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PERCEPTION OF SELECTED TYPES OF FAMILY HOUSES WITH REGARD TO WOOD-BASED STRUCTURES

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ABSTRACT

Sustainable development is the topic associated with economic growth, and it is discussed with the need to find a way how to satisfy requirements of the present generation without compromising the limits of future generations, guaranteeing the balance between economic growth, care for the environment and social well-being. This idea is analysed within different industries including the building industry looking for the possibilities to meet housing demands in accordance with environmental and health requirements. Therefore, the importance of innovation in the building construction material for sustainable growth focusing on wood-based structures represented by eco-innovation and alternatives to brick buildings in this context is still growing. The results of the survey aimed at investigating the perception of respondents towards various construction types of buildings with reference to reverse thinking is presented in the paper. A questionnaire survey was applied allowing to collect information based on the answers of the investigated sample of respondents in Slovakia to various facts regarding their perception of selected construction types of buildings. Subsequently, the obtained facts were compared to find out the influence of construction type on the choice of family houses of the respondents and, paradoxically, the design effect if they did not have more information about the construction type. Based on the results, the design of family houses significantly influences the decision-making of respondents when choosing a family house unless they have more specific information about its construction.

Keywords: innovation, buildings, wood-based structures, construction, design, attitudes.

INTRODUCTION

The issue of sustainable development deals with economic growth regarding the requirements of society by creating well-being conditions from a short-term, medium-term as well as long-term perspective. The economic and demographic development is obviously reflected in the demand for natural resources. The continual commitment to participate in sustainable development by innovations adjusted to customers and trends in world markets is adapted when applying the principles of sustainable development and environmental protection (Loučanová *et al.,* 2015; Šterbová *et al.,* 2016; Parobek *et al.,* 2015; Loučanová *et al.,* 2017).

Sustainable construction is a possibility how the building industry can contribute towards sustainable development. The essence of this intention consists in modifying the

demand for sustainable development into an opportunity, creating and breaking into new markets, and innovating responses that satisfy traditional needs in the industry and the new societal demands for sustainable development (Bourdeau, 1999). A building project can be considered sustainable just when environmental, economic, social, and cultural dimensions of sustainability are dealt with. The various sustainability issues are connected, and the interaction of a building with its surroundings is also important. The environmental issues and related concerns (such as reduction of the use of non-renewable materials, emissions, wastes, and pollutants) can be found in several building sustainability assessment methods (for example, optimization of site potential, minimization of energy consumption, protection and conservation of water resources, use of environmentally friendly materials and products) (Bragança *et al.,* 2010).

Current lifestyle trends, especially in the housing sector, indicate a preferred return to more natural as well as more personalized housing. Changes in preferences can be accomplished by a wide range of options, they are mostly perceived in the preferred types of houses (family homes against the impersonal and often restrictive housing that is typical for living in a block of flats) as well as in the choice of materials. Modern construction methods encourage the application of ecologically and energy-efficient buildings, responding to negative externalities caused by the production of construction materials (Švajlenka and Kozlovská, 2018). One of them is the contribution to significant environmental pollution and greenhouse emissions (particularly CO_2). As stated by Hurmekoski (2015) the global construction and building sector is responsible for 42 % of total energy consumption and 35 % of total greenhouse gas emissions. Construction and housing play a fundamental role when aiming at enhancing societal goals for sustainable development and in accordance with Hurmekoski *et al.,* (2015) environmental impacts of construction practices are considered in the context of material renewability and recyclability. It is claimed that the total final energy consumption could be decreased by approximately 40 %, total greenhouse gas emissions by 35 %, and the use of building materials by 50 % by developing the construction and utilization of buildings in the EU, (Herczeg *et al.,* 2014; Olšiaková *et al.,* 2017).

Due to one of the critical issues of climate change mitigation, the public perception of wood as a sustainable building material that can facilitate the shift towards a bio-based economy is necessarily important to consider (Petruch and Walcher, 2021). In this context, the traditional and long-established construction materials (e.g., brick and concrete) are supplemented by modern, innovative, and viable construction alternatives, where one of the most popular alternatives is wood (Švajlenka and Kozlovská, 2018), as it is natural, renewable, low-carbon, reusable and recyclable building material that already is used widely in the construction industry (Mitterpach and Štefko, 2016; Štefko *et al.,* 2013).

