Exploring the socio-cultural sustainability of old and new housing: two cases from Jordan.

Yahya Qtaishat*, Stephen Emmitt, Kemi Adeyeye
Department of Architecture and Civil Engineering, the University of Bath, Bath, UK.

Abstract

Vernacular architecture serves as inspiration and learning material to create more impactful and meaningful contemporary building solutions. However, most research in this area focuses on the technical aspects of sustainability. There remains a gap in sociocultural aspects of both contemporary and vernacular architecture and a coherent understanding of the indicators that inform this vernacular-inspired sustainable architecture is still lacking. The study aimed to propose and categorize indicators of a theoretical eco-cultural sustainability framework and indicators. This was underpinned by a literature review of existing sustainability assessment frameworks and tools. A qualitative approach was used comprising 81 semi-structured interviews from two case study areas, historic and contemporary development, in Jordan. Framework and thematic analysis guided the analysis stage. Factors related to cultural appropriation are the most prioritised by participants and linked to sustainability. It was also found that due to its intangibility and complexity, most sustainability frameworks in the built environment only focus on the environmental criteria and have failed to integrate cultural indicators. Therefore, this study makes a significant theoretical and practical contribution in that it bridges this gap by proposing tangible metrics relating to intangible cultural factors so that this can be effectively incorporated into existing design assessment.

Keywords: Eco-cultural design; sustainability assessment framework; sustainable development; indicators

1.0 Introduction

The United Nations estimates that the building industry accounts for more than 35% of global final energy use and nearly 40% of energy-related CO2 emissions (Abergel *et al.*2017). Around 55% of the global population live in cities compared to 30% in the 1950s. This percentage will exceed 60% by 2050 (UN, 2015). The trend of urbanisation is the result of ever changing ecological, social and economic aspects of human society that puts its toll on the environment (Mori & Christodoulou, 2012). Thus, the United Nations Industrial Development Organisation (UNIDO) proposed the 'three pillars' framework for sustainable development (UNIDO 2005). The sustainable development framework transcends the tangible and intangible themes of social, environmental and economics as well as institutional and regulation factors. The three pillar model has been criticised for being loosely defined and too conceptual (Pissourios, 2013). The definition also lacks many intangible and human cultural aspects, which has a major influence on human life in general, in particular, policymaking. (Memmott & Keys, 2015). Still, there has been keen interest in sustainability over the past decade, both within and outside of architectural research and practice (Lozano, 2011).

Sustainability within any field of research or practice requires measuring the aspects that represent the progress of such sustainable development (Cutaia, 2016). How to measure sustainability represents a major challenge for the implementation of sustainable solutions in the built environment, mainly because there is no universally agreed list of indicators (Böhringer & Jochem, 2007; Verma & Raghubanshi, 2018). Despite this, sustainability indicators remain useful as they represent the environmental, economic, social and cultural factors of sustainability (Mansour & Radford, 2014).

Therefore, indicators should be present in every type of assessment-oriented framework (Guzmán *et al.*2017a).

Globally, many governmental and non-governmental bodies have proposed sustainability frameworks and tools for various sectors and activities, primarily to help reduce environmental impact. Sustainability assessment is considered a keystone for sustainable development within the built environment (Awadh, 2017). Among these sustainability assessment tools are the green building rating systems such as LEED (USA), CASBEE (Japan), BREEAM (UK) and SBTool (international). These tools are the product of the combination of domestic and international policies and the commercial need for environmentally assessed and sound products (Haapio & Viitaniemi, 2008). These assessment tools aim to promote sustainable development and follow larger legislative frameworks (Ness *et al.*2007, Srinivasan *et al.*2011). They usually follow the United Nations three pillars model of sustainability and sustainable development goals.

The current assessment frameworks and tools for a sustainable built environment emphasises the ecological and physical factors over socio-cultural ones (Guzmán *et al.*2017b). The focus on environmentally tangible factors is driven by the pressing need for practical solutions to address ecological crises. It also may be related to the fact that the socio-cultural aspects are harder to implement. Furthermore, the views on the socio-cultural aspects of sustainability remain diverse (Wu *et al.*2016; Olakitan Atanda 2019). Wu *et al.* (2016) emphasised the importance of incorporating intangible indicators that are related to culture. However, this requires the input of various stakeholders in the assessment stages and most importantly, the final users of the building who are often neglected (Cassell *et al.*2005; Awadh 2017). Without this, there will be insufficient interpretation and integration of the socio-cultural aspects into sustainable building developments.

The primary aim of this research is to investigate the potential for better integration of the tangible and the non-tangible aspects of vernacular architecture for socio-cultural sustainable developments. The principles of vernacular architecture provide the basis to investigate this integration; alongside an architectural approach to incorporate the economic, socio-cultural and ecological principles. This paper presents knowledge from literature and primary data from case studies to propose a new theoretical framework for an eco-cultural approach for sustainable housing developments. It complements previous bodies of work on assessment tools and frameworks with socio-cultural aspects and their link to sustainable practice and physical solutions which has been largely ignored.

The paper is structured into four sections. The first section presents a general introduction to the concept of eco-cultural sustainability. From this a conceptual framework of eco-cultural indicators, their interrelationships were proposed to inform the next stage of the project. This framework and its indicators were evaluated during the primary work. The second section summarises the adopted qualitative methods for defining the categories and indicators. The third section presents the findings from the case studies and the final section concludes the main findings, refined framework, list of eco-cultural indicators and potential implications for further research.

2.0 Eco-cultural indicators and the theoretical framework

Previous research has investigated eco-cultural indicators in various ways. For example, Ferriss (2010); Al Rabady (2013); and Vallega (2007) focussed on the provision of cultural heritage landmarks. They argued that these historic structures provide a sense of place, local culture and tradition. Others like Atanda and Öztürk (2018); Al-Jamea (2014) presented the indicators as part of social sustainability. They interpreted cultural sustainability in the presence of cultural activity facilities and the artistic aspects of the human culture such as theatres, community centres and art schools building.

Significantly (Halicioglu 2012; Zhai & Previtali 2010; Motealleh *et al.*2016; Ozorhon & Ozorhon 2014; Kırbaş & Hızlı 2016) regarded the ecological impact of vernacular architecture as components of cultural heritage and sustainability. While their themes and concerns were varied, their main concern was the physical parameters and aspects of vernacular architecture. This included its bioclimatic lessons, topographic and thermal properties of these vernacular architecture examples. Vernacular architecture was considered more in harmony with the local natural environment (Brown & Maudlin, 2011). Yet mimicking vernacular architecture out of sentiment or purely for environmental concern can be ill-fated with cited examples including Hassan Fathy's project in New Gourna village.

Abel (2000; 1993) stated that architecture comprised of differentