

Article

How Eco-Labeling Influences Environmentally Conscious Consumption of Construction Products

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Abstract: Interior wall paints and coatings may evaporate hazardous emissions such as volatile organic compound and formaldehyde. Hence, for these products, Material Safety Data Sheets (MSDSs) with information about toxicological and environmental properties and on safe handling practices must be handed out to professional users. However, this obligation does not include end-users which places them at risk. In order to provide a service to the end-users, some German manufacturers issue an Environmental Product Declaration (EPD). An EPD is a certificate for a construction product that is based on its Life Cycle Assessment (LCA). This paper investigates potential solutions to direct end-users' awareness of environmental and health effects of the products they purchase. Therefore, two questionnaire surveys are held on several trade fairs for construction products in Germany. On the one hand, the first survey targets visitors of these trade fairs, i.e., average consumers, or end-users of construction products. On the other hand, the second survey targets participants of these trade fairs that include manufacturers of indoor paints and varnishes as well as companies who use painting pigments in their manufacturing process, e.g., carpet floors and ceramics. The objectives of these surveys were to learn experts' opinions on the transfer of relevant data, i.e., about health and environmental effects their products might cause, to end-users and compare them to those of the end-users. One of the outcomes of the survey shows that, according to the experts' survey participants, Environmental Product Declarations are of main interest to make LCAs transparent. Moreover, the paper investigates the perception of one of the most broadly known eco-labels in Germany, the Blue Angel eco-label, by the average consumers.

Keywords: sustainability; Material Safety Data Sheets; Life Cycle Assessment; Environmental Product Declaration; qualitative study; interior paints; Blue Angel eco-label; end-users; expert users

1. Introduction

Most certified construction products on the market such as interior, also called indoor, wall paints and coatings, do not contain any hazardous chemical components or contain them in low concentrations. However, if containing them, interior wall paints and coatings may evaporate hazardous emissions such as volatile organic compound (VOC) and formaldehyde. In low air concentrations, VOCs may cause an irritation of eyes and respiratory organs [1–3]. In accordance with European Directive 2004/42/EC [4], the maximum allowed limit of VOCs for both, water-borne and solvent-borne coatings for interior walls, is 30 g/L (2010). Moreover, properties of the coating material should be classified according to DIN EN 13300 [5]. The product must not contain any plasticizer classified as harmful to the environment, as defined in CLP Regulation 1272/2008, as amended from time to time [6]. Additionally, a content of VOCs shall not exceed 0.2% (m/m) of a product and a proportion of preservatives in total may not exceed 0.1% [7].

Nonetheless, such paints may cause allergies for odour sensitive people. Moreover, leukaemia, lymphoma and even cancer are relative risks caused by indoor VOCs [8]. Fortunately, more and more paint manufacturers throughout the world tend to use aqueous, i.e., water-borne solutions.

All legislation documents for the paint products available in Germany, such as European Directive 2004/42/EC on the limitation of VOC due to the use of organic solvents in certain paints and varnishes (2004), Construction Products Regulation (CPR 2011) and Environmental Product Declaration (EPD), have been described in detail in Rochikashvili and Bongaerts (2016) [9].

For a paint product, its Technical Bulletin contains detailed information including all ingredients. In addition, the Material Safety Data Sheet (MSDS) of such a product includes information on potential hazardous substances and its properties, such as toxicity, biodegradability and flammability. In the European Union, MSDSs are obligatory for paint manufacturers to be handed out to professional users but not to end-users [8,10]. To end-users, MSDSs are mostly handed out upon request. Consequently, end-users may be at risk, since they have to ask for the MSDSs themselves prior to purchasing a paint product or they have to find the MSDSs on the Internet.

For this study, the Environmental Product Declaration plays a pivotal role in making Life Cycle Assessment accessible and transparent to end-users [11]. The EPD describes environmental effects of construction products on the environment and human health taking the fundamentals of LCA into consideration. In Germany, the Institute for Building and Environment (IBU; Institut Bauen und Umwelt e.V.) certifies EPDs for construction products, where independent experts verify EPDs submitted by the manufacturer. The whole procedure of verification is based on ISO 14025 and EN 15804 standards [10–13]. In fact, manufacturers may use EPDs in order to inform end-users. However, until now, this has happened on a voluntarily basis. In comparison to end-users, through MSDSs and EPDs, professional users of paint products get substantially more information about health and environmental effects such products may cause. In this regard, asymmetry of information takes place [14].

In fact, the issue on giving appropriate information about health and environmental effects of the products to end-users is not trivial because this information must be transmitted in an understandable manner. On the one hand, the complexity of the LCA may become an obstacle in transmitting this information: End-users may have difficulties in understanding it. On the other hand, the EPDs may be a step in between, as the EPDs facilitate understanding. However, the solution to the problem of information asymmetry is not easy to find. Potential solutions might be as follows: Duty to inform, right to know, obligation of voluntary labelling, compensation for damage, etc. Each of the mentioned solutions needs its application in certain circumstances.

1.1. Research Background and Hypothesis Development

In order to shed light on the issue of information asymmetry, two studies including research questionnaire surveys on the construction market in Germany were conducted. At first, a quantitative study was completed with a questionnaire survey involving end-users of construction products. Second, a qualitative study on surveying opinions on similar questions involving expert users of construction products was made. This research questionnaire survey addressed experts with various functions within the construction industry, namely, architects, engineers and researchers. As experts, they are aware of this issue and they fully understand the MSDSs and the EPDs. Hence, they may know how to bring the required information in the appropriate way to end-users.

After designing a questionnaire, eight research hypotheses were developed. The first hypothesis has as its purpose to reveal if any relationship between awareness of the LCA and importance of making this LCA available to end-users:

Hypothesis 1 (H1). *There may be a relationship between responses to the questions on awareness of the LCA and importance of making LCA available to end-users.*

Addressing the question of information asymmetry to end-users, this leads to the second hypothesis:

Hypothesis 2 (H2). *There may be a relationship between responses to the questions on availability of the MSDSs and odour sensitivity.*

Moreover, with the help of EPDs, manufacturers may identify the “optimisation potential” of their products over the life-span, and, thereby, adjust their manufacturing processes helping to preserve raw materials and protect the environment for future generations. Product Category Rules (PCR) determine the requirements and rules for Environmental Product Declarations of a product category. Similar to the EPDs, Product Category Rules are based on ISO 14025. The PCR enable transparency and comparability between the EPDs.

A discussion on the importance of eco-certificates brings the third and the fourth hypotheses:

Hypothesis 3 (H3). *There may be a relationship between responses to the questions on importance of an eco-certificate and importance to protect ground water.*

Hypothesis 4 (H4). *There may be a relationship between responses to the questions on importance of an eco-certificate and importance of indoor air quality.*

Previous research on sustainable construction products relates to designing decision-making tools for selecting construction materials and products applied by experts such as construction engineers, decorators and architects. Ogunkah and Yang (2012)’s study was on the decision-making process of local and recycled construction materials [15]. In that study, a questionnaire survey was conducted among 50 expert users in the USA, the UK and Australia for collecting information about essential factors and variables that could influence the decision-making process of respondents, who were experts on construction materials. The respondent experts were accredited for expertise in the labelling and certification councils on sustainable building: LEED (the US) [16], BREEAM (the UK) [17] and Green Star (Australia) [18]. Above all, the survey revealed that information regarding the efficient use of the Life Cycle Assessment tools was ranked high by respondents. Ogunkah and Yang designed a toolkit based on the results of their expert opinion polling. This toolkit was presented within an Analytic Hierarchy Process (AHP) model on decision-making for the selection of local and recycled construction materials, reflecting the most satisfactory factors and variables for the building material performance and service-life.

1.2. Objectives of the Study

In order to fill the gap in studies with respect to the sustainability for construction products, a comparison of the two research questionnaire surveys is reported in this paper. These questionnaire surveys were designed and conducted for non-expert and expert users in the German construction market, targeting trade fairs for construction materials and products. The questionnaire surveys were held in form of profound face-to-face interviews with participants of trade fairs. Both surveys targeted at showing and analysing non-experts’ and experts’ opinions on sustainability of construction products as well as on interior paint products using statistics data analysis.

As already mentioned, this paper focuses on the importance of making the LCA transparent and available for end-users. Moreover, according to the experts’ survey outcomes, the EPD certificates are strongly connected to the LCA and considered among the most important environmental certificates for construction products. Furthermore, over 62% participants of the end-users’ survey responded they paid attention to the Blue Angel eco-label on the packaging of a paint product.

1.3. Environmentally Conscious Behaviour of the Average Consumers in Germany

Environmentally conscious behaviour of the average consumers in Germany was studied thoroughly in the past decades. As for the importance of eco-labelling, Gaus and Zanger (2002) made a survey targeting the perception of the Blue Angel created in 1978 as well as EU-eco-labels in Germany in the period from 1993 to 2002 [19]. The Blue Angel eco-label is an officially German Government supported label for environmentally friendly products. The study revealed that the relevance of eco-labels for decisions to buy eco-labelled products has decreased [20]. Grunenberg and Kuckatz (2003) stated that people under 25 do not know the Blue Angel eco-label [21].

Further studies by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in Germany in respect to the perception and importance of the eco-labelling for an average consumer also showed a reduction in the percentage of respondents who paid attention to the Blue Angel from 41–42% in 2006 to less than 40% in the period from 2006 to 2008 [22].

In 2010, the Federal Environmental Agency published results of another representative survey [23]. This survey revealed clear differences regarding the name recognition and relevance of the Blue Angel in individual population groups. The eco-label was known mainly in the age groups of the 30- to 65-year-olds. Significantly weaker is the importance of the Blue Angel among younger age groups. Less than 30% of respondents under 30 said they paid their attention to the eco-label on the packaging when purchasing products. Although the Blue Angel was equally well-known among women and men, 42 % of women and 35 % of men said they were looking for the Blue Angel on the products packaging.

Stiess and Birzle-Harder (2013) conducted a study concerning the recognition of the Blue Angel in comparison with other eco-labels, such as Bio logo, EU-Eco-label, EU-Energy label and Fairtrade [24]. The study targeted respondents' knowledge of the Blue Angel contents. Furthermore, it attempted to gain insights into consumers' perception of the product portfolio that is associated with the Blue Angel, studying cognitive and emotional aspects. The study consists of two parts, including an online survey and a qualitative questionnaire survey with the help of focus groups. The online survey was conducted via the Online-Access panel "Respondi" and encompassed 2304 German respondents aged 18 to 69. It provided visual information with respect to the eco-labels, which helped to make the quantitative study more effective. Online results revealed 93% awareness of the name of the Blue Angel eco-label among all respondents. At the same time, 26% were well conscious, 42% knew only a bit, 14% knew less and 7% knew nothing about this eco-label. Men, older people and people with a higher level of education and higher income were more aware of the Blue Angel compared to women, people under 30 and people with a lower level of education and lower income. In 2012, less than 50% of the respondents bought products with the Blue Angel eco-label on the packaging.

A perception analysis of the Blue Angel eco-label was divided into five criteria that are influencing respondents. This step was accomplished with the help of the qualitative survey. It covered three groups of respondents, with ten respondents in each group and it took 2.5 h to interview each group of respondents. This resulted into a focus-group model for the Blue Angel and was evaluated with the Cluster Analysis (Ensemble-Clustering). The first set of perception criteria was identified as seriousness, independence and reliability. All interviewed respondents showed open sympathy towards the Blue Angel, however, with no emotional identification. The Blue Angel eco-label influenced on the moral and rational level. Respondents showed respect and paid attention to the Blue Angel eco-label. The second criterion was entitled by Stiess and Birzle-Harder (2013) as "a lack of presence" [24]. The eco-label is too small to be noticed on the back of a packaging. It was perceived unconsciously. A lot of new labels were in competition, reducing the attractiveness of the Blue Angel. The third criterion relates to the complexity of the Blue Angel, as it is not clear which environmental properties of a product it stands for. Respondents did not identify any specific motivation to buy a product with the Blue Angel eco-label. The fourth criterion was that the Blue Angel eco-label is "too honest" and "as a matter of course". According to Stiess and Birzle-Harder (2013), there were no environmental scandals and media attention since the 1980s, where the Blue Angel could have stood out. The last criterion relates to a lack of a radiant power: There was no emotional power connected to the

Blue Angel eco-label. It did not have any positive and important functions for consumers anymore. Only less than 20% of respondents knew that the Blue Angel to be a national environmental label.

In addition, Stiehs and Birzle-Harder (2013) suggested assessment of a product portfolio for the respondents. Considering the “Paints and Varnishes” category, 68% of the respondents supposed there were products with the Blue Angel label in this product category, while 12% supposed there were not. Therefore, for this product group, the Blue Angel eco-label was attractive and plausible because of its purposes of the environmental and health protection. Furthermore, 33% respondents found it very important to have construction products with the Blue Angel, 42% found it important, 17% as less important and only 8% as unimportant [24].

A recent study on environmental awareness held by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in 2014 showed that 92% of the surveyed respondents were aware of the Blue Angel and 37% named this eco-label as an influencing factor on their purchasing decision-making [25]. Thus, a discussion about the Blue Angel eco-label leads to the fifth hypothesis:

Hypothesis 5 (H5). *There may be a relationship between responses to the questions on importance of an eco-certificate and importance of the Blue Angel on the packaging.*

There is a hypothesis that environmental and human health safety of an interior wall paint is of a higher priority for a non-expert user, i.e., average consumer, than a market price [10]. Rochikashvili and Bongaerts (2016) presented an AHP (Analytic Hierarchy Process) model reflecting the most sufficient criteria that should be considered in the decision-making process for a wall paint by an average consumer. This model leads to setting up further several hypotheses:

Hypothesis 6 (H6). *There may be a relationship between responses to the questions on importance of using a solvent-free paint and awareness of evaporation of hazardous emissions through paints.*

Hypothesis 7 (H7). *There may be a relationship between responses to the questions on importance of using a solvent-free paint and importance of harmlessness of colours for respiratory tract diseases.*

Hypothesis 8 (H8). *There may be a relationship between responses to the questions on importance of using a solvent-free paint and complaints to the bad air quality caused through emissions of paints.*

In this paper, Section 2 describes the research questionnaire surveys used in both, quantitative and qualitative studies. Section 3 outlines the main statistics results within the surveys' data analysis. Section 4 highlights respondents' statements and notes obtained during the in-depth interviews. Section 5 links the presented results between various questions and introduces the main conclusions within the two studies.

2. Materials and Methods

2.1. Questionnaire Surveys

To facilitate the empirical investigations, research questionnaire surveys on environmental and health aspects, awareness and importance of information about these aspects of paints and varnishes, as well as construction products were developed. For both studies, each research questionnaire comprises five sections and include 26 questions and a socio-demographic part in addition, which does not exceed a tolerable limit of 30 questions. The questionnaires are designed with the help of closed-end questions that also include multiple-choice questions. However, the surveys include two open-end questions controlling the closed-end questions [26].

These two questionnaire surveys have equal structure and objectives. However, stating the questions may differ depending whom they are addressed to, end-users or experts. Additionally,

Section 3 outlines some of the key questions in more detail. The Likert-scale of five is used in both surveys, where *one* meaning *highly important*, *two—very important*, *three—quite important*, *four—less important* and *five—not important*. The *sixth* suggested option is *not specified*. Participants of both research questionnaires were being interviewed within the scope of a number of trade fairs on construction products in Germany.

1. Importance of eco-labels and environmental certificates. The first section of the research questionnaires includes a set of eight questions regarding the assessment of importance of the environmental certificates, eco-labels and the MSDSs for the construction products. This assessment is made with the help of the Likert-scale from one to five and an extra option *not specified*. One question of this set has a multiple choice, targeting points of sale of construction products. This is followed by questions that intend to retrieve information about the MSDSs and the LCA. Here, one question refers to the importance of the MSDSs. While in the experts' survey, the other question about the MSDSs points to the awareness of a respondent if his or her customers had asked for any MSDS prior to purchasing a product, in the end-users' survey, this question has an intention to retrieve information whether respondents ask for the MSDS in the do-it-yourself store or read them on the Internet. Questions with respect to the LCA seek for information about respondents' awareness of LCA and the importance of making it transparent and available for the end-users. These questions offer *yes* and *no* answer options and they are followed by extra questions asking for an explanation in case of a negative answer. This applies throughout the whole questionnaire.
2. Environmental and health issues. The second section of the questionnaires includes eleven questions referring to the environmental and health issues with respect to indoor paints. Five of them cover an assessment of the importance of the suggested statements. These statements include ground water protection, indoor air that is not polluted by chemical substances, use of solvent-free interior paints, use of indoor paints without health risk and a question about odour sensitivity. The other questions require a *yes* or *no* answer as well as explanatory questions in case of a *no* answer.

In the end-users' survey, these questions intend to retrieve information about the respondents' behaviour, e.g., if respondents try to obtain more information regarding environmental characteristics of a product before purchasing it at do-it-yourself stores, the importance of eco-labels and paying attention to eco-labels, such as the Blue Angel eco-label on the packaging of interior paints.

In the experts' survey, these questions target the awareness of their customers' behaviour towards the mentioned issues. Additionally, the questions intend to generate information about the respondents' awareness of the evaporation of hazardous emissions through paints as well as about any complaints of respondents or their colleagues (in the experts' survey) in connection with poor air quality caused by indoor paint emissions.

3. Assessment of quality and application of indoor paints. The third section evaluates the assessment of quality and application of indoor paints. Six properties are offered for assessing their significance ranking from one to five with an extra *not specified* option. The options are as follows: covering property, market price, aesthetics, persistence on surfaces, warranty that paint lasts longer without cracks, easy application and easy touch-ups, when applicable. In future research, the information about these assessments will be applied to a multi-criteria decision-making analysis which is beyond the scope of this paper.
4. Respondents awareness of definite paint products. The fourth questionnaire section intends to generate information regarding respondents' experience with environmentally certified wall paints and how often they personally use environmentally certified or non-certified paints. Moreover, two questions in this section name six well-known paints that are widely present on the German construction market. These two questions serve the purposes to find out which of them are familiar to respondents and which of them respondents personally have used.

5. Respondents experience. The fifth section contains two open-end questions with respect to personal experiences of respondents with environmentally certified wall paints either mentioned in the fourth questions section or in general. However, this information is only available if respondents have answered that they have used one or more paints mentioned in the previous section of questions.
6. Socio-demographic information. Finally, the last section includes general socio-demographic information about respondents' gender, age and level of education. In addition to the end-users' survey, information whether respondents have children or not was also included to this section. In addition to the experts' survey, this section includes a question about respondents' professional relation to construction works and paint production as well as an enquiry into the department to which respondents belong within a company. This helps to form job categories for the survey evaluation. However, respondents can give this information optionally.

2.2. Study Implementation

The research questionnaire surveys were conducted between October 2016 and March 2017 at four trade fairs for construction products that took place in Germany. This paper does not name these trade fairs as well as their locations for reasons of anonymity. Nonetheless, it focuses on analysing nineteen key questions in full detail with additional socio-demographic information. The other seven questions from the third, the fourth and the fifth questionnaire sections called "Assessment of quality and application of indoor paints", "Respondents awareness of definite paint products" and "Respondents experience", respectively, are beyond the scope of the current paper. The responses on these sets of questions will be used for future research. The responses to the key questions are compared between two questionnaire surveys using data analysis.

2.3. Socio-Demographic Information: End-Users Survey

In the survey for end-users, participants were visitors of the various trade fairs for construction products that took place in Germany. Overall, four hundred trade fair participants were asked to take part in the questionnaire survey. However, 188 of them rejected and 212 agreed to participate in the survey.

The survey included 134 female participants, which is 63.2% in total and 78 male participants, or 36.8%. Table 1 gives an overview of the participants according to their gender, age and whether they have children or not.

Table 1. Distribution of the survey participants according to gender, age and having children.

Age Group	Gender		Total (N)	Total (%)	Participants with Children		
	Females	Males			Females	Males	Total (N)
Less than 20	0	2	2	0.9	0	0	0
20–35	38	19	57	26.9	13	6	19
36–50	34	22	56	26.4	19	17	36
51–65	41	23	64	30.2	35	21	56
Over 65	21	12	33	15.6	17	10	27
Total (N)	134	78	212	100	84	54	138
Total (%)	63.2	36.8	100	–	39.6	25.4	65

2.4. Socio-Demographic Information: Experts Survey

Participants in this research questionnaire were experts that visited and participated in international trade fairs for construction works and construction products organised in various German cities. Overall, one hundred trade fair participants were asked to take part in the questionnaire survey. In fact, 41 of them rejected to take part. In total, 59 experts in construction took part in the survey: Engineers, architects, sales engineers, product managers and scientists were among them. In addition,

there was a category named other, including participants outside of any category named above. The survey includes 11 female participants, which is 18.6% in total.

Most participants, namely, engineers, sales engineers, product managers and general managers, belonged to companies that use painting pigments in the manufacturing process, e.g., indoor and outdoor paints and varnishes, paint coatings, carpet floors, ceramics. More than half of the participants were engineers: 36% working as sale engineers and 25% as engineers, respectively. Other participants were involved in scientific research on construction products, in the certification system of EPD and in architectural associations. Figure 1 shows the distribution of the research questionnaire survey participants by job category.

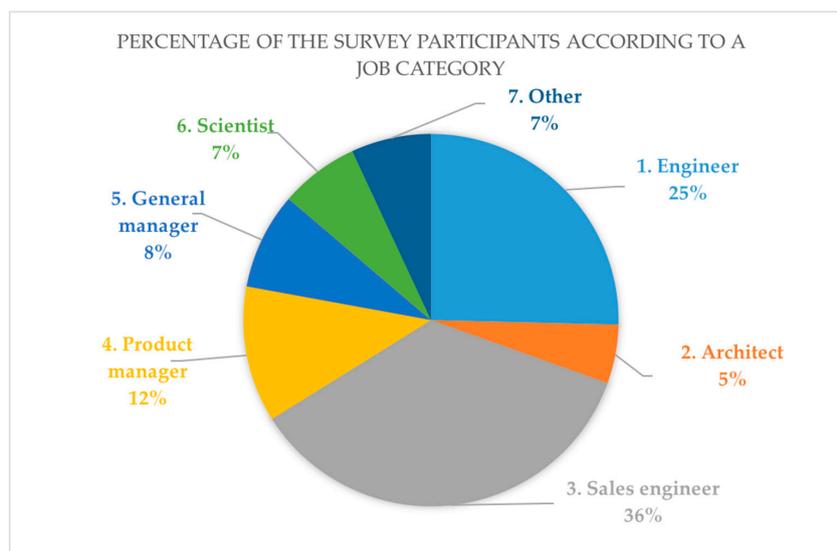


Figure 1. Distribution of the survey participants by job category, shown in percentages.

Table 2 gives an overview of the participants by job category, age and gender. Moreover, while 76% of the participants had university degrees, only 17% received professional education. The remaining 7% did not specify their level of education. As to age groups, 19 participants were in the age group of 20 to 35 years, 23 participants were between 36 and 50 years old and 17 participants belonged to the age group of 51 and 65, respectively.

Table 2. Participants by job category, age and gender.

Job Category	Gender		Total (N)	Total (%)	Age Group		
	Females	Males			20–35	36–50	51–65
Engineer	1	14	15	25.4	6	3	6
Architect	1	2	3	5.1	0	3	0
Sales engineer	6	15	21	35.6	6	8	7
Product manager	1	6	7	11.9	2	3	2
General manager	0	5	5	8.4	0	4	1
Scientist	2	2	4	6.8	3	1	0
Other	0	4	4	6.8	2	1	1
Total (N)	11	48	59	100	19	23	17
Total (%)	18.6	81.4	100	–	32.2	39	28.8

2.5. Procedure

In the end-users' survey, interviews took place during the trade fairs on construction products. The visitors of such trade fairs were being interviewed. The interviews lasted from ten up to twenty minutes each.

In the experts' survey, interviews took place during the trade fairs on construction products directly at participants' exhibition booths and they lasted from twenty minutes up to one hour each.

All participants were asked to answer the suggested questions and use the Likert-scale where necessary. All given responses were processed anonymously. Company names were not documented either. Comments beyond the close-end questions were handwritten throughout the paper surveys. Originally, the paper questionnaire survey that served as a basis for the interviews, was in German. Respondents were offered to have a look at the questionnaire upon request. Although the initial intention of the experts' survey procedure consisted in interviewing trade fair participants primarily involved in paints and pigments manufacturing, it occurred that more than 60% of them in this qualitative study are members of the German Sustainable Building Council.

No manipulation that might include any graphic or imagery stimuli was used in the questionnaire surveys. Notably, the interviews had a non-biased approach.

2.6. German Sustainable Building Council

In fact, explicitly more than half of all participants in the qualitative study ($N = 39$, or 66%) are members of the German Sustainable Building Council (DGNB; in German—Deutsche Gesellschaft für Nachhaltiges Bauen e.V.). Founded in 2007, DGNB integrates more than 1200 members worldwide. Among DGNB's members there are architects, planners and engineers working in the construction industry, as well as investors and scientists. DGNB developed a system for labelling buildings in Germany [27]. According to DGNB's statute, the main purpose of the Council is to stimulate "sustainability throughout the construction and real estate sectors" as well as enhance "consciousness in the general public" [28].

