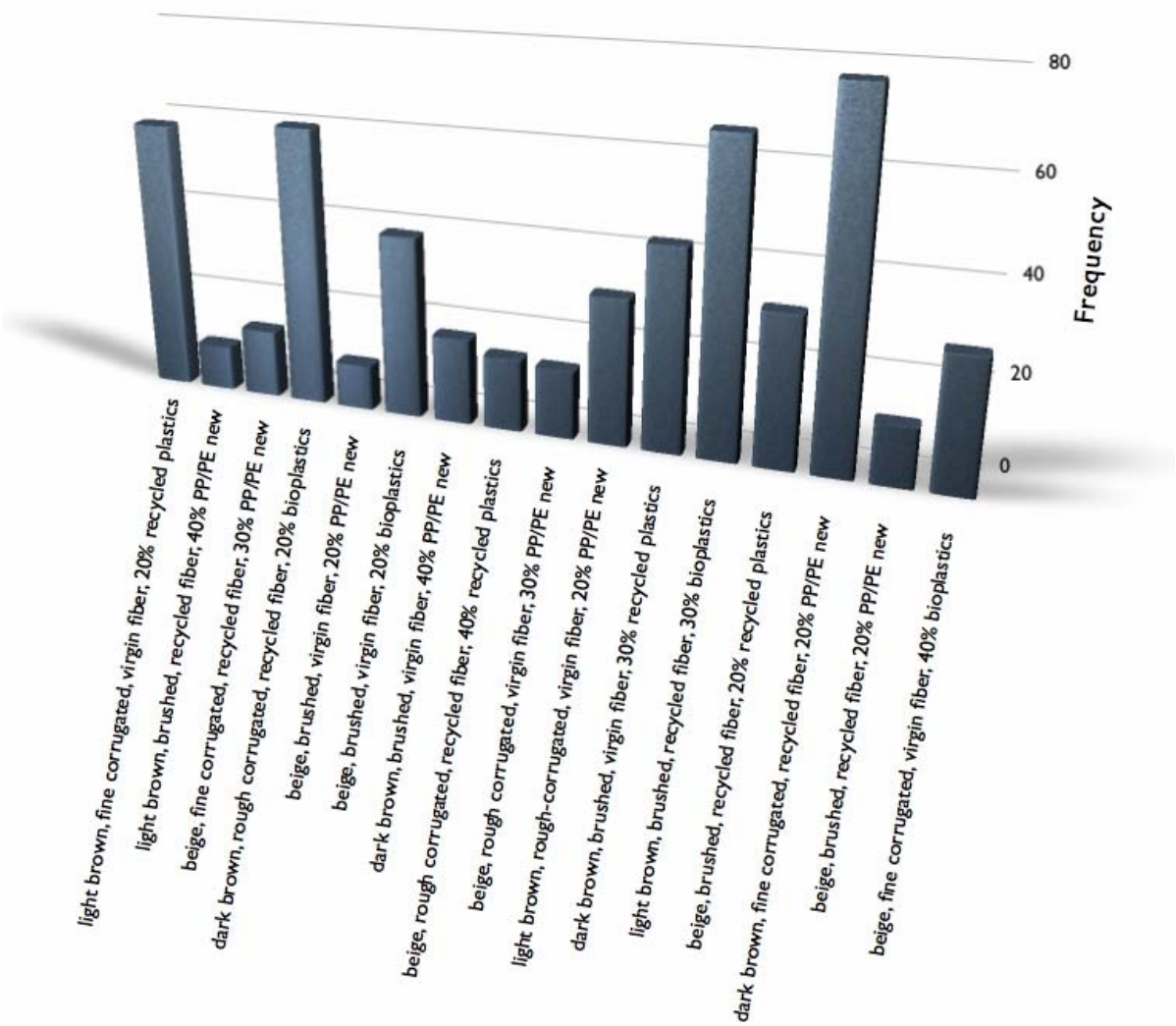


Figure 27: Conjoint stimuli – first choice (survey 07/08, n = 541)

4 Summary

The wood plastics composites market is growing worldwide. Extensive technical research is continuing specifically in Europe, North America, and Japan. Nevertheless, wood-plastic composite still is an unfamiliar material to consumers, especially in Europe.

Therefore, two very similar surveys were carried out in Austria to reveal consumers' perceptions of wood-plastic composite decking quality. Hereby, the term quality incorporated product quality as well as service quality. Decking was chosen, because it is an important component of the booming garden market and because wood-plastic composite decking is one of the very few wood-plastic composite products that became available for Austrian consumers recently. In both surveys single-family home owners and "do-it-yourselfers" were the target groups.

Results of both surveys scarcely diverged: Willingness-to-buy measures point toward cautious "go for it"-decision. Reasons named by respondents in favor of buying wood-plastic composite decking were durability, appearance, and low maintenance. Reasons for denial of buying wood-plastic composite decking were the preference for wood and or other materials and its artificial character. Corresponding to that a majority of respondents would prefer a low plastics share in the compound that cannot yet be met by the existing technology for outdoor wood-plastic composite application. But current technology can "easily" accomplish the plastics share accepted by a majority of respondents, namely 30 percent. A slight majority favors solid decking profile cross-section compared to hollow profile cross-sections.

In general, wood-plastic composite decking was perceived positively by respondents. It was perceived clearly innovative and durable, rather comfortable, but a little expensive and artificial. For marketing, that means innovativeness and durability do not have to be thoroughly communicated to consumers any more. Though stressing that wood plastic composites are recyclable might help overcoming their lack of naturalness.

Clustering respondents into meaningful potential customer segments, worth being treated differently by marketing, could not be retrieved, neither a priory by demographic or psychographic nor by explorative cluster analysis, with two exceptions: (1) Splitting respondents into prospective buyers and non-buyers. (2) Separating respondents into those

without experience with wooden decks or who were unsatisfied with it and those who were satisfied with wooden decks.

