



An Evaluation of the Role of Environmental, Social and Economic Factors in Architects' Choice of Building Materials

Ülkemizde Mimarların Yapı Ürünü Seçimlerinin Çevresel, Toplumsal ve Ekonomik Açıdan Değerlendirilmesi

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ABSTRACT

The environment is in an ever-changing state as a result of humankind's ongoing relationship with nature. Recent developments in industry and technology are resulting in a diminishment of the benefits of environmental change for all forms of life, and the lack of awareness in the construction sector of the necessity for sustainable approaches is leading to an ever more rapid depletion of natural resources. A combination of these factors has now led to damage of the natural balance and triggered the global warming that is threatening our world. One response to this in recent years has been the development of numerous building and material assessment models that aim to evaluate the environmental impact of buildings and materials. While each model evaluates building materials using different methods, all share one characteristic, in that they mainly deal only with the environmental effect of building materials. Hence, while research into the economic, social and cultural factors involved in building material choices is of equal importance, study numbers are very limited in this area. This article aimed to make a survey the deficiencies of current models, and evaluate architects' sensitivity in choosing materials. In this context, a survey study was conducted to compare and evaluate the criteria architects use when selecting materials.

ÖZET

Çevre, geçen yıllar içinde insanoğlunun doğa ile ilişkisine bağlı olarak sürekli bir değişim içindedir. Son yıllarda özellikle sanayi ve teknolojinin gelişmesi ile bu değişimin tüm canlılara sağladığı yararlar azalmaya başlamıştır. Sürdürülebilirlik bilinci olmayan inşaat sektörü, doğal kaynakların kontrolsüz bir şekilde tükenmesine yol açmaktadır. Bu olumsuz tablonun kaçınılmaz bir sonucu olarak doğal dengenin bozulması, hayatımızı tehdit etmekte olan küresel ısınmayı tetiklemektedir. Son yıllarda bu olumsuz gidişe bir son verebilmek adına, binaların ve yapı ürünlerinin çevresel performanslarını değerlendirmek için dünya çapında birçok bina ve yapı ürünü değerlendirme yöntemi kullanılmaya başlanmıştır. Bu yöntemlerin yapı ürünü konusunu ele alışları farklılık göstermesine rağmen ortak bir noktada buluşmaktadırlar. Hepsini ağırlıklı olarak yapı ürünlerinin çevresel etkileri üzerine değinmektedirler. Çevresel etkiler kadar önemli bir yere sahip olan toplumsal, ekonomik ve kültürel konular üzerindeki çalışmalar oldukça kısıtlıdır. Bu makalede değerlendirme yöntemlerinin bu konulardaki eksiklikleri incelenerek, mimarların yapı ürünü seçimi konusundaki hassasiyetleri değerlendirilecektir. Bu kapsamda, ülkemizdeki mimarların tasarım ve uygulama aşamalarında yapı ürünü seçiminde önemsedikleri ölçütler ve konuya yaklaşımları bir anket çalışması ile irdelenecektir.

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Introduction

Environment is in constant change depending on human's relationship with nature. With the development of industry and technology, especially in recent years, the benefits of these changes to living things began to decline. Building production which focuses on the idea of growth rather than sustainability is leading to the depletion of resources in an uncontrolled manner. The deterioration of natural balance as an inevitable consequence of this negative picture is triggering global warming which is a threat to our lives. There are many methods of assessing building and building products worldwide to assess their environmental performance.^{1,2} Some methods are designed for the sole purpose of studying the life cycle of building products. Among these methods are Athena™, BEES 4.0 and GaBi. Methods such as BREEAM, LEED® and EcoEffect aim to make a more comprehensive assessment of the whole building, including the use of the building product. Although these methods differ in handling the issue of building products, they meet on a common ground. All methods often refer to the environmental impact of building products. Studies on economic and cultural issues, which have as much significance as environmental impacts, are quite limited.^{3,4,5} However, one of the components that form the basis of sustainable architecture is the protection and the development of social and economic structure as well as the prevention of environmental damage caused by the building products.^{6,7,8}

Purpose and Scope of the Research

Methods assessing buildings and building products worldwide mostly refer to the environmental impact of products. Regarding the selection of building products, studies on the impacts of the assessed products on human health, earthquake and natural disasters, climate, and the socio-economic status of users are very limited. Furthermore, issues such as the aging and decay phases of products, interaction between users and products, compatibility of the products used with the built environment, impact of products on the environment and user psychology as well as the effects of user comfort and cultural values on product selection are not sufficiently studied. However, the criteria in the selection of building products have environmental as well as social and economic aspects.

The decisions made by architects at the design and implementation stages have a significant impact on the sustainability of buildings. Therefore, a questionnaire was conducted through data collection in order to determine the criteria employed by architects for their selection of building products. Within the scope of this questionnaire, the criteria of importance in selecting building products were evaluated by way of comparison.

On the Methodology of the Research

The study which focuses on architects' selection of building products has a two-stage structure; the implementation of a questionnaire on the criteria employed by architects for their selection of building products and the comparative evaluation of the questionnaire results. The web address of the page including the questionnaire on architects' criteria of selecting building products was delivered to professionals in various branches of architecture via e-mail. The responses to the questionnaire were received between 17th 12, 2011 and 30th 12, 2011. The form was answered 168 times. The responses were assessed on a 5 level Likert type scale.

Within the scope of the questionnaire, architects were asked to rate the importance of criteria they encounter while selecting building products.

Building Product Preferences of Architects

According to the questionnaire, the building product choice of architects could be followed under the following sections.

