HOW TO BUILD WHAT BUYERS WANT – UNVEILING CUSTOMER PREFERENCES FOR PREFABRICATED HOMES

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An increasing number of buyers demand houses that are configured according to their personal needs and wants. However, in order to be effectively responsive and to control variety, it is important to determine what buyers wish to customise and to what degree. The prioritisation of customised attributes in house design still remains an unknown by builders. This indicates the importance of developing an appropriate model to determine customer preferences that can be adapted to different house building methods. This research identifies buyer preferences in prefabricated house building projects through the application of a modified Analytical Hierarchy Process approach, using a paired comparison-based preference measurement. This method considers changing attribute positions in a survey, which compels respondents to continuously reconsider the importance of a feature. This paper contributes by applying a preference measurement method in order to prioritise and identify what buyers of prefabricated homes really focus on when configuring a house. This is important as only knowledge of the preferences will enable practitioners to be effective in customisation efforts and also ensuring operational efficiency.

Keywords: customer preference measurement, customization, design and build, marketing, prefabrication.

INTRODUCTION

Over recent years the house building industry has seen a radical change in market requirements. Modern lifestyle trends have introduced unprecedented competition that calls for a change in operations of the house building sector. As a consequence house builders have tried to increase customisation efforts so as to deliver exactly what clients require. But much more is needed than simply redesigning existing standard house types. There has to be a supporting revolution in the house building sector (Barlow, 1999). This involves the construction of houses from a mixture of standardised components and consequently requires the housing supply chain to be changed radically but will finally grant customers access to the design activity of their houses. Hence, there needs to be a rapid development of custom-made houses while still imposing the rule of economies of scale. This positions economies of scale in direct conflict with economies of scope (Kooii and Situmdrang, 2003).

Lessons learnt from other sectors (e.g. automotive, clothing) show how important it is to exactly know clients' preferences in order to deliver new product variety at a price that is acceptable to house buyers (Hofman et al, 2006 and Stäblein et al, 2011). There

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is therefore a need to find out how potential customers assign priorities to the different elements in a house that can be customised. If house building companies knew customer's preferences in advance, they could increase variety where it is really necessary and offer standardised solutions where individualisation is not needed, taking advantage of economies of scale.

With this research we aim to present a preference measurement method in order to prioritise and identify what buyers of prefabricated homes really focus on when configuring a house. This will enable practitioners to be effective in customisation efforts and ensure operational efficiency accordingly. However, determining the appropriate level of choice is difficult and insight into the nature of choice is sparse within the literature. Collecting and analysing empirical data in this area is also a complex undertaking, meaning the evidence base is thinner than would be expected. Hence, we empirically investigate the question: How do we determine buyers' preferences for mass customised homes? In doing so, we focus on Germany, the leading country for self-build housing in Europe.

THE IMPORTANCE OF CUSTOMER PREFERENCE

To successfully compete in the long term, a company has to make sure that customers are satisfied. One way of achieving customer satisfaction in the house building industry is to build houses that reflect the personal preferences of the buyer. Ozaki (2003) presents two empirical studies in the UK speculative house building industry. Her conclusion starts with the sentence: "Overall, UK housing customers do not seem to be very satisfied customers." (p. 562). She continues and states that the industry lacks customer-focus and that customer requirements are not sufficiently considered.

Japanese companies have successfully implemented manufacturing principles derived from the car industry in order to produce attractive, affordable and, above all, customized houses through prefabrication (Towill, 2001). In this regard, clever product architecture is vital and can give the impression of a fully customized house although in reality it involves standard operating procedures in production (Halman et al., 2008). More specifically, as Gibb (2001) writes, the whole product design, although consisting of standardized components, must provide variation: i.e. 'customized solutions from standardized components' (p. 312).

Leishman and Warren (2006) present research on housing design customisation. They highlight the importance of capturing user requirements and suggest that wider choice of internal specification is associated with greater consumer demand. However, the house is a complex product and consists of a large sub-system with many different components and subcomponents. These are then partially available in many different attributes which increases the options that can potentially be offered to a customer. Thus companies wanting to provide houses that are built according to customers' needs must develop strategies on how to identify customer preferences and consequently configure the supply chain in a way that can cope with the degree of choice that needs to be provided (Barlow et al, 2003). In this regard it is also important to know how customers prioritise their preferences. Only then will it be possible to identify elements with the need and degree of variety.

