Preliminary report

The influence of the 2020 crisis on the demand for traditional and novel construction and building materials in Serbia

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A B S T R A C T

Even though the specific COVID-19 consequences for sales have been extensively discussed, no academic research has been done on how the pandemic has affected consumer choice and purchases of construction and building products by private individuals. This research was conducted to fill in the gaps in the body of knowledge and advance understanding of how the crisis has impacted wages, market prices, and material usage in the construction industry in a developing country. The data are collected through the use of a questionnaire survey. The respondents shared their experiences between the period before 2020 and after the beginning of the crisis up until the end of 2022 and showed that purchases of these products decreased during the lockdown and afterward. The obtained results were analyzed using statistical tools, namely frequencies, descriptive statistics, and constructs. This study reveals a high interest in using novel materials but also a desire to be more informed on the details and their potential benefits. The results present a first-of-a-kind approach that will help further development in this branch of the industry by following the needs of potential private customers in a developing country. Further studies would need to include not only contextual but also personal factors that influence environmentally friendly choices.

1   Introduction

The construction industry represents a great threat to the natural environment and thus is under a lot of pressure to become more sustainable, considering the high consumption of energy and raw materials and its considerable contribution to global greenhouse gas emissions [1,2]. Besides, this sector generates huge quantities of waste after the construction and demolition phases [3,4] and requires a high-profile change. Nearly 30-40% of total solid waste in the world is from construction and demolition processes, whereas its production only in Europe is around 0.175 billion tons/year [3]. Developing countries are estimated to produce more than 10 times the quantities produced in Europe [3]. Sustainable solutions are increasingly available; however, they do not appear to be generally used.

The UN Sustainable Development Goals, which call for consideration of environmental, social, and economic life cycle sustainability in buildings, are closely tied to the need for sustainability adjustments in the residential construction sector [5]. Seen in this light, the possibility of using different waste or lower-quality materials in production has been examined for decades [3, 4, 6, 7], increasingly implementing mathematical modeling of large datasets [8]. Various new production methods are also being tested, such as geopolymerization [9, 10]. Life cycle assessments are recently being intensively performed, to judge the impact of a certain product on the quality of the living environment [11-13]. In addition, the introduction of the ecological label on certain products from this branch of industry has become mandatory [14] and is a good practice to bring relevant information to the customers [15].

In 2019, Serbia's economy was in a mediocre state, with real GDP growth of 3.2% and the lowest 10-year unemployment rate of 10.5% [15]. Early in 2020, the nation's finances were in much better shape thanks to considerable reductions in its fiscal deficit and external debt [16]. A global pandemic that had never been seen before began to spread in 2019 [17]. The effects of COVID-19 in Serbia had an increasingly negative impact on workers in the informal economy and smaller enterprises. With the Russian-Ukrainian war beginning on February 24, 2022, the world economy has continued to undergo major changes [18]. The cost of building materials in Serbia has dramatically risen since 2020 [18-20]. A further increase is anticipated given the rising cost of energy [20] and the fact that it contributes a high amount to the price of building materials, especially steel and concrete [21]. The result was an increase in the price of

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residential space per square meter, which is estimated to be 1.8 % for new dwellings when 2019 and 2020 are compared [22]. Top-down and bottom-up economic shocks occurred, and substantial changes in corporate and personal circumstances affected both domestic and global supply and demand trends for products and services [17, 18].

The previously published surveys in the field of construction and building materials and products are scarce, while many include experts in the field and are based on construction projects in developing countries [18,23]. Only one partly similar 100-respondent survey was conducted in Russia in 2016, aiming to find the behavior patterns of private consumers of construction materials. The main conclusions were that price and quality were the key criteria and that a low share of respondents were oriented toward environmentally friendly materials [24]. Other studies were concerned about specific environmentally friendly solutions (using construction and building materials incorporated with dredged sediments or construction and demolition waste) by consumers in Belgium [15] or contractors in China [25]. While consumers were mainly worried about the quality and chemical resistance of such products [15], contractors were mainly driven by government measures. Furthermore, a review study on willingness to use construction and demolition waste containing materials determined "negative attitude" as the main personal boundary, and as a contextual problem, price and quality were found [26]. Furthermore, the factors influencing the willingness to use recycled building materials based on the perceptions of the main stakeholders in the construction industry are studied in New Zealand. Results indicated that price and self-satisfaction are of the highest influence, while the choice was also found to depend on the age, gender, and income of the respondents [27]. In addition, a study dealing with general green product consumption in India was based on an in-depth questionnaire survey of 20 professionals. The price and quality of the products were determined to be a major concern for customers of green products [28]. Another similar study was done in Germany with 306 participants and aimed to find out the decision-making process of individuals to buy environmentally friendly construction products [29]. Their findings show that although customers are generally interested in sustainable building goods, they do not have a comprehensive understanding of the term.