The Council developed a certification system and launched a quality label with respect to sustainability criteria. While the world-known certification systems focus on energy-efficient solutions for the building sector, DGNB primarily focuses on the Life Cycle Assessment (LCA) and the EPD, paying more attention to materials that are sustainable and, thereby, not hazardous for human health and the environment. Furthermore, DGNB operates an Academy to provide "a knowledge platform" for experts in the sustainable building worldwide [29].

2.7. Data Analysis

All collected responses were translated from German (as stated by respondents) into English. Research questions were tested with statistical models using null hypothesis significance testing (NHST) [30]. Calculations were implemented using MS Office Excel including Data Analysis Toolkit. Section of Supplementary Materials includes both questionnaire survey with nineteen questions that are discussed in the paper. The questionnaire surveys were translated from German into English.

3. Results

In order to highlight the essential findings within the research questionnaire survey described in Section 2.1, the key nineteen questions out of each survey are analysed here. In this paper, a correlational, i.e., cross-sectional, research between the responses to various questions have been executed. As already mentioned above, the NHST has been applied. All tests have been made within non-directional two-tailed significance value testing stating that a supposed effect took place. Correlational testing has been used in order to find if there is any relationship between variables, e.g., between responses to different questions. Regression testing follows the correlational testing and confirms whether the found relationship is significant or not. Pearson's correlation coefficient r has been used in regression testing. Pearson's correlation coefficient is a measure of the strength of a relationship between two variables, i.e., it quantifies the experimental effect [30].

Testing has been made for the results of each survey. Results of these tests have been discussed and compared afterwards. As described in the Introduction, eight alternative hypotheses have been designed. According to Pagano, each null hypothesis for each of the alternative hypotheses states

that any difference between two variables is due only to chance, i.e., that correlation is perhaps spurious [31].

3.1. Statistics within the End-Users Survey

Table 3 presents statistics results after testing the hypotheses within the survey for the end-users. In cases of H3 and H6, the null hypotheses have been retained. In six other cases, the null hypotheses have been rejected, i.e., the relationships between variables are confirmed as significant. Furthermore, according to the measures of strength of Pearson's correlation coefficient r , the variables are very weakly to moderately related to each other [31]. For H3 and H6, correlation is perhaps spurious.

Table 3. Statistics results within the end-users' survey.

Hn	Correlation Coefficient r	R SQUARE	Significance (p -Value)	Relationship between Variables	Linear Regression Formulae	H0: Retain vs. Reject
H1	0.19 (weak)	0.04	0.01 *	Significant	$y_1 = 0.17x_1 + 0.83$	Reject
H2	0.19 (weak)	0.03	0.01 *	Significant	$y_2 = 0.18x_2 + 1.78$	Reject
H3	0.22 (moderate)	0.00	0.33	Not significant	$y_3 = 0.14x_3 + 2.23$	Retain
H4	0.07 (very weak)	0.05	0.00 *	Significant	$y_4 = 0.59x_4 + 1.75$	Reject
H5	-0.31 (moderate)	0.10	0.00 *	Significant	$y_5 = 2.84 - 0.69x_5$	Reject
H6	-0.08 (very weak)	0.01	0.23	Not significant	$y_6 = 2.15 - 0.21x_6$	Retain
H7	0.43 (moderate)	0.18	0.00 *	Significant	$y_7 = 0.53x_7 + 1.24$	Reject
H8	-0.14 (weak)	0.02	0.04 *	Significant	$y_8 = 2.09 - 0.44x_8$	Reject

* $p < 0.05$.

Formulae for linear regression serve to predict values on a line that shows a relationship between variables. Therefore, the following equation has been used:

$$y_n = Bx_n + C \quad (1)$$

where B = slope of line, C = y-intercept, i.e., a point where line crosses y -axis.

3.2. Importance of the Blue Angel on the Packaging for the End-Users

For the end-users' survey, test results for H5 are significant, which means there may be a relationship between the responses to these questions. Moreover, this relationship is moderate. Figure 2 demonstrated a distribution of the participants that pay attention to the Blue Angel eco-label on the packaging of indoor paint products. Overall, 62.2% of the respondents responded positively, including 43.4% females and 18.8% males. Among them, 9% respondents were in the age between 20 and 35, 16%—in the age between 36 and 50, 23.5%—in the age between 51 and 65 and 13.7% respondents were over 65, respectively. None of two respondents in the age under 20 were aware of an existence of such an eco-label.

However, most of the participants who responded to this question negatively stated that either they "have never thought about this eco-label" or they "hear about it for the first time".

3.3. Statistics within the Experts Survey

Table 4 shows statistics results after testing the hypotheses within the survey for the experts. Here, relationships between variables have been confirmed as significant only for hypotheses H3 and H8, which means the null hypotheses have been rejected. In six other cases, the null hypotheses have been retained, i.e., the relationships between variables are perhaps spurious. For H3 and H8, the variables are moderately related to each other [31].

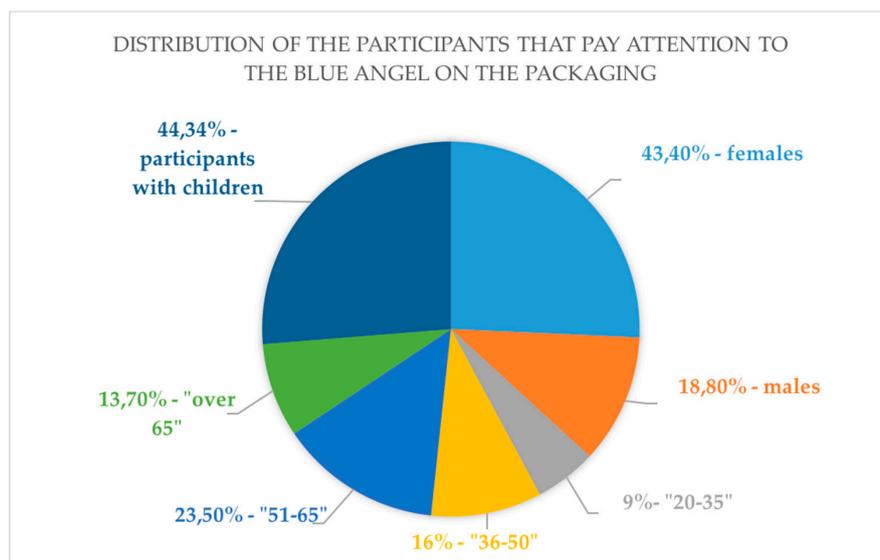


Figure 2. Distribution of the participants paying attention to the Blue Angel eco-label on the product packaging, shown in percentages.

Table 4. Statistics results within the experts' survey.

Hn	Correlation Coefficient <i>r</i>	R Square	Significance (<i>p</i> -Value)	Relationship between Variables	Linear Regression Formulae	H0: Retain vs. Reject
H1	0.06 (very weak)	0.00	0.66	Not significant	$y_1 = 0.06x_1 + 0.71$	Retain
H2	−0.21 (weak)	0.05	0.10	Not significant	$y_2 = 2.19 - 0.17x_2$	Retain
H3	0.33 (moderate)	0.11	0.01 *	Significant	$y_3 = 1.08x_3 + 0.99$	Reject
H4	0.18 (weak)	0.03	0.17	Not significant	$y_4 = 0.5x_4 + 1.55$	Retain
H5	−0.23 (weak)	0.05	0.07	Not significant	$y_5 = 2.63 - 0.65x_5$	Retain
H6	−0.15 (weak)	0.02	0.26	Not significant	$y_6 = 2.05 - 0.38x_6$	Retain
H7	−0.05 (very weak)	0.00	0.72	Not significant	$y_7 = 1.88 - 0.06x_7$	Retain
H8	−0.36 (moderate)	0.13	0.00 *	Significant	$y_8 = 2.05 - 0.98x_8$	Reject

* $p < 0.05$.

4. Results within the In-Depth Interviews

In this Section, a discussion on the qualitative study within the in-depth interviews with the expert users is presented. Here, *Qn* stands for *question with its number*. Additionally, questions are shown in the order as they appear in the research questionnaire. As already mentioned, answers to some questions were given on a Likert-scale of five, where *one* implies the highest value of importance, or *highly important* as used in the survey and *five* representing *not important*. The sixth option of *not specified* also appeared throughout the survey. Several questions allowed for only two response choices: *Yes* and *no*. Furthermore, some questions succeeded specific "critical" questions in the survey requiring further explanations from respondents who answered *no* to such a critical question. However, these questions were optional.

For questions that included a Likert-scale, the average mean, i.e., *M* and the standard deviation, i.e., *SD*, were calculated with the help of the Data Analysis Toolkit within the MS Office Excel. The Sections 4.1–4.19 describe the results obtained from the survey and the analysis with respect to the answers to each question. In most figures, the *x*-axis shows a value of importance in plain numbers, while the *y*-axis shows the number of responses in percentages.

4.1. Q1: "How Important Is It for You That Construction Products Have Eco-Labels?"

Responding to the question concerning the importance of an eco-label for a construction product ($M = 2.15$; $SD = 1.24$), the analysis indicated the highest value of importance among product managers

with 32.2%. Figure 3 demonstrates a distribution of responses on a Likert-scale of five including the *not specified* option, described in Section 2.1. The ranking shows the value of importance among all respondents by job categories. Overall, while 61% of the respondents chose *highly important*, almost 37% of respondents selected *very important*. Option *quite important* was taken by 14% of responses and option *less important* was mentioned by 11.8% of the respondents.

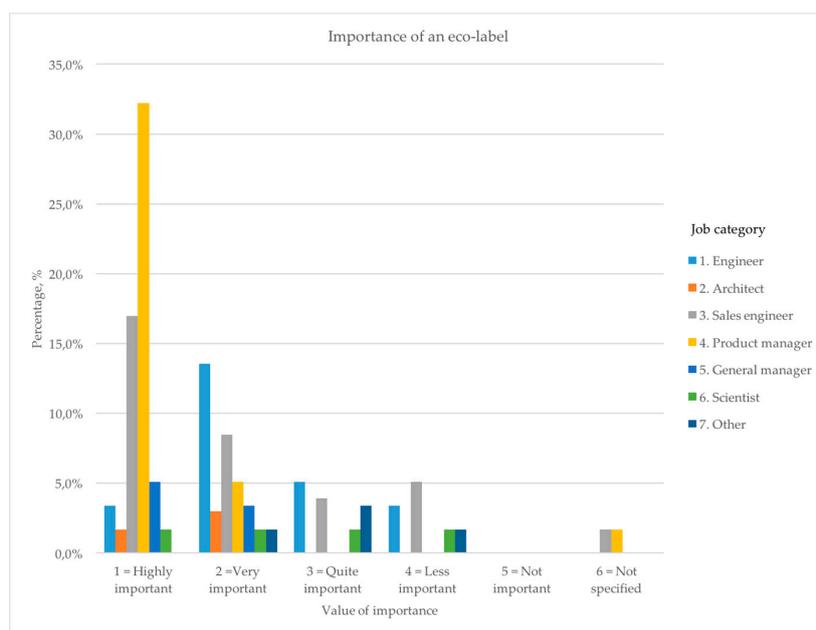


Figure 3. Importance of an eco-certificate, ranking according to a job category, shown in percentages.

In addition, some respondents noted the following:

- “Construction products have the Environmental Product Declaration of a technical chemical product such as paint” (sales engineer);
- “Eco-labelling is important” (sales engineer);
- “Labelling and certification problems are important to solve. Labelling can help make environment better” (engineer);
- “Construction products cannot be assessed along but only in context with a building” (engineer);
- “Eco-labels are important because they are end-user oriented” (sales engineer).

Importantly, one respondent stated that “construction products integrate with other products: That is why environmental certificates are less important” (scientist).

4.2. Q2: “Where Can Average Consumers Buy Your Products?”

When asked where average consumers, i.e., end-users, can buy the products presented at the trade fair, most respondents (i.e., 44 out of a total of 59, or 75%) who represented manufacturing companies stated that their products are available only directly from the manufacturer. The remaining respondents noted their products are available also online, in construction markets and in special construction stores.

4.3. Q3: “How Important Is It for You That Material Safety Data Sheets (MSDSs) Are Available with Your Products?”

When asked about the importance of the MSDSs handed out with paint products ($M = 1.66$; $SD = 1.21$), 22% of sales engineers, 16.9% of engineers and 8.5% of general managers responded *highly*

important. Figure 4 shows the distribution of responses on a Likert-scale among all respondents by job categories. Overall, 63.4% of the respondents chose *highly important*, while only 16% of them responded *very important*.

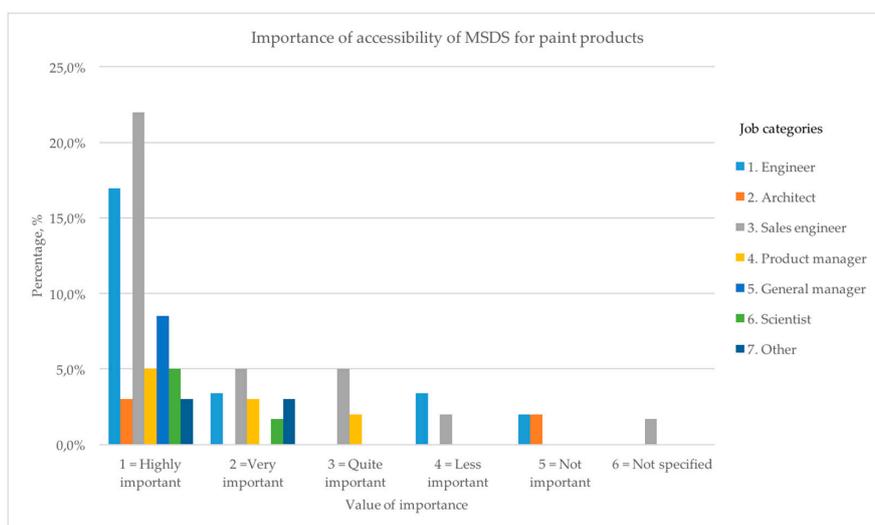


Figure 4. Importance of accessibility of the MSDSs for paint products, ranking according to a job category, shown in percentages.

Moreover, some respondents stated the following:

- “It is important that MSDSs are available” (sales engineer);
- “We hand out MSDSs to our customers” (product manager);
- “They should be handed out to everyone” (sales engineer).

In addition, some respondents noted that “they are provided by law” (general manager) and even “mandatory” (sales engineer; engineer; product manager).

- “MSDSs are not necessary since the Environmental Product Declaration contains this sort of information” (general manager);
- “In regard to MSDSs, the Environmental Product Declaration is very important” (sales engineer).

4.4. Q4: “Do Your Customers Ask for MSDSs in the Store for Construction Products?”

For this question, only two response options were allowed: *Yes and no*. Overall, 37 respondents, i.e., 62.7%, answered positively. Some respondents mentioned the following:

- “Not many customers ask for MSDSs” (sales engineer);
- “Customers ask for MSDSs but only regarding chemical products” (sales engineer);
- “Customers ask for MSDSs but only for quality manufactured products” (product manager).

Moreover, other statements included that “demand for MSDSs was rising for the past two years” (engineer).

4.5. Q5: “If Not, May I Ask You Why?”

Obviously, only 22 (i.e., 37.3%) respondents replied negatively to question Q4. Question Q5 aimed at retrieving explanation to the negative answers to question Q4. Hence, some of the responses to question Q5 were as follows:

- “Customers ask for definite components or properties” (sales engineer);
- “Customers ask only for technical information” (sales engineer).

4.6. Q6: “Are You Familiar with the Life Cycle Assessment (LCA)?”

Regarding the question on awareness of Life Cycle Assessment, answer options were *yes* and *no*. Overall, 42, i.e., more than 71%, of all respondents, were familiar with LCA. By job category, 23.7% of sales engineers showed their awareness of LCA, while 16.9% of the engineers were familiar with LCA as well. Figure 5 shows the whole distribution of responses marked in blue.

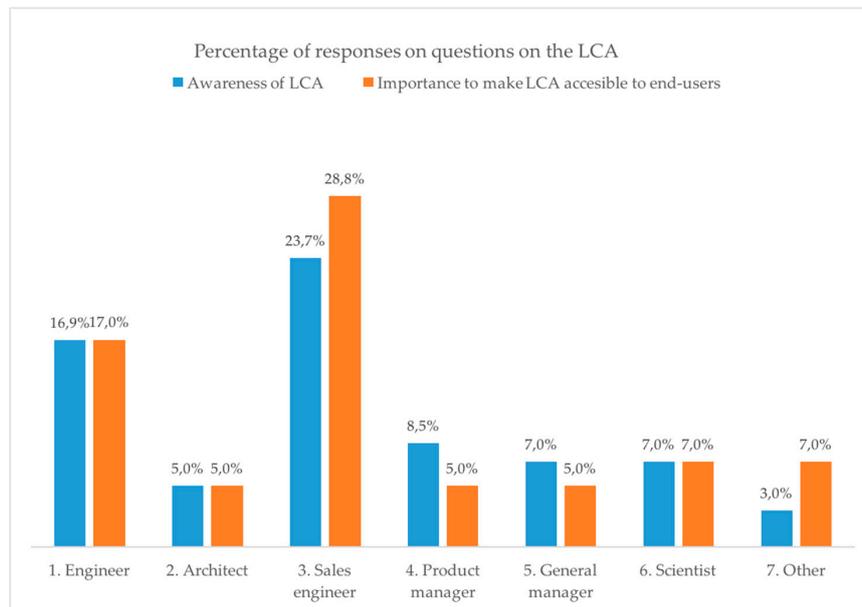


Figure 5. Distribution of responses on questions regarding the LCA, ranking according to a job category, shown in percentages.