“Non-buyers” significantly perceive wood-plastic composite decking in a more negative way e.g. less innovative, less durable, less natural, colder, and more expensive. It is further obvious that “non-buyers” perceive many of the product and service attributes of the multi-item list significantly less important. All this is valuable information for convincing to consumers not yet willing to buy wood-plastic composite decking.

Another fraction of respondents, those satisfied with wooden decks perceive wood-plastic composite decking in a more negative way, too. As with non-buyers, it is them to be persuaded of wood-plastic composite decking and focus marketing communications on.

In both surveys, respondents named following factors for their satisfaction with wooden decks: appearance, comfort, naturalness and workability. Reasons provided by respondents for dissatisfaction were: lack of durability, extensive maintenance work, warp, splintering and cracks, greying i.e. discoloration, and slipperiness. These can be addressed and improved by wood-plastic composites.

Factor Analysis revealed three dimensions: (1) “product and handling,” (2) service, and (3) ecology. Marketing implications are quite clear. Considered most important by respondents were “product and handling.” That is durability and associated attributes and ease of handling the product e.g. assembling and maintenance. These are the product characteristics that have to be met “first” and best. Less important but not to be neglected are ecological matters. Least important are various kind of services. That reduces the opportunity for distinguishing wood plastic composites decking through services.

Finally conjoint analysis, focusing on environmental issues, revealed that the attributes most important to respondents are the wood-plastics composite deck’s color and its surface. So, appearance seems to be the major purchase criterion followed by the plastics share and plastics type. Having a closer look at the attribute levels, a fine-corrugated surface and a light brown color seem to provide the highest utility to the respondents.

Concerning the environmental issues, respondents clearly prefer bioplastics and recycled plastics in contrast to new polypropylene and new polyethylene. Care has to be taken when interpreting the utilities for plastics type because they might not be based on true behavior but

socially desired behavior. Furthermore, the development of wood-**bio**plastics composites are just under way. Last but not least, it doesn't seem to matter to respondents if either virgin fiber or recycled fiber is used in the wood plastics composite compound.

5 Bibliography

Backhaus, K., B. Erichson, W. Plinke and R. Weiber. 2000. Multivariate Analysemethoden. Eine Anwendungsorientierte Einführung. Springer, Berlin.

Bearden, W.O., and R.G. Netemeyer. 1999. Handbook of Marketing Scales: Multi-Item Measures for Marketing and Consumer Behavior Research. 2nd ed. Sage Publications, Thousand Oaks, California.

Bruner, G.C. and P.J. Hensel. 1992. Marketing scales handbook; a compilation of multi-item measures. American Marketing Association, Chicago.

Carcia, R. and R. Calantone. 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. Journal of Product Innovation Management 19:110-132.

Churchill, G.A., Jr. 1991. Marketing Research Methodological Foundations. 5th ed. The Dryden Press, Chicago.

Crawford, C.M. and C.A. Di Benedetto. 2003. New Products Management. McGraw-Hill, Boston, Ma.

Cronbach, L.J. 1951. Coefficient alpha and the internal structure of tests. Psychometrika 31: 93-96.

Dahan, E. and V. Srinivasan. 2000. The Predictive Power of Internet-Based Product Concept Testing Using Visual Depiction and Animation. Journal of Product Innovation Management 17:99–109.

De Bont, C.J.P.M. and J.P.L. Schoormans. 1995. The effects of product expertise on consumer evaluations of new-product concepts. Journal of Economic Psychology 16:599-615.

DeVellis, R.F. 2003. Scale Development: Theory and Applications. 2nd ed. Sage Publications, Thousand Oaks, California.

Eder, A. 2005. Marktchancen für innovative Holzwerkstoffe. Ergebnisse einer Business-to-Business Befragung in der Bau-, Innenausbau-, Möbel- und Autoindustrie. Dissertation. BOKU - University of Natural Resources and Applied Life Sciences, Vienna

Eder, A., S. Strobl and P. Schwarzbauer 2007. Worldwide Market Report on Wood-Plastic Composites. WOOD K plus – Competence Center for Wood Composites and Wood Chemistry, Linz.

Fishbein, M. 1967. A consideration of Beliefs, and Their Role in Attitude Measurement. In: Fishbein, M. (Ed.) Readings in Attitude Theory and Measurement. John Wiley, New York.

Garvin, D.A. 1984. What does product quality really mean? Sloan Management Review 26(Fall):25-43.

Hackwell Group. 2006. Wood Plastic Composites in Europe. 4th N-FibreBase Congress Proceedings. Hürth/Köln.

Hair, J.F., Jr., R.E. Anderson, R.L. Tatham, and W.C. Black. 1995. Multivariate data analysis. 4th ed. Prentice Hall, New Jersey.

Bowyer, J.L., R. Shmulsky, and J.G. Haygreen. 2003. Forest Products and Wood Science: An Introduction. 4th ed. Iowa State Press, Ames, Iowa.

Hsu, S.H., M.C. Chuang, C.C. Chang. 2000. A semantic differential study of designers' and users' product form perception. International Journal of Industrial Ergonomics 25:375-391.

Kikuchi, T. 2005. Opportunities and challenges for wood-plastic composites in the growing Asian market. AMI Wood-plastic Composites Conference Proceedings. Vienna.

Lilien, G.L. and A. Rangaswamy. 1998a. Marketing Engineering: Computer-Assisted Marketimg Analysis and Planning. Addison-Wesley, Reading, MA.

Lilien, G.L. and A. Rangaswamy. 1998b. Marketing Engineering: Computer-Assisted Marketimg Analysis and Planning. Tutorial. Addison-Wesley, Reading, MA.

MacLennan, R.N. 1993. Interrater reliability with SPSS for Windows 5.0. The American Statistican 47(4):292-296.

Nairn, A., L. Ede and P. Naude. 2004. Multivariate statistics in industrial marketing management. Industrial Marketing Management 33:573-582.

