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Identifying the Most Significant Factors Affecting Urban Housing Sustainability and Their Scales/Sectors of Influence: A Systematic Review of the Recent Literature

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Abstract. Housing is always crucial for the sustainable development of communities, specifically in urban areas, due to the population density of cities. The present study constructs its own structure on the basis of the recent papers investigating various sustainability factors for the urban housing sector. By doing a comprehensive systematic literature review, one of the most extensive lists of urban housing sustainability factors is gathered from 118 recent related papers. The factors are prioritized by their frequency of investigation and categorized by their scale(s) and sector(s) of influence. According to the results, the top three significant factors affecting urban housing sustainability are "natural resource or energy consumption/efficiency of the building/equipment (during the construction, operation, etc.)", "materials performance (durability, cost, thermal capacity, permeability, ability to re-use, recycled, eco-friendly materials)", and "access to public services/infrastructure: availability/quality of services and/or distance/time of travel time to the services (public transport, education/health/shopping/leisure facilities, parks, etc.)". By analyzing the results with an integrative approach, it is understood that environmental factors are the most considered ones (more considered than the factors with influence on all sustainability sectors) whereas institutional factors received the least attention. Also, the most significant measures are the ones that have impacts on both 'building' and 'neighborhood/community' scales. It should be noticed that the neighborhood/community scale indicators are seen, as almost important as the measures that affect the building itself. The results of this study can be helpful in establishing future housing-related policies, and also in having more efficient housing sustainability assessment tools.

Keywords: Sustainability Assessment; Urban Housing Sustainability; Sustainability Indicator

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1 Introduction

Houses are always regarded as important factors shaping human communities. No more they can be considered as simple roofs to cover people. They, as well, produce employment, create wealth, mitigate natural disasters, and help societies to achieve integrated physical and economic, and in general, sustainable development [1]. According to UN-Habitat (2012), besides other factors, the location of houses, their design and construction procedures, and the quality of their integration with the existing social, environmental, cultural, and economic sections of communities affect the people's daily lives, safety, health, and welfare [2]. This points out that housing is a central notion of sustainable development. The concept of sustainable housing not only indicates zero-energy, low-carbon, green or high-performance houses but also includes the features of resource usage, energy efficiency, socio-cultural and natural structures, economic requirements and the people's lifestyles [3-5]. Of the 17 Sustainable Development Goals and their 169 supplementary targets that present massive benefits and chances for community, businesses and the ecosystem, some are specifically relevant to the housing sector, with their focus on society, wellbeing, and place-making [6]. The necessities of sustainable developments in cities are becoming increasingly more important [7], and it is essential to come up with some solutions for spaces that can increase the social capacity of the community [8]. Consequently, the new global development emphasis on urban areas, as well, offers a group of targets that go further than the usual concentration on slum upgrading and housing to comprise secure, accessible, affordable and sustainable transportation, integrated and participatory planning, public and green spaces, enhanced waste management and air quality, natural disaster risk reduction and climate resiliency [9].

Subsequent It is clear that a great part of failures in societies is connected to the housing in one way or another. Throughout the world, housing is forming societies, repentantly on many occasions, by generating inequalities and disintegration. The contrasts between slums and gated neighborhoods, homelessness and vacant homes, overcrowding and sprawl, and other similar examples can be helpful to understand these inequalities and fragmentations. On the other hand, the resulting models are ending up with environmental, social and economic expenses much higher than what most societies are able to grant. Therefore, the future of urban development will be based on how communities prioritize housing in their public argument with reference to sustainable development [10].

The UN-Habitat has expanded attempts to reposition housing as a priority in arguments about sustainable urbanization. The rising necessity to deliver adequate housing to a huge number of people and the requisite to do so by means that assure a sustainable prospect for communities require a paradigm shift in housing-related practice and policy. Stimulating well-founded housing policies plays vital roles also in other related sectors, such as climate change, resilience, energy consumption and mobility [11]. As sustainability needs to be defined and used as a tool to uphold policy and decision-making procedures, it should be supervised, assessed, and reported. Consequently, enhancing the management of international, national, regional and local policies, strategies, plans, and projects is crucial to reaching more sustainable results with fewer

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adverse impacts on humans and nature [12]. Here, sustainability indicators can be of great importance. They are not only customary performance metrics but also imperative tools to support urban development [13].