This study focused on a randomly chosen private group of people to observe their experiences and opinions on the subject. A minimal sample size required was calculated from the formula [30], and it was determined that a sufficient number of 391 respondents to describe a 7 million-person nation answered the questionnaire [18]. The following questions are addressed: In what ways has the crisis affected salaries, market pricing, and material consumption in the building sector? Which factors influence the choice of construction and building materials in Serbia? What is the connection between being interested in ecological and novel products and purchasing them? A special emphasis in this work is given to novel and ecological materials and further directions of sustainable development in this industry.

2 Methodology

The inquiry was open to all Serbian citizens who were at least 18 years old. The goal was to compile a representative sample of people from a range of demographics, including age groups, specialties, and levels of ownership of flats, houses, and cottages. An objective and wide picture of the situation in Serbia is expected to be seen since the survey was not based on respondents like experts in this field. Industry and business specialists were given a draft of the questionnaire for discussion and improvement. After the agreed-upon revisions had been incorporated, a small random sample of participants completed the survey to ensure clarity and improve the study's validity. The list of questions is given in the Appendices. The answers were gathered using multiple methods, such as an online and paper-form questionnaire, between January and September 2022. Only those respondents who fully answered the survey were included in the analysis. A total of 391 respondents were deemed qualified to describe a country like Serbia with a population of 7 million people [18].

The first group of questions was primarily concerned with important sociodemographic information (age, gender, education, occupation, and salary satisfaction). Additionally, the respondents fulfilled the information on possessing a residential or guest property and what kind of home they resided in (an apartment or house, rented or owned). Another set of queries focused on the purchase of building materials and products before and during pandemics and major world crises. The goods in question were divided between construction products with a specific shape (bricks, tiles, sanitary ware, carpentry, etc.) and building materials (cement, glue, paint, etc.). During this session, a quantitative seven-point Likert scale survey was given out as needed. The final set of questions aimed to find out if respondents had ever used novel construction materials and how likely it was that they would do so in the future.

Statistical analysis is employed to explain and study the collected data using the IBM SPSS 22 program. Exploratory data analysis, such as frequencies and descriptive statistics was used to analyze the obtained database. Furthermore, to determine the number of components (constructs) that dominate the observed variables and, consequently, options for data aggregation, a principal factor analysis was carried out [15, 31].

3 Results and Discussion

The initial round of questions concentrated on crucial sociodemographic information, including age, gender, education, profession, income satisfaction, and changes in earnings following the crisis starting in 2020 (Q1-Q14, Appendices). The detailed results of these extended socio-demographic results for a tested group are presented in a previous study [18]. The age group of the respondents with the highest percentage (30.2%) was 31–40, while the least numerous group (0.3%) was aged between 71–80. Those with a college degree had the fewest percentages (1.0 %). In addition to office professionals (11.5%), doctors and medical personnel (14.3%), and engineers (16.9%), the group also included professors/lecturers (10.7%) and scientists (8.4%).There were a reasonable number of people in various professions and also those who were unemployed, which enriched the database's diversity. Women with university degrees and residents of the city with a population of more than 2 million (Belgrade, Serbia) made up the majority of the participants [18]. Respondents in questionnaire research carried out in Croatia had a similar sociodemographic distribution [32].

A 7-level Likert scale is used to gauge salary satisfaction, which is primarily expressed as average (27.6% of the respondents). Their income generally grew (51.4%) after the start of the pandemic and the current crisis, which might be attributable to advances in the workplace—a factor that was ignored in this study [18]. The respondents were also

questioned about the kind of home they occupied and if they owned a residential or a guest house. Most interviewees claimed they had never relocated before. The vast majority of survey participants do not own a private residence, and of those who do, the bulk of the homes were constructed more than 40 years ago [18].