Sustainable development is frequently discussed issue in considering the acceptability and efficiency of solutions based on building and living preferences. There is a significant environmental change in societal values toward sustainability and sustainable development (e.g., Autio *et al.,* 2009, Pätäri *et al.,* 2016), which is reflected in the customer's purchasing behaviour. This idea can also be applied in household preferences. Environmental and health-benefitting issues have increased the focus on using natural and renewable building materials such as wood in the built environments. The following influence of wood and wooden materials on perceived indoor environmental quality has been of interest lately, with a growing number of research studies (Alapieti *et al.,* 2020).

There are different approaches from the perspective of architects and customers regarding the specific country (Harju, 2022; Farkašová and Baďura, 2021; Farkašová and Petránsky, 2020). According to Harju (2022) in terms of geographical area, wood

consumption research was worldwide, focusing on Europe, North America, and Asia, but the majority in developed countries and most of the research was conducted in Finland. Harju (2022) also points out that most of the research investigated wood as a building material in the context of wood flooring or decking but did not focus on applications such as the use of wood in load-bearing construction, facades of houses, or interior walls. The reason may be the fact that consumers might have fewer opportunities to decide on the construction or systems of houses in the context of multi-storey construction markets.

The share of wood construction in total construction varies greatly among countries (Leszczyszyn *et al.*, 2022). Nordic countries, where wood is a locally produced and readily available resource, have long traditions of using wood for construction (Strobel *et al.*, 2017). In Sweden, according to Roos *et al.*, (2010) architects and constructional engineers prefer wood because of its strength, environmental friendliness, easy handling, and appropriateness for use in conjunction with other materials. But on the other side, Swedish architects and contract managers also associate it with several disadvantages and uncertainties, primarily with respect to fire safety, stability, durability, and acoustic properties (Hemström *et al.*, 2011).

The use of wood in non-residential construction projects has increased in the last decades, but as stated by Toppinen *et al.*, (2014) as well as Gosselin *et al.*, (2016) it is still not a common practice. While many world well-known non-residential buildings have used wood as the key construction material, many studies point to still unexplored economic potential (Gosselin *et al.*, 2016). Consumers and as well as construction material companies consider the environmental quality of wood to be important (Toivonen, 2011, Toivonen, 2012). According to Toppinen *et al.*, (2013), the aesthetic characteristics of wood, following the social acceptability of products and the environmental sustainability of wooden products in housing are associated with a distinct consumer lifestyle, arising from a complex system of consumer backgrounds, values, and behaviour. According to Toivonen (2011), wood represents an attractive material compared to many other materials. However, as Kaputa *et al.*, (2022) claim, a positive perception of wood does not automatically result in a willingness to live in multi-story wood-based structures.

Although the consumer perceptions of the environmental quality of wooden products are logical (Toivonen, 2012), the practical meaning of environmental attributes can still be vague for the majority of consumers, and it is typically not the main quality attribute driving consumers in their choice of construction materials. As for targeting, according to a recent study by Hoibo *et al.*, (2015) from Norway, younger people with strong environmental values were found to be the best target for increasing wood-based urban housing. Kaputa *et al.*, (2022) also point to young people, whereas to identify the target group of consumers for wood-based urban housing, current studies indicate to young people with an unconventional approach to innovative things. The domestic origin of wood materials has been found to associate with environmental quality, for example in Finland (Toivonen, 2012) as well as in Europe (Rametsteiner, 1998). Also in other contexts, the environmental quality of wood has been found to connect with consumer willingness to buy and even to pay premiums for products of higher environmental quality (Hansmann *et al.*, 2006; O'Brien and Teisl, 2004). Overall, consumer knowledge probably is yet likely to be relatively low when it comes to building materials´ impact on human health (Keith, 2011).