According to Mateus and Bragança (2011), developing and using sustainability measurement techniques and building benchmarking are among the possible approaches to reach a more sustainable built environment [14]. Consequently, sustainability assessment of houses can play a major role in the sustainable development of cities, and to do so there should be a collection of indicators [15]. This is why there has been an enlarged concern about developing and utilizing sustainability indicators for assessing the influences of housing development projects [16]. Providing the indicators that are linked to sustainable urban housing is critical if a productive sustainable housing policy is to be employed [17]. Academics and experts have developed several sustainability evaluation methods and indicators for construction projects, some of which look after the housing sector. However, it is still a question in theory and practice that what factors should be more prioritized among others. The present study primarily tries to answer this gap of knowledge.

According to Mazon et al. (2018), it is logical to presume that particular sets of sustainability indicators should be present at different scales including universal, national, regional, and institutional levels [13]. Moreover, diverse sustainability indicators and sustainability assessment systems are being employed to evaluate sustainability in housing-related projects in various countries [16]. Gathering the factors from the literature from various areas of the world (with possible differences in indicator collections and assessment methods), this study has been done at a universal scale and the results are in this level. By doing a comprehensive systematic review of the recent literature in the field, this study tries to deliver an inclusive and effective collection of sustainability factors, which are influencing not only the housing itself but also its surrounding community. The foundation of the research is constructed on gathering, prioritizing and analyzing the factors affecting the sustainability of urban houses (we do not consider the factors that are especially related to the sustainability of rural housing, however, the factors with influence on both urban and rural sectors are included in the results). Each factor can be made of multiple sustainability indicators, as there are so many indicators related to urban housing sustainability studied in the literature. Also, we have tried to investigate the scale (building and/or neighborhood/community) and sector (different sustainability dimensions) of influence for each factor. This has resulted in integrative analysis of the scale and sector of influence for each factor, to see more clearly the importance of each one in the overall sustainability of houses and to understand which ones are more considered and studied in the literature.

Accordingly, this research has constructed an inclusive prioritized set of factors (based on the frequency of usage in literature) and their scale(s) and sector(s) of influence. It should be noticed that, since this study is a part of a project which aims to assess the priorities used in international Sustainability Assessment Tools (SAT; e.g., LEED [18], BREEAM [19, 20]) the indicators that are completely behavioral (e.g., consumption behaviors) are not considered in the results, as these factors are not considered in most housing-related SATs. The results can fill the gap of knowledge about the most significant factors affecting the sustainability of houses (on a global scale) and guide

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policymakers to make their decisions and strategies more precisely regarding the needs of the housing sector. The outcomes, as well, can give designers, planners, managers, and other related authorities a deeper understanding of issues considering housing sustainability, and can be helpful to evaluate currently used SATs for the housing sector.

1.1 The Considered Dimensions of Sustainability

It is not possible to make an exact definition of sustainability in architecture [21]. However, the objectives of sustainable development are originally defined for the economic, social and environmental dimensions. These are the three well-known sectors –also known as pillars– of sustainability, which are studied for decades. Some authors, such as Chiu (2004), have studied another dimension which includes cultural aspects [3]. Furthermore, for efficient compliance as well as considering sustainability features, like justice, the sustainability sections should be accompanied by an institutional dimension. Consequently, for the purpose of this paper, sustainability is understood to comprise four dimensions: socio-cultural, economic, environmental, and institutional. The reason for merging the social and cultural issues into one dimension is the strong two-sided connection [22] and closeness of the concepts, and also having common aspects [3].

To clarify each dimension, in this study, the environmental dimension can be defined to be any type of bio-geological procedures and their included features; the socio-cultural dimension consists of the personal potentials of humans and their surroundings, such as skills, values, aesthetics, norms, interactions and practices; and the economic dimension includes not only the formal economy, but also any kind of informal action that deliver services to people (individual/group), and therefore, escalate the standard of living further than the financial aspects [23]. Also, the institutional dimension contains the issues regarding the regulations, institutional cooperation, policy-making procedures, standards, and other similar aspects.

