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Urban Sustainability and Smartness Understanding (USSU)—Identifying Influencing Factors: A Systematic Review

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Abstract: Urban Sustainability and Smartness Understanding (USSU) can be defined by a group of sociopsychological determinants (such as awareness, perception, attitude and behavior) which shapes the relationship between human beings and the environment in which they live. A variety of influencing factors must exist in relation to USSU, however, a comprehensive examination of these, looking at personal, social, environmental, economic, technical, and governance perspectives in an urban context, appear to be less well researched. As such this paper provides an exploratory and critical evaluation of the literature by focusing on the USSU determinants; with an aim toward identifying the key factors (and sub-factors) that are in relation with these determinants. Two big databases of Scopus and Web of Science—have been searched systematically for the relevant studies. Therein it is observed how these factors affect USSU according to the characteristics of the study. Sustainability focused studies were found to be more commonplace than smartness studies. Moreover, there is currently ambiguity in evaluating the impacts of the identified factors. This paper concludes that a holistic approach is needed for clarifying the relationship and causality between sociopsychological determinants on Urban Sustainability and Smartness context. A framework with six dimensions is presented to initiate future studies to develop a consistent; coherent and comprehensive methodology to assess an individuals' USSU.

Keywords: urban sustainability; smartness; sustainable behavior; sustainability understanding; influencing factors; awareness; perception; attitude; behavior

1. Introduction

The current and future rates of urbanization are accepted as prominent challenges for human-nature relations and are expected to reach around 70% by 2050 [1]. Since the United Nations Conference on the Human Environment (Stockholm Conference) in 1972, studies on environmental sustainability have been dominant within academic literature [2]. Whilst early studies deal with environmental concerns which were becoming apparent in the 1970s [3], over the decades the scope of the sustainability studies expanded [4]. The most well-known definition of sustainability was made by the Brundtland Commission in 1987 as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' [5] (para. 27). This led to the conceptualization of the three pillars approach [6]. Whilst pillars such as culture and governance have long since found a place in a sustainability approach, smartness per se has gained weight only in the last decade with the role of information and communication technologies (ICT) finding their place as both an enabler for and barrier against sustainable development [7]. Notwithstanding this addition authors have suggested also that smartness is not just about technology alone and the human element should be

considered just as important [8]. Given this recent addition it is suggested that further investigation is required in Urban Sustainability and Smartness **(USS)** to involve the human factor and explore their overall understanding.

The values, judgements and daily practices of individuals play a critical role in USS. Likewise their sociopsychological determinants should be further explored in order to investigate the understanding of individuals—the related determinants suggested in our study are awareness, perception, attitude and behavior [9], where a complicated nuanced connection and relationship exists between each [10]. From here forward, this overarching approach will be referred to as Urban Sustainability and Smartness Understanding (USSU).

The relation between an individual's environmental attitudes and their behavior is complicated and intertwined and the first step in handling knowledge and perception is very much a cognitive process [11]. Barr [12] associates behavior with three independent variables, which are environmental values, situational values, and psychological factors. Likewise, Steg and Vlek [9] suggested four key issues for behavioral change:

- Identification of the related behavior;
- Determining the motivational factors for that behavior;
- Intervention for behavioral alteration;
- Assessment of the effect.

Although the specific inter-relationships between these determinants and USSU are beyond the scope of this current study, it is important to highlight them.

Barr and Gilg [13] reviewed factors influencing environmental attitudes and behaviors, however, the focus was not on sustainability (i.e., all three conventional pillars) and did not include smartness—key areas of work within this current study. Similarly, Gifford and Nilsson [14] examined personal and social factors influencing pro-environmental concerns and behavior, but their study focused mainly on environmental behaviors, and with a limited emphasis on factors including personal and social ones but excluding others such as environmental, governance, technical etc.

This paper aims to explore the underpinning factors that influence the determinants of awareness, perceptions, attitudes and behavior within USSU. Furthermore, it assesses the current methods that are used to identify these relevant factors, in other words—their data sources, scales, context, and target groups. The present research takes account of urban sustainability and smartness perspectives considering a wide range of personal, social, psychological, environmental, economic, technical, and governance aspects.

The paper is organized in five sections. Section 2 presents the methodology that will be implemented. Therein a general overview of the studies is provided. Section 3 gives an overview of the studies including methods and the data sources, scale and context, target groups, subject and target areas. Section 4 concentrates on the influencing factors that are identified from the studies and groups these under six categories: Demographics, Information and Policy, Infrastructure, Concerns, Perceptions, and Values and Actions. Discussion and Conclusions are presented in Section 5.

2. Methodology

In order to identify relevant studies to be reviewed, two major databases of Scopus and Web of Science were rigorously searched. The scope was limited to peer-reviewed articles, books and conference papers in the English language. The search has been conducted on the Title/Abstract/Keywords of the studies to be able to determine relevant publications as wide as possible, keeping in mind the necessity of having a confined and reasonable amount that is convenient for a literature review paper. A four step clustering algorithm (i.e., Scope, Target Group, Subject Domain and Methods) was applied in order to find relevant studies using the OR operator within the group terms along with AND operator within each cluster (see Appendices A.1 and A.2 for the whole search strings).

2.1. Keyword Selection

The 'Scope' of the studies was specified with the key terms of "environment* sustainab*", "sustainab* urban*", "urban sustainab*", "city sustainab*", "sustainable city", "smart city".

The main focus of the review is the sustainability of urban environment, city sustainability, or smartness of the city. The motivation behind including "environmental sustainability" is due to its broad and intertwined meaning with urban and city sustainability. On the other hand social or economic sustainability terms mainly represent pillars of sustainability with specific and distinct meanings. Therefore, they are not included in the search terms. Regarding the smartness, other alternative terms such as ICT are not included. These terms having the aspects not directly related with city, and being used interchangeably with specific technological applications which are not directly related to city, are excluded in order to provide clear boundaries to scope [15].

As sustainability and environment areas are considerably broad in nature and the main aim was to analyze sustainability and smartness at the urban/city scale, the above selection is reasonable for the database search.

The 'Target Group' of the literature was searched by implementing the key terms of "public", "citizen", "community", "expert", "official", "stakeholder", "consumer". It is aimed to keep the search comprehensive in terms of the sustainability actors. Therefore, either ordinary people or expert and governance level parties were included.

The 'Subject domain' of the search was confined to sociopsychological determinants, using the key terms of "aware*" [16], "relevan*", "perception", "attitude" [13], "behavior" [17], "expectation". These key terms seem inclusive enough to be able to determine the USSU aimed in our study.

In the last group, the data collection '*Methods*' used in the selected studies were clarified. Empirical studies that are in line with the scope, which have been conducted by either survey or interview, are included in the study. Therefore key terms "survey", "interview", and "questionnaire" are used [15].

2.2. Database Search

The database search returned 942 and 448 articles in Scopus and Web of Science respectively. The results were merged in EndNote Library. After automatic removal of duplications, 1041 articles remained. Journal editorials, articles in languages other than English, grey literature and non-academic research are excluded from the search results [18]. As inclusion criteria, articles are required to be focusing on the understanding of the urban sustainability and smartness with wider city focus, and they are required to concentrate on socio-psychological determinants which are awareness, perception, attitude, and behavior in urban context. Moreover, following criteria are specified for the exclusion:

- Focusing on rural areas
- Focusing on specific sustainability aspect (social, environment, economy, or governance)
- Focusing on specific sustainability topic (such as sustainable consumption, sustainable construction, sustainable household, sustainable energy saving behavior, sustainable transportation, sustainable tourism, green purchasing)
- Focusing on specific smartness topic (such as smart grid, ICT, smart mobility, smart applications, smart governance)