Some studies indicate that wood tends to be selected slightly more often than before, although it could technically be used in a more construction projects. In the coming decades, the need for the sustainable building will increase on a global scale due to population growth, urbanization, and densification of cities (Seto *et al.*, 2012). Gosselin *et al.*, (2016) were concerned with the factors of motivation but also possible barriers in the context of wood

used for buildings. The motivations were linked to sustainability, technical aspects, costs, rapidity of construction, and aesthetics of wooden construction. In contrast, some barriers (such as building code implementation, lack of expertise, costs, material durability and technical aspects, the culture of the industry, and material availability) still prevent its use. Espinoza *et al.*, (2016) showed that one of the most significant market barriers for civil engineers and researchers in timber construction is the public misperception about wood and new technologies. Leszczyszyn *et al.*, (2022) in their study indicate strong regional and cultural differences regarding the acceptance of some of the opportunities and barriers related to the development of wood construction. The findings indicate a need to promote wood construction based on its technical and economic benefits. Through environmentally oriented management of product portfolio, it is necessary to apply activities that allow overcoming the conflicts among market, society, and environment through ecological innovation (Kalamárová *et al.*, 2014; Olšiaková *et al.*, 2016; Parobek *et al.*, 2016; Paluš *et al.*, 2018). An increase of wood as a construction material in non-residential buildings would stimulate the forest products industry (Gosselin *et al.*, 2016).

The paper presents results of the evaluation of respondents' attitudes towards various construction types of buildings including certain types of family houses of wooden construction. The objective of the applied survey is to find out the possible change sequence in the preferences of respondents for individual selected types of family houses before and after knowledge of specified information associated with the particular types of family houses.

MATERIALS AND METHODS

The survey was applied online by the questionnaire, and aimed at investigating the perception of respondents towards various construction types of buildings with reference to reverse thinking. This method allows to obtain a wide range of information based on predetermined questions. It achieves a higher quality, and respondents have time to consider answers. On the other hand, it is a disadvantage when questions require spontaneous answers.

The questionnaire consisted of three parts:

1. ***Demographic data about the respondents (age, gender, place of residence, income).***

2. ***The characteristics of selected types of buildings:***

   - Brick houses – The basic element of brick house is a brick – a type of block used to build walls and other elements in masonry construction. Bricks can be joined using mortar, adhesives or by interlocking them (Beamish, Donovan, 1989).
   - Prefabricated wooden buildings – they are made up of prefabricated components delivered (wooden panels) and assembled on site. Panels can be open – that is a preassembled wall that is later fitted with insulation, weather barriers and cladding – or closed, such as a total preassembled wall panel complete with windows, doors, plumbing, electrical and finishes (Naturallywood.com, 2023).
   - Container houses – A container house is a dwelling made from recycled steel shipping containers that may have been used as a cargo carrier on a ship, train,

or truck (O'Connor, 2022).

- Mole houses – These are houses protected by the ground (part of the building is partially underground) (Armstrong, 2019).
- Thatched houses – There are houses where the basic building material is straw. The straw was either long straw, combed wheat reed or in wetland areas water reed was used (Sule, 1987).
- Log cabins – are houses of wooden construction. There are log cabins of several forms, having different methods of corner timbering, and they utilized both round and hewn logs (Weslager, 1969).

3. Survey questions

The survey questions were related to the areas such as preferred type of a family house according to the construction type. In the next step, the respondents were asked to choose preferred type of the house when they were provided with more information about pros and cons of individual types of family houses.
Subsequently, they were provided with the average prices of selected types of family houses with a usable area of approximately 100 m^2 (new buildings).
Finally, respondents obtained pictures of family houses without specifying the type of the family house from the construction point of view were presented (Figure 1), their price and the pros and cons of individual buildings.