4.7. Q7: “Is Making LCA Accessible for End-Users Important for You?”

As well as in question Q6, regarding the importance of making the LCA transparent for public in question Q7, the answer options were *yes* and *no*. Overall, 44 respondents, i.e., almost 75%, stated that “making LCA accessible for end-users is important” and even “very important” (scientist). Figure 5 shows the distribution of responses which are marked in orange. Moreover, Figure 5 demonstrates a comparison between responses to questions Q6 and Q7 by job category. Hence, engineers, architects, sales engineers and scientists, who are familiar with LCA, found it important to make LCA accessible to end-users. Some respondents noted the following:

- “It is important for definite product lines, especially with respect to the EPD” (engineer);
- “Basically, it is important” (engineer);
- “LCA issues are very critical at the moment” (general manager);
- “LCA is strongly focused on sustainability” (product manager);
- “LCA is very important because it would save us a lot of work” (architect);
- “It would be important but should not be available in technical details” (product manager).

Consequently, a discussion on the LCA brought the most responses that included EPD as a solution to the issue of transparency of the LCA. Notably, it appeared during the interviews that respondents from the companies that had an EPD certificate for their products stated a high importance of making the LCA transparent to end-users.

Testing the H1 hypothesis revealed that a relationship between questions Q6 and Q7, i.e., between awareness of LCA and importance of making LCA accessible to end-users, *was* not significant ($p > 0.05$).

4.8. Q8: “If Not, May I Ask You Why?”

Quite to the contrary, with regard to the question “why is making LCA accessible to end-users is not important?” 15 responses were collected. They represented 25.4% of all responses in total. During the interviews, this question was discussed in as many details as possible. Most of the 15 respondents argued that LCA is overly complicated for an end-user’s comprehension:

- “LCA would be too confusing for end-users” (product manager);
- “End-users have lack of general understanding” (engineer);
- “LCA is too confusing, it holds too much information” (product manager);
- “Understanding from a side of customers is not obvious” (sales engineer);
- “It is too complex. I am not sure if end-users can evaluate it” (engineer);
- “It would be good if it would not be so complicated” (scientist);
- “LCA is less connected to end-users” (sales engineer);
- “End-users are not interested in LCA” (sales engineer);
- “I am not sure if end-users can understand it” (general manager);

However, there were also views that were not strictly negative. These respondents did not mention a problem of comprehension by an end-user but pointed out the general context in which LCA should be placed:

- “Construction products cannot be evaluated alone but only in a context with the building” (engineer);
- “The tendency of people interested in LCA is temporarily increasing but at the moment it is a definite “no go” (sales engineer);
- “People are getting more sensible and aware of that issue. However, there is a problem of confidence or even trust. People are disturbed by these data” (engineer).

4.9. Q9: “Is It Important to Protect Ground Water?”

Figure 6 clearly shows that almost 90% of the respondents placed a high importance on Ground Water protection: *highly important* ($M = 1.08$; $SD = 0.38$). 22% of all engineers and almost 34% of sales engineers shared this view. In addition, 8% of the respondents quoted *very important* and only 2% mentioned *quite important*. Most manufacturers working with paints and paint pigments, i.e., ceramics and carpet floors, found that question crucial to the topic “sustainability”.

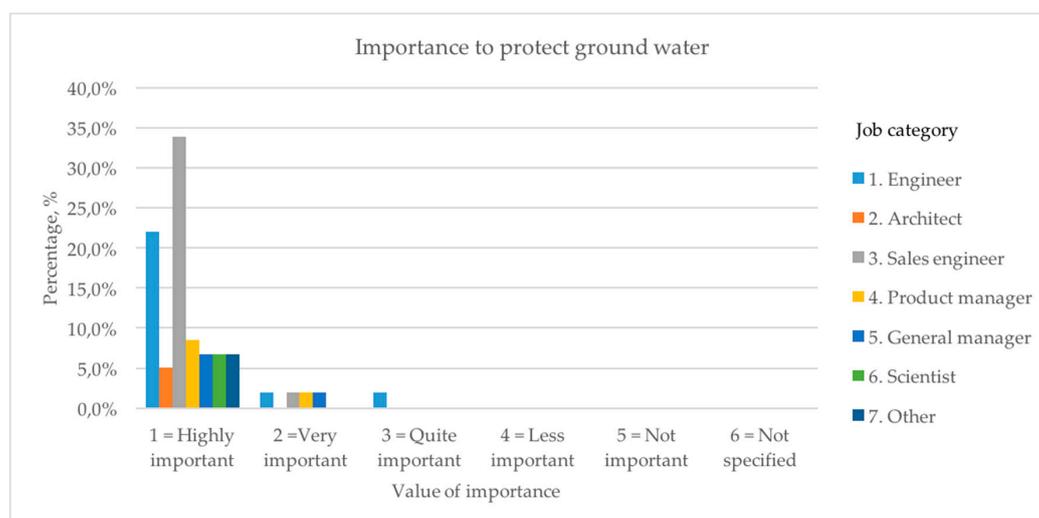


Figure 6. Distribution of responses regarding the importance of protecting ground water, ranking according to a job category, shown in percentages.

Moreover, the H3 hypothesis appeared significant, i.e., there might be a relationship between responses to the questions on importance of an eco-certificate and importance to protect ground water ($p < 0.05$). Furthermore, this relationship is moderate.

4.10. Q10: “How Important Is It for You That Indoor Air Is Not Polluted by Chemical Substances?”

Overall, the question regarding indoor air that should be not polluted by chemical substances collected only 40 responses for *highly important*, i.e., 67.8% and 14 responses for *very important*, i.e., 24%, ($M = 1.22$; $SD = 0.46$). In the interviews, VOCs and formaldehydes were mentioned as chemical substances. Figure 7 demonstrates the distribution of responses regarding this issue by job categories. Interestingly, one respondent noted that “Decopaint (Directive 2004/42/CE) does not identify which kinds of VOCs are restricted, which is a definite disadvantage of the Directive itself” (engineer) [5].

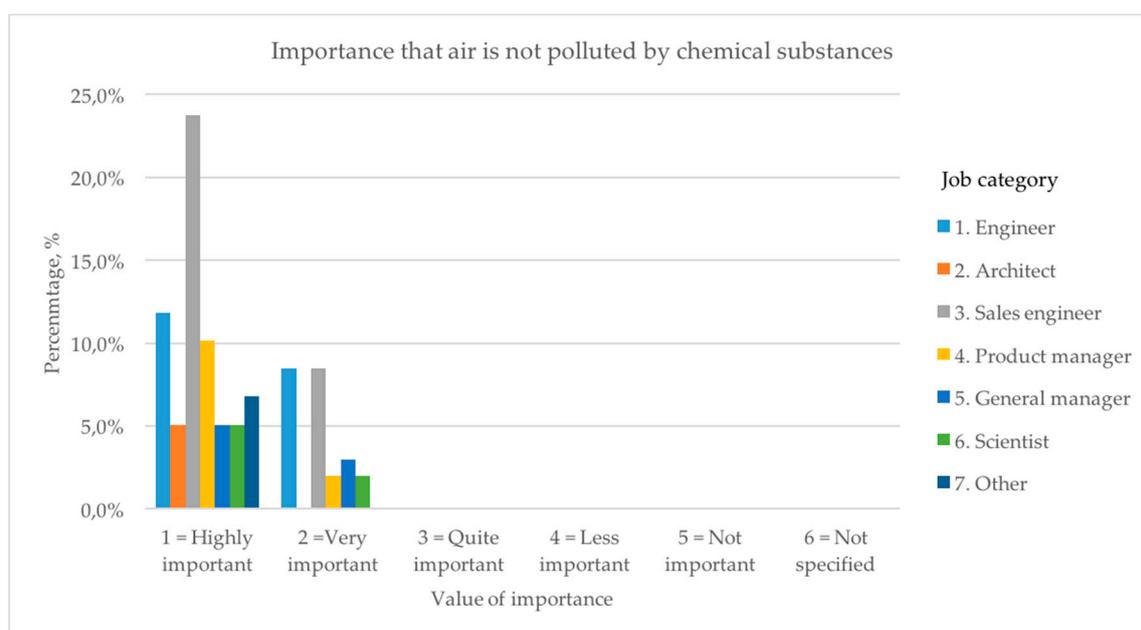


Figure 7. Distribution of responses regarding the importance of an unpolluted air by chemical substances, ranking according to a job category, shown in percentages.