Impacts of Building Products on Human Health

According to the analysis based on the item that reads "I care about the fact that building products posit a threat to human health.", of the 168 participants, 62% (105) stated that they attached very great importance to the fact that building products should not posit any threat to human health, while 24% (40) attached great, 11% (18) moderate, 1% (2) little and 2% (4) very little importance (Figure 1).

Use of Recycled Content in Building Products

According to the analysis based on the item that reads "I care about the use of recycled content in building products in my designs/implementations.", of the 168 participants, 14% (23) attached very great importance to the use of recycled content in building products while 26% (44) attached great, 41% (69) moderate, 14% (23) little and 5% (9) very little importance (Figure 2).

Comparative Product Cost Analyses

According to the analysis based on the item that reads "I care about the effect of comparative product

¹ Tuna Taygun, 2005.

² Sev ve Canbay, 2009.

³ Haapio ve Viitaniemi, 2008.

⁴ Building Research Establishment (BRE), 2010.

⁵ Cole, Howard, Ikaga ve Nibel, 2005.

⁶ ISO 14040, 2006.

⁷ Seçer Kariptaş ve Özşirkintı Kaşap, 2010.

⁸ Say Özer ve Özer, 2010.

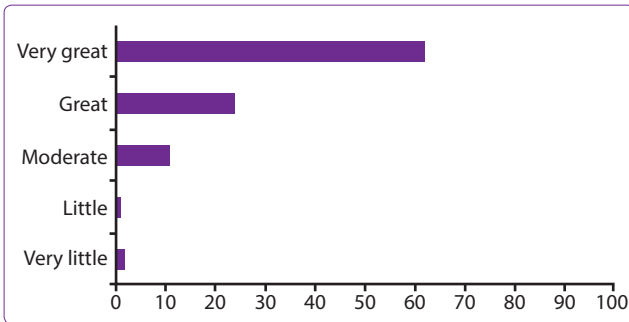


Figure 1. Architects' preferences on selecting building products: importance given to the criteria "The impact of building products on human health" in percentages.

cost analyses on the selection of products.", of the 168 participants, 22% (37) attached very great importance to the effect of comparative product cost analyses on the selection of products, while 40% (68) attached great, 28% (47) moderate, 8% (13) little and 2% (3) very little importance (Figure 3).

Life Cycle Assessment of Building Products

According to the analysis based on the item that reads "I care about the fact that products are subjected to life cycle assessment.", of the 168 participants, 19% (32) attached very great importance to the sub-

jection of products to life-cycle assessment in design and implementation stages, while 36% (61) attached great, 31% (52) moderate, 11% (18) little and 3% (5) very little importance (Figure 4).

Analysis of the Aging and Deterioration Phases of Building Products

According to the analysis based on the item that reads "I care about the analysis of the aging and deterioration phases of building products", of the 168 participants, 33% (56) attached very great importance to the analysis of the aging and deterioration phases of building products in design and implementation stages, while 41% (69) attached great, 15% (25) moderate, 9% (15) little, 2% (3) very little importance (Figure 5).

Impacts of Earthquakes and Natural Disasters

According to the analysis based on the item that reads "I care about the impact of earthquakes and natural disasters on the selection of building products.", of the 168 participants, 60% (102) attached very great importance to the impact of earthquakes and natural disasters on the selection of building products in design and implementation stages, while 29% (48) attached great, 8% (14) moderate, 2% (3) little, and 1% (1) very little importance (Figure 6).

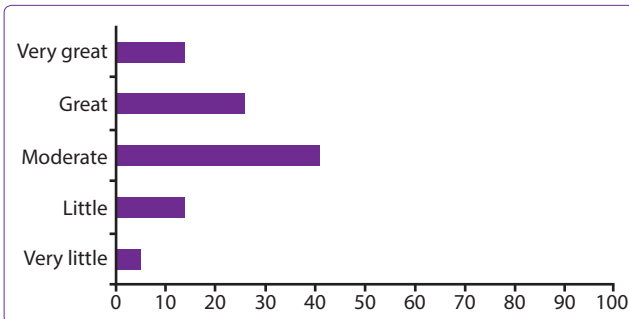


Figure 2. Architects' preferences on selecting building products: importance given to the criteria "The use of recycled content in building products".

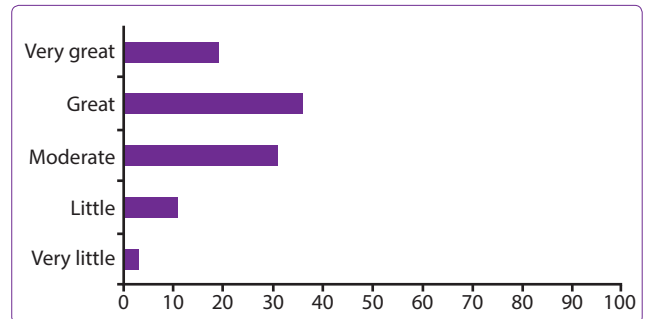


Figure 4. Architects' preferences on selecting building products: importance given to the criteria "Life cycle assessment of building products" in percentages.