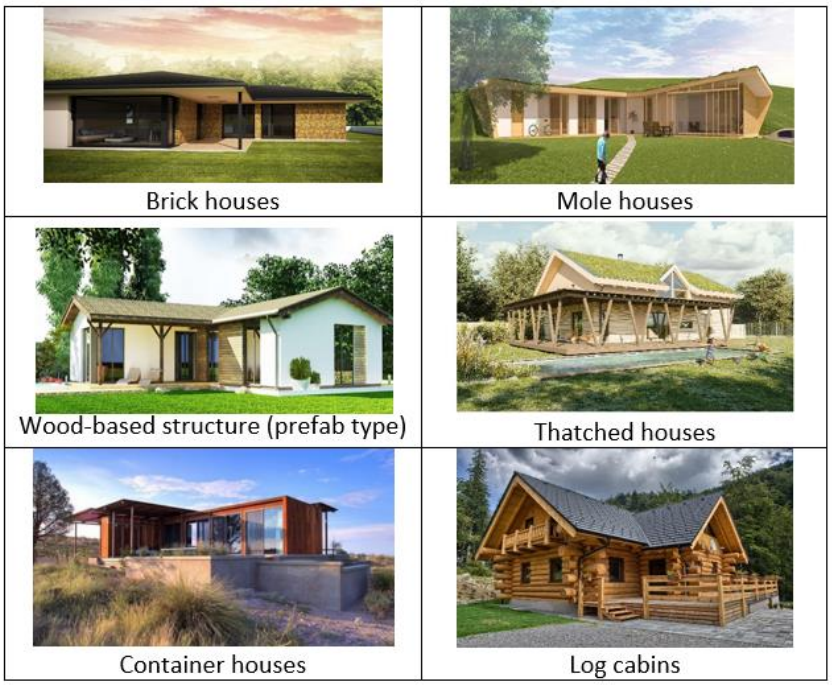

Fig. 1 Selected types of the houses used in the survey.
Source: Bývanie SK (2017), Inblok (2022), Loft (2021), Mešťanová (2019), Murovany dom (2022) and Rodinný dom krok za krokom (2022).

4. Type of the family house presented in the picture meeting the respondents' expectations

The last question represented experimental survey, which can be considered the most beneficial from a scientific point of view. Its aim was to reveal the causal relationships

between the cause and its effect while excluding other influences acting on the effect.

The purpose of the survey was to reveal the causal relationships between the traditionalist approach of respondents to brick family houses and its consequence while excluding other influences on this consequence, such as the building construction itself when presenting only the visual form of alternative, innovative and modern supplies of family houses.

Respondents had the opportunity to answer on a Likert scale from 1 = I would definitely prefer the specified type of the family house, 2 = I would prefer the specified type of the family house to, 3 = I do not know or a neutral attitude, 4 = I would not prefer the specified type of the family house, until 5 = I would definitely not prefer the specified type of the family house. As it is stated by Kotler and Keller (2016) and Tomšik (2017) this method of measuring the attitudes of respondents to the investigated issue is typical for measuring attitudes in marketing. It is one of the most used method in research, and this is the reason why it was applied in the survey. It is used to measure people's opinions and attitudes. The measurement of attitudes allows the respondent to express the degree of agreement, or disagreement with a product or a group of products and other motivational manifestations of behaviour. The biggest advantage of the Likert scale is the possibility to compare variables with respect to a certain characteristic.

The Likert scale of answers was not used for the last question, as the respondents chose from pictures of individually selected types of family houses.

5. Sample of respondents

As the next step, we set a sample of respondents. The sample of respondents was determined at a confidence level of 99 %, with a tolerance error of +/- 5 % of the standard deviation of 0.5, which at the given data represents the value of 665.64, i.e., 666 respondents.

6. Survey implementation and evaluation

There were 670 respondents, so the results regarding the confidence level, standard deviation, and margin of error are relevant.

The subsequently created database was evaluated through descriptive statistics, according to Chráska (2000) – average, standard error, median, mode and confidence level.

The standard error indicating the inaccuracy of the estimate of the given value from the measured data burdening the sampling error of the file is low, and on average it is about 5 %.

The median or middle value of the investigated parameter determines the value that divides the sequence regarding the size of the organized results into two equally numerous halves.

The mode or the most probable value is the value of the quantitative characteristic of the statistical file that has the highest relative frequency, so it occurs most often.