According to the statistics tests, the H4 hypothesis appeared not significant, i.e., there might be no relationship between responses to the questions on importance of an eco-certificate and importance of indoor air quality ($p > 0.05$).

4.11. Q11: “How Sensitive Are You Personally to Odours of Indoor Paints?”

For the question on odour sensitivity, a similar Likert-scale was used, with the wording “sensitivity” replacing the wording “importance,” where *one* stands for *highly sensitive*, *two* for *very sensitive*, *three* for *quite sensitive*, *four* for *less sensitive* and *five* for *not sensitive*. The *sixth* suggested option was *not specified*.

Interestingly, while 61% of respondents replied just *sensitive* to odours of indoor paints, not *highly sensitive* or *very sensitive*, 39% of respondents noted they were *less sensitive* or even *not sensitive* at all ($M = 3.12$; $SD = 1.51$).

Moreover, H2 hypothesis testing results have clearly shown that there might be no relationship between responses to odour sensitivity and responses to the questions on the LCA and the MSDSs with respect to interior paints ($p > 0.05$).

4.12. Q12: “Do Your Customers Ask about Environmental Issues before Buying Your Product?”

When asked if their customers ask for more information about environmental issues before buying their products, e.g., if products at any step of their life cycle can make any harm to the environment, most respondents, i.e., 78%, answered *yes* out of the two permitted answers, *yes* and *no*.

4.13. Q13: “If Not, May I Ask You Why?”

The 22% respondents that answered *no* to question Q12 commented their answers as follows:

- “Everything is available on the product packaging” (product manager);
- “Customers do not need such information” (sales engineer);
- “With clay paints everything is clear enough” (engineer);
- “Our customers are aware of the fact that our products can be harmful to the environment” (sales engineer).

Three respondents working as engineers stated that most of their customers “do not ask for this information because they read it” prior to a product purchase.

4.14. Q14: “Is the Blue Angel Eco-Label on the Paint Packaging Important for You?”

For that question, only options *yes* and *no* were available. Almost 73% respondents answered *yes*. The Blue Angel eco-label indicates that products are especially environmentally friendly [19]. However, along with the Blue Angel, most respondents mentioned other eco-labels as important according to the type of products they produce. With regard to indoor paints, EPD [13], Nature Plus [32], Blue Angel [19], ECO [33], ISO 14001:2015—Environmental Management [34], DGNB [27], BREAM [17], Cradle to Cradle [35], LEED [16] and ÖKOTEX [36], were named among the most essential eco-labels. For carpet floor manufacturers, eco-labels such as TÜV [37] and GUT signet [38] were named important. Eco-labels EPD, Nature Plus and EMICODE EC 1 Plus [39] were named important for manufacturers of ceramics. Moreover, EPD, Nature Plus, DGNB, GUT and TÜV were mentioned most frequently as “the most important eco-labels”.

Some respondents stated the importance of eco-labels as follows:

- “Eco-labels are important because of a market demand” (sales engineer);
- “Eco-labels are important for our competitiveness” (engineer).

Furthermore, as H5 significance testing showed that there might be no relationship between responses to the questions on importance of an eco-certificate and importance of the Blue Angel on the packaging ($p > 0.05$).

4.15. Q15: “If Not, May I Ask You Why?”

Respondents who answered *no* regarding the Blue Angel eco-label either named other eco-labels that seem more important for them, mentioned in Section 4.14, or noted the following:

- “No information on the Blue Angel” (engineer; sales engineer);
- “It does not tell me anything, it is not a quality sign” (sales engineer);
- “It is not an environmental label” (sales engineer);
- “I have not thought about it yet” (engineer);
- “Not interested because of the EPD” (product manager; general manager);
- “Customers know that our products are not sustainable” (sales manager);
- “The Blue Angel eco-label covers only packaging, not the product itself” (sales engineer).

4.16. Q16: “Are You Aware of Evaporation of Hazardous Emissions through Paints?”

When asked about the awareness that indoor paints may evaporate emissions, such as VOC or formaldehyde, that can be hazardous to human health, most respondents, i.e., 67.8%, showed their awareness of that issue by answering *yes*.

4.17. Q17: “How Important for You Is Using Solvent-Free Indoor Paints?”

More than half of the respondents, i.e., 51.2%, noted that it is *highly important* for them to use a solvent-free indoor paint ($M = 1.80$; $SD = 1.19$). Whilst 29.1% of the respondents noted it as *very important*, only 15.9% noted it as *quite important*. Answers on a Likert-scale of *four* for *less important*, *five* for *not important* and *six* for *not specified* only caught 2% each. Figure 8 shows the distribution of responses by a job category.

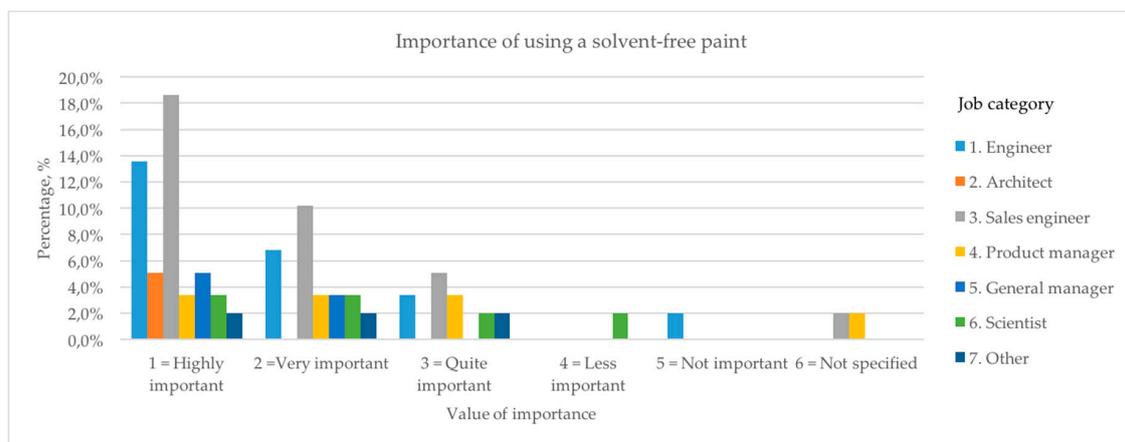


Figure 8. Distribution of responses regarding the importance of using a solvent-free paint, ranking according to a job category, shown in percentages.

While one respondent noted that “higher quality is what is important” (product manager), another stated that “evaporation time is very short” (engineer). Moreover, one respondent mentioned that “modern paint products do not evaporate any hazardous emissions that can be only transported, i.e., aromatics such as White Spirit” (engineer).

Moreover, as H6 significance testing confirmed, there might be no relationship between responses to the questions on importance of using a solvent-free paint and awareness of evaporation of hazardous emissions through paints ($p > 0.05$).

4.18. Q18: “How Important for You Is Using Indoor Paints that Are Not Harmful for Respiratory Tract Diseases?”

Regarding the question about the importance of using indoor paints that are not harmful for respiratory tract diseases, the majority of respondents, i.e., 78%, answered *highly important* on a Likert-scale of five ($M = 1.39$; $SD = 1.00$). Among these, 32.2% were sales engineers and 20.3% of them were engineers. Furthermore, 15.4% of the respondents selected *very important* and only 4% mentioned *quite important*. Figure 9 demonstrates the distribution of responses by job categories.