In this review, the process proposed by Yigitcanlar et al. [19] is adopted. In the first round, all articles are monitored according to title relevance. Articles are eye-balled in order to assure they are consistent with keyword search, scope and the aim of the research [19], and consequently the results are dropped to 294. In the second round, abstracts—and full-texts when needed—are investigated with respect to research aim and focus. Following the above inclusion and exclusion criteria, 35 studies were selected for full text in-depth review as shown in Figure 1.
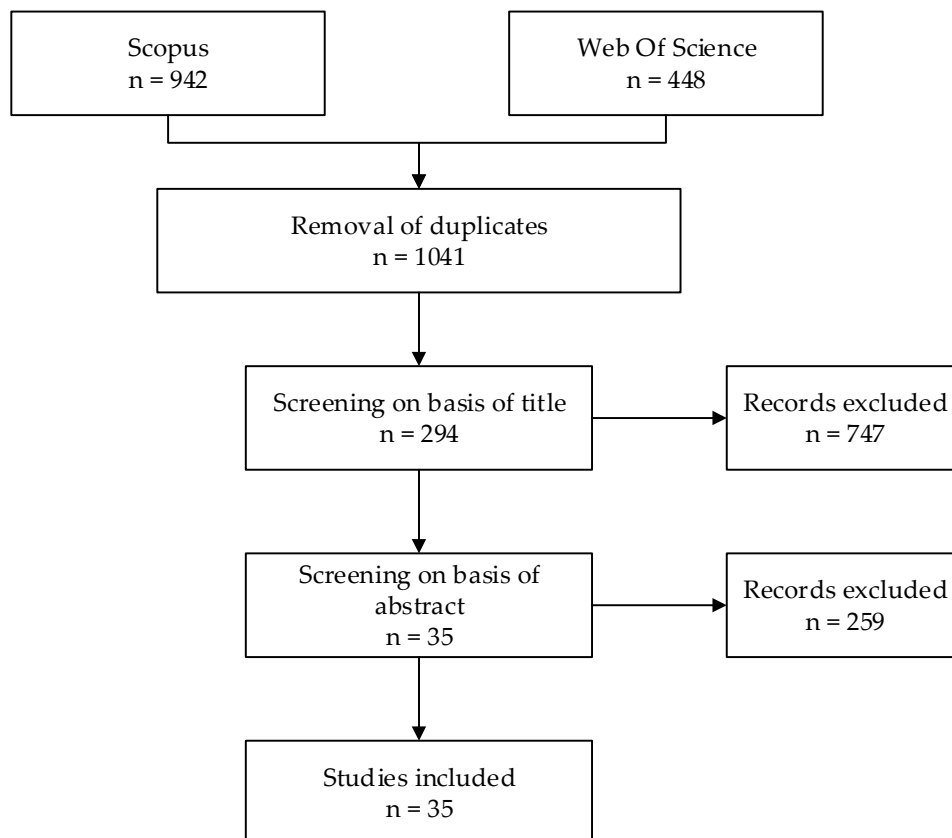
Figure 1. Article selection process.

3. Overview of the Studies

To conceptualize the analytical approach, studies were categorized according to their data analysis methods, data sources, scale and context, target groups, subject areas and target areas. Table 1 highlights the relevant properties of the studies which are discussed in detail within Sections 3.1–3.4.

3.1. Methods and Data Sources

The studies reviewed use either a qualitative, quantitative or mixed method approach. Moreover, most of the studies used survey as the primary source of data while interview is the second most popular data source. Limited studies used both and just four studies implemented a focus group approach for data collection [20]. For surveys, most preferred data collection and extraction methods are:

- Structured questionnaires with closed end questions [21–23];
- Telephone survey [24];
- Public survey [25–27];
- Postal survey [28,29];
- Field survey [30];
- Web survey [31–33];

Likert scale has been the most popular method of questionnaire design for structured surveys [34,35]. On the other hand, methods used in interview studies are:

- Telephone interviews [36];
- Focus groups [37];
- In-depth interviews [38];
- Semi structured interview [39–42];

Interviews are mostly implemented semi-structured or open ended questions. Although qualitative data sources appear to be the more preferred for the specificity of the data, they have several drawbacks identified during the review.

Firstly, collection and assessment procedures of qualitative data needs much more effort [43], therefore these studies are inevitably limited in their scales [37,38]. Most of the studies used either qualitative interviews [41], or surveys with open-ended questions [44]. Interviews were mostly limited to local scale [45], whilst qualitative survey studies extended this to city scale and quantitative survey questionnaires gave opportunity to conduct studies on regional [25], or even national scales [31].

Secondly, qualitative data sources, especially interviews, are more subjective in nature. In other words it might be argued that they highlight the opinions of individuals [40] and therefore there is likely to be bias. Therefore, a survey approach appears to be the more preferred option in data collection processes. On the other hand, other researchers argue that using both strengthens their data and results [46,47].

3.2. Scale

As illustrated in Table 1, twenty-one of the studies have been conducted at local scale which is interpreted as a spatial scale that is essentially equivalent to a community (i.e., at specified bounded area or specific city). Local scale for these studies was mostly preferred for data collection due to its logistical and spatial advantages. Furthermore, it should be mentioned that, USSU appears to be highly context-based [48], with local context and conditions playing a significant role, therefore it is not inappropriate to focus on local scale urban sustainability studies. Fourteen papers focused on either a regional (multiple cities within a particular region of a country), national (multiple cities within the boundaries of the nation itself) or international scale (multiple cities within the international context), therein the main aim of the regional studies was to compare various cities and target groups [27]. Six national scale studies identified the national condition and current state of the country with respect to sustainability understanding [31]. Within the four International studies countries and cultures alike focus well on sustainability issues, trying to specify commonalities and global problems for mutual benefit of human beings [21,49].

3.3. Target Groups

There is much confusion and inconsistency used in the terminology for target groups. For example, while some studies use resident [50] others use household [35] depending on their scale of study, whereas others use citizens [51]. Unfortunately, there is no clear distinction between these target groups and more-often-than-not they are used interchangeably or collectively. In other words, the term "public" is likely to mean citizen, resident and household altogether. For other studies, target groups such as developers, practitioners, students, governmental officials or experts are mentioned. The term "Stakeholders" appears to refer to both an individual and collective of target groups, which can lead to confusion.

Table 1. Overview of the Studies.

		[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Method	Qualitative					✔			✔	✔					✔												✔					✔			✔	
	Quantitative	✔	✔	✔	✔		✔	✔			✔	✔	✔			✔	✔	✔	✔	✔	✔			✔	✔	✔							✔			
	Mixed													✔								✔	✔					✔	✔	✔						✔
Data Source	Focus Group													✔														✔	✔							✔
	Survey	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔		✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔
	Interview									✔			✔		✔			✔	✔				✔				✔		✔	✔	✔	✔			✔	✔
Scale	Local	✔												✔	✔	✔	✔	✔	✔	✔	✔		✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔
	Regional		✔		✔						✔										✔															
	National			✔				✔		✔														✔										✔	✔	
	International		✔			✔				✔													✔													
Location	Asia					✔			✔	✔			✔														✔		✔							✔
	Europe		✔	✔	✔		✔	✔						✔					✔				✔	✔	✔	✔				✔						
	Middle East			✔																			✔													
	Far East	✔				✔		✔	✔					✔																				✔	✔	
	Australia								✔						✔					✔								✔	✔					✔	✔	
	America					✔						✔						✔	✔		✔									✔						
Target Group	Public	✔	✔		✔	✔		✔			✔	✔	✔			✔	✔	✔			✔	✔	✔		✔		✔	✔	✔	✔				✔	✔	
	Stakeholders		✔			✔			✔	✔			✔	✔				✔				✔		✔	✔			✔	✔						✔	✔
Subject	Sustainability	✔	✔		✔	✔	✔	✔		✔	✔	✔	✔			✔	✔	✔			✔	✔	✔				✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Smartness		✔		✔					✔				✔	✔					✔			✔	✔	✔	✔										

3.4. Subjects and Target Areas

Sustainability and Smartness are the focal points of this study therefore nearly all of the identified articles investigate either sustainability or smartness with more emphasis appearing to come from sustainability prior to 2014, with smartness gaining importance and popularity after 2014 [40,45]. Other subject areas such as liveability [42,54] and Sustainable Development [22,31] are put under the same Sustainability umbrella and again sometimes used interchangeably within the literature. Only one study within those reviewed in this paper explicitly focused on both Sustainability and Smartness [53].