A confidence interval was determined to find out the statistical significance of the results. Confidence intervals are set so that the expected ratio of independently determined intervals in which the real value of the parameter occurs is equal to the confidence level.

The change in attitudes of selected individual types of family houses among respondents is analysed by the method of comparison. Conclusions following the obtained results are formulated by the methods of deduction and induction.

RESULT AND DISCUSSION

The aim of the paper was to find out the change sequence in the preferences of respondents for individually selected types of family houses before and after the effect of specifying the information provided for the particular types of family houses. The results of a questionnaire survey evaluated by descriptive statistics point to differences in perception and preferences of analysed family houses, see Table 1.

Tab. 1 Model Summary.

	Family house type	Mean	SD
Preferred family house when specifying the construction	Brick house	1.54	0.0348
	Wood-based structure	2.42	0.0508
	Container house	3.83	0.0459
	Molehouse	3.55	0.0544
	Log cabin	2.98	0.0586
	Thatched house	4.23	0.0397
Preferred family house after considering advantages and disadvantages of selected types of family house	Brick house	2.64	0.0505
	Wood-based structure	2.35	0.0494
	Container house	4.16	0.0416
	Molehouse	2.92	0.0568
	Log cabin	3.71	0.0467
	Thatched house	3.34	0.0565
Preferred family house after considering the price of selected types of family houses	Brick house	2.31	0.0479
	Wood-based structure	2.45	0.0501
	Container house	3.57	0.0463
	Molehouse	2.59	0.0534
	Log cabin	3.90	0.0421
	Thatched house	2.94	0.0572

The research results confirm that the brick house has remained a timeless classic and it is still the most preferred type of family house among respondents from the point of view of construction. It is followed by a wood-based structure, subsequently by log cabin, molehouses, container houses and finally by the thatched family houses as the least popular.

Subsequently the respondents were informed about pros and cons of the selected types of family houses. This newly provided information was reflected in the change of the order of preferred houses. In this case as well, the respondents perceive the most positively a wood-based structure, followed by a brick house. The types of family houses such as molehause, thatched house, and log cabin were perceived less positively. Despite the additional information provided about the pros and cos, the container house remains in last place even in this case.

The next finding of the research is the confirmed effect of house price on respondents' preferences. The average prices of individual types of family houses in new construction with an area of approximately 100 m^2 were used for assessment. Following the price assessment, respondents identified a brick house as the most preferred type. In terms of preferences this type of house is followed by a molehouse and a wood-based structure. At

last, the respondents perceived thatched house, container house and log cabin less positively.

Obviously, specifying the information provided for the particular types of family houses caused obvious changes in the respondents' preferences for individual selected types of family houses (see Table 2).

Tab. 2 The change sequence in the preferences after specifying information about houses.

Sequence	Preferred family house when specifying the construction	Preferred family house after considering advantages and disadvantages of selected types of family house	Preferred family house after considering the price of selected types of family houses
1	Brick house	Wood-based structure	Brick house
2	Wood-based structure	Brick house	Wood-based structure
3	Log cabin	Molehouse	Molehouse
4	Molehouse	Thatched house	Thatched house
5	Container house	Log cabin	Container house
6	Thatched house	Container house	Log cabin

Then, we focused on the experimental part of the survey. It aimed to reveal causal relationships between the traditionalist approach of respondents and the determination of their attitudes towards the choice of a family house and its consequence when excluding other influences acting on this result (e.g., characterization of the construction of the building, price etc) and presenting only a visual form of alternative, innovative and modern family house possibilities. The following graph illustrates just these respondents' preferences regarding the design of the house (see Figure 2).

Fig. 2 Preferences of individual selected types of family houses regarding their design without specific information.

We compare the obtained facts to find out the construction type influence on the choice of a family house of the respondents and, paradoxically, the design effect, if they do not have more information about the construction type, see Figure 3.