2 Methodology

This research is done through a comprehensive systematic review of the recent related literature. For this purpose, the Scopus search engine is used. Some keywords were selected according to the research topic, to find suitable results for the review. As is depicted in fig.1, the query structure began with searching the items “sustainability OR sustainable” and “factors OR indicators OR measures” in TITLE-ABS-KEY fields, and the items “house OR housing OR home” in TITLE field. The document types were limited to “article”, “conference paper”, “review” and “book chapter”, which were in the “final” stage regarding the publication status. For the publication year, the last recent years from 2015 to 2020 (including 2020) were chosen as we wanted to investigate the recent approaches that are used in the studies. As subject areas, “engineering”, “social sciences”, “environmental science”, “energy”, “business, management and accounting”, “economics, econometrics and finance”, “decision sciences”, “arts and humanities”, and “multidisciplinary” were selected to provide a great range of suitable results for each sustainability sector. Finally, “English” was marked as the language of the publications. The overall 512 results were found, and then through three stages of

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title, abstract and paper reviews, 394 results were dismissed and 118 papers were eventually selected for the final review. The dismissed papers were neither related to the purpose of this article nor appropriate in terms of the study scale (i.e., too general or detailed in subjects, such as investigating the solar panel specifications, etc.).

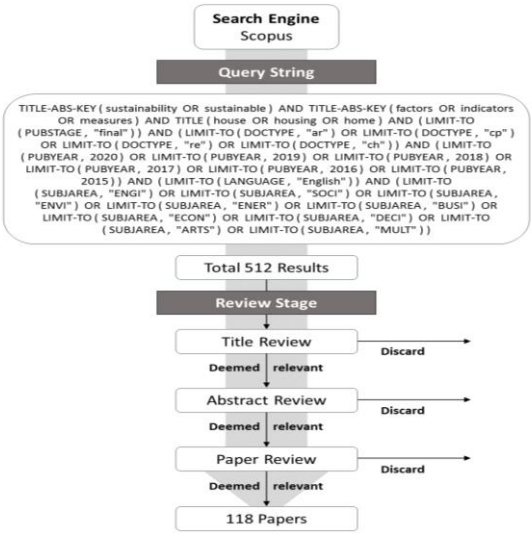

Fig. 1. The structure chart for the literature selection process.

The selected literature was reviewed carefully. The whole text (not only the results and discussion parts) of the papers was read to find the factors, which can influence the sustainability of urban houses. This means that although the reviewed literature is published recently there are many factors extracted from this literature that are originally from other older papers. Therefore, it can be said that the gathered indicators are not only based on the literature published since 2015. It should be noticed that the factors which only affect some specific types of houses, such as log houses or emergency ones, are not marked. However, we included those factors that could be applicable to the general urban housing sector. In selecting the indicators, we also excluded the factors which were too broad or limited in definitions, such as quality of life or the material albedo coefficient.

As there is a vast domain of particular factors and indicators affecting the sustainability of urban houses, we were obliged to simplify and brand many of them in classes as the final factors. We have tried to categorize the factors in a simple and understandable way. The attempt was to classify all related aspects to one issue, as much as possible, into a separate category. As categories and factors are highly related in some cases, some measures might be classified in more than one category. For example, the cost of materials is a measure that is considered in F2: material performance, F51: construction cost, and F62: renovation/repair/reconstruction cost. It should be noticed that if some measures are considered unique or individually noticeable –according to the authors' opinions– they are listed individually. As mentioned before, we excluded the factors that are completely behavioral, regarding their direct effects. Also, we

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considered the factors that are only partially related to housing but are important in the overall sustainability of the housing sector (e.g., housing affordable costs). Additionally, only the factors with the local scale of influence (building or neighborhood/community) are collected from the papers. Others with bigger scales of influence (e.g., regional/national scale) are not considered as they do not have direct effects on buildings. The exceptions for this are some institutional factors, such as building codes and standards, which can directly affect the local level criteria of housing. Finally, we have included the measures that only partially play roles in housing sustainability, but their roles are very crucial. An example of these measures could be the affordability of housing-related costs (purchase price, rent price, etc.) which are partially related to the house itself but also to the household income rate. Therefore, it is important to notice not all these factors may be useful to measure the actual performance of buildings. However, this data is crucial for decision-makers in the housing sector to know what factors and subjects require more attention regarding the overall housing sustainability.