The second set of questions focused on the purchase of building materials before and during pandemics and major world crises. The majority of respondents (32.7 %) experienced that a product's price is averagely correlated with its quality, that the price/quality relationship has not considerably changed since the crisis, and that the cost of construction and building materials has significantly grown [18]. This is consistent with a report by the National Association of Home Builders, which claims that building material costs in the US grew by 20.4% annually and by 33% overall since the pandemic began [33]. The respondents mostly purchased these products 2-5 years before the pandemic (41.4 %). An increased percentage of study participants (54.5 %) stopped buying the products of concern once the pandemic and crisis started. A more thorough picture of the situation, seen from the point of view of private individuals, in the analyzed country, was created.

The third set of inquiries aimed to assess the methodology by which construction and building materials and products were purchased before and during the crisis (Q17-Q21 in the Appendices). Before 2020, 34% of respondents chose these products based on a fair price/quality relationship, which was found to be the same in previous studies [15, 24]. The smallest share of people bought the most expensive (4.6 %) or products from famous firms (9.7 %). This result could be a problem when accepting waste-added products since private purchasers tend to put confidence in those when they trust the manufacturer [15], which might be different from the point of view of contractors as primary purchasers of these products [25]. If particular knowledge is absent, trust is regarded as crucial [15]. During

the crisis, these products were mostly not purchased by private individuals, and among those that did, they again chose a fair price/quality relationship (26.1%) [18].

Furthermore, the respondents' usage of novel building materials as well as their likelihood of choosing to do so in the future are asked (Q24-Q28 in the Appendices). Presumably, the respondents (78.5%) do not presently use novel materials, while only 9 % claimed they do [18]. Among those that are aware of using these products in Serbia, the majority of participants use shaped products (58.14%), while the rest (41.86%) use non-shaped materials [18]. The majority of respondents claimed they are mostly interested in using novel and ecological materials at an above-average Likert scale level, while the scope of work required, the price of a product, and their knowledge of the benefits would influence their choice to a similar degree (Fig. 1). In conclusion, it is seen that the producers ought to be more open about this topic. This is consistent with other studies and surveys carried out in the industrial sector [15, 24] where purchasers from developed countries expressed concern about the quality and chemical inertness of the waste-added products.

Another issue is that there are not many of those clearly labelled environmentally friendly goods on the market [26]. A product's price increase would result in more information being needed by prospective customers, which can present a drawback to adopting Eco-labelled products [18, 34]. Performance and return on investment will improve if construction companies and individual customers are aware of the key advantages of using environmentally friendly construction and building products. The demand-supply dynamics in this market segment will improve as the potential benefits become more apparent [35].

The answers considering construction and building materials and products were calculated per response (Fig. 2) since some of the answerers offered multiple responses to

Likert`s 7-level scale: *1– very low, 7 – extremely high*
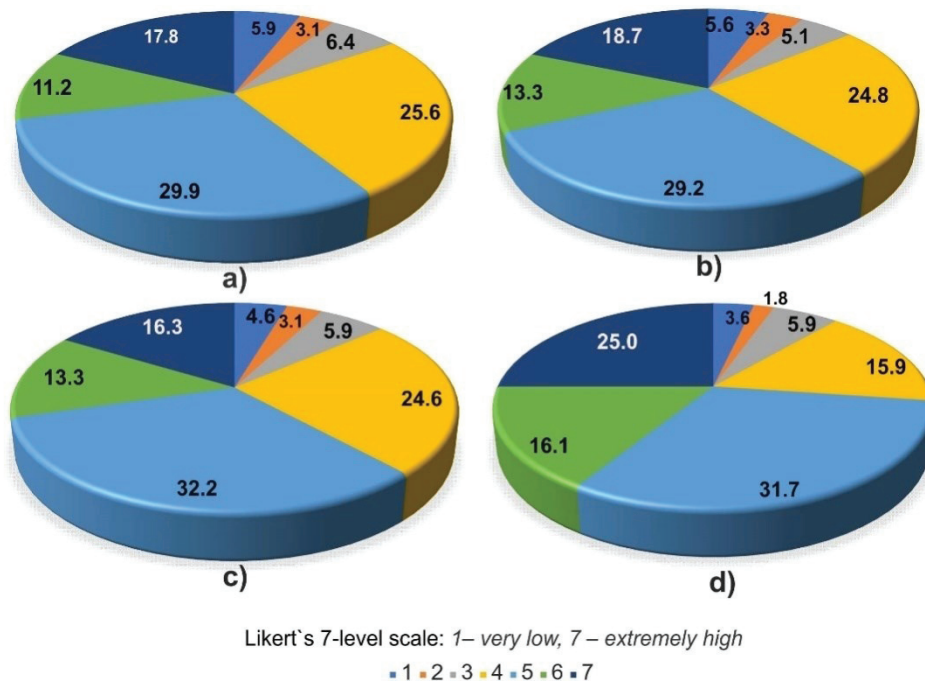
■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7