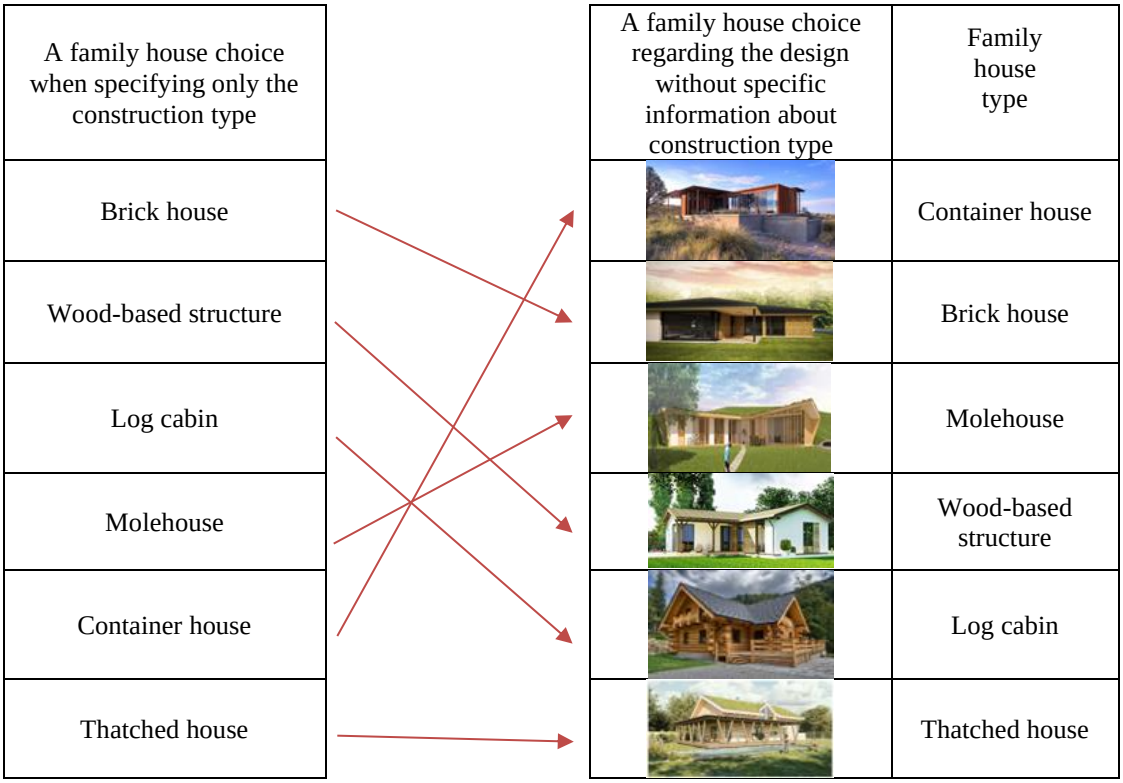

Fig. 3 Comparison of respondents' attitudes towards selected types of family houses according to the provided information about construction types of houses.

With respect to the given results and the realized analyses, we can conclude that the design of family houses has a significant influence on the decision-making of respondents when choosing a family house, until they have more specific information about its construction. The most significant change in perception was demonstrated in the case of container family houses, where they changed from the least preferred to the most preferred when considering the design. The other considered types of family houses recorded only a slight negative movement in position caused by the radical shift of container family houses.

When analysing the obtained results with regard to wood-based structures, the primary places belong to wood-based structures after specifying the advantages and disadvantages of individual selected types of family house. As it is presented by Gosselin *et al.*, (2016) identified motivations were related to sustainability, technical aspects, costs, speed of assembly etc. From the perspective of respondents this type of family houses achieved the second place when considering the price of wooden constructions. By Espinoza *et al.*, (2016) this fact about the perception of wooden houses is one of the most significant market barriers in the wood-based structures, and it is caused by the wrong perception of wood and new technologies used in the construction of wood-based structures by the public. A similar fact is also confirmed for other types of family houses, which represent an alternative to brick family houses, representing the conservative approach of respondents to family houses.