Netemeyer, R.G., W.O. Bearden and S. Sharma. 2003. Scaling Procedures: Issues and Applications. Sage Publications, Thousand Oaks, California.

Norusis, M.J. 2000. SPSS 10.0 Guide to Data Analysis. Prentice-Hall, Upper Saddle River, New Jersey, USA.

Nova. 2006. Wood-Plastic-Composites: Märkte in Nordamerika, Japan und Europa mit Schwerpunkt auf Deutschland. Nova-Institut, Hürth.

Osgood, C.E., C.J. Suci, P.H. Tannenbaum. 1957. The Measurement of Meaning. University of Illinois Press, Urbana.

Rodeghier, M. 1997. Marktforschung mit SPSS. Analyse, Datenerhebung und Auswertung. Redline, Heidelberg

Schwarzbauer, P. 1996. Studienunterlagen zur Holzmarktanalyse. 2. Aufl. Schriftenreihe des Instituts fuer forstliche Betriebswirtschaft und Forstwirtschaftspolitik. Band 20. Eigenverlag. Wien

Shocker, A.D. and V. Srinivasan. 1979. Multiattribute approaches for product concept evaluation and generation: a critical review. Journal of Marketing Research.16(May):159-180.

Shook, S.R. and I.L. Eastin. 2001. A characterization of the U.S. residential deck material market. Forest Products Journal 51(4):28-36.

Smith, P.M. and M.P. Wolcott. 2006. Opportunities for Wood/Natural Fiber-Plastic Composites in Residential and Industrial Applications. Forest Products Journal 56(3):4-11.

Ulrich, K.T. and S.D. Eppinger. 2004. Product Design and Development. 3rd ed. McGraw-Hill/Irwin, Boston, MA.

Weinfurter, S. 2006. Central European Consumer Perceptions of Selected Wood Composite Products. In: University of Toronto & Ontario Centres of Excellence: Progress in Wood & Bio Fibre Plastic Composites International Conference, May 1-2, Toronto, Ontario, Canada

Weinfurter, S. 2007. Central European Consumer Perceptions of Selected Wood Composite Products. In: AMI Applied Market Infomation Ltd: International Wood-Plastic Composites Conference and Exhibition, Februar 6-8, Vienna

6 Appendices

Appendix 1: Questionnaire

Appendix 2: Sociodemographics - frequencies

Appendix 3: Group results from conjoint analysis

6.1 Appendix 1: Face-to-face questionnaire

Terrassendielen aus Holz-Kunststoff-Verbundwerkstoff

(WPC = Wood Plastic Composite)

Eigenschaften:

- formstabil
- dimensionsstabil
- rutschfest
- dauerhaft und witterungsbeständig
- widerstandsfähig gegen Insekten und Pilze
- wartungsarm & pflegeleicht
- schwer entflammbar
- splitterfrei
- recyclebar

Anschaffungspreis & Lebensdauer im Vergleich:

~ 60 € / m^2	bis 30 Jahre	WPC
~ 60 € / m^2	bis 30 Jahre	Bangkiraiholz (Indonesien/Malaysia)
~ 50 € / m^2	bis 20 Jahre	Thermoholz
~ 40 € / m^2	bis 15 Jahre	Lärche

Holz-Kunststoff-Verbundwerkstoff:

Dieser besteht zum größten Teil aus Holz(fasern) und zu einem geringeren Anteil aus Kunststoff (üblicherweise PP Polypropylen oder PE Polyethylen).

Aus dieser Mischung können mit einem *Extruder (Abb.)* Profile mit verschiedenen Querschnitten z.B. Terrassendielen hergestellt werden.

Wie steht es mit Ihrem Interesse, Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff zu kaufen?

Würde ich kaufen	Würde ich wahrscheinlich kaufen	Würde ich eher nicht kaufen	Würde ich nicht kaufen
☐	☐	☐	☐

Bitte nennen Sie die wichtigsten Gründe, warum Sie Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff <u>kaufen</u> würden:

1. _____
2. _____
3. _____

Bitte nennen Sie die wichtigsten Gründe, warum Sie Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff <u>nicht kaufen</u> würden:

1. _____
2. _____
3. _____

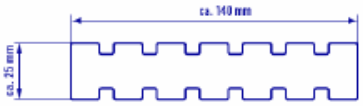
(a) Welche Rohstoffzusammensetzung bevorzugen Sie ?
(Bitte wählen Sie nur 1 x)

(b) Welcher maximale Kunststoffanteil ist für Sie gerade noch akzeptabel ?
(Bitte wählen Sie auch hier nur 1 x)

Kunststoffanteil	Holzanteil	Maisstärke	(a) bevorzugt	(b) akzeptabel
10%	70%	20%	☐	☐
15%	75%	10%	☐	☐
20%	80%		☐	☐
30%	70%		☐	☐
40%	60%		☐	☐
50%	50%		☐	☐

Bevorzugen Sie Hohl- oder Vollprofile?
Beide haben die gleichen technischen Eigenschaften; Vollprofile sind schwerer.

☐ **Hohlprofil** ☐ **Vollprofil**



Wie wirken Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff auf Sie?

Gehen Sie einfach nach Ihrem Gefühl vor und überlegen Sie nicht lange. Machen Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff einen gemütlichen oder ungemütlichen Eindruck? Oder treffen beide Begriffe überhaupt nicht zu? Entscheiden Sie bitte bei jedem Paar.

	sehr	eher	weder/ noch	eher	sehr	
gemütlich	☐	☐	☐	☐	☐	ungemütlich
billig	☐	☐	☐	☐	☐	teuer
kalt	☐	☐	☐	☐	☐	warm
vornehm	☐	☐	☐	☐	☐	rustikal
dauerhaft	☐	☐	☐	☐	☐	kurzlebig
künstlich	☐	☐	☐	☐	☐	natürlich
dezent	☐	☐	☐	☐	☐	auffällig
innovativ	☐	☐	☐	☐	☐	traditionell

Haben Sie Erfahrung mit Terrassenböden/-dielen aus HOLZ ?
Wenn JA, wie zufrieden waren/sind Sie mit diesen ?

sehr zufrieden	eher zufrieden	eher unzufrieden	nicht zufrieden
☐	☐	☐	☐

Warum waren/sind Sie mit Terrassenböden/-dielen aus Holz <u>zufrieden</u> ?