The final result is a prioritized list of factors gathered from the papers. It is analyzed in terms of investigation frequency (IF, number of repetitions in the literature for each factor), investigation coefficient (IC, investigation frequency divided by the total number of the literature), the scale of influence (building and/or neighborhood/community), and direct impacts on sustainability sections (environmental, socio-cultural, economic, and institutional dimensions). In this research, scrutinizing the frequency of each factor is chosen as a possible method to show how much a factor is investigated in the selected literature, and therefore, to be a base to calculate the degree of importance that the literature has given to each scale/sector of sustainability. The qualitative analysis regarding the recognition of the scale and the area of impact for each factor is done based on the authors' knowledge, and not on the findings from the reviewed literature. Each factor may have influence on multiple sectors or scales.

3 Results and Discussion

Fig. 2 illustrates the distribution of the papers throughout the world. Divisions are made by the affiliation addresses of the authors.

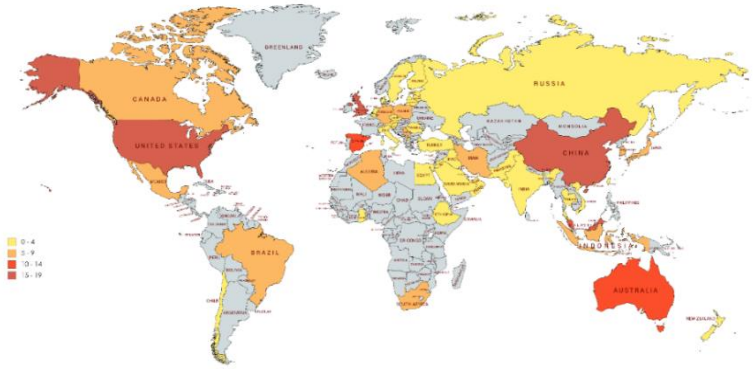

Fig. 2. Distribution of the literature based on authors' affiliation addresses.

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As is depicted, it can be said that the results of this study are not based on the priorities of a limited region in the world, but it is constructed in a more or less universal context. The important issue here is especially the development level of countries. It can be seen that there are examples from the developed, developing, and also the least developed countries among the results, and there is not any significant consideration of one part among others. Therefore, the study is done on a global scale and the results should be considered on this scale.

The factors related to the sustainability of urban houses are gathered from the literature and depicted in a long list (see the appendix) together with the number of references mentioning them (i.e., Investigation Frequency (IF)). The full list of factors with all the references mentioning each of them can be found, as a supplementary file, in [24]. They are prioritized based on IF and investigation coefficient (IC). The factors with frequency numbers less than 3 are combined together as the "other" category, which is excluded from analyses.

The numerical values for factors' IFs and ICs are shown in Table 1. Table 1 also shows the scale(s) and area(s) of influence for each factor. The overall mean values for IF and IC (MIF and MIC) for each influence scale (building, neighborhood/community) is illustrated in Table 2. MIF and MIC values are, as well, shown in Table 3 for sustainability sectors that are affected directly by the factors. It should be noticed that the factors which have their impacts on one sustainability dimension may affect other sections as well. For example, the factors that are considered for the environmental section may or may not affect other aspects. MICs and MIFs are not dependent on the quantity of factors (from the total 98 factors) that are related to each scale/sector of influence, and therefore, are calculated as values showing the degree of importance that the studied papers have given to different scales/sectors of sustainability.

Table 1. The scales/sectors of influence for urban housing sustainability factors and their investigation frequency/coefficient numbers.

No.	IF	IC	Building Effect	NBH/Community Effect	Envr. Sust.	Soc-Cult. Sust.	Econ. Sust.	Inst. Sust.
F1	87	0.74						
F2	78	0.66						
F3	72	0.61						
F4	72	0.61						
F5	67	0.57						
F6	66	0.56						
F7	66	0.56						
F8	62	0.53						
F9	59	0.50						
F10	56	0.47						
F11	53	0.45						
F12	52	0.44						
F13	49	0.42						
F14	48	0.41						
F15	48	0.41						
F16	47	0.40						
F17	46	0.39						
F18	43	0.36						
F19	41	0.35						
F20	40	0.34						
F21	40	0.34						
F22	40	0.34						

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F23	39	0.33
F24	37	0.31
F25	37	0.31
F26	36	0.31
F27	35	0.30
F28	35	0.30
F29	35	0.30
F30	35	0.30
F31	34	0.29
F32	34	0.29
F33	34	0.29
F34	33	0.28
F35	31	0.26
F36	31	0.26
F37	31	0.26
F38	29	0.25
F39	28	0.24
F40	27	0.23
F41	27	0.23
F42	26	0.22
F43	26	0.22
F44	26	0.22
F45	25	0.21
F46	25	0.21
F47	25	0.21
F48	24	0.20
F49	23	0.19
F50	23	0.19
F51	22	0.19
F52	21	0.18
F53	21	0.18
F54	20	0.17
F55	19	0.16
F56	19	0.16
F57	18	0.15
F58	16	0.14
F59	15	0.13
F60	15	0.13
F61	14	0.12
F62	14	0.12
F63	14	0.12
F64	13	0.11
F65	13	0.11
F66	13	0.11
F67	13	0.11
F68	12	0.10
F69	12	0.10
F70	11	0.09
F71	11	0.09
F72	11	0.09
F73	10	0.08
F74	9	0.08
F75	9	0.08
F76	9	0.08
F77	9	0.08
F78	8	0.07
F79	8	0.07
F80	7	0.06
F81	7	0.06
F82	7	0.06
F83	7	0.06
F84	6	0.05
F85	6	0.05
F86	6	0.05
F87	5	0.04
F88	4	0.03
F89	4	0.03
F90	4	0.03

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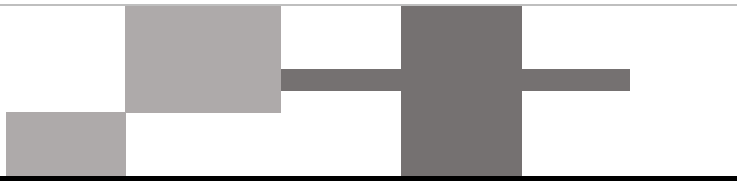
F91	4	0.03
F92	3	0.03
F93	3	0.03
F94	3	0.03
F95	3	0.03
F96	3	0.03
F97	3	0.03
F98	3	0.03



As can be seen from the previous table (Table 1), a total number of 98 factors are extracted from the literature and prioritized. According to the results, the top five investigated factors in the literature are "natural resource or energy consumption/efficiency of the building/equipment (during the construction, operation, etc.)", "materials performance (durability, cost, thermal capacity, permeability, ability to re-use, recycled, eco-friendly materials)", "access to public services/infrastructure: availability/quality of services and/or distance/time of travel time to the services (public transport, education/health/shopping/leisure facilities, parks, etc.)", "building spatial layout (size and dimensions, building form, internal space distribution, etc.)", and "location – site – development land" with the investigation frequency numbers of 87, 78, 72, 72, and 67 respectively. Three of these factors (F1, F2, F5) have their impacts on both scales of building and neighborhood/community, while each F3 and F4 impose effects on one scale only (neighborhood/community and building scales respectively). As well, it can be seen that all five factors have direct impacts on environmental and economic sustainability sections, while F3, F4 and F5 affect the socio-cultural section as well. None of these factors has a direct influence on institutional sustainability issues. At the bottom of the list, there are 11 factors (F88-F98) which are the least investigated ones with IF values of 4 or 3 and IC values of 0.03.

Table 2. Overall results for factors' influence scales.

Values	Factors with Building Impacts	Factors with NBH/Community Impacts	Factors with Impacts on both Building and NBH/Community
MIC (Mean Investigation Coefficient)	0.24	0.24	0.29
MIF (Mean Investigation Frequency)	28.65	28.14	33.69

As it is depicted in Table 2, MICs for the factors with impacts on building and NBH/community scales are equal (0.24), while it is higher (0.29) for the factors that have impacts on both scales. This shows that, in the housing sector, the most important factors are the ones that directly affect both the building and its surroundings. Consequently, these factors should be specifically taken into consideration during the design, operation and all the actions regarding both houses and neighborhoods, as they have impacts on both scales. Examples of this matter could be the development and planning of the local area.