There are a wide variety of target areas investigated in the studies. The dominance of the environmental perspective of sustainability is readily evident. Moreover, other target areas of governance [49], infrastructure [35], consumption [39], climate change [28], urban development [44], and services [50] are also stated but are less well-developed.

4. Influencing Factors

The studies selected for the review were examined to identify the factors (and sub-factors) that are influential to an individuals' USSU. Through the review, six broad categories naturally emerged which are demographics, information and policy, infrastructure, concerns, perceptions, and values and actions. An accompanying framework along with more detailed explanation and justification for the categorization is given in Section 5. Therefore, this section has been structured accordingly. Tables A1 and A2 in Appendix B further illustrate the outline of the factor grouping mechanism. Corresponding factors are discussed in following sections.

4.1. Demographics

Table 2 shows the demographic factors and sub-factors drawn from the studies reviewed. These are sorted according to *Individual* (Section 4.1.1) and *Other* (Section 4.1.2).

4.1.1. Individual

The literature suggests that *age* seems to be one of the most significant factors of USSU, however there are some divergent findings which could be explained away by considering the different cultural and socioeconomic factors involved.

The literature reviewed suggested that younger populations (aged between 18 and 40) generally have a higher level of environmental awareness [46], combined with more knowledge about sustainability [27] and were more readily engage with smart services—e-participation [32]. Moreover, they are identified to have stronger environmental concerns and tethered with a tendency to protect it [24].

Age groups appear to have different perceptions about urban greenery [35]. Newton and Meyer [29] suggest older generations appear less concerned about environmental problems, whilst Guo, Cao, DeFrancia, et al. [27] suggest older citizens (aged 40 and above) have more positive perceptions about their city's sustainability performance, whereas Drews and van den Bergh [31] claims that older people have a more balanced view of environment and growth. Allied to this Wong and Wan [24] reported that the youth are more optimistic about their government's environmental performance.

In terms of behaviour Wong and Wan [24] indicates a strong positive relationship between younger ages and sustainable behaviours. Reportedly, the younger generation has a greater tendency to adopt smart services, and engage with technological approaches [45] and sustainable projects [53]. That said, Peng, Nunes and Zheng [50] also report younger cohorts to have lower awareness of the smart parking services, which was due to lower income level. It is therefore possible to argue that smart city conceptualizing has a stronger base than sustainable city in younger generation. On the contrary, Hsu and Feng [51] claims that older people are more probable to show environmentally sustainable behaviour and typically use less resources leading to more sustainable lifestyles [33].

Table 2. Demographic Factors.

	Factors	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Individual	Individual Age	✔						✔			✔		✔		✔					✔	✔		✔	✔			✔			✔					✔	
	Gender	✔						✔			✔				✔					✔											✔			✔	✔	
	Income							✔			✔	✔	✔							✔				✔										✔	✔	
	Education		✔		✔			✔			✔		✔							✔	✔							✔							✔	
Other	Residential Household Type	✔										✔																					✔			
	Residential Length and Status									✔	✔						✔										✔									
	Ideological Employment/Area of Expertise	✔							✔					✔	✔			✔																		
	Religiosity and Political Orientation							✔			✔																									

Many studies found *gender* to impact on USSU reporting that females tend to have better sustainable performance than males. Although Guo, Cao, DeFrancia et al. [27] observed that male respondents have more knowledge about sustainability due to the fact that such information tended to be given to male heads of households, not least in places like China. Wong and Wan [24] stresses the consistent effect of gender on individual's environmental beliefs and values, and mentions females to have better environmental perceptions than men. Likewise female households are reported to have better understanding of urban greenery [35]. Drews and van den Bergh [31] points out that, although males seem to have stronger belief on growth, females are more concerned about the environment, Newton and Meyer [29] shares the view that male-dominated group have less environmental concerns. A view held up by Hsu and Feng [51] who report that females have better tendencies to show pro-environmental behavior than men. The research showed that females commit to sustainability practices far more readily than males, in particular at household level [28]. Moreover, many papers strongly endorse the important role women play in promoting sustainability at all scales [22]. Overgeneralizations in this respect must be viewed with caution and the role that local context and condition plays must be considered.

Newton and Meyer [29] found that, households with higher income constitute the majority of environmentally sensitive groups, since they can afford green behaviours. Similarly, higher income group are identified as being more aware of environmental limits [31] and more knowledgeable about sustainability [27], therein they use smart tools, e-participation [32] and smart services [50].

On the contrary, Wong and Wan [24] explored that there is a negative correlation between income and environmental sensitivity, and a positive linear correlation between income level and resource consumption such as water [36] as a result of purchasing power. Moreover, low-income groups are found to have greater willingness to change their behavior and practices for the improvement of sustainability—because they cannot afford otherwise. As a result, they are expected to have more pro-sustainability actions than those of higher income [28].

The effect of income on USSU seems to have different impacts depending on different contexts and local conditions. While some sustainable behaviors require better financial conditions, such as the purchase of greener options and smart services, others would support the budget of individuals where consuming lower resources is a necessity rather than a personal choice.

Education has been stressed in several of the studies reviewed to have a considerable impact on USSU. The term education here as a demographic factor refers to general educational level of individuals such as primary school, high school, university degree and postgraduate study etc. It is a commonly found that, education level has a positive correlation with environmental [30] and sustainability [27] knowledge and awareness. In addition the level of education is reported to have a considerable impact on environmental attitudes as well, in this respect it is seen to shape the attitudes of individuals about achieving a balance between economic growth, environmental and social performance [31]. In other words, they provide a more considered approach to equity, bearability and viability. People tend to be more critical about the condition of their living environment (i.e., natural and built) with increasing levels of education obtained [27]. Notwithstanding it is reported that those with lower levels of education obtained have a more positive impression about government's environmental efforts [24].

It is further discussed within the literature that levels of education obtained has both a direct and indirect impact on behavioral change [56]. For instance, Newton and Meyer [29], reported that more university graduates are observed among the group which is more pro-environmental in their belief and behaviors. On the contrary, Noonan, Zhou and Kirkman [53] found that the use of sustainable project of beltline is more widespread amongst those without tertiary education. Likewise there is a suggestion that those with tertiary education have a tendency to underestimate their contribution to sustainability, in particular environmental Bleys, Defloor, Van Ootegem, et al. [26]. In a similar way, He, Boas, Mol, et al. [32] found a positive correlation between level of education and use of smart tools.

In conclusion it can be seen that, effect of education level is different at various sociopsychological determinants. While it could contribute to the knowledge and awareness, its relation to attitudes and

behaviors is far more debatable and the evidence base to support the hypothesis, based on the studies reviewed within this paper, is less well-developed.

4.1.2. Other

4.1.2.1. Residential

Household type is mentioned among the influencing factors of USSU, in particular with its relation to resource consumption. According to Harlan, Yabiku, Larsen, et al. [36], larger houses have considerably larger resource consumption apart from other characteristics, therefore directly affecting both the attitude and behaviour of individuals. On the other hand, Waitt, Caputi, Gibson, et al. [28] claims that people living in detached houses have more pro-sustainability habits than those living in flats or complexes.

In terms of residential status, Kang [23] emphasizes that people who rent their property display more sustainable behavior than their landlords, the suggestion was that this is much more related with resource consumption (i.e., food, energy and water) and waste production. Moreover, as the length of residency increases, Guo, Cao, DeFrancia, et al. [27] observed that residents tend to have more positive perceptions about the sustainability of their environment. Similarly, Rogers and Bragg [38] observed a positive relation between length of residency and better environmental understanding. The authors claimed that, 'place attachment' occurs as a result of longer living periods within an area which then encourages people to both enhance and protect their surrounding environment. However, Harlan, Yabiku, Larsen, et al. [36] contests this view suggesting that resource consumption increases with the length of residency. That could be because of the sense of ownership and confidence that is fostered long-term within the living environment.