RESEARCH METHOD

Selecting the appropriate preference measurement method

Customer preference measurement in general is problematic as many customers are not able to exactly specify the importance of product attributes. Moreover the perception of an attribute independently from others may be completely different compared to the perception of the same attribute in combination with others. Eggers and Sattler (2011) categorise preference measurement techniques as:

1. Compositional approaches. Evaluation of product attributes and levels separately. The perceived utility of the entire product is then composed of the importance allocated to its specific attributes and levels.
2. Decompositional approaches. Evaluation of products by considering the attributes and levels jointly. Preferences can then be decomposed using statistical methods.
3. Hybrid approaches. Combination of compositional and decompositional approaches.

Although there is no clear recommendation in the literature, Conjoint Analysis (CA) has become the most frequently used method for measuring customer preferences. However, this decompositional approach uses a ranking procedure to assign customer priorities to product attributes. This means that the CA cannot be first choice when it comes to measuring customer preferences for complex products as the questionnaire length increases considerably with growing numbers of attributes and attribute levels resulting in information overload for respondents (Green and Srinivasan, 1990).

The analytic hierarchy process (AHP) has also been used as a customer preference measurement tool (Scholl et al, 2005). Although this is an effective method to identify respondents' priorities for products with a normal architecture, as the number of attributes increases, more comparisons become necessary thus risking that the respondents are overburdened.

In general compositional tools have been used more frequently to analyse customer preferences. This is mainly due to the fact that these approaches are cognitively less demanding than decompositional tools. Recently Scholz et al (2010) recommended the paired comparison-based preference measurement (PCPM) as a preference measurement tool for complex products. PCPM is a modified version of the AHP method and differs from the latter in some important aspects (Meißner et al, 2010). It has a simple three layer hierarchy; static two-cyclic designs are used to reduce the number of paired comparisons needed in the data collection process; and a bipolar equidistant scale is shown.

One advantage of the PCPM approach is that it takes into account the Number-of-Levels Effect. In PCPM the average preference weight is reduced when further attributes are included in the sub-problem. With increasing numbers of attribute levels the range in the preference weights between the most and the least preferred levels is thus reduced. The PCPM approach tries to balance this effect by multiplying the respective preference weights by the number of attributes being compared. As a consequence the average preference weights stay constant even if additional elements are included (Scholz et al, 2010).

The PCPM is used in this study as it has a proven track record of successful application in complex product environments (e.g. Scholz et al, 2010) and an appropriate software tool is readily available to conduct the online survey.

Attributes included in the survey

Previous empirical research (Schoenwitz et al., 2012) yielded a product architecture overview showing all the components and attributes a house typically consists of, as shown in Figure 1. The set-up of the questionnaire followed this product architecture but not all components and subcomponents were included as otherwise the questionnaire would have been too long. The above mentioned empirical research, also from the German prefabricated house industry, identified subcomponent options taken up by customers on a regular basis. The highest ranked subcomponents for each component have been considered in the preference measurement task.