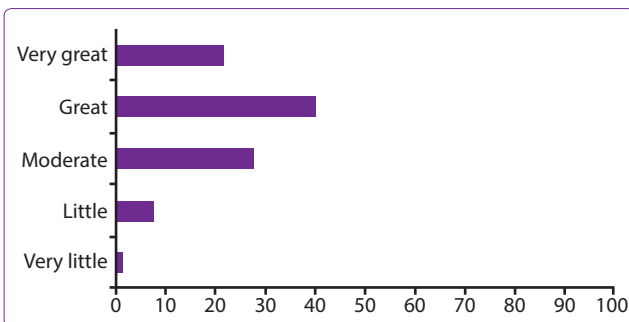


Figure 3. Architects' preferences on selecting building products: importance given to the criteria "Comparative product cost analyses" in percentages.

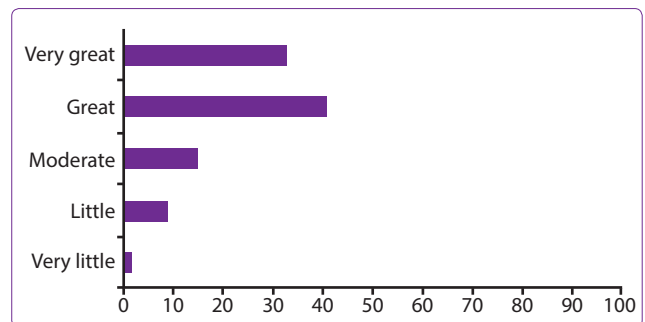


Figure 5. Architects' preferences on selecting building products: importance given to the criteria "Comparative product cost analyses" in percentages.

Impact of Green Product Standards

According to the analysis based on the item that reads “I care about the fact that building products meet green product standards in my designs/implementations.”, of the 168 participants, 13% (22) attached very great importance to the fact that building products meet green product standards in design and implementation stages, 44% (74) attached great, 30% (51) moderate, 11% (18) little and 2% (3) very little importance (Figure 7).

Usability of Building Products in Another Project/ Building

According to the analysis based on the item that reads “I care about the usability of building products without any change in another project/building in my designs/implementations.”, of the 168 participants, 10% (16) attached very great importance to the usability of building products without any change in another project/building, while 18% (31) attached great, 36% (62) moderate, 23% (38) little and 13% (21) very little importance (Figure 8).

Interaction between Building Products and Users

According to the analysis based on the item that reads “I care about the interaction between building

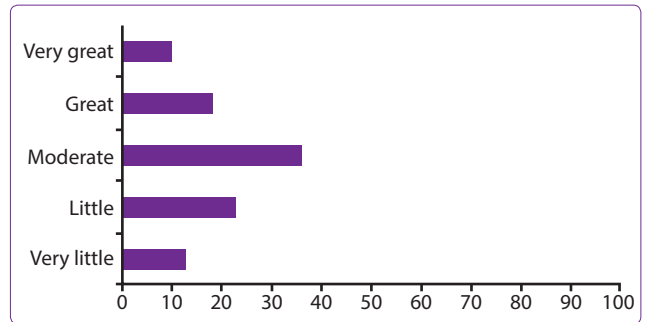


Figure 8. Architects’ preferences on selecting building products: importance given to the criteria “Usability of building products in another project/building” in percentages.

products and users in my designs/implementations. (for instance, the impact of wood used in a school building on students...”, of the 168 participants, 51% (86) attached very great importance to the interaction between building products and users in design and implementation stages while 33% (55) attached great, 12% (20) moderate, 3% (5) little, 1% (2) very little importance (Figure 9).

The Impact of Green Product Catalogues

According to the analysis based on the item that reads “I care about the use of green product catalogues

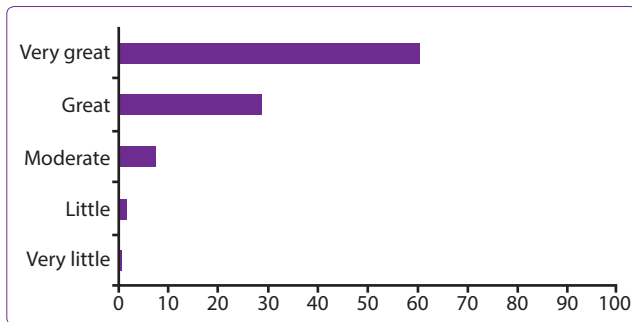


Figure 6. Architects’ preferences on selecting building products: importance given to the criteria “Impacts of earthquakes and natural disasters” in percentages.

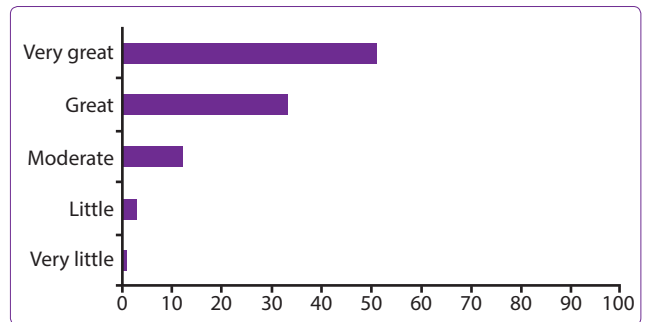


Figure 9. Architects’ preferences on selecting building products: importance given to the criteria “Interaction between building products and users” in percentages.

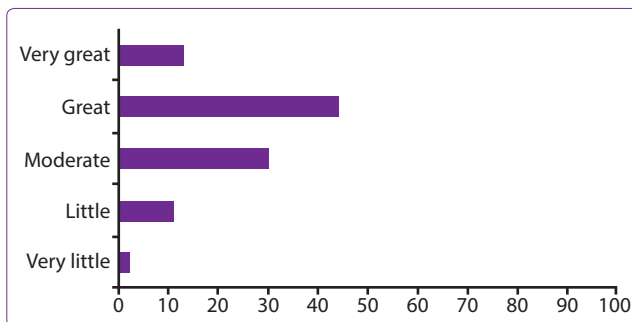


Figure 7. Architects’ preferences on selecting building products: importance given to the criteria “Impact of green product standards” in percentages.