4.1.2.2. Ideological

Employment, Area of expertise and Source of Income are considered as key parts of USSU [42]. For instance, the recognition of environmental consequences and perceived criticality is relatively higher among people from working within the tourism sector as compared with those workers from industrial areas, and directly related to their environmentally behavior (both positively and negatively) [25]. This difference is suggested to be as a direct result of different social-cultural working environments where one group has a more direct relationship with environmental degradation. Interestingly, Gambini [21] reported that students of economics have more trust on technological innovations to find better environmentally efficient solutions for contemporary problems than geography students. Likewise Hsu and Feng [51] suggested that students *per se* would have better environmental performance than those working in agriculture, business, manufacture and military services. This is a view upheld by Barau [35] who suggested that although there is a general knowledge about sustainability among different groups such as housewives, retirees and full-time workers, the last of these groups were found to have less time available to them in order to become involved in sustainability activities when compared to the first two groups.

Religiosity and political orientation are found to have a good correlation with the understanding of environment and growth [31]. Likewise, Guo, Cao, DeFrancia, et al. [27] revealed that, people with stronger religious beliefs have greater and more positive perceptions about the sustainability of their city. Interestingly Guo, Cao, DeFrancia, et al. [27] suggested also that members of the political parties in China have more knowledge on sustainability issues than those who are not.

4.2. Information and Policy

Table 3 shows the information and policy factors collated from the literature reviewed. This is broken down into sub-factors of Awareness (Section 4.2.1), Communication (Section 4.2.2), and Policy and Governance (Section 4.2.3).

Table 3. Information and Policy Factors.

	Factors	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Awareness	Knowledge Familiarity										✔									✔																
	Information and Knowledge Level	✔				✔		✔	✔			✔			✔					✔					✔					✔	✔				✔	
	Access to Information and Knowledge												✔											✔												
	Improved Knowledge Sharing																										✔									
	Publicity / Publicity and Promotion				✔																								✔		✔				✔	
	Visibility of Issue, Service, Consequence												✔											✔					✔	✔	✔					
	Training / Training and Education			✔	✔								✔															✔	✔	✔	✔				✔	
Communication	Informative / Public Information and Communication												✔			✔							✔													
	Interactive Mechanisms									✔													✔													
	Communicative / Mass Media															✔												✔							✔	
	Public Involvement		✔							✔									✔																	
	Dialogue Between Local Actors																		✔											✔						
Policy and Governance	Regulative / Legislation and Regulations												✔																✔		✔				✔	
	Controlling and Monitoring																												✔						✔	
	Incentives (Governmental, Social, NGO)											✔																	✔						✔	✔
	Managerial / Residential Length and Status		✔																											✔			✔			
	Participatory Governance		✔							✔									✔				✔		✔			✔		✔						

4.2.1. Awareness

4.2.1.1. Knowledge

Familiarity is a key part of Knowledge and Awareness within the USSU. It is observed that familiarity has positive impact on sustainability awareness of residents [27] and people tend to use the sustainable services far more as they gain familiarity [39,53]. Its impact on smartness seems more direct and practicable than sustainability.

Cagáňová, Stareček, Horňáková, et al. [44] stressed the importance of information and knowledge level of respondent's awareness of smart city concepts. For example, Political decision makers revealed that providing better access to information and knowledge enhances public awareness of smart services [45] whilst promoting a positive and strong correlation with environmental concerns [26]. However to achieve full participation and buy-in this improved knowledge sharing must occur for all sectors of society, including passing of information to governmental actors [22] in order to improve their sustainable behaviors [37] as well as those they govern [32]. Similarly, information and knowledge levels about sustainable issues [51,56] and related solutions [21] are all suggested to be enablers for pro-environmental attitudes and behaviors of individuals [30,38]. Conversely, low information [39] and lack of access to new knowledge [29] is found to be a considerable barrier. For instance, He, Boas, Mol, et al. [32] stated the negative effect knowledge restrictions could have on sustainable behaviours of Chinese citizens.

4.2.1.2. Publicity

Publicity and promotion by social campaigns for sustainability are suggested to have positive contributions on awareness of the issues at play [22]. In order for people to demand sustainable solutions and products a campaign of increased public awareness is required [37]. The same is true for smart solutions and products [44].

Awareness is also directly related with the visibility of the sustainability issues that really matter [22], only then can environmental responsiveness ensue [46]. Visibility of services enhances the awareness of people [45] and ultimately leads to efficient and sustainable use of resources [20]. Similarly, visible sustainability guidance through labelling or visibility of economic consequences and pressures is suggested to help people to develop more sustainable behaviors and practices [39].

4.2.1.3. Training

Training and education category is accepted as the educational and training policies, interventions, incentives, activities, or opportunities that are directly related with and concentrated on sustainability and/or smartness. It is highlighted by a number of studies and provides a key influence for USSU in order to improve people's understanding about the urban challenges [22], increase their sustainability awareness [39] and knowledge [20], and engage them in sustainability actions [38]. Through citizen oriented training and education project, it is found that the sustainable knowledge and awareness of participants improves significantly [30]. Likewise where mechanisms for educating about smart city tools are adopted, for better application of urban policies, there is a remarkable link with improved awareness [44].

Similarly, educational policies increase awareness and enables consumers to use resources in more sustainable ways [36]. Zainul Abidin [37] states that sustainability training of government officials and the wider provision of other incentives (e.g. financial) are important and have direct effect on the awareness and practices of stakeholders. This is certainly true for parts of Malaysia, where informative processes on the environment have resulted in higher environmental awareness. Similarly, Tononi, Pietta and Bonati [46] identified an increase sustainable consumption habits as a result of training on sustainability issues and concepts. As the information and knowledge level of selected families' increases, they adopt better options and reduce their ecological footprint.

4.2.2. Communication

4.2.2.1. Informative

Public information and communication plays an important role in increasing the awareness and creating environmentally friendly attitudes [20]. Kang [23] mentions the significance of public communication, not least the power and impact of face-to-face. Interactive information mechanisms via public screens or other forums (e.g. internet) are also found to be an effective way of increasing public awareness [45]. Similarly, public participation is greatly enhanced by provision of interactive feedback mechanisms [45]. Granier and Kudo [40] further claims that, behavioral change is better achieved via real-time feedback from citizens (e.g. use of smart meters, metrics and benchmarks).

4.2.2.2. Communicative

Mass media could play a crucial role for USSU by creating awareness, enhancing knowledge and increasing concern of public [39]. Communication through the media, whilst not as highly reported as awareness, is an important influence for the improvement of sustainability awareness of the public [37]. When combined with online communication and media they are significant facilitators for sustainable behavior generation [23]. The power of media in the battle against Covid-19 in 2020 is a shining of example of how this can work effectively.

Tallied with this Public involvement is also seen as a facilitator for social acceptance and behavioral change of individuals [40]. Not least, for smart cities where greater interaction with citizens via public involvement has been seen to improve value creation [49]. Due to the gap between knowledge and understanding of different stakeholders such as public, experts and other local actors [22], the importance of dialogue / interaction between them is seen as paramount to overcoming this [25].

4.2.3. Policy and Governance

4.2.3.1. Regulative

There is a general consensus about the value of strong legislations and regulation mechanisms for USSU [39]. They are seen as an important driver for achieving (and enforcing) the success of sustainable policies and implementations [22], without which reluctance to accept ensues [37]. However, excessive governmental legislation and regulations can also give rise to the rebelling [32] therefore a careful balance must be struck. In addition to legal regulations, controlling and monitoring can provide useful pathways to improve sustainable behavior [22] and is seen as a vital tool for implementation [37].

Incentives (alongside enforcement) directly or indirectly through taxation and pricing policies (see Harlan, Yabiku, Larsen, et al. [36]) are also key promoters of success [37] inadvertently advancing consumer sustainability awareness and perceptions. A combination of Governmental, Social and NGO incentives are found to have positive impact on sustainable behaviors [39]. For example, Zhang, Chen, Wu, et al. [47] revealed that providing that Government incentives in the form of direct financial support are sufficient (e.g., >10% of actual cost) they can increase consumer's willingness to pay for sustainability options.

4.2.3.2. Managerial

There is a strong link between the USSU and Managerial governance. A number of these can be seen in Table 3. Bolívar [49] suggests that smart and efficient governance is seen essential by stakeholders as a pre-requisite to achieving smart cities and Tononi, Pietta and Bonati, [46] supports this view reporting that strong governance also impacts directly on the daily habits of individuals. Conversely, Wong and Wan [24] reported that weak governance can give rise to less public concern (and action) not least toward environmental improvement.

Participatory governance as a fundamental part of Urban Governance can: increase awareness [22]; help manage various stakeholders successfully through dialogue [25]; provide active engagement of

citizens with other stakeholders [49], advance collaboration [55] and enhance political inclusivity [38]. Moreover, early stage participation of citizens and other stakeholders in decision-making mechanisms improves their sustainable perceptions and behaviors [40,45].

4.3. Infrastructure

Table 4 shows the infrastructure factors collated from the literature reviewed. This is broken down into sub-factors of Physical Infrastructure (Section 4.3.1), Social Infrastructure (Section 4.3.2) and Monetary Elements (Section 4.3.3). The second order factors are discussed therein.

4.3.1. Physical Infrastructure

4.3.1.1. Availability

Success of the services and infrastructures, measured in terms of utilization by citizens, can be seen to be highly dependent on their *Availability and proximity* to the user. For example, Holdsworth, Kenny, Cooke, et al. [42] argues that, availability of amenities close to a living area has a direct effect on the individual's perception about livability. Similarly, lack of physical infrastructure or services is found to be a barrier for sustainable practices of people [39]. Noonan, Zhou and Kirkman, [53] supports this view suggesting that whilst the intention to use infrastructure may be high the underpinning driver to whether they access it or not is shaped by their proximity to it.

In a similar way, urban greenery is seen as a major factor of livability for all cultures and societies [44,54] and it directly and indirectly increases public awareness and perceptions [52].

ICT, as a facilitator for USSU plays an important role in enhancing public perceptions, behaviours and participation [20] along with knowledge, awareness and daily use of life-enhancing technological tools [32]. While ICT provides people with necessary infrastructural provisions which in turn enhances the use of smart tools and increase their participation in smart city services, it improves the conceptual understanding of individuals regarding the sustainability. This is a view shared by Kang [23] who claims that ICT, such as internet media and social media, enhances active citizenship opportunities for the public (both old and young) which is beneficial for the public awareness of smart and sustainable city services [44].

4.3.1.2. Quality

Quality and functionality [46] in addition to ease and feasibility of services, not least smart [45], are reported to directly influence sustainable consumption patterns and practices. Low quality and functionality (e.g., technical problems and functional inadequacies) leads to slow/no uptake, poor user behavior and low satisfaction [50]. Whereas, with high quality and functionality the opposite is true. Likewise, satisfaction level of building form(s), scale of space(s), street character [54] and living spaces [42] can impact the behavior [44,56] and livability perception of individuals [42,52].

4.3.2. Social Infrastructure

Social infrastructure, both its quality and availability undoubtedly play a role within USSU, although in comparison to other factors it appears to be less well-reported within the literature reviewed.

4.3.2.1. Availability

Availability of cultural and public facilities and areas are reported to have considerable impact on sustainability, wellbeing and quality of life perceptions of individuals [44,52]. Those areas without them report to be less-well performing.

Table 4. Infrastructure Factors.

	Factors	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Physical Infrastructure	**Availability**																																			
	Availability and Proximity														✔						✔								✔							
	Green Areas					✔												✔					✔													
	ICT					✔							✔	✔			✔																			
	Quality																																			
	Quality, Functionality and Feasibility of Services																	✔				✔	✔							✔						
	Satisfaction with Built Environment					✔									✔			✔					✔		✔											
Social Infrastructure	**Availability**																																			
	Availability of Cultural and Public Facilities					✔												✔																		
	Quality																																			
	Quality and Comfort of the Living Environment														✔																					✔
	Citizen Centric Services			✔																																
Monetary Elements	**Material**																																			
	Cost—Price								✔					✔						✔							✔	✔	✔	✔	✔				✔	✔
	Purchasing Power											✔																				✔				
	Market Demand								✔																										✔	
	Managerial																																			
	Advertising and Monetary Benefits																							✔			✔									
	Economic Stability and Growth			✔				✔																												

4.3.2.2. Quality

Similar to availability the quality and comfort provided by living Environment strongly effects directly livability perceptions [42]. Moreover when considered in isolation or in combination to functionality it is an influential factor in buyers' willingness to pay [47]. Similarly, citizen centric services are found to enhance public acceptance whilst improving sustainable and smart behaviors [49].

4.3.3. Monetary Elements

Financial determinants are found to have a significant and direct impact on the USSU, featuring strongly in over half of the literature reviewed.

4.3.3.1. Material

The most distinctive financial parameter appears to be the cost of resources, products and services [21]. They are the main determinant of consumer preferences [46] and influence the behaviours of the old and young, (e.g., students) [20], not least when it comes to the cost of the water, electricity or gas. High pricing appears to motivate pro-environmental behavior leading to reduced consumption and better resource efficiency [39,56]. Conversely the willingness to pay (e.g., for a green certified house) is directly related to long-term savings that can be achieved [47]. This links back to financial incentives that are an important driver for companies less willing to take sustainable options due to short term cost constraints [37]. Purchasing power also in relation with sustainable behaviours [36], those who can afford it might use more [28] or mitigate their consumption habits by investing in expensive but sustainable/smart technologies (e.g., electric cars/smart homes). Market demand and the requirement for the client or consumer, each with their own financial constraints [21,37], to ask for sustainable and smart features can be the determinant of creating sustainable habits and providing sustainable services [29].

4.3.3.2. Managerial

Despite financial constraints, long term perceived or actual monetary benefits [33], are facilitated by advertising campaigns [50] and are known to increase awareness and encourage pro-environmental behaviors. The importance of economic growth for public value creation is evidenced within the literature [49]. Similarly, the opposite is true for economic shrinkage (e.g., in Spain, [31]).

4.4. Concerns

Table 5 shows the concern factors collated from the literature reviewed. This is broken down into sub-factors of Internal Concerns (Section 4.4.1) and External Concerns (Section 4.4.2). The second order factors are discussed.

4.4.1. Internal Concerns

4.4.1.1. Personal

In terms of personal concerns people seek for happier, healthier and more sustainable lives motivated through concern for health and wellbeing, and the state of the environment [38] which has a direct positive impact on sustainable behaviour [39] and adoption of greener options and actions [35]. On the other hand, safety concerns influence directly the perception of quality-of-life in a city [52] and are a strong determinant for smart urban perception [44].

Table 5. Concern Factors.

Category	Factors	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Internal Concerns	Personal Health and Wellbeing Concerns	✔																										✔	✔							
	Safety Concerns					✔												✔																		
	Social Concern for Social Appraisement																														✔					✔
	Trust on Society																	✔																		
	Ownership of the Problem																			✔						✔										
External Concerns	Physical Concern for Future													✔							✔								✔							
	Concern for Environment		✔									✔								✔							✔							✔		✔
	Conceptual Trust on Science and Technology							✔	✔																										✔	
	Trust on Actors and Mediators									✔								✔											✔							

4.4.1.2. Social

Zhang, Chen, Wu, et al. [47] stressed the role of concern for social environment appraisement on purchasing behavior. When combined with trust of society this can be a fundamental motivation for sustainable community construction [52]. A low level of ownership of the problem leads to a lack of responsibility and action [29] which in turn becomes a barrier for achieving a more sustainable community. For example, viewing protection of the environment as a governmental rather than personal responsibility [56].

4.4.2. External Concerns

4.4.2.1. Physical

Concern for future, not least in terms of resources [36], is a factor in urban sustainability influencing directly how people perceive and behave [22], both positively and negatively, leading to dis-engagement [53]. This includes young students who are suggested to have concerns about the future of the cities they live in [20], but are not aware of the mechanisms by which they can help.

Concern for environment is another important component of USSU [29]. Increased concern for environmental degradation appears to enhance environmental understanding of individuals [24,36], resulting in reduced resource consumption (e.g., such as water, see Rajapaksa, Gifford, Torgler, et al. [33]) accompanied by a lower Ecological Footprint [26].

4.4.2.2. Conceptual

Trust is an important determinant of USSU, where trust in science and technology, for example, can shape peoples' understanding of urban sustainability and smartness [21]. While science and technology perception affects the cognitive understanding of urban sustainability, it has practical influence on smartness approach of people. Those with lower levels of education, sometimes combined with lower income are reported to have more trust and confidence in science and technology solving environmental problems than those with higher levels of education and income [24]. Reduced confidence is reported to result in decreased concern and lower levels of responsibility about environmental issues [31].

Similarly, the trust (of people) on governmental actors has a direct effect on how they perceive issues and how they behave [52]. Participation of citizens in sustainable actions is induced where trust is lacking [40]. Likewise, sustainable behaviour (and willingness to change) ensues where trust is fostered between mediators (e.g., such as media and NGO's) and the public as a whole [39].

4.5. Perceptions

Table 6 shows the perception factors collated from the literature reviewed. This is broken down into sub-factors Internal Perceptions (Section 4.5.1) and External Perception (Section 4.5.2). The second order factors are discussed.

4.5.1. Internal Perceptions

4.5.1.1. Personal

Perception of personal action (and positive or negative consequences) shapes USSU through either encouragement, discouragement [22] or a combination of both. Both Tononi, Pietta and Bonati [46] and Bleys, Defloor, Van Ootegem, et al. [26] observed that, many people are neither aware of nor able to self-evaluate the environmental impact of their personal actions. Hence where incorrect (or uninformed) perceptions (about their personal actions) are present, individuals tend to ignore their responsibilities and merely justify their unsustainable behaviors [41]. On the other hand, if people have a chance to observe the positive consequences of their personal (more sustainable) actions (or the negative consequences of their unsustainable actions, such as plastics in the oceans) and believe

that they have the opportunity to change things, they are more motivated to do so [38]. In contrast motivation decreases where a highly economically oriented perception of prosperity ensues [31]—in other words if it is going to cost me too much or I am going to save very little, why should I bother?

The perception of danger/risk/threat has a strong connection with assessing of the importance of environmental issues [22]—as proximity increases, so does perception of danger which in turn enhances public consciousness [46] and emotional connection [34] leading to motivate a responsibility for more sustainable behavior to occur.

4.5.1.2. Social

Newton and Meyer [29] stress the strong effect community perception has on sustainable behavioural change, this is a view upheld by Rajapaksa et al. [56] who reported the perception of inequality within the community to have a more negative effect on environmentally sustainable behaviours. In contrast Harlan et al. [36] reported a much less distinctive effect between perception and behaviour.

4.5.2. External Perceptions

4.5.2.1. Physical

An inaccurate perception of environmental issues can reportedly endanger the construction of sustainable behaviors—resulting in either low interest or impaired meaning attached to issues at hand [39]. For example, Waitt, Caputi, Gibson, et al. [28] suggested there is a willingness of individuals to change their behavior if they believe they have an impact on climate change. In contrast where this perception of environmental impacts is missing a lack of individual responsibility prevents them from taking any action [22]. Likewise Guo, Cao, DeFrancia, et al. [27], reported on the perception of citizens in China where there is a lack of recognition of the detrimental environmental impacts the mining industry (not least coal) brings in their cities—hence no change ensues.

Likewise, perception about living environment in terms of crowd and density of urban spaces influences the sense of comfort and livability of individuals [54] and ultimately their behaviors [29,56]. Better behavioral outcomes occur where a more pro-environmental perceptions exist and where priority is given to environmental rather than economic development [31] or where a more balanced perception of nature exists, rather than a human-centric understanding of the environment [51]. For example, those with little or no physical connection to nature may be less willing to protect it.

4.5.2.2. Conceptual

Relevance of sustainability issues depends on how they are perceived—those perceived less critical are typically rated with less importance [22]. Interestingly these can change dramatically between different stakeholder groups and individuals [25]. Drews and van den Bergh [31] found that individuals' views are directly affected by the current economic situation of their countries where high growth rates in Spain were identified to be more important than environmental concerns.

4.6. Values and Actions

Table 7 shows the values and actions factors collated from the literature reviewed. This is broken down into sub-factors of Norms and Context (Section 4.6.1), Feelings and Notions (Section 4.6.2) and Activity (Section 4.6.3). The second order factors are discussed.

Table 6. Perception Factors.

	Factors	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Internal Perceptions	Personal Perception of Personal Action	✔												✔					✔									✔		✔	✔	✔				
	Perception of Prosperity							✔																												
	Perception of Danger/Risk/Threat						✔																							✔	✔					
	Social Perception of Community											✔								✔																
	Perception of Inequality																									✔										
External Perceptions	Physical Perception of Environmental Issues																											✔				✔				
	Perception of Environmental Impacts										✔																			✔						
	Perception About Environment							✔								✔			✔			✔				✔										
	Conceptual Perception of Criticality																		✔											✔						
	Perception of Current Situation							✔																												

Table 7. Values and Actions Factors.

Category	Factor	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Norms and Context	Normative Socio-Cultural Norms	✔							✔																							✔	✔		✔	
	Moral Values and Beliefs		✔												✔																	✔				
	Cognitive Personality Traits		✔												✔																					
	Sustainability Conceptualization																															✔				
	Collective Perspective																✔							✔												
	Contextual Physical-Social Context					✔														✔							✔	✔					✔	✔		
Feelings and Notions	Sense — Sense of Contribution									✔																	✔					✔				
	Sense of Self-fulfilment and Satisfaction																															✔				
	Sense of Place and Nature Attachment	✔																			✔		✔													
	Identity — World Mindedness						✔																													
	National Identity						✔																													
	Sustainability Identity																															✔				
Activity	Personal Habitual Behaviour		✔						✔						✔					✔										✔	✔					
	Ease and Time Constraint																			✔																
	Communal Public Activities and Collective Actions																										✔	✔	✔							
	Community Involvement									✔																	✔		✔							

4.6.1. Norms and Context

4.6.1.1. Normative

Socio-cultural norms are found to be a distinctive determinant of USSU [21]. Barau [35] stresses the effect of culture on greener behaviors of individual households and suggests a direct relationship between culture, ecosystem services and green infrastructure. Individuals find it difficult to behave in (sustainable) manners that go against their societal and cultural norms [41]. Moreover, the collective norm of the society is found to strongly shape the consumption patterns of consumers [28] (and project developers), especially those who are of an older generation with stronger cultural boundaries [37]. Similar to norms, moral values and beliefs of individuals also affect their understanding of sustainability [26,41,51]. These can be shaped strongly through both family and society.

4.6.1.2. Cognitive

Personality traits are mentioned in the literature as playing a role in the formation of USSU albeit it less well recognized as other factors. For instance, people who are more conscientious and altruistic are identified as giving more importance to sustainability [26] thereby having higher possibility to adopt pro-environmental behavior [51]. Furthermore, it is important to clarify the sustainability conceptualization in the local context [41] where a collective city perspective improves different stakeholder's sustainable behaviors and willingness to participate in sustainable actions [55]. Kang [23] mentions that collective efficacy has a positive correlation with sustainable urban development behaviors.