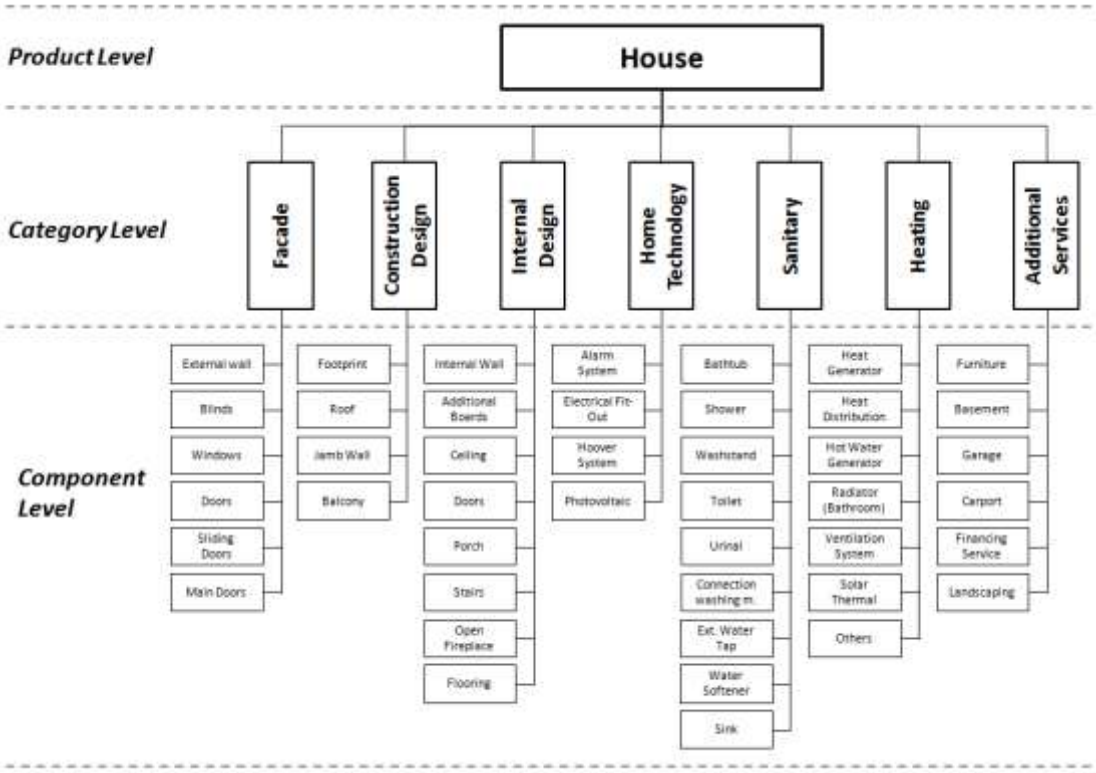

Figure 1: Product architecture matrix of prefabricated house

Data collection and analysis

An online survey was the chosen data collection method for this study. This type of survey has become very popular recently, due to the ever increasing number of internet users and the availability of improved and more sophisticated online survey software. The latter was decisive for this study as it is important for a preference measurement using pairwise comparisons to have software that visualizes the questions effectively. This survey method is also cost effective, an important advantage as it enables the researcher to collect a lot of data in a short period of time (Brandenburg and Thielsch, 2009). The advantages and disadvantages of online surveys are illustrated in Table 1.

In order to set up the online questionnaire and conduct the survey a software tool (AHPlab version 2.2.6) was used. This tool supports the data input and weights preferences according to the PCPM approach. Furthermore the questionnaire can be designed in a way that appeals to respondents. As the survey was conducted in Germany the questionnaire was set up in German language.

As is good practice in questionnaire design easy introductory questions were asked first and the most important questions were asked in the first half of the questionnaire when concentration and focus is still high (Burns and Bush, 2008). In total the respondent had to respond to twenty questions. Some were dual- and others multiple choice. Expected time to complete the questionnaire was twenty minutes which was indicated on the start page so that each respondent knew exactly what the associated expenditure of time was.

Table 1: Methodological advantages and disadvantages of online surveys (adapted from Brandenburg and Thielsch, 2009).

Advantages	Disadvantages
Time efficiency during data collection, analysis and presentation of data.	The programming of the online questionnaire needs more time. There may be a dependency on third parties
Time and effort as well as expenses for print, distribution and coding of questionnaire do not apply. No interviewee and data transfer is needed.	Additional training on the software may be necessary.
Automation and with this increased objectiveness: no error sources through data transfer, no test supervisor effects, no group effects.	The conditions of the data collection cannot be controlled, which results in problems with the objectivity.
More heterogeneous sample formation compared to offline studies. Online surveys will never be able to represent the total population.	Online surveys will never be able to represent the total population.
Availability of the medium: some groups of people can be better reached online.	Not all target groups go online and not all computers are up to date with current soft- and hardware.
Higher data quality, well programmed online questionnaires avoid “missing data” and consistency checks through time protocols are possible.	Multiple participation cannot be ruled out completely. Questions a respondent may have can only be answered asynchronous and on the initiative of the respondent.
Higher acceptance due to voluntariness, flexibility and anonymousness.	Problems with acceptance if the respondents suspect a marketing campaign or data abuse.
Ethical transparency: online surveys are much more transparent as they are easier accessible than offline surveys.	The database of the online survey needs to be protected against unauthorized access. Data protection in general more difficult.