1. _____
2. _____
3. _____

Warum waren/sind Sie mit Terrassenböden/-dielen aus Holz <u>nicht zufrieden</u> ?

1. _____
2. _____
3. _____

Wie wichtig sind für Sie die folgenden Eigenschaften und Serviceleistungen bezüglich Veranda- und Terrassenböden?

	sehr wichtig	eher wichtig	weniger wichtig	un-wichtig
Markenprodukt	☐	☐	☐	☐
Garantie	☐	☐	☐	☐
Umweltzertifikat	☐	☐	☐	☐
persönliche Beratung	☐	☐	☐	☐
geruchsneutral	☐	☐	☐	☐
montagefreundlich	☐	☐	☐	☐
Dauerhaftigkeit	☐	☐	☐	☐
Farbbeständigkeit (keine Vergrauung)	☐	☐	☐	☐
Brandbeständigkeit	☐	☐	☐	☐
Festigkeit	☐	☐	☐	☐
formstabil	☐	☐	☐	☐
Anschaffungspreis	☐	☐	☐	☐
Entsorgungsmöglichkeit	☐	☐	☐	☐
Montageservice	☐	☐	☐	☐
leicht bearbeitbar	☐	☐	☐	☐
streichbar	☐	☐	☐	☐
Zubehör vorhanden	☐	☐	☐	☐
wartungsfreundlich	☐	☐	☐	☐
Natürlichkeit des Materials	☐	☐	☐	☐
Telefon-Hotline vorhanden	☐	☐	☐	☐
Produkt-Hompage inkl. Installations- und Pflegehinweisen vorhanden	☐	☐	☐	☐
Lieferservice	☐	☐	☐	☐
geriffelte Oberfläche	☐	☐	☐	☐
holzähnliches Aussehen	☐	☐	☐	☐
niedrige Instandhaltungskosten	☐	☐	☐	☐
recyclebar	☐	☐	☐	☐
splitterfrei	☐	☐	☐	☐
rutschfest	☐	☐	☐	☐
rissfrei	☐	☐	☐	☐
niedrige Montagekosten	☐	☐	☐	☐

Einige Fragen zu Ihrer Person für die Statistik:

Geschlecht
- männlich ☐
- weiblich ☐

Geburtsjahr: _____

Hauptwohnsitz:
- Burgenland ☐
- Kärnten ☐
- Niederösterreich ☐
- Oberösterreich ☐
- Salzburg ☐
- Steiermark ☐
- Tirol ☐
- Vorarlberg ☐
- Wien ☐
- _____ ☐

Stammen Sie <u>ursprünglich</u> aus einer städtischen oder eher ländlichen Gemeinde?

- eher städtisch ☐
- eher ländlich ☐

Leben Sie <u>heute</u> in einer städtischen oder eher ländlichen Gemeinde?

- eher städtisch ☐
- eher ländlich ☐

Wohnen Sie in:
- Einfamilienhaus ☐
- Bauernhaus ☐
- Reihenhaus ☐
- Doppelhaushälfte ☐
- Eigentumswohnung ☐
- Mietwohnung ☐

Eine letzte Frage, die Sie nicht beantworten müssen, wenn Sie nicht wollen.
Welche der folgenden Kategorien entspricht am ehesten dem derzeitigen monatlichen Nettoeinkommen Ihres gesamten Haushaltes?

- unter € 1.000,- ☐
- € 1.000-1.500,- ☐
- € 1.500-2.000,- ☐
- € 2.000-3000,- ☐
- über € 3000.- ☐

Terrassendielen aus einem Holz-Kunststoff-Verbundwerkstoff kosten ca. 60 € / m^2 und haben eine Lebensdauer von bis zu 30 Jahren

Wir haben mit 16 Bildern und Beschreibungen unterschiedliche Terrassendielen aus Holz-Kunststoff-Verbundwerkstoffen dargestellt.
(Erklärungen zu möglicherweise unklaren Eigenschaftsausprägungen – siehe letzte Seite)

Welche dieser 16 Dielen spricht Sie alles in allem am meisten an?

1. Wahl: Nr. _____

Reihen Sie nun bitte die restlichen Dielen danach, wie sehr sie Sie ansprechen. Geben Sie also bitte jeder Diele einen Rangplatz von 2 bis 16, wobei 16 jene Diele erhält, die Sie am wenigsten anspricht.

2. Wahl: Nr. _____
3. Wahl: Nr. _____
4. Wahl: Nr. _____
5. Wahl: Nr. _____
6. Wahl: Nr. _____
7. Wahl: Nr. _____
8. Wahl: Nr. _____
9. Wahl: Nr. _____
10. Wahl: Nr. _____
11. Wahl: Nr. _____
12. Wahl: Nr. _____
13. Wahl: Nr. _____
14. Wahl: Nr. _____
15. Wahl: Nr. _____
16. Wahl: Nr. _____

1	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**hellbraun** **fein-geriffelt** **Frischfaser** **20%** **Recycling-PP/PE**	
2	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**hellbraun** **gebürstet** **Recyclingfaser** **40%** **PP/PE neu**	
3	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **fein-geriffelt** **Recyclingfaser** **30%** **PP/PE neu**	
4	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**dunkelbraun** **grob-geriffelt** **Recyclingfaser** **20%** **Biokunststoff**	
5	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **gebürstet** **Frischfaser** **20%** **PP/PE neu**	
6	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **gebürstet** **Frischfaser** **20%** **Biokunststoff**	
7	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**dunkelbraun** **gebürstet** **Frischfaser** **40%** **PP/PE neu**	
8	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **grob-geriffelt** **Recyclingfaser** **40%** **Recycling-PP/PE**	