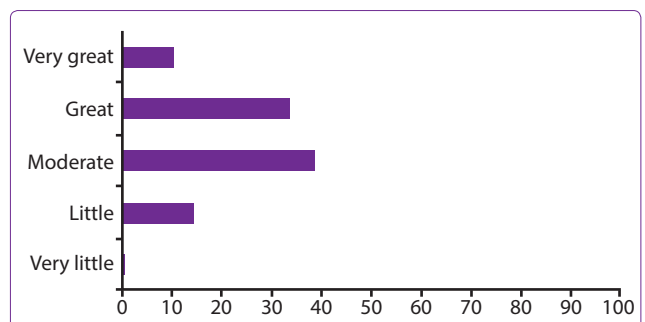


Figure 10. Architects’ preferences on selecting building products: importance given to the criteria “Impact of green product catalogues” in percentages.

in my designs/implementations.”, of the 168 participants, 11% (19) attached very great importance to the use of green product catalogues in the selection of building products in design and implementation stages while 34% (57) attached great, 39% (65) moderate, 15% (25) little and 1% (2) very little importance (Figure 10).

Compliance with the Building Products Used in Built Environment

According to the analysis based on the item that reads “I care about the compliance of the building products I use in my designs/implementations with the building products used in built environment.”, of the 168 participants, 31% (52) attached very great importance to the compliance of building products used in design and implementation stages with the building products used in built environment while 34% (57) attached great, 24% (40) moderate, 7% (12) little and 4% (7) very little importance (Figure 11).

The Impact of Transport

According to the analysis based on the item that reads “I care about the impact of transport on the selection of building products.”, of the 168 participants, 16% (27) attached very great importance to the impact of transport on the selection of building products in

design and implementation stages while 24% (41) attached great, 29% (49) moderate, 23% (38) little and 8% (13) very little importance (Figure 12).

The Impact of the Socio-Economic Status of Users

According to the analysis based on the item that reads “I care about the impact of the socio-economic status of users on the selection of building products in my designs/implementations.”, of the 168 participants, 30% (50) attached very great importance to the impact of the socio-economic status of users on the selection of building products in design and implementation stages while 39% (66) attached great, 23% (38) moderate, 7% (11) little and 2% (3) very little importance (Figure 13).

The Impact of Building Function

According to the analysis based on the item that reads “I care about the impact of building function on the selection of building products in my designs/implementations.”, of the 168 participants, 57% (96) attached very great importance to the impact of building function on the selection of building products in design and implementation stages while 33% (56) attached great, 8% (14) moderate, 1% (1) little and 1% (1) very little importance (Figure 14).

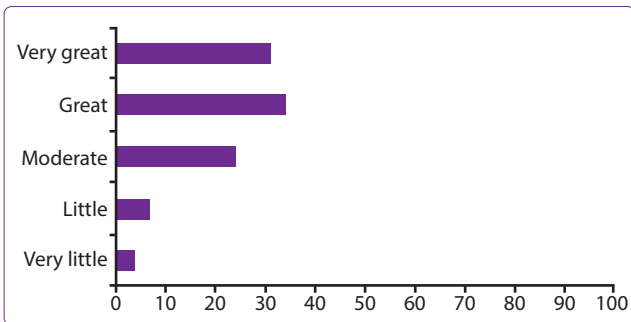


Figure 11. Architects' preferences on selecting building products: importance given to the criteria “Compliance with the building products used in built environment” in percentages.

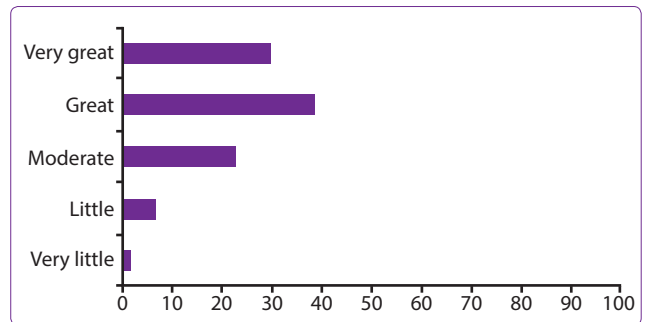


Figure 13. Architects' preferences on selecting building products: importance given to the criteria “Impact of the socio-economic status of users” in percentages.

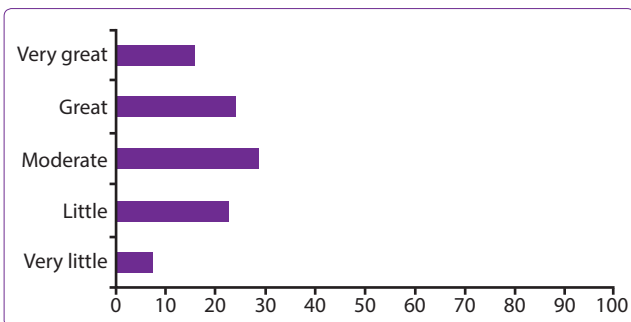


Figure 12. Architects' preferences on selecting building products: importance given to the criteria “Impact of transport” in percentages.

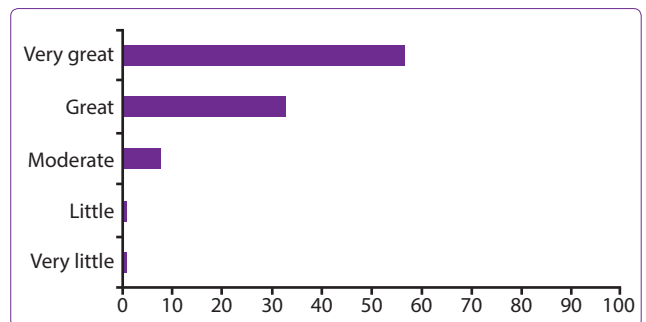


Figure 14. Architects' preferences on selecting building products: importance given to the criteria “Impact of building function” in percentages.

Impact of User Psychology

According to the analysis based on the item that reads “I care about the impact of building products on user psychology in my designs/implementations.”, of the 168 participants, 45% (75) attached great importance to the impact of building products on user psychology in design and implementation stages while 33% (56) attached great, 17% (29) moderate, 4% (6) little and 1% (2) very little importance (Figure 15).

Energy Used for Maintenance-Repair-Renewal of Building Products

According to the analysis based on the item that reads “I care about the energy used for maintenance-repair-renewal of building products in my designs/implementations.”, of the 168 participants, 28% (47) attached very great importance to the energy used for maintenance-repair-renewal of building products in design and implementation stages while 39% (66) attached great, 25% (41) moderate, 6% (10) little and 2% (4) very little importance (Figure 16).

Impact of User Comfort

According to the analysis based on the item that reads “I care about the impact of building products on user comfort in my designs/implementations.”, of the

168 participants, 46% (78) attached very great importance to the impact of user comfort on the selection of building products in design and implementation stages while 43% (73) attached great, 10% (16) moderate, 1% (1) little and 0% (0) very little importance (Figure 17).

The Impact of Climate

According to the analysis based on the item that reads “I care about the impact of climate on the selection of building products in my designs/implementations.”, of the 168 participants, 58% (97) attached very great importance to the impact of climate on the selection of building products in design and implementation stages while 33% (55) attached great, 8% (13) moderate, 2% (3) little and 0% (0) very little importance (Figure 18).

Impact of Cultural Values

According to the analysis based on the item that reads “I care about the impact of cultural values on the selection of building products in my designs/implementations.” of the 168 participants, 29% (49) attached very great importance to the impact of cultural values on the selection of building products in design and implementation stages while 33% (55) attached great, 26% (43) moderate, 7% (12) little and 5% (9)

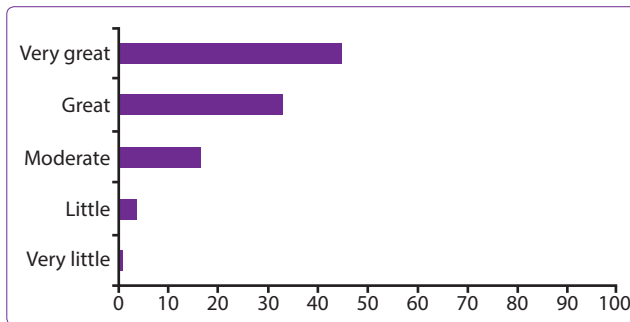


Figure 15. Architects’ preferences on selecting building products: importance given to the criteria “Impact of user psychology” in percentages.

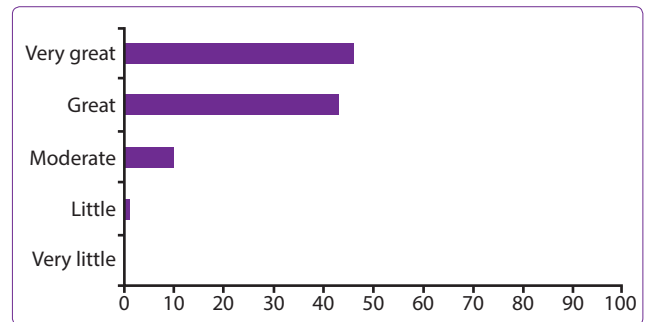


Figure 17. Architects’ preferences on selecting building products: importance given to the criteria “Impact of user comfort” in percentages.

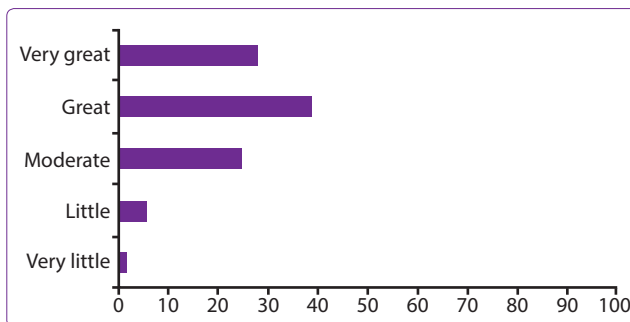


Figure 16. Architects’ preferences on selecting building products: importance given to the criteria “Energy used for maintenance-repair-renewal of building products” in percentages.

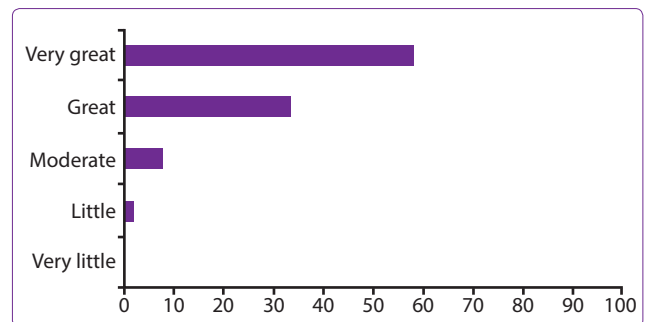


Figure 18. Architects’ preferences on selecting building products: importance given to the criteria “Impact of climate” in percentages.

very little importance (Figure 19).

Use of Environmentally Friendly Resources

According to the analysis based on the item that reads "I care about using materials made of environmentally friendly resources in my designs/implementations.", of the 168 participants, 27% (45) attached great importance to the use of building products made of environmentally friendly resources in design and implementation stages while 38% (64) attached great, 27% (46) moderate, 5% (8) little and 3% (5) very little importance (Figure 20).

Review and Discussion of Research Findings

It is possible to summarize the results of the questionnaire conducted to assess the architects' criteria of priority for the selection of building products in design and implementation stages as follows. According to the responses given, architects' priorities while selecting building products are the impacts of climate, function of the building, earthquake factor, user comfort, user interaction and impact of building products on human health. On the other hand, architects do not attach importance to criteria such as transport, use of green product catalogues, recycled content and the usability of materials without any change in another project. It is possible to view these findings in detail in Figure 2.21 which is constituted by taking the total percentage (5= very great, 4=great) of the first two responses to each item in the questionnaire (Figure 21).

Environmental, Social and Economic Factors in The Selection of Building Products

When the architects' criteria for selecting building products are analyzed in terms of environmental, social and economic aspects, the following findings are observed. Beyond doubt, it is not possible to categorize the criteria for the selection of building products as only environmental, social or economic. While some of these selections are analyzed merely in terms

of environmental, social and economic aspects, different preferences or criteria may be assessed within two or three dimensions. Figure 3.1 demonstrates the criteria grouped according to environmental, social and economic aspects.

The responses which received a rating of 50% and above are colored in red. Accordingly, the criteria referring to environmental aspects; namely, 'Use of Building Products Made of Environmentally Friendly Resources', 'Impact of Climate on the Selection of Building Products', 'Impact of Green Product Standards on the Selection of Building Products' and 'Significance of Life Cycle Assessment of Building Products for the Selection of Building Products' received high ratings from the architects. Another environmental criterion, 'The Impact of Green Product Catalogues on the Selection of Building Products' was not very influential on the architects' decisions of selecting building products.

Among the criteria assessed in terms of social aspects, 'The Impact of Building Function on the Selection of Building Products', 'The Impact of Cultural Values on the Selection of Building Products', 'Compliance with Built Environment', 'The Impact of the Selected Building Products on User Comfort', 'The Impact of the Selected Building Products on User Psychology', 'The Significance of Interaction between Building Products and Users in the Selection of Building Products' and 'The Significance of Human Health in the Selection of Building Products' received high ratings from the architects.

Among the criteria regarding the economic aspect, 'Comparative Product Cost Analyses in the Selection of Building Products' is an item to which architects attached importance in their selection of products.

As for the criteria assessed in terms of both environmental and economic aspects, 'The Significance of Aging and Deterioration Phases of Building Products', 'The Significance of the Energy Used for Maintenance-

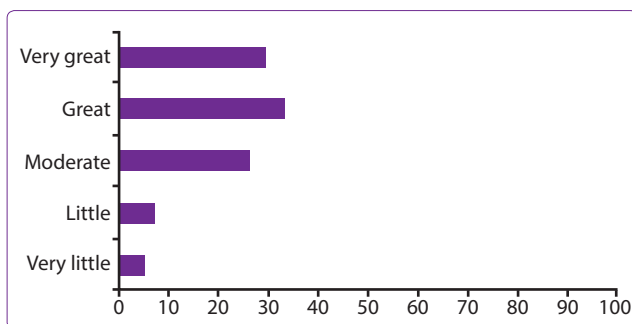


Figure 19. Architects' preferences on selecting building products: importance given to the criteria "Impact of cultural values" in percentages.

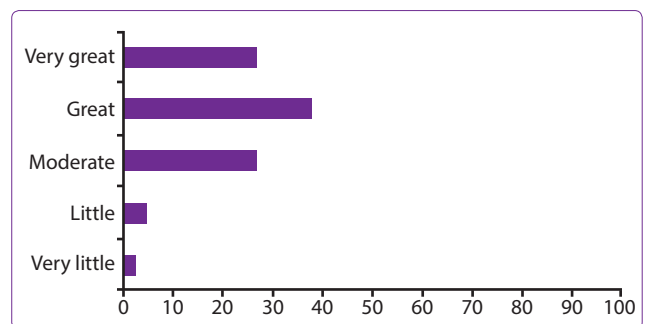


Figure 20. Architects' preferences on selecting building products: importance given to the criteria "Use of environmentally friendly resources" in percentages.

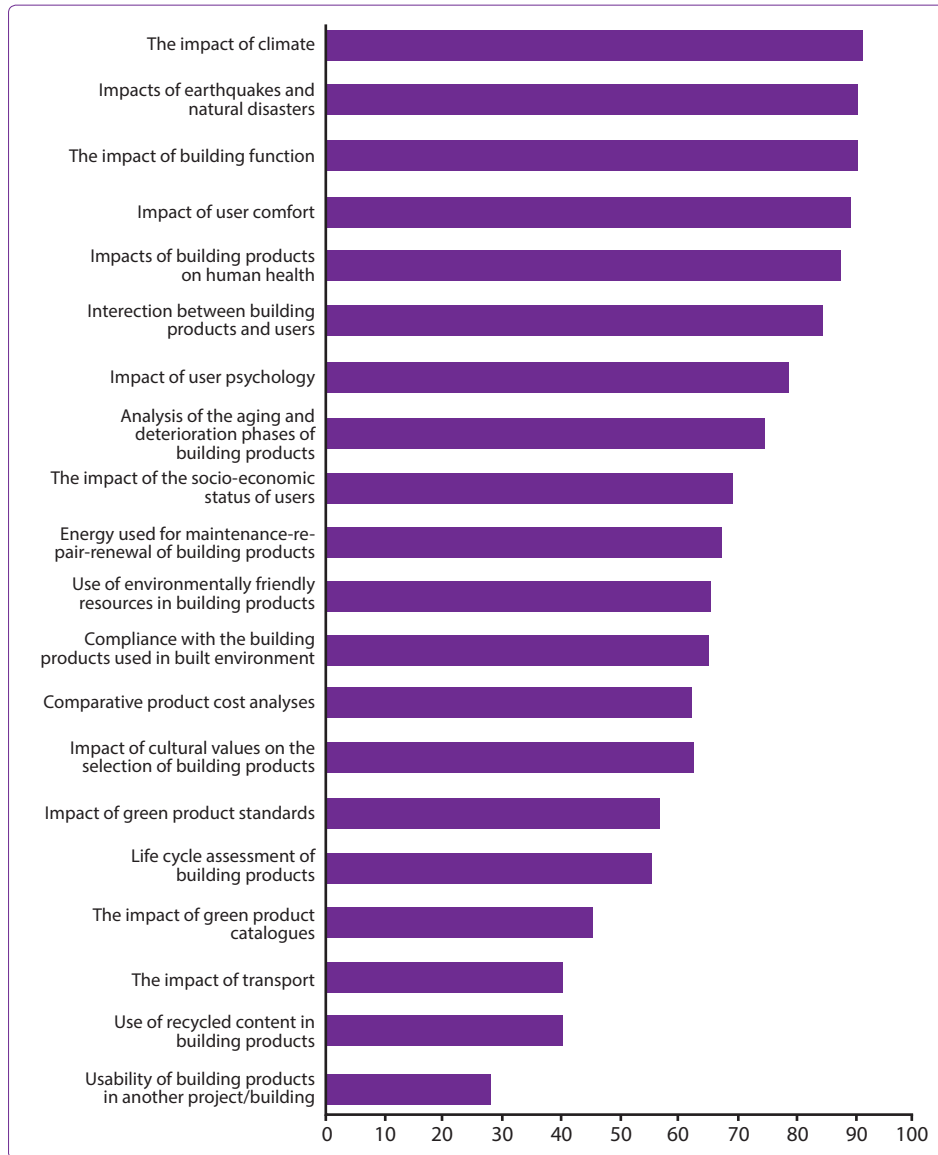


Figure 21. Questionnaire results ranked according to the importance of the criteria related to the selection of building products (The graphic shows sum of the percentages of the first two responses (5=very great importance, 4=great importance).

Repair-Renewal of Building Products’ were among those considered importance by the architects while the items in the same category such as ‘The Usability of Building Products in Another Project without Any Change’, ‘Use of Recycled Content in Building Products’ and ‘The Impact of Transport on the Selection of Building Products’ are not included within the architects’ criteria of priority.

The item that read ‘The Impact of the Socio-Economic Status of Users on the Selection of Building Products’ which is categorized as both social and economic aspect had an important place among the architects’ criteria of selection.

The item that reads ‘Impacts of Earthquakes and Natural Disasters on the Selection of Building Products’ which is related with all the environmental, social and economic aspects is among the top-rated criteria to which the architects were sensitive (Figure 22).

Within the framework of the research conveyed in this paper, the items presented to the architects were grouped according to their environmental, economic and social aspects, and the architects’ criteria of priority in selecting building products were assessed. According to Figure 3.1 which demonstrates the findings, it is seen that all the items related with the social aspect are among the architects’ criteria of priority in

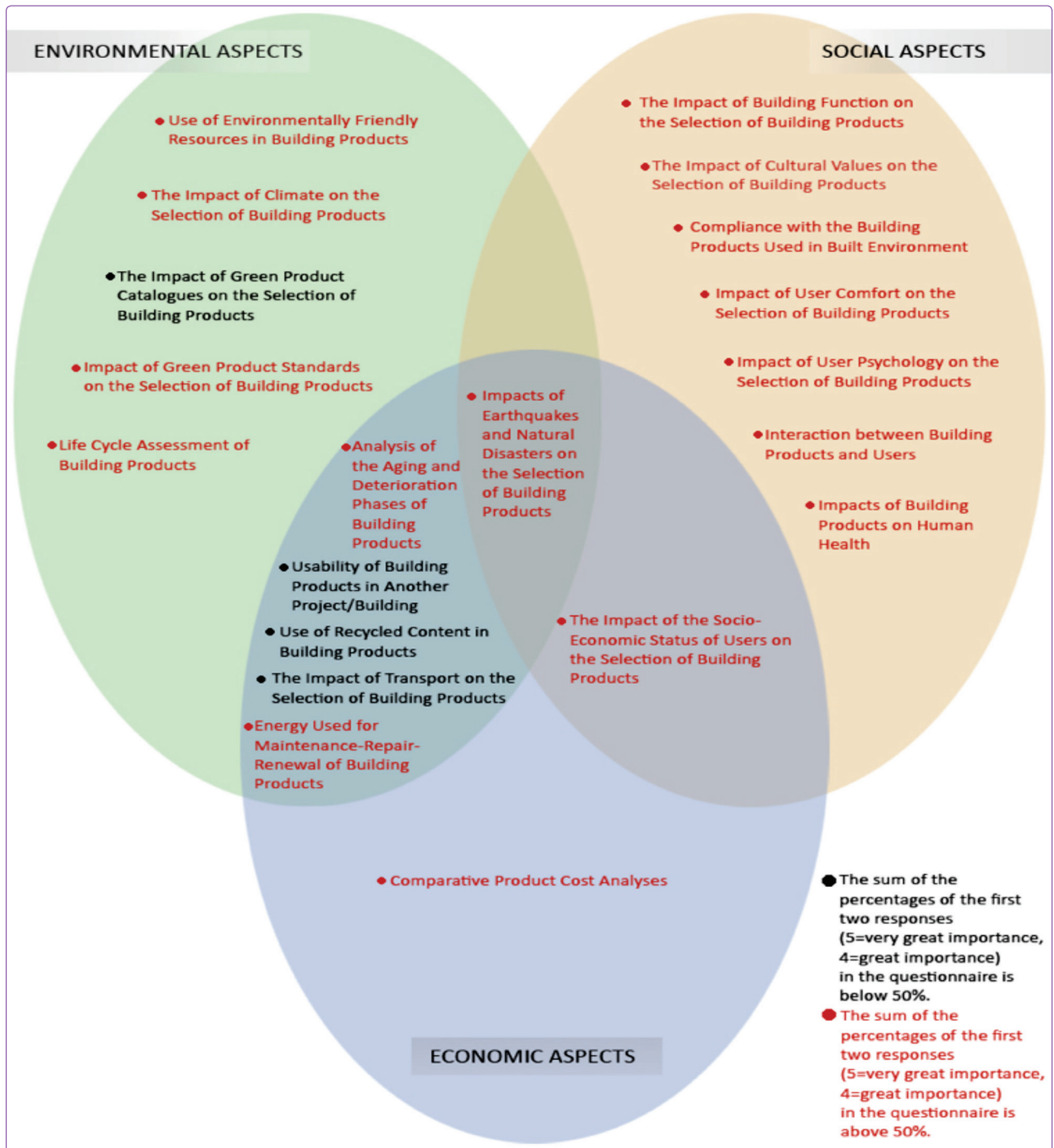


Figure 22. Evaluating architects' criteria of importance for the selection of building products according to environmental, social and economic aspects.

selecting building products. Furthermore, it was determined that most of the criteria related with environmental and economic aspects also received high ratings from the architects.

Conclusion

For the selection of building products, there are different building assessment systems and models to

guide architects. However, they generally tend to assess the features of building products independently and focus on environmental criteria. However, as put forward by this research, architects' criteria for selecting building products are formed in an interactive manner. On the other hand, social and economic criteria as well as environmental criteria also play a major role in the selection of building products. Accordingly,

it is possible to develop the following recommendations. The building products which directly affect the lifespan of a building should be selected by taking into consideration the climate of their location, the amount of energy to be used for maintenance-repair-renewal, transport of the product to project site, use of environmentally friendly resources, conduction of LCA and resistance to earthquakes. The economic features of the selected building products also have a major role among the sustainable building criteria. Therefore, the usability of the selected products in other projects, analysis of the aging and deterioration phases of products and the socio-economic status of users for future renewal and maintenance requirements should be taken into consideration, and comparative product analysis should be conducted for the selection of the most financially and physically viable product. Analyzing environmental and economic impacts for the selection of building products is crucial for creating sustainable design and environment. Many methods developed for this purpose make comprehensive assessments. Decision made based on merely environmental and economic aspects may directly or indirectly affect the health and social life of the residents of the building and the environment as well as the cultural values of the environment where the building is located. The physical features of the selected building products (color, texture etc.) may have a positive or negative impact on its residents. For the adaptation of residents to their living environment, interaction between products and users as well as user comfort should be taken into consideration. The compliance of potential building products with the products used in built environment also has a positive impact on both social life and the cultural values of the environment where the building is located. Protection of cultural values should guide architects and designers in creating sustainable environments.

According to the results of the questionnaire, it is seen that there is a need for a method which could be used interactively with worldwide methods and studies issues such as 'human health', 'social life', 'environmental values' and 'economy' which are unaddressed by building assessment methods.

The method to be developed should be a guide for users for the following items responded by architects in the questionnaire:

- Investigation of the significance of the function of the building in the selection of the building products,
- Analysis of the aging and deterioration phases of building products,
- Significance of climate in the selection of the

building products,

- Impact of earthquakes and natural disasters in the selection of the building products,
- Analysis of the socio-economic status of users in the selection of the building products,
- Impact of user psychology on the selection of the building products,
- Interaction between building products and users,
- Impact of user comfort on the selection of the building products,
- Analysis of the compliance of selected building products with the products used in built environment,
- Significance of cultural values in the selection of building products.

The proposed method will not only serve as a guide for architects and users in creating sustainable designs but also allow users to develop a different perspective of sustainability criteria since it will interact with other methods. Users will be able to think more comprehensively in the decision-making process and make better analyses of the impacts of their decisions. In this way, the issue of building products will be evaluated in every aspect paving the way for positive innovations for other issues as well.

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Key words: *Building assessment models; sustainability; building material choice.*

Anahtar sözcükler: *Bina değerlendirme yöntemleri; sürdürülebilirlik; yapı ürünü tercihi.*