Figure 1. Based on what did the respondents choose construction: a) Materials before the pandemic and world crisis (Q17), b) Products before the pandemic and world crisis (Q18), c) Materials during the pandemic and world crisis (Q20), and d) Products during the pandemic and world crisis (Q21)

Q28. The responses about all novel material usage are summed to 100%. Considering shaped products (Fig. 2a), most of the answers were related to relatively novel carpentry options (13.1%). The next choice in line was kitchen work surfaces like HDMR wooden boards and nano-composite or onyx stone. (8.2 % of all the answers). Masonry and covering building products like siporex concrete blocks and roofing tiles, or eco-separate walls, were a 6.6 % choice. Floor covers, including eco-ceramic tiles and other novel materials, were also utilized. There are also rare examples of using green and fiber-reinforced concrete, structural timber products, and solar panels, accounting for 3.3.% of the responses each (Fig. 2a). The rarest were the recycling of construction aggregates, eco-lightning, and eco-electrical installation. Among non-shaped products (Fig. 2b), most of

the answers (11.5%) were related to different kinds of paint (acrylic, specialized, or polymer). The next choices in line were materials used for fungal treatment purposes (9.8%) and coatings used for thermal insulation and protection of wooden materials. Waterproofing agents, novel adhesives for parquet and ceramic tiles, and polymer cement mortar were also utilized. The low practical acceptance of novel products is not surprising considering that having a general awareness of the environment does not guarantee that one will act in an environmentally friendly manner [15]. Furthermore, market demand determines whether resource recovery efforts are successful [26]. However, a personal attitude and being aware that everyone influences the quality of the global environment through their choices is a powerful motivator for those choices [36].
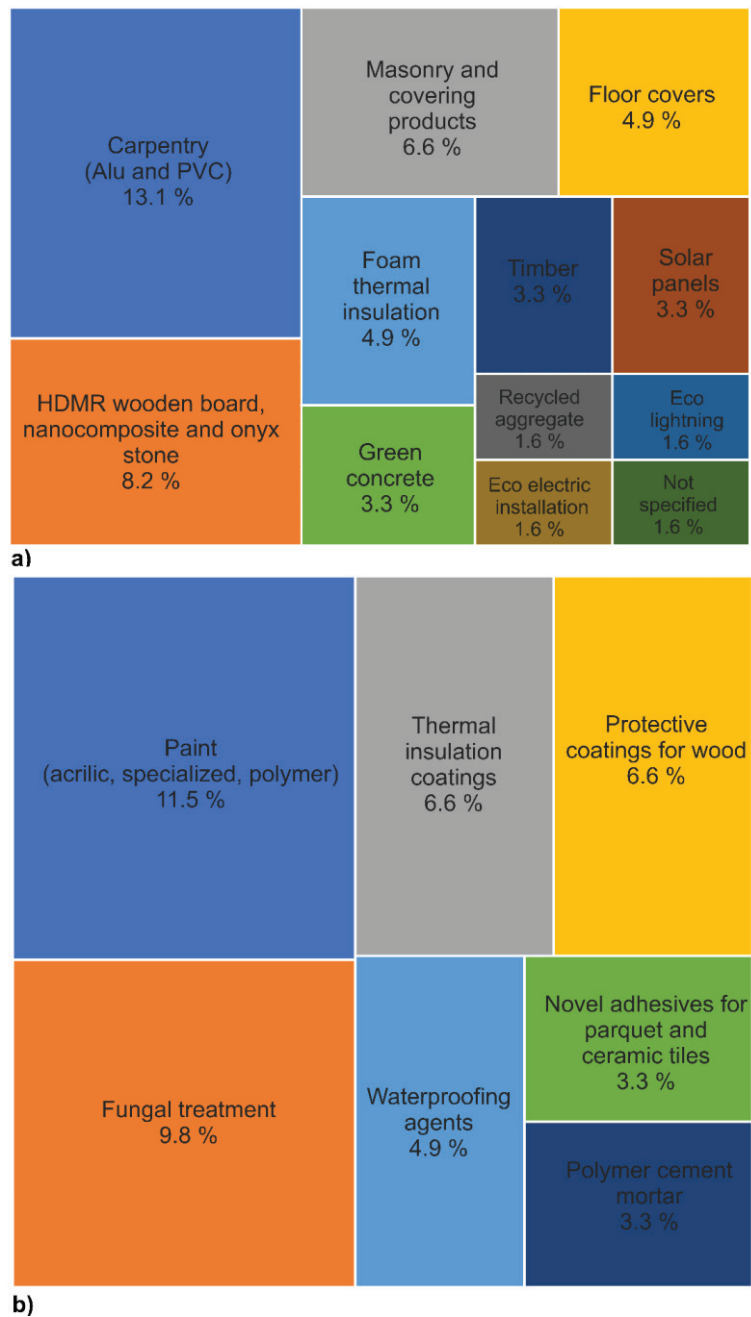

Figure 2. The novel construction and building materials usage: a) Shaped and b) Non-shaped products
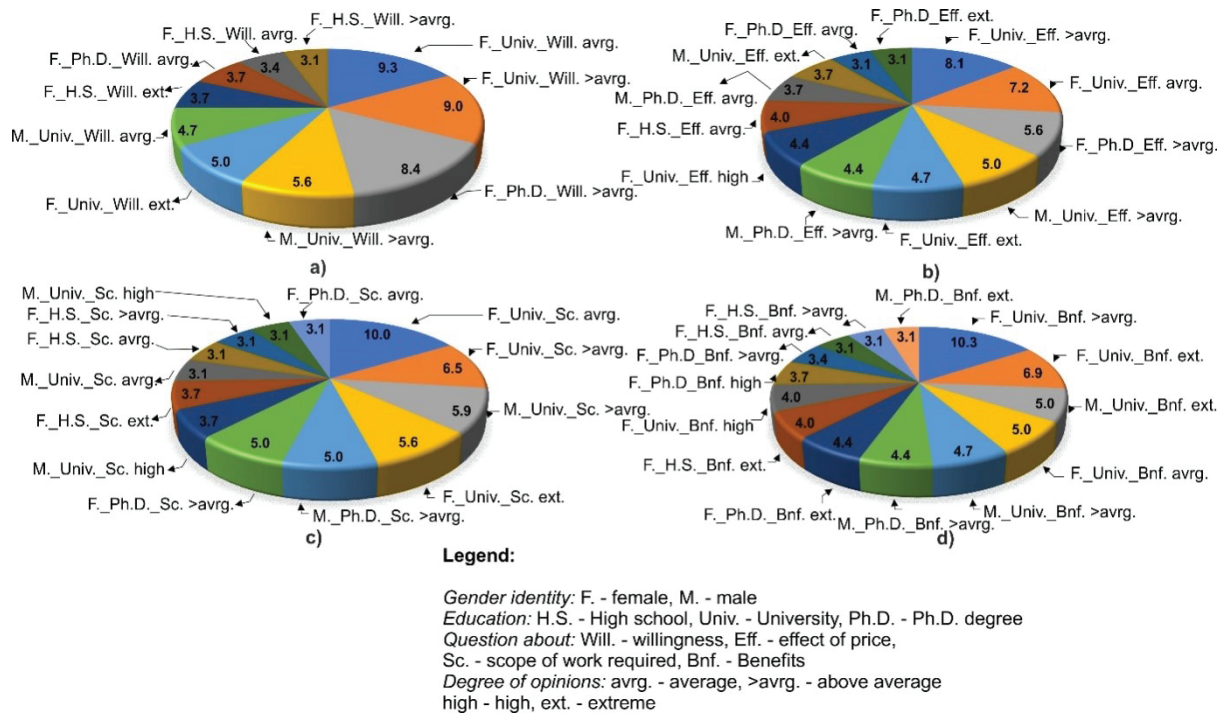
Legend:
Gender identity: F. - female, M. - male
Education: H.S. - High school, Univ. - University, Ph.D. - Ph.D. degree
Question about: Will. - willingness, Eff. - effect of price,
Sc. - scope of work required, Bnf. - Benefits
Degree of opinions: avrg. - average, >avrg. - above average
high - high, ext. - extreme