4.6.1.3. Contextual

Contextual factors should also be taken into consideration for USSU of norms and context within the community. Either physical or social context are important determinants of awareness constitution [39] and environmental perceptions [24]. Social and urban context further influences the consumption patterns of residents [28] and sustainable behaviors formation [38]. In their study, Newton and Meyer [29] identified that people living in the inner city suburb context have more environmentalist attitudes than people living in outer suburbs. Similarly, Cagáňová, Stareček, Horňáková, et al. [44] reported a direct relation between local context and awareness about smart city concepts in his study—the more urban the context the greater the awareness.

4.6.2. Feelings and Notions

4.6.2.1. Sense

In terms of senses, sense of contribution to society is reported to improve people's motivation for sustainable actions [33,40]. Uren, Dzidic, Roberts, et al. [41] states that, having the sense of self-fulfillment and satisfaction, drives people to engage in pro-environmental behaviors and sustainable actions. Sense of place attachment is also mentioned in the literature to have positive impact on engaging in sustainable lifestyles [38]. A greener environment resulted in individuals having a stronger place attachment [35]. Likewise it is well-reported that as people get more attached to their society, their pro-environmental behaviors improve [56]. Similarly, a feeling or sense of being connected to nature appears to motivate people to become more pro-environmentally active by contributing positively environs and inadvertently improving to their physical and psychological wellbeing [38].

4.6.2.2. Identity

Notions should be considered carefully in order to evaluate USSU. Der-Karabetian, Cao and Alfaro, [34] mentions that, having a world-minded approach and or sense of national identity contributes to the sustainable values and behaviors because feelings of a collective identity reinforce actions

against common threats. Similarly, due to the desire of self-representation, people are eager to carry a sustainability identity and their behaviors are determined accordingly [41].

4.6.3. Activity

4.6.3.1. Personal

Habitual behaviour of individuals is reported to have a prominent effect on USSU. For example, People's current consumption habits of some services and resources [46], and their routine lifestyles have direct impact on their behavioural formation about sustainability [53]. Bleys, Defloor, Van Ootegem, et al. [26] and Hsu and Feng [51] reveal that when actions are occurring daily, i.e., as a habitual behaviour, people have better chance to act more environmentally friendly. However, these actions could be limited by several constraints, not least time and ease of action [29].

4.6.3.2. Communal

Public activities are useful to improve awareness of citizens to sustainability [39] and provide a solid base for collective actions that enhance community involvement and acceptance [46]. Similarly, they are key elements of creating smart cities [40], which in both cases consequently result in improved social and communal relationships and more sustainable lifestyles [38,46].

5. Discussion and Conclusions

5.1. Key Findings

From the reviewed studies it can be seen that there are a wide range of factors and sub-factors that influence USSU. The factors differed according to characteristics of the studies (i.e., location, geography, culture, and context). What appeared to be missing was the development of an integrative and inter-relational model [57] of the USSU framework and associated methodological process to help identify an individuals' USSU. It can be understood that different factors are linked to USSU through different channels and pathways, some directly and some indirectly. There could also be other conceptualizations of the linkages. There are a lot of complexities that are going on underneath the surface. Differentiating between external and internal factors is the starting point of this process, and actually what is required is a better way to represent and explain such complicated linkages. Within the confines of this paper, the authors accept this is presented in a very simplified reductionist manner. However, the purpose of the proposed framework is to allow further in depth research as part of a future publication. Moreover, this paper paves the way for this to be further developed in order to rationalize the relations and causality that exist amongst its determinants (i.e., awareness, perceptions, attitudes and behaviors).

Studies conducted in Europe and other developed countries constitute the majority of studies reviewed. USSU studies in developing countries are less-well developed and should be encouraged, not least as they are increasingly becoming strong actor(s) in urbanization and more often than not this is accompanied by unsustainable behaviors—in particular with respect to natural resource consumption. Hence application of the framework within urban areas of Turkey will feature in a future publication.

Sustainability focused studies are greater in number than those for smartness. While urban sustainability is understood from a more conceptual perspective, smartness is seen from more practical aspects. Therefore, the contributions of influencing factors on urban sustainability and urban smartness understanding occur differently. The requirement to study them in combination is gaining recognition [58]. Hence, the role that smartness plays within the overall sustainability agenda and the way it impacts on USSU should be further investigated within developing countries.

5.2. Theoretical Framework

Based on the influencing factors, a preliminary theoretical framework is presented as illustrated in Figure 2. It is stated that the quality of a framework depends mainly on the features of independence, comprehensiveness, contextual responsiveness, interlinkages, comparability, temporality, flexibility, and feasibility [59,60]. As Jabareen [61] stated, conceptual analysis should be implemented to extract concepts, in order to compose a theoretical framework. Factors (and sub-factors) drawn from the literature reviewed here are grouped under six broad categories to provide a coherent and reasonable clustering while to be able to assess their relations with USSU. This framework is mainly inspired by and synthesized from the studies of Barr [12], Peng, Nunes and Zheng [50], and Sharifi [59]. Situational variables in Barr [12] further improved and represented under "Demographics", and "Information and Policy" categories. Similarly, the environmental values group is extended to include norms, feelings, and notions and presented under "Values and Actions" category. Psychological variables group in his model is divided into two broad categories of "Concerns and Perceptions" in our model, in order to include broader psychological factors mentioned in the literature. Sharifi [59] represented governance and people themes in his model, which are gathered under the "Information and Policy" category of our model. Moreover, the "Infrastructure" category comprises the important subthemes mentioned in his model under environment and economy themes. This categorization is further compatible with clustering done by Peng, Nunes and Zheng [50] in the form of natural environment, built infrastructure, and economy and business models, which was concentrated on crucial non-technical elements of smart city.
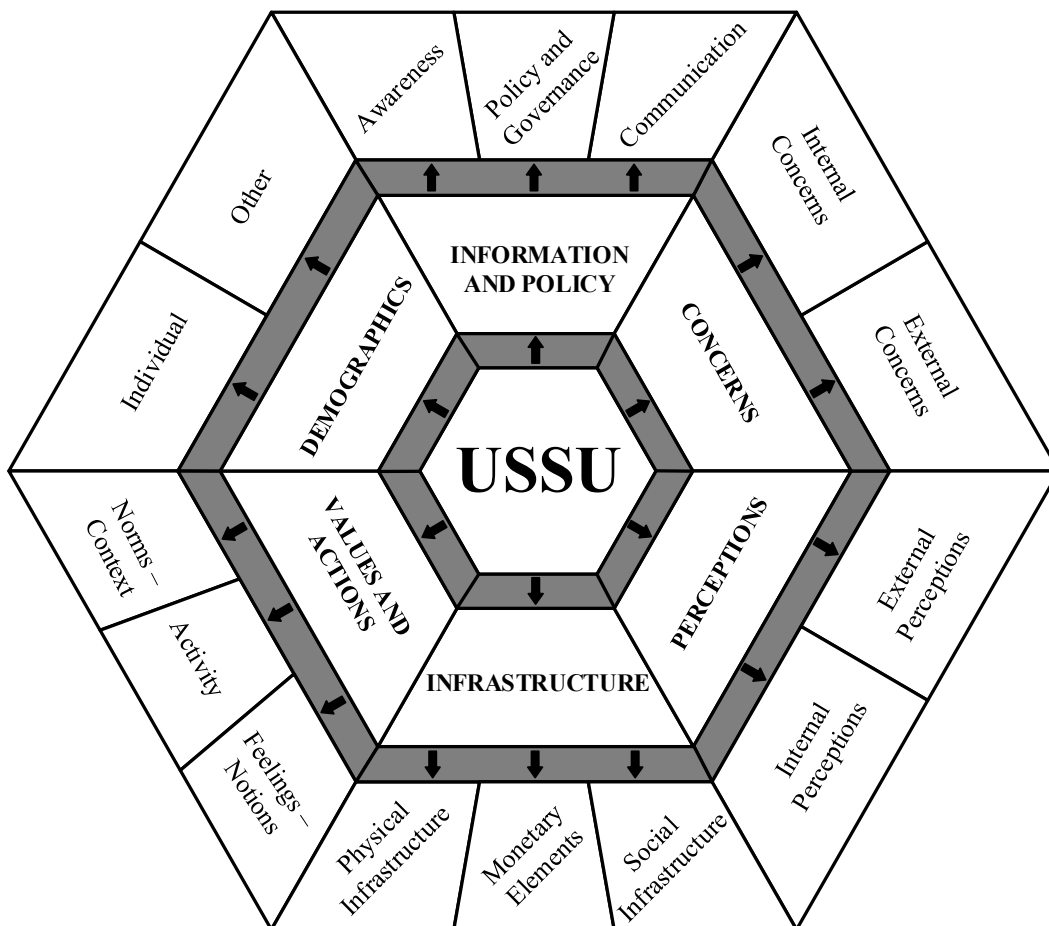

Figure 2. Theoretical Framework.