9	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **grob-geriffelt** **Frischfaser** **30%** **PP/PE neu**	
10	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**hellbraun** **grob-geriffelt** **Frischfaser** **20%** **PP/PE neu**	
11	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**dunkelbraun** **gebürstet** **Frischfaser** **30%** **Recycling-PP/PE**	
12	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**hellbraun** **gebürstet** **Recyclingfaser** **30%** **Biokunststoff**	
13	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **gebürstet** **Recyclingfaser** **20%** **Recycling-PP/PE**	
14	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**dunkelbraun** **fein-geriffelt** **Recyclingfaser** **20%** **PP/PE neu**	
15	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **gebürstet** **Recyclingfaser** **20%** **PP/PE neu**	
16	Farbe: Oberfläche: Holzfaser: Kunststoffanteil: Kunststoffart:	**beige** **fein-geriffelt** **Frischfaser** **40%** **Biokunststoff**	

Erklärungen zur letzten Aufgabe

Frischfaser:	*Holzfasern von geschlägertem Holz und aus Holzresten (z.B. Sägespäne aus Sägewerken, ...)*
Recyclingfaser:	*aus „Holzabfällen" bzw. Altholz (schon einmal in Verwendung gewesen z.B als Bauholz, aber Holzfasern sauber, gesund und intakt)*
Kunststoffanteil:	*20% Kunststoffanteil = 80% Holzanteil* *30% Kunststoffanteil = 70% Holzanteil* *40% Kunststoffanteil = 60% Holzanteil* *(egal welcher Kunststoff, der Rest ist immer Holz)*
PP/PE neu:	*Polypropylen/Polyethylen neu hergestellt (auf Erdölbasis)* *(fast überall verwendet: z.B. Getränkeflaschen, ...)*
Recycling PP/PE:	*z.B. aus Getränkeflaschen recycelt*
Biokunststoff:	*aus nachwachsenden Rohstoffen und/oder biologisch abbaubar*
gebürstet:	*Oberfläche nur aufgeraut*
fein-geriffelt:	
grob-geriffelt:	

6.2 Appendix 2: Sociodemographics – frequencies – surveys of 06/07 and 07/08

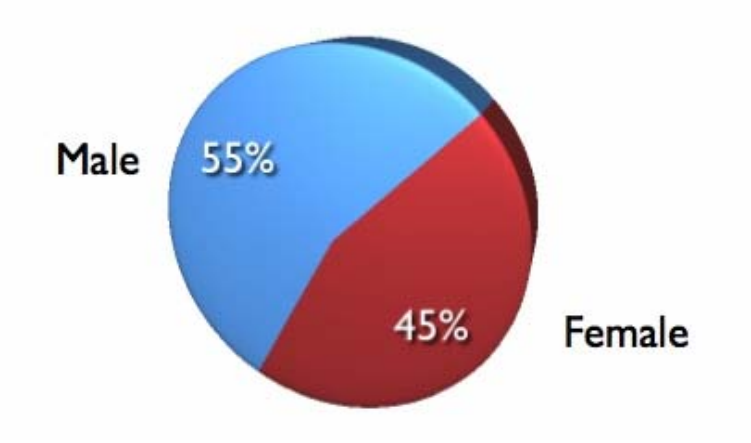


Figure 28: Respondents' sex distribution of survey 06/07 (n = 383)

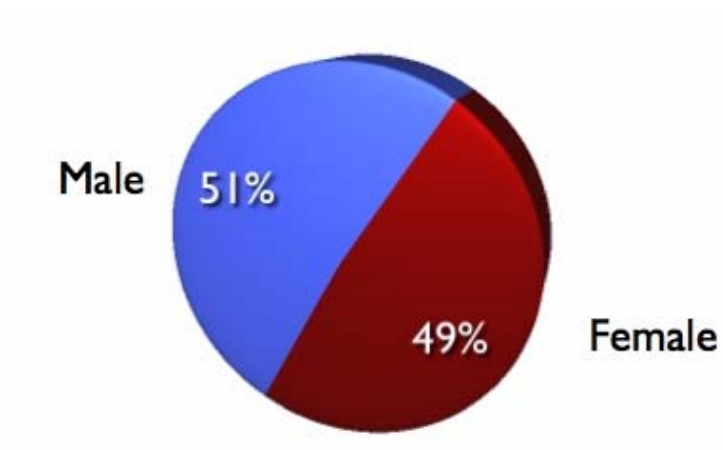


Figure 29: Respondents' sex distribution of survey 07/08 (n = 542)