Having finalised a draft version of the questionnaire, a pilot was tested with a group of three experts and two non-experts. This was important to ensure that the questionnaire is suitable for people with and without specific knowledge of the house building industry. The group was asked to evaluate each question and pairwise compare attributes with regard to clarity, relevance and preciseness. Following this, small improvements were made before the questionnaire was finalised.

Initially, people particularly interested in prefabricated housing were targeted for data collection. The Association of German Premanufactured Building Manufacturers (BDF) represents nearly 90% of the German prefabrication industry (BDF, 2013) and runs over 20 show home 'villages', which are usually the first contact points for those interested in such houses. Hence, the BDF was contacted to enquire whether a survey could be conducted in one of the centres. A new show house centre in Cologne was chosen as it had 5,228 visitors per month on average from January - July 2012, making it the most frequently visited centre. Two computer stations were set up for

one day (Saturday) for visitors to complete the questionnaire. Although the centre was very well visited, only five respondents agreed to complete the questionnaire in over eight hours. Most of the visitors on that day were families or groups who wanted to visit the show house centre together, and none of these visitors were prepared to complete the questionnaire and delay the whole group. Furthermore it was difficult to convince people that the survey was for academic purposes.

Given this low completion rate, a conventional online survey approach was adopted. A random sample of available email addresses was taken and the link to the questionnaire was forwarded to these recipients. The sampling frame consisted of 397 potential respondents who received an email explaining the purpose of the research and giving reassurance that the survey would be anonymous. After four weeks 62 responses were received and a reminder was sent to the above mentioned potential respondents. Following another four weeks the survey was closed and the link was deactivated. 33 responses had to be removed from the result spread sheet due to biased responses. These included unrealistic responses to questions where for example postcodes or figures were not indicated in a correct way. Furthermore data sets were removed where a response pattern was identifiable. This happens when respondents always activate the same field and do not specifically respond to the question. In total 82 valid responses were received from the online survey. This means that a response rate of 20.65% was achieved. Braun Hamilton (2009) indicates that a typical response rate for online surveys is 26%. Hence, the response rate of the survey conducted in this research can be classified as acceptable.

The software used recorded the respondents input in a data format that enabled an export of the data into an Excel spreadsheet. This facilitated further analysis of the data. First, the biased data sets were removed. Following this the raw data was formatted and decoded so that figures could be derived from the data. These activities involved mainly the conversion of the system data into usable information. For example if a respondent indicated that he is male, the system recorded a 1. In the spreadsheet the 1 was then substituted by the word 'male'.

A first analysis showed that 68% of the respondents were male and the majority was between 31 and 40 years old. Respondents were from throughout Germany, although particularly concentrated in the west of the country.

RESULTS

One of the first questions was whether respondents think that it is important to have a certain degree of choice when configuring a house. Nearly 90% of the respondents thought that it is rather important or very important to have a certain degree of choice. However, this can only indicate that house buyers actually appreciate choice. But it is much more relevant for companies offering prefabricated houses to know exactly where choice is required and where options can be reduced.

Respondents were asked to rate the importance of the categories in Figure 1. This is the first real pointer with regard to customer preferences in the prefabricated house building industry. As can be seen in Figure 3 the respondents indicated particular customisation interest in the following categories: construction (18.31%), home technology (16.94%) and heating (18.01%). In categories like internal design (12.84%) or facades (12.60%), the need to customise is rather low. Often, prefabricated houses have specific design traits that are common to all, and many of the components for this are within these categories. However, this does not mean that

within these categories customers do not wish to have a high degree of choice for certain components. Hence it is important to consider all layers of the product architecture in the preference measurement exercise. Only then can the option list be set up according to customer preferences and needs.