Figure 3. Constructs that show summed links between gender and education of answerers and a) Willingness to use novel materials, b) Effect of price, c) Scope of the required work, and d) Knowledge of the benefits

Finally, the principal factor analysis is implemented to reveal the constructs of answers that have been tested to see the relationships between the parameters observed and the data collected, which fulfill the conclusions of Spearman`s correlation published previously [18]. The constructs were created from the three most frequently appearing questions to show the correlations and the most common combination of responses among them. When grouped (constructed), the gender and education of the participants were the most influential factors in the questions related to novel material usage (Figure 3). Most women who own a university degree have an average willingness to use novel construction and building materials and believe that the scope of work required is of medium importance. These women declared that the price and knowing the benefits of novel materials have significance at an above-average level (Figures 3b and 3d) [15, 24]. A fair number of respondents from the same group (women with a university degree) believed that the scope of work required during the application or installation of novel construction products was extremely important (Fig. 3d). Since more women than men answered the questionnaire, this influenced the number of responses. However, men holding a University degree claimed that their willingness toward novel material usage was above average, and their opinion on the importance of the effects of price and scope of work was at the same level, while the expected benefits were mostly marked as extremely important. Among the Ph.D. holders, most of the four factors were noted as "above average" by men and women, while both also claimed that knowledge of the benefits is of extreme importance, which is consistent with previous studies from developed countries [15]. Most high school-educated women noted an extremely high willingness toward novel material usage and the same level of importance concerning the scope of work and knowledge of the benefits. Other studies revealed that higher educational levels had a positive influence on environmentally friendly choices [15], which is in disagreement with the results of this survey.

4 Conclusions

This preliminary study investigates the effect of socioeconomic issues during the crisis on the use and purchase of construction materials and products in Serbia as an example of a developing country. Furthermore, it offers a broad overview of environmental awareness and consumer acceptance of newly developed sustainable products from the perspective of private individuals. Answerers with higher education degrees were the majority of those who purchased or showed interest in novel products. Only 9% of the respondents use novel materials and among them are mostly carpentry, kitchen work surfaces, specialized paint, and fungal treatment coatings. The willingness to use novel materials is seen as high, but the purchasers would like to gain more information on the prices involved, the scope of work required, and the benefits. The study aims to provide an in-depth perception of green consumer behavior that may aid academics and marketers in better comprehending the issue. To improve the coherence of our understanding of the factors that influence purchases, future studies should also include the respondents' personal and attitude factors, such as flexibility, self-confidence, risk perception and behavior, readiness to act, etc. Besides, having more answerers would be beneficial.

Appendices

A study on the use of building materials in developing countries before and after the pandemic- A socio-economic analysis (List of the questions [18])

Q1. The method of responding to the survey:
- Smartphone
- Desktop
- Tablet
- In paper

Q2. What is your age group?
- 18-30
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80

Q3. What gender are you?
- Male
- Female
- None of the above

Q4. How many inhabitants are there in the place where you live?
- Under 100,000
- Between 100,000 and 300,000
- Between 300,000 - 500,000
- Between 500,000 and 800,000
- Between 800,000 - 1,000,000
- Between 1,000,000 and 2,000,000
- Over 2,000,000

Q5. What is your final education level?
- Primary school
- High School
- College
- Researcher/Doctor of Science
- Professor

Q6. What is your profession/job description?
- Unemployed
- Manual worker
- Office work
- Laboratory technician
- Medical worker
- Craftsman
- Student
- Artist
- Engineer
- Manager
- Scientist
- Professor
- Retired
- Other

Q7. How satisfied are you with your salary concerning the work you do? (the optional question)
From very dissatisfied to very satisfied
(Scale 1-7)

Q8. Has your income changed since the crisis (pandemic) began?
- Incomes have decreased
- They haven't changed
- Incomes have increased
- Not applicable (retired, non-employed)