Demographic factors have been shown to be in complex and intertwined connection with other influencing factors of USSU. Among demographic factors, age, gender, income and education are specified to most frequently. Although the strength of the evidence presented for each can considerably often result in conflicting viewpoints. One of the reasons would be the sociocultural, political and geographic differences among the study samples. Information and policy factors appear to have less conflicting results which is in line with governance and people themes of Sharifi's [59] framework for smartness indicators. Emphasis is placed on the awareness and training sub-factors. It is therefore a common acceptance to provide necessary sustainability education to public along with supportive communication policies and efficient governance.

The attempt to specify concern and perception factors in the literature required the distinction between internal and external, hence these sub-factors are adopted [26]. These factors cover the important components of human-driven themes and indices mentioned in the sustainability assessment literature such as environmental quality and performance indices, environmental concerns index, human development index, quality of life indices, and wellbeing index among others [62]. While internal concerns of individuals shaped their perceptions and behaviors to some extent, external concerns either supported or hindered this interaction. Moreover, internal and external perceptions have been found to form how people tend to think and act about sustainability. In the factor group of values and actions [12,26], the effect of norms, context around people, their feelings and notions, and daily collective or individual activities are investigated. Numerous studies stressed the impact of physical and social context, sociocultural norms and habitual behavior on USSU. This finding is in line with the local focused characteristic of USSU studies.

Last but not least, physical, technical and material parameters of USSU should not be overlooked which are grouped under infrastructure factors. Sharifi [59] also states the similar indicators under environment and economy themes in his framework. As seen from the review, physical infrastructure availability and quality factors are important elements of USSU. In addition, monetary elements are highly addressed in studies with strong emphasis on cost and purchasing power. Therefore, monetary interventions can be seen as a useful tool in policy-making.

The next steps of this research and the focus of a future publication will be to apply this theoretical framework to better understand the USSU within key neighborhoods of Istanbul within the developing country of Turkey.

Appendix A

Appendix A.1. Scopus Search String

TITLE-ABS-KEY ((environment* PRE/0 sustainab*) OR (sustainab* PRE/0 urban*) OR (urban PRE/0 sustainab*) OR (city PRE/0 sustainab*) OR (sustainable PRE/0 city) OR (smart PRE/0 city))

AND TITLE-ABS-KEY (public OR citizen OR community OR expert OR official OR stakeholder OR consumer)

AND TITLE-ABS-KEY (aware* OR relevan* OR perception OR attitude OR behaviour OR expectation)

AND TITLE-ABS-KEY (survey OR interview OR questionnaire)

AND (LIMIT-TO (LANGUAGE, "English"))

Appendix A.2. Web of Science Search String

((TS = (sustainab* OR smart* OR "sustainab* development" OR "environment* sustainab*" OR environment* OR urban* OR city OR "sustainab* urban*" OR "urban sustainab*" OR "city sustainab*" OR "sustainable city" OR "smart city"))

AND (TS = (public OR citizen OR community OR expert OR official OR stakeholder OR consumer))

AND (TS = (aware* OR relevan* OR perception OR attitude OR behaviour OR expectation))

AND (TS = (survey OR interview OR questionnaire)))

Appendix B

Table A1. Factor Grouping Frequency.

Main Category	Subcategory	Factor Group	Frequency
Demographics	Individual	Age	12
		Gender	8
		Income	8
		Education	9
	Other	Residential	6
		Ideological	7
Information and Policy	Awareness	Knowledge	17
		Publicity	7
		Training	8
	Communication	Informative	4
		Communicative	7
	Policy and Governance	Regulative	6
		Managerial	9
Infrastructure	Physical Infrastructure	Availability	9
		Quality	8
	Social Infrastructure	Availability	2
		Quality	3
	Monetary Elements	Material	13
		Managerial	3
Concerns	Internal Concerns	Personal	5
		Social	4
	External Concerns	Physical	9
		Conceptual	6
Perceptions	Internal Perceptions	Personal	9
		Social	3
	External Perceptions	Physical	9
		Conceptual	2
Values and Actions	Norms and Context	Normative	7
		Cognitive	4
		Contextual	6
	Feelings and Notions	Sense	6
		Identity	2
	Activity	Personal	7
		Communal	4

Table A2. Outline of Factor Grouping.

	Subcategory	Factor Group	[35]	[26]	[49]	[30]	[44]	[34]	[31]	[21]	[40]	[27]	[36]	[32]	[20]	[42]	[51]	[23]	[52]	[25]	[29]	[53]	[54]	[45]	[50]	[55]	[56]	[33]	[38]	[39]	[46]	[22]	[41]	[28]	[24]	[37]	[47]
Demographics	Individual	Age	✔						✔			✔		✔			✔				✔	✔		✔	✔			✔			✔				✔		
		Gender	✔						✔			✔					✔				✔												✔		✔	✔	
		Income							✔			✔	✔	✔											✔								✔		✔		
		Education			✔		✔		✔			✔		✔							✔	✔					✔								✔		
	Other	Residential	✔									✔	✔			✔													✔						✔		
		Ideological	✔						✔	✔		✔					✔	✔		✔																	
Information and Policy	Awareness	Knowledge		✔			✔		✔	✔		✔	✔	✔			✔				✔	✔		✔					✔	✔	✔	✔				✔	
		Publicity					✔							✔										✔						✔	✔	✔				✔	
		Training				✔	✔							✔															✔	✔	✔	✔				✔	
	Communication	Informative				✔					✔			✔			✔		✔			✔								✔		✔				✔	
		Communicative			✔						✔						✔		✔											✔		✔				✔	
	Policy and Governance	Regulative			✔								✔	✔									✔		✔				✔	✔	✔				✔	✔	✔
		Managerial			✔						✔									✔			✔		✔				✔	✔	✔				✔		
Infrastructure	Physical Infrastructure	Availability				✔								✔	✔	✔	✔		✔				✔	✔					✔								
		Quality				✔										✔			✔				✔	✔	✔	✔		✔		✔							
	Social Infrastructure	Availability				✔										✔																					
		Quality			✔											✔																					✔
	Monetary Elements	Material					✔		✔			✔		✔						✔	✔								✔	✔	✔	✔			✔	✔	✔
		Managerial			✔				✔																	✔											
Concerns	Internal Concerns	Personal	✔			✔											✔												✔	✔							✔
		Social															✔	✔																✔			
	External Concerns	Physical		✔								✔		✔			✔				✔	✔					✔			✔		✔			✔		✔
		Conceptual							✔	✔	✔						✔													✔					✔		
Perceptions	Internal Perceptions	Personal		✔			✔	✔						✔			✔				✔								✔		✔	✔	✔				
		Social												✔						✔						✔											
	External Perceptions	Physical							✔							✔				✔	✔		✔						✔		✔		✔		✔		
		Conceptual							✔										✔																		
Values and Actions	Norms and Context	Normative	✔	✔							✔					✔																	✔	✔		✔	
		Cognitive		✔														✔					✔								✔		✔				
		Contextual				✔														✔						✔			✔	✔				✔	✔		
	Feelings and Notions	Sense	✔								✔																		✔	✔	✔		✔				
		Identity						✔																							✔						
	Activity	Personal		✔							✔					✔					✔	✔									✔	✔		✔			
		Communal										✔																	✔	✔	✔						

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