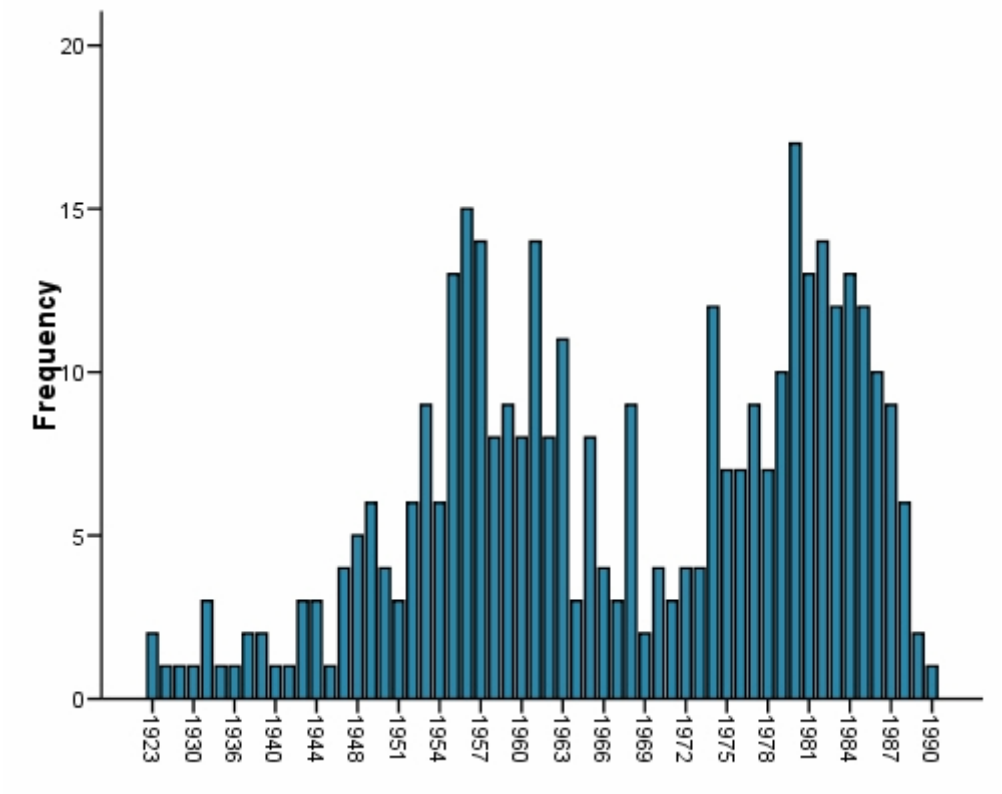


Figure 30: Respondents' year of birth distribution (survey 06/07, n = 380)

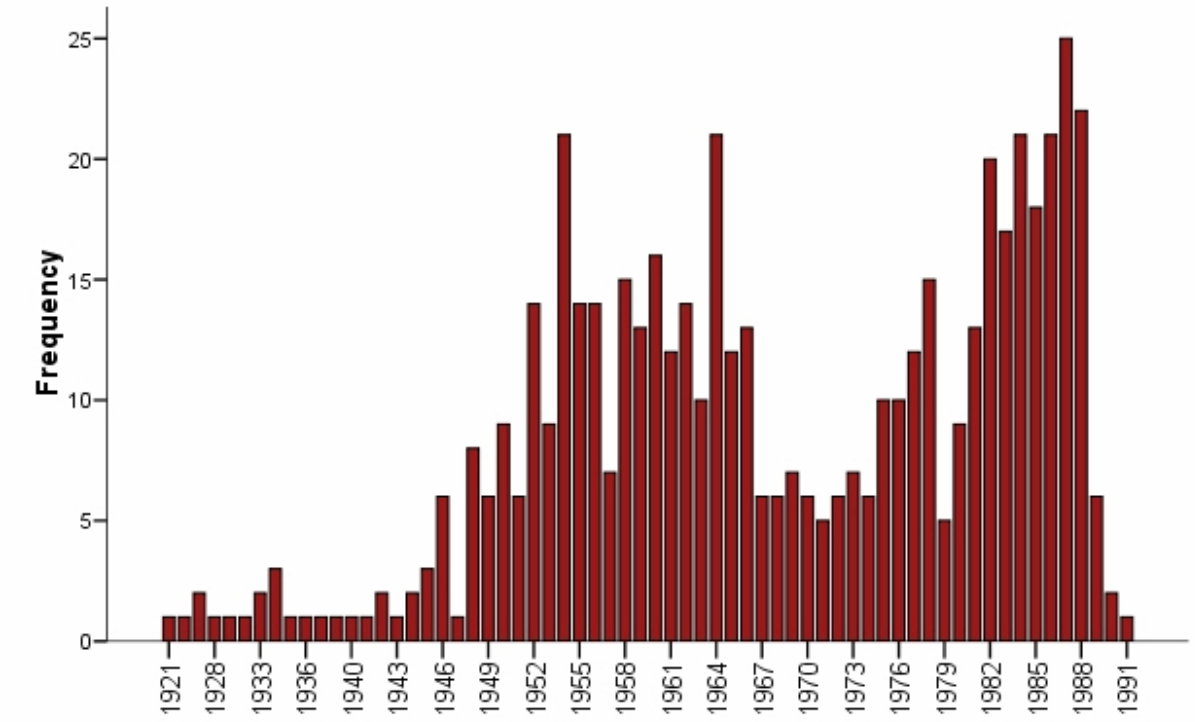


Figure 31: Respondents' year of birth distribution (survey 07/08, n = 543)

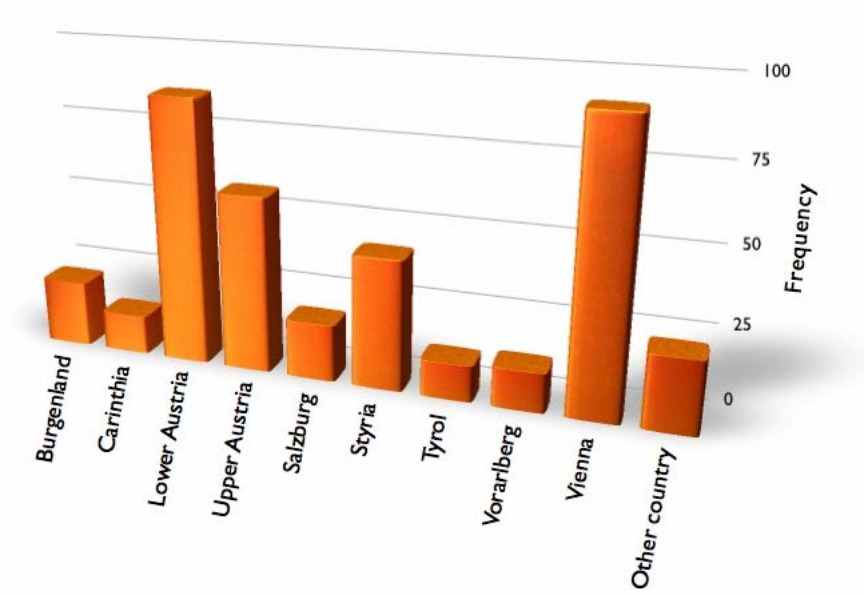


Figure 32: Respondents' location of residence (survey 06/07, n = 383)