Q9. When was the last time you changed your place of residence?
- In the last 5 years

-. During the last 10 years
- 20 years ago
- 30 years ago
- More than 40 years ago
- Never

Q10. Do you live in an apartment or a house?
- Apartment
-A house

Q11. Are you renting the space you live in or is it owned by you or your family?
- I'm renting
- I live in mine/our apartment/house

Q12. When was the building/house (you currently live in) built?
- In the last 5 years
-. During the last 10 years
- 20 years ago
- 30 years ago
- 40 or more years ago

Q13. Do you own a cottage, a rest private house, or more than one apartment?
- Yes
- No

Q14. If you own a cottage, a rest private house, or more than one apartment, when was it built?
- In the last 5 years
- During the last 10 years
- 20 years ago
- 30 years ago
- 40 years ago, or more
- Not applicable

Q15. To what extent do you believe that the price of a product speaks of its quality?
(Likert`s scale 1 – 7)
1– very low, 7 – extremely high

*Q16. In the period **before the pandemic**, did you buy construction materials or products (glue, varnish, paint, wall paint, cement, ceramic tiles, sanitary equipment, bricks, tiles, and floor coverings)?*
- Yes, about 2-5 years ago.
- Yes, about 5-10 years ago.
- Yes, over about 10-20 years.
- No

*Q17. Based on what did you choose for construction materials in the period **before the pandemic** (glue, varnish, paint, wall paint, cement, etc.)?*
- You choose to buy the most expensive product
- You choose to buy a product whose price is average
- You choose a fair relationship between quality and price
- You choose the cheapest
- You listen to the recommendation of a contractor or a friend/acquaintance you trust
- You buy from familiar manufacturers
- I did not buy construction material during that period

*Q18. Based on what did you choose for construction products in the period **before the pandemic** (ceramic tiles, sanitary equipment, bricks, tiles, floor coverings, etc.)?*
- You choose to buy the most expensive product

- You choose to buy a product whose price is average
- You choose a fair relationship between quality and price
- You choose the cheapest
- You listen to the recommendation of a contractor or a friend/acquaintance you trust
- You buy from familiar manufacturers
- I did not buy construction material during that period

*Q19. In the period **after the beginning of the pandemic** (March 2020), did you buy glue, varnish, paint, wall paint, cement, ceramic tiles, sanitary equipment, bricks, tiles, and floor coverings?*
- Yes
- No

*Q20. Based on what did you choose for construction materials (glue, varnish, paint, wall paint, cement, etc.) in the period **after the beginning of the pandemic** (March 2020)?*
- You choose to buy the most expensive product
- You choose to buy a product whose price is average
- You choose a fair relationship between quality and price
- You choose the cheapest
- You pay attention to the recommendation of a contractor or a friend/acquaintance you trust
- You buy from familiar manufacturers
- I did not buy construction material during that period

*Q21. Based on what did you choose for construction products in the period **during the 2020 crisis** (ceramic tiles, sanitary equipment, bricks, tiles, floor coverings, etc.)?*
- You choose to buy the most expensive product
- You choose to buy a product whose price is average
- You choose a fair relationship between quality and price
- You choose the cheapest
- You listen to the recommendation of a contractor or a friend/acquaintance you trust
- You buy from familiar manufacturers
- I did not buy construction material during that period

Q22. To what extent has the way you choose products according to the price/quality ratio changed since the 2020 crisis?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q23. If you bought construction material and/or products in the period before and after the 2020 crisis, to what extent do you have the impression that prices have changed?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q24. To what extent are you willing to accept a newer type of product compared to those traditionally used (nanocoating, cement-based geopolymers, fly ash-based cement, concrete based on geopolymers, self-healing concrete, concrete block instead of brick, concrete reinforced with bamboo, lightweight block of large dimensions, ceramic tiles of large dimensions, etc.)?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q25. To what extent would the price affect the acceptability of switching to some type of better environmental material/product in your household?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q26. To what extent would the scope of work be required to affect the acceptability of switching to some type of better environmental material/product in your household?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q27. To what extent would adequate knowledge of the benefits of new environmental materials/products affect the transition to that material/product in your household?
(Likert`s scale of 1-7)
1– very low, 7 – extremely high

Q28. Do you use any of the innovative materials/products from this sector and which ones?
- Indicate: _____
- I do not use

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