The results also prove that to have a sustainable house, paying attention to the building's surrounding context is as important as the building itself issues. This should be applied to all housing-related procedures, such as architectural design and management, as well as housing evaluation methods and SATs. Although housing assessment tools consider some aspects regarding the neighborhood scale, the importance given is lower

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than the indicators which affect the building itself. It should be mentioned that applying these factors to the housing assessment processes faces many challenges, such as increasing the cost and time of the assessment, and therefore there should be solutions to decrease these negative aspects.

Table 3. Overall results regarding the factors' sectors of influence

Values	Factors with Envr. Impacts	Factors with Soc-Cult. Impacts	Factors with Econ. Impacts	Factors with Inst. Impacts	Factors with Envr.+Soc-Cult.+Econ. Impacts	Factors with Soc-Cult.+ Econ.+Inst. Impacts	Factors with Impacts on All Sectors
MIC	0.28	0.20	0.25	0.19	0.25	0.19	0.21
MIF	33.57	23.22	29.97	22.23	29.57	22.56	24.50

According to Table 3, the highest MIC value is allocated to factors with environmental impacts (0.28). Also, the lowest value goes to the indicators with institutional effects (0.19) and the ones that affect socio-cultural, economic and institutional sustainability sectors together (0.19). The MIC value for measures with impacts on all sustainability sections is 0.21, and this rate for measures that affect environmental, socio-cultural and economic sectors is higher and is equal to 0.25. It should be noticed that in highlighting and categorizing the factors based on their influence scale(s)/sector(s), the indicators must affect the targeted area, while they may, as well, have additional impacts on other scale(s)/sector(s).

As expected, from the four sustainability sectors that are studied the environmental section is the most important one according to the recent literature. A great amount of this importance level can be related to energy matters that are studied a lot in the literature and discovered to a great extent in practice. Table 3 shows that, after the environmental factors, economic issues have the most significance in the sustainability of houses, in comparison with the two remaining sectors. Socio-cultural and institutional factors come next, with the least importance level assigned for the institutional sector. It should be noticed that although it is expected that the measures affecting all sectors should be of great importance, their importance level is almost 27 percent less than environmental issues and 18 percent less than economic factors. However, the factors with influences on the three aspects of environmental, socio-cultural and economic sustainability are the most important factors after the environmental ones, with only 1 percent of less significance (regarding their MIFs). The reason for that could be the closeness of this combination of sectors with the combination of the well-known pillars of sustainability (environmental, social and economic pillars). In summary, although in recent years many authors have tried to implement holistic approaches in their works, it is pointed out that different sections of sustainability are not given similar degrees of importance in the literature throughout the world. This difference between the actual approach of the recent literature and the theoretical strategy of giving the same amount of significance to all sustainability dimensions is considerable.

4 Conclusion

Housing is no longer recognized as a simple shelter for us. It has inestimable importance

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in our quality of life and well-being. Also, it plays an important role in the sustainable development of the communities. Therefore, it is crucial to know comprehensively what factors contribute to housing sustainability. This project tries to provide required and useful information that can be used for two purposes: first the sustainability evaluation of houses, and second the evaluation of existing housing-related sustainability assessment methods and SATs. To do this, the present study has gathered and categorized 98 of these factors from 118 selected papers from recent years. As the studied literature is from all over the world, the results are on a global scale. The listed factors are mainly categories of some housing sustainability indicators and measures, so they may not be used for measuring the actual performance of buildings. However, these factors and their prioritization can be of high importance in decision-making-related procedures to act in line with the actual state of knowledge in this area.

We have, also, investigated the scale (building and/or neighborhood/community) and sector (environmental, socio-cultural, economic, and institutional dimensions) of influence for each factor. The overall degrees of importance for scales/sectors are calculated, as well. This data can be helpful to evaluate SATs indicators and the measures used by other assessment procedures. These results, as well, can lead the related policy- and decision-making processes in a better orientation lined with the current state of knowledge. According to the results, the top five investigated factors in the literature are “natural resource or energy consumption/efficiency of the building/equipment (during the construction, operation, etc.)”, “materials performance (durability, cost, thermal capacity, permeability, ability to re-use, recycled, eco-friendly materials)”, “access to public services/infrastructure: availability/quality of services and/or distance/time of travel time to the services (public transport, education/health/shopping/leisure facilities, parks, etc.)”, “building spatial layout (size and dimensions, building form, internal space distribution, etc.)”, and “location – site – development land” with the investigation frequency numbers of 87, 78, 72, 72, and 67 respectively.