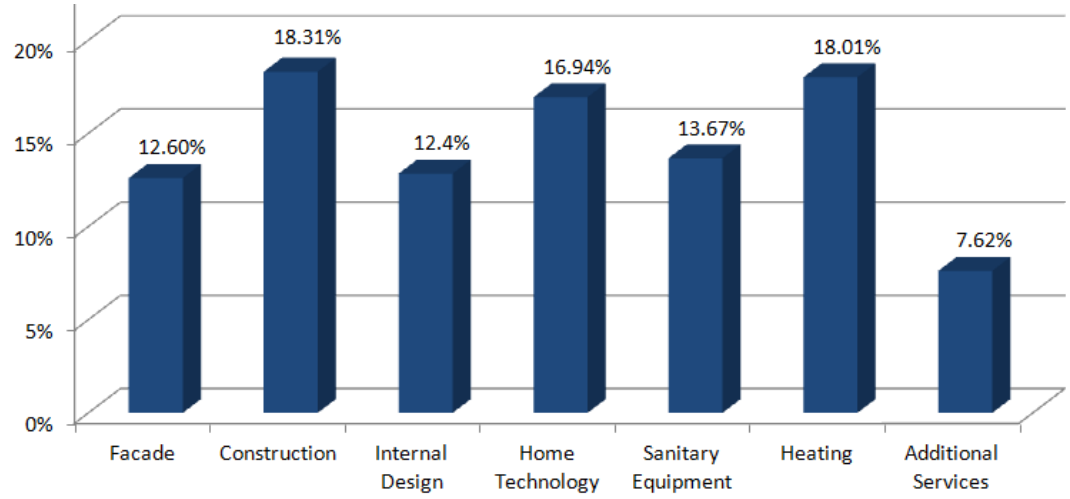

Figure 3: Importance of categories

Figure 4 shows the appropriate results on a subcomponent level. Focussing on components that have been rated as very important in terms of choice being offered, it emerges that flexibility of construction and security seemed to be particularly important for potential house buyers.

It becomes apparent that the possibility to change the footprint of the building is more important than choice for the other attributes. It needs to be adaptable to the appropriate family situation and/or life style of the house buyer. Related to this is the design and construction of the ceiling. An opening in the ceiling for example influences the overall footprint of the building and this seems to be highly relevant for respondents. Figure 4 also confirms that security of the facade (building shell) seems to be very important for respondents. This is even more important than the design of the main door in the same category which has more of an impact on visual appearance.

The results of the survey differ from results of a case study presented by Schoenwitz et al (2012). In their study, subcomponents which signify lifestyle and design of the house are much more important than others. Furthermore choice in the electric fit-out (e.g. switches and sockets) was extensive. The latter is in line with the results of this survey. However, in contrast to the case study results lifestyle and design issues do not seem to be as important for respondents. More important are practical issues concerning the construction of the building. The differences between options actually taken up by customers when configuring a house and the results of this survey further confirm assumptions from researchers that customisation is made only because choice is available and not necessarily because it is really needed (Huffman and Kahn, 1998).

The results presented above already give some guidance for prefabricated house builders on where to focus customisation efforts at a component level. However, not all prefabricated house builders offer a one-stop-shop-solution to their customers. This means that not all the categories highlighted as being important to potential house buyers are relevant. However, even if the components and subcomponents contained

in an important category are not offered to customers, it may be a sensible decision to at least offer support and consultation in these areas.

The results not only show where choice needs to be offered but they also show which attributes and categories can be neglected. This is probably more important than to know what needs to be offered as every option that does not need to be offered any more reduces variety and complexity. Features like a central vacuum cleaner, photovoltaic system or furniture can be identified as not being high in demand.