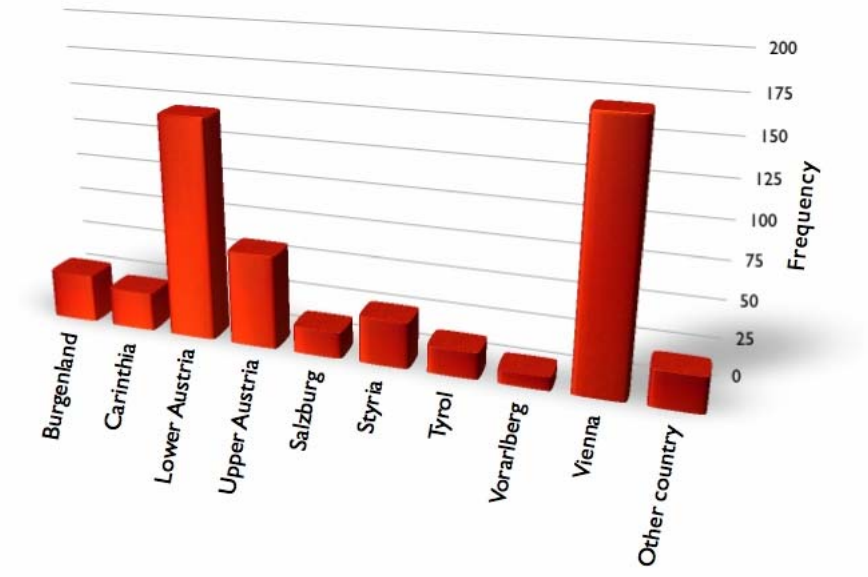


Figure 33: Respondents' location of residence (survey 07/08, n = 541)

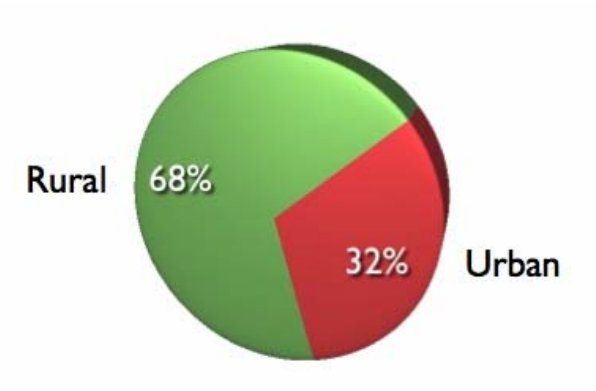


Figure 34: Respondents' origin (type of community) (survey 06/07, n = 383)

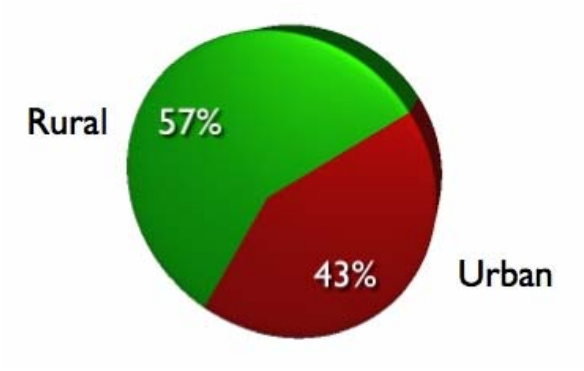


Figure 35: Respondents' origin (type of community) (survey 07/08, n = 542)

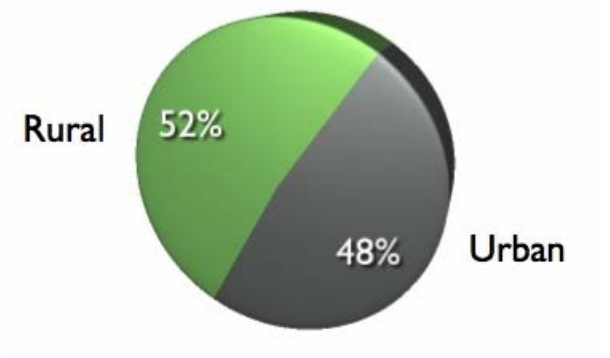


Figure 36: Respondents' current type of community (survey 06/07, n = 383)

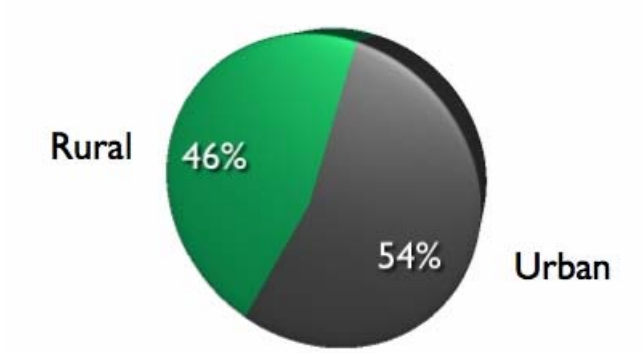


Figure 37: Respondents' current type of community (survey 07/08, n = 545)