Based on results, environmental aspects get the most importance among others (more than the factors with influence on all sustainability sectors), whereas institutional factors received the least attention. Also, the factors with impacts on both building and neighborhood scales are the most significant ones. Another interesting result is that neighborhood/community-related issues are considered almost equally important as the building scale factors in the overall sustainability assessment of houses. Therefore, it is needed to line up the housing- and neighborhood-related policies and strategies, and SATs as well, with the importance of neighborhood/community factors, dealing with housing sustainability. Also, the analysis outcomes show an opposition between the approach used in the recent housing-related literature on a global scale and the theoretical suggestions regarding giving a similar degree of importance to different sustainability dimensions.

The research has some limitations regarding its comprehensiveness (e.g., not directly including the literature published before 2015 or the ones which are not indexed in Scopus, not considering the literature written in other languages than English, etc.). Decreasing these limitations in future studies can be of use to validate the results. Also, to have a more all-inclusive view of the factors affecting the sustainability of housing, it could be very useful to analyze the importance of completely behavioral factors (such

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as resource consumption behaviors) as well, in such a broad way and improve the validity of the presented results by combining the analyses outcomes. The second suggestion is to widen the scope of the investigation to include, additionally, the non-recent studies. Also, prioritizing the results of this study in different local contexts can be very useful to understand better the role of local circumstances in the significance of sustainability factors.

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Appendix. Prioritized list of urban housing sustainability factors based on the number of references mentioning them (IF).

No.	Factors	IF
F1	Natural resource or energy consumption/efficiency of the building/equipment (during the construction, operation, etc.)	87
F2	Materials performance (durability, cost, thermal capacity, permeability, ability to re-use, recycled, eco-friendly materials)	78
F3	Access to public services/infrastructure: availability/quality of services and/or distance/time of travel time to the services (public transport, education/health/shopping/leisure facilities, parks, etc.)	72
F4	Building spatial layout (size and dimensions, building form, internal space distribution, etc.)	72
F5	Location – Site – Development land	67
F6	Healthy conditions (hygiene, clean environment, air/water quality, mental health, etc.)	66
F7	Housing affordable purchase/rental/mortgage costs (market value, relation to household income)	66
F8	Waste management/facilities (waste recycle/reduction, appropriate disposal of waste, etc.)	62
F9	Safety and security	59
F10	Building equipment/technologies (heating/cooling systems, ventilation systems, kitchen appliances, furniture, etc.)	56
F11	Rehabilitation/refurbishment of the building/community (repairing the deteriorations, functional improvements, etc.)	53
F12	Building envelope (thermal performance of the building, insulation, air tightness/exchange, etc.)	52
F13	Indoor environment (air quality, humidity, mold, thermal comfort, air circulation, etc.)	49
F14	Carbon footprint – GHG emissions	48
F15	Water management (consumption rate, irrigation systems, recycling, etc.)	48
F16	Use of renewable/clean resources (solar, wind, geothermal, renewable material, etc.)	47
F17	Opportunity for social cohesion/integrity/interaction/connectivity (common use areas, facility sharing, etc.)	46
F18	Re-use/recycle (materials, water, waste, etc.)	43
F19	Housing-related policies/strategies/guidelines/plans/decision-making procedures	41
F20	Building's basic services (safe drinking water availability, access to electricity, sewer, sanitation, etc.)	40
F21	Noise level – Acoustic design – Aural comfort	40
F22	Building codes/energy standards/technical specifications/regulations	40
F23	Investment/finance measures (subsidies, financial risk/support options, Investment cost, return of investment, payback period, profitability, cost-benefit data, budget adaptability)	39
F24	Pollution (air, water, land)	37
F25	Climatic/microclimatic conditions (air temperature, humidity, wind speed, solar radiation, heat island effect, etc.)	37
F26	Land use (Mixed-use building/community, zoning plans, re-using a developed area instead of new developments, land use change, amount of land supplied, etc.)	36
F27	Natural light – Solar radiation (availability, intensity, etc.)	35
F28	Built-up density	35
F29	Building typology (single-family, attached, apartment, etc.)	35
F30	Flexibility/adaptability (design, construction, function)	35
F31	Neighborhood spatial layout (street layout and network, space between blocks, pedestrian paths, open space layout, human scale features, public furniture, disables accessibility, etc.)	34
F32	Construction method/techniques/technologies (prefabrication, light/heavy structure, energy efficient techniques, traditional method, etc.)	34
F33	Passive/green/low-energy/near-zero-energy/plus energy design/principles	34
F34	Lighting systems (indoor lights, street lights, open space lights, etc.)	33
F35	Housing occupancy rate – Community population	31