These facts correspond to the results of the study by Lähtinen *et al.,* (2016) who claim that the willingness to live in wooden houses and prejudices against the suitability of wood as a construction material differ. Two main categories of consumers were identified based on their perception of the benefits of wood in terms of sustainability, i.e., those that prioritize the ecological and physical-technological advantages of wood and those that prefer the aesthetic and good properties of wood. The results highlight the need to deepen the understanding of sustainability issues affecting the acceptability of wood among different types of consumers. Toivonen (2011, 2012) presented that consumers and companies consider wood-based structures to be rather ecological and important, they associate them with environmental sustainability in construction industry. As it is stated by Toivonen (2012) and Hoibo *et al.,* (2015), the main target group of these constructions is created mainly by people with strong environmental values and people are willing to buy and pay more for products of higher environmental quality (Hansmann *et al.,* 2006; O'Brien a Teisl, 2004).

Finally, we can state that wood-based structures, despite considerable positives, are still strongly competitively influenced by brick houses in Slovakia. Toppinen *et al.,* (2013) stated that wooden houses though represent an alternative in the construction industry, but they are not traditionally used. Therefore, within the creation of marketing strategies of manufacturers of wood-based structures as well as the creation of policies focused on the construction industry and sustainability, it is appropriate to consider the obtained facts, and expand experiential marketing, pointing out the design and other advantages of wooden houses.

Based on the results, we can conclude that wooden houses are the second most preferred types of houses in terms of construction and price. From the point of view of the advantages and disadvantages of individual types of houses, wooden houses have the leading position. Design largely determines the choice of houses as the types of houses that were given lower rating than the brick or wooden houses were preferred when design was considered. Therefore, it can be recommended that marketing strategies promoting wooden houses should be focused on raising awareness of the advantages of wooden houses rather than the design itself as this information may significantly change the preferences of the respondents. In particular, it should focus on the advantages of wooden houses such as the use of as many ecological materials as possible, good thermal insulation properties, low weight, easy assembly and other advantages, while maintaining the quality of the construction and thus meeting the conditions of fire protection and other safety standards (Gracovský *et al.,* 2020). At the same time, the marketing strategy itself should utilise the potential of environmental aspects within the framework of fashion marketing, bring together originality, creativity, and intuition within the framework of design proposals while providing required profitability. As stated by Ginsberg and Bloom (2004), the concept of fashion marketing tries to include all the positive aspects of a high focus on design, customers and profit and their interdependence. If the designer understands that marketing can help the creative process and the marketer understands that without design it is impossible to meet the customer's requirements, this is a significant step towards progress and greater establishment of wooden houses on the market.

Despite of our efforts to incorporate all relevant background in this study, some limitations can be assigned to the territoriality of the survey as well as incomplexity of definition of relevant factors and aspects influencing customer decision-making.

CONCLUSION

Innovation and sustainable growth play an evitable role in a market economy. A lot of improvements, mainly allowed by innovations, occurred in the building industry where the consumers challenge the question of which type of ~~the~~ building is more suitable while keeping the environmental burden as low as possible. This idea is also part of many studies focusing on attitudes towards selected attributes of individual innovative types of buildings.

Following our survey results, we can assume that consumers' preferences differ according to the provided information about alternative housing possibilities. The aim of the survey was to reveal causal relationships between the traditional approaches of respondents who change their choice of an alternative form of a family house according to the amount of information provided. The subsequent comparison of their first preferences pointed to the change in their preferences when respondents decided only based on the design of a house or if they already had information about the construction of the alternative house. We can conclude that the design of a family house has a significant influence on the decision-making of respondents when choosing a family house, until they have more specific information about its construction.

It is obvious that wood-based structures present a highly competitive construction to brick buildings in Slovakia. This fact should be also considered in the construction industry. Concurrently preferences in ~~the~~ alternative houses design and their construction should be elaborated in the marketing strategies with the intention of supplying consumers with the most suitable residential solutions. The offered alternatives should consider respondents' demands not only regarding the design of the house, but mainly to take into account their requirements related to the construction of the house. A lot of improvements mainly allowed by innovations occurred in the building industry where the consumers challenge the question of which type of the building is more suitable while keeping the environmental burden as low as possible. This idea is also part of many studies focusing on attitudes towards selected attributes of individual innovative types of buildings.

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