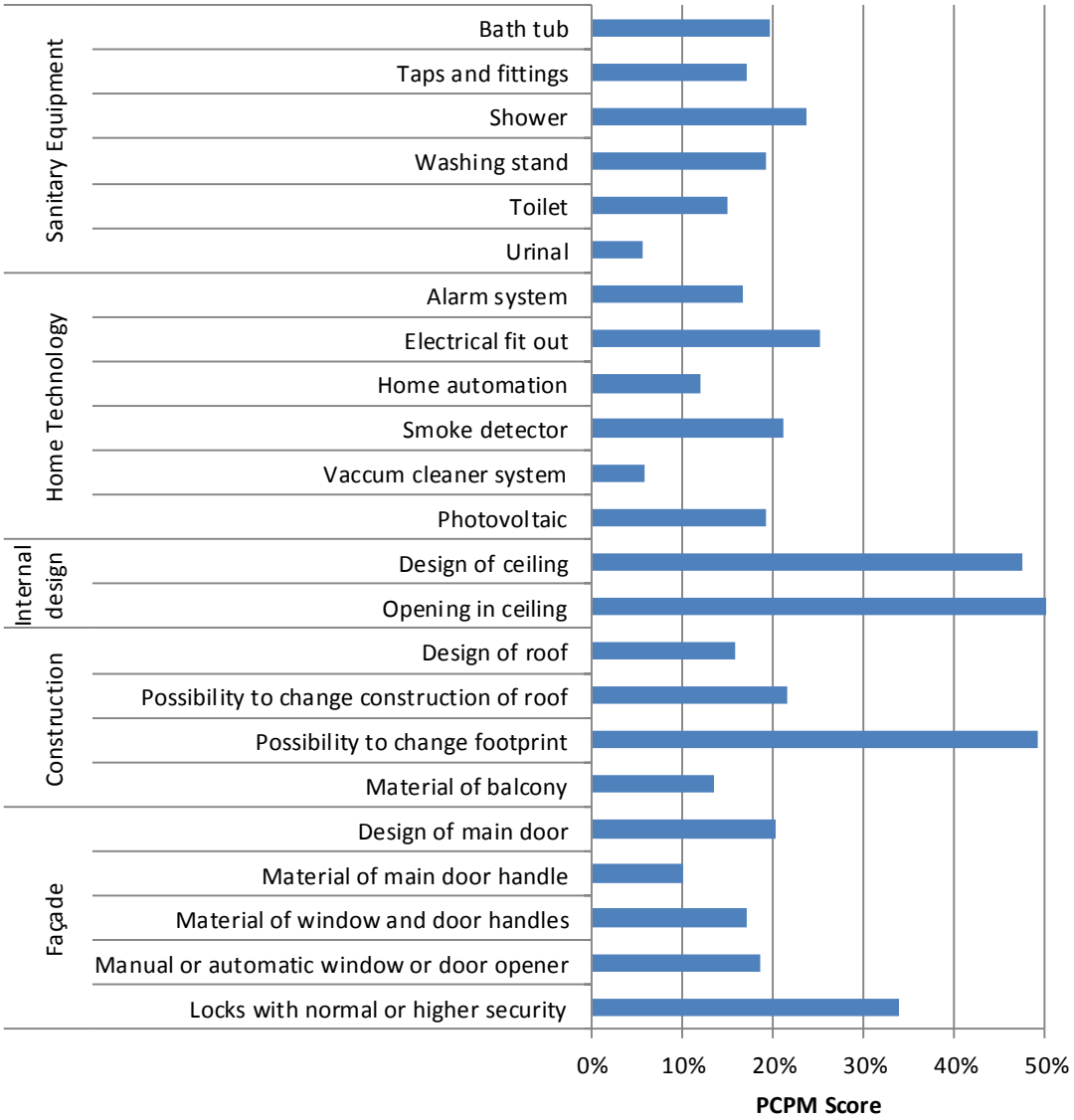

Figure 4: PCPM results for sub components, grouped by category

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

This empirical research contributes by applying a preference measurement method for multi-attribute products (PCPM) in order to prioritise and identify what buyers of prefabricated homes really focus on when configuring a house. This is important as only knowledge of the preferences will enable practitioners to be effective in customisation efforts and ensuring operational efficiency accordingly.

There are two main outcomes of this study. First, a procedure has been developed that prioritises categories and components in a prefabricated house design. This procedure

can be adopted by building companies interested to offer customised houses. Second, results of an online survey have been presented which can help prefabricated house building companies to make the right decisions about the level of variety to offer.

The results of the online survey clearly show that attributes associated with flexibility and security have significant higher impact on the overall product preference compared to others. However, one has to be careful with the interpretation of the results as these can be biased by current trends influencing respondents. Furthermore due to the multi-layer product architecture and the many different alternatives, the possible preference orders can be very long and thus respondents have to make a lot of difficult decisions.

Differences between Schoenwitz et al. (2012) and this survey indicate that although customers have other interests and preferences, customisation in certain areas is considerable when customers configure their house. A reason for this could be that they only take up options because these are made available. If this can be confirmed then there would be considerable potential for house builders to reduce variety and hence costs in order to align options offered with potential buyers' preferences.

There are some limitations to this research. First, the survey was conducted in Germany, thus there may be cultural differences influencing preferences and requirements when building a house. Second, an online survey excludes all nonusers of the internet. The latter could have different preferences when it comes to technological issues. Hence, any conclusions drawn from the above mentioned results cannot rely exclusively on the internet sample. Third, house building companies need to decide who their target customer is and any sample needs to be constituted on this basis, rather than the random sample used above.

Further research is necessary to analyse the collected data in more depth. In particular we are interested to look at the influence of demographics on preferences.

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