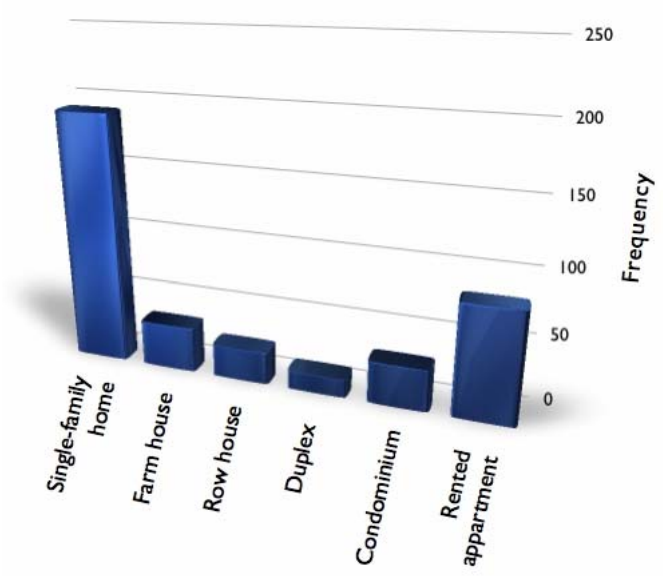


Figure 38: Respondents' type of residence (survey 06/07, n = 383)

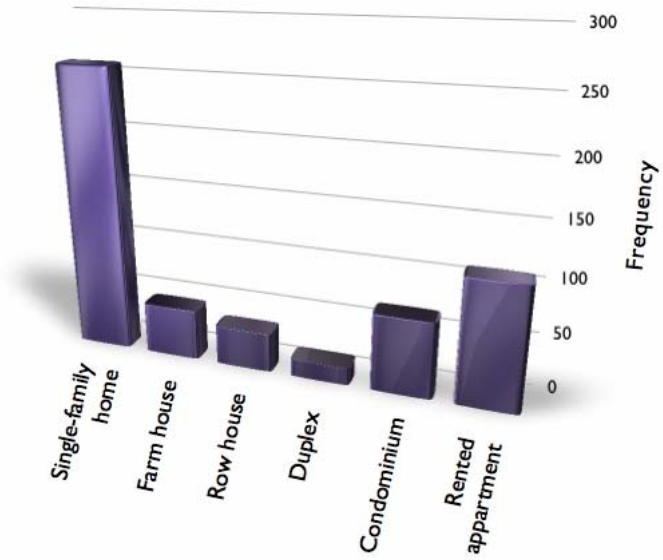


Figure 39: Respondents' type of residence (survey 07/08, n = 541)

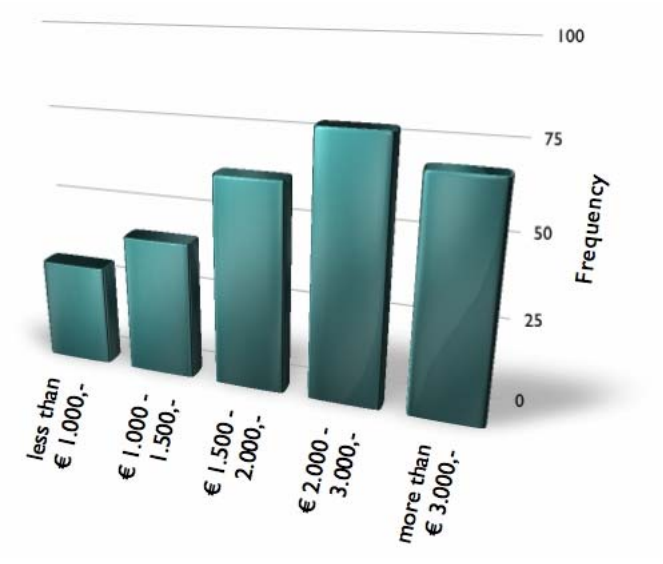


Figure 40: Respondents' monthly net household income (survey 06/07, n = 284)

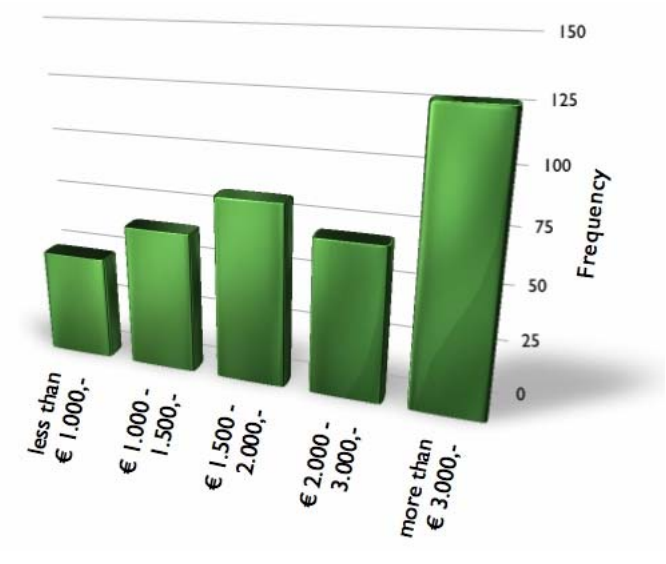


Figure 41: Respondents' monthly net household income (survey 07/08, n = 398)

6.3 Appendix 3: Group results from conjoint analysis

```
SUBFILE SUMMARY

 Averaged
Importance   Utility        Factor

                            Farbe       Farbe
 32,84       -,5980           --|         beige
              ,6663              |---      hellbraun
             -,0683              |         dunkelbraun

                            Oberfl      Oberfläche
 29,15        ,0897              |         gebürstet
              ,9354              |----     fein-geriffelt
            -1,0251         ----|         grob-geriffelt

                            Holzfas     Holzfaser
 5,98        -,0789              |         Frischfaser
              ,0789              |         Recyclingfaser

                            KAnteil     Kunststoffanteil
17,08         ,4995              |--       20%
             -,0052              |         30%
             -,4943           --|         40%

                            Kunstoff    Kunststoffart
14,95        -,5560           --|         PP/PE neu
              ,1665              |-        Recyclingkunststoff
              ,3895              |--       Biokunsstoff

             8,6412         CONSTANT

Pearson's R   =  ,994                    Significance =  ,0000

Kendall's tau =  ,950                    Significance =  ,0000
```

Figure 42: Group results from conjoint analysis (survey 06/07, n = 374)