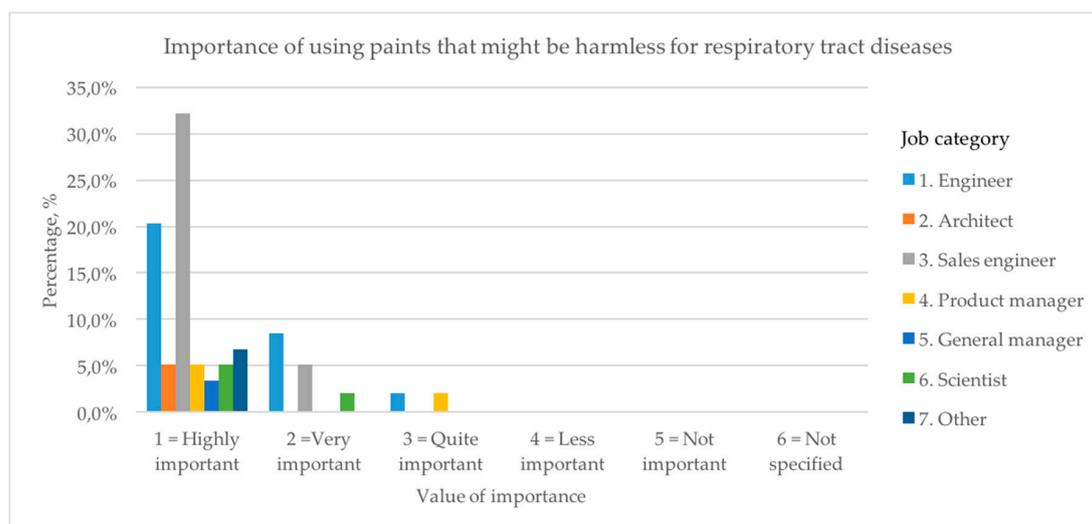


Figure 9. Distribution of responses regarding the importance of using paints that are harmless for respiratory tract diseases, ranking according to a job category, shown in percentages.

Furthermore, as H7 significance testing confirmed, there might be no relationship between responses to the questions on importance of using a solvent-free paint and importance of harmlessness of colours for respiratory tract diseases ($p > 0.05$).

4.19. Q19: "Have You or One of Your Colleagues Ever Had Any Complaints to the Bad Air Quality Caused through Emissions of Paints?"

Overall, 25.4% of the respondents stated that they or one of their colleagues once had a complaint about the bad air quality caused by emissions of paint, appearing in allergic reaction.

However, H8 hypothesis testing results confirmed that there might be a relationship between complaints about the bad air quality and responses to the questions on importance of using solvent-free interior paints ($p < 0.05$). Moreover, this relationship is moderate.

5. Discussion

As explained in the Introduction, the objective of the research questionnaire surveys presented in this paper was to show and analyse and compare end-users' and experts' opinions on sustainability of construction products in general with a detailed discussion on interior paint products. The key questions included the importance of eco-labelling and making LCA transparent and accessible for the end-users. Eight hypotheses were designed and tested on significance.

Whilst among the end-users, it was confirmed that there might be a relationship between responses to the questions on awareness of the LCA and importance of making LCA available to end-users, this was not confirmed in the experts' survey. The same applies to the relationship between responses to the questions on availability of the MSDSs and odour sensitivity. Table 5 gives an overview of confirmed hypotheses for both surveyed groups, the end-users and the experts.

Moreover, it was confirmed among the experts that there might be a relationship between responses to the questions on importance of an eco-certificate and importance to protect ground water. However, it was not confirmed among the end-users.

Furthermore, there was a relationship between responses to the questions on importance of an eco-certificate and importance of indoor air quality in the end-users' survey but it was not confirmed in the experts' survey. The same applies to the relationship between responses to the questions on importance of an eco-certificate and importance of the Blue Angel on the packaging and to the relationship between responses to the questions on importance of using a solvent-free paint and importance of harmlessness of colours for respiratory tract diseases.

Table 5. Hypotheses significance testing confirmation.

Hypotheses	End-Users	Experts
H1: There may be a relationship between responses to the questions on awareness of the LCA and importance of making LCA available to end-users.	Yes	No
H2: There may be a relationship between responses to the questions on availability of the MSDSs and odour sensitivity.	Yes	No
H3: There may be a relationship between responses to the questions on importance of an eco-certificate and importance to protect ground water.	No	Yes
H4: There may be a relationship between responses to the questions on importance of an eco-certificate and importance of indoor air quality.	Yes	No
H5: There may be a relationship between responses to the questions on importance of an eco-certificate and importance of the Blue Angel on the packaging.	Yes	No
H6: There may be a relationship between responses to the questions on importance of using a solvent-free paint and awareness of evaporation of hazardous emissions through paints.	No	No
H7: There may be a relationship between responses to the questions on importance of using a solvent-free paint and importance of harmlessness of colours for respiratory tract diseases.	Yes	No
H8: There may be a relationship between responses to the questions on importance of using a solvent-free paint and complaints to the bad air quality caused through emissions of paints.	Yes	Yes

In both surveys, there was found no relationship between responses to the questions on importance of using a solvent-free paint and awareness of evaporation of hazardous emissions through paints. However, a relationship between responses to the questions on importance of using a solvent-free paint and complaints to the bad air quality caused through emissions of paints was found among the end-users as well as among the expert respondents.

It is important to mention, that, in most cases during the interviews with experts, respondents were talking about their “customers,” where “customers” do not refer to average consumers (i.e., end-users) but rather users in the professional sense, e.g., craftsmen, architects, painters and decorators. Nonetheless, this clearly describes why more than 75% of the respondents noted that their products were only available directly from the manufacturer: Hence, for an end-user obtaining information about such products is literally impossible.

Regarding the importance of the MSDSs, 63.4% of all experts replied *highly important* and 16% of the respondents replied *very important*. Notably, one respondent mentioning that “it should be handed out to everyone” implicitly suggested that this should be obligatory for all manufacturers. Moreover, 62.7% of the respondents stated that their customers, who are not end-users, actually ask for the MSDSs at their respective points of sale.

In comparison to the studies of environmentally conscious behaviour of the average consumers in Germany from 2010, the overall percentage of respondents that pay attention to the Blue Angel eco-label is rising, namely 62.2%. However, most of the people who answered negatively to the question about the Blue Angel were not aware of the existence of this eco-label. Moreover, women and men were aware of the Blue Angel not in equal proportions. Thus, women were paying explicitly more attention to it while purchasing products, 43.4% to 18.8%, respectively.

The age of the respondents also played a role in the decision-making about products with the Blue Angel. Hence, 70% of respondents in the age of 36–65 years old were aware of the Blue Angel and paid their attention to it. However, as for the younger people, only 32.2% of the respondents under 30 paid their attention to the Blue Angel on the packaging. However, most all the people in the age over 65, that is 90%, knew the Blue Angel and paid their attention to it in their decision-making about

products. However, in this study, 212 people participated in the survey for the end-users. Sample size may influence the hypotheses significance testing results.

In fact, the availability of an eco-label, or an eco-certificate, for a construction product, mostly for indoor paints and carpet floors, appears as a highly important issue for an expert user. First, an eco-certificate helps adjust a product to market requirements. Thus, it can keep a manufacturer to remain competitive among other manufacturers with a similar product line. Second, in most cases for a tender procurement, an eco-certificate is one of the prior conditions to fulfil. In some cases, well determined eco-certificates are required. And third, as already mentioned in Section 4.14, EPD, DGNB, GUT, TÜV and Nature Plus were named among the most important eco-labels.

6. Conclusions

Hence, the survey helps analysing and comparing end-users' and experts' views on sustainability and eco-labelling of construction products.

While most of the suggested hypotheses for the end-users were confirmed, only two of the similar hypotheses for the expert users were confirmed either. This may lie on different sample sizes of two groups, 212 to 59, respectively. However, since the experts' survey was a qualitative study, a detailed discussion on experts' responses is presented in the paper.

Interestingly, a direct connection between LCA and EPD was found among the experts' responses. Most respondents suggested that the best way of performing an LCA for end-users should be done in the format of an EPD. The EPD certificates received the strongest attention among those respondents who kept mentioning it during the interviews. Again, it is important to recall that respondents from companies possessing EPD certificates for their products stated a higher importance of making the LCA transparent to end-users. This seems to suggest that companies investing in information gathering about the environmental properties of their products, have an interest in communication about that information. Hence, such information might have a practical relevance for those companies as it creates value for them and their customers. This assumption is based only on the authors' experience gained during the interviews and it might be useful to investigate this issue further.

As already mentioned in the description of the procedure, it appeared that 66% of the expert participants in the presented survey were members of the German Sustainable Building Council. Hence, it is most likely that expert participants in the questionnaire survey, who apparently are members of DGNB, are well informed about issues related to LCA and the EPDs and that this fact which might have influenced some of the outcomes of the survey, especially with respect to the high importance of eco-labelling and EPDs (up to 61%).

For further investigation, the second part of the research questionnaire which includes an assessment of quality and application of indoor paints as well as respondents' experience, helps designing a multi-criteria decision-making model on indoor paints. However, a detailed description of that decision-making model lies within the scope of future research.

Supplementary Materials: The following materials have been provided: www.mdpi.com/2071-1050/10/2/351/s1, Questionnaire survey for end-users; questionnaire survey for experts.

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Conflicts of Interest: The authors declare no conflict of interest.

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