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F36	Overall/lifecycle costs of the building	31
F37	Operation cost (energy/water/telephone bills, technology investment price, etc.)	31
F38	Aesthetical quality	29
F39	Traffic – Car dependency – Parking area	28
F40	Space functionality	27
F41	Participatory actions (design, management, bottom up governance, educational programs, etc.)	27
F42	Housing/community administration and management (cost/time/risk/maintenance management, etc.), and the types (self-managed, co-managing, etc.)	26
F43	Accessible house (easy physical accessibility for pedestrians/cars/elders/disables/etc.)	26
F44	Structural quality and durability	26
F45	Natural hazards and the related resilience/repair (earthquake, flooding, etc.)	25
F46	Building orientation	25
F47	Natural ventilation	25
F48	Walkability/bikeability (auto-free zones, sidewalks, bike routes, etc.)	24
F49	Access to workplaces (distance/time of travel)	23
F50	Local materials	23
F51	Construction cost (material, transport, labor, equipment and installation, etc.)	22
F52	Household/project team overall satisfaction rate	21
F53	Employment/business activity rate/opportunities in the area	21
F54	Compatibility with household/community cultural values or heritage	20
F55	Shading options – Rain protection	19
F56	Building's/neighborhood's identity/reputation/popularity	19
F57	Private/semi-public outdoor space (courtyard, garden, greenhouse, green roof, etc.)	18
F58	Privacy	16
F59	Presence/preservation of cultural heritage/natural resource (ponds, preserved greenery, topographical contours, etc.)	15
F60	Pleasant view/scenery	15
F61	Maintenance cost	14
F62	Renovation/repair/reconstruction cost (material, transportation, etc.)	14
F63	Greening the building (plants, green wall/roof, garden, etc.) and types of greening/plants	14
F64	Light pollution/quality – Visual comfort	13
F65	Innovation (design, management, technologies, etc.)	13
F66	Socio-cultural mixing of the community	13
F67	Fire prevention/emergency measures	13
F68	Building age – Year of construction	12
F69	Cost/value of land – Land use rights	12
F70	Household transport costs	11
F71	Type of tenure (private ownership, shared/private rent, etc.)	11
F72	Property value retention – Balanced housing market – Market trends	11
F73	Life expectancy of housing – Long lasting house	10
F74	Biodiversity/wildlife in the area	9
F75	Cater for senior citizens/disables	9
F76	Ease of movement inside the building (elevators, stairs, furniture and decoration placement, etc.)	9
F77	Construction time/speed	9
F78	Smart home/community (smart technologies/equipment: energy management systems, smart communication, intelligent controlling of home performance, smart toilets, etc.)	8
F79	Sense of belonging	8
F80	Odors – Olfactory comfort	7
F81	Access to the city center/urban space (distance/time of travel)	7
F82	Skilled/local labor and/or manager	7
F83	Security of tenure	7
F84	Standards of living	6
F85	Administration/government/management/design cost	6
F86	Ease of maintenance/cleaning (space, equipment)	6
F87	Level of physical deterioration	5
F88	Green/electric car usage – Carpooling	4
F89	Community acceptance/opposition with the project	4
F90	Economic mixing of the community	4
F91	Demographic/ethnic mixing of the community	4
F92	Diversity of building typology and/or spatial/aesthetic forms in the area	3
F93	Openness/closeness of the community (open/semi-open/gated neighborhoods)	3
F94	Community agriculture/gardening	3
F95	Mixed tenure community	3
F96	Access to internet (speed, capacity)	3
F97	Access to telecommunication service	3
F98	Access to television/cable system	3
	Other	23

Note: The full list of factors with all the references mentioning each of them can be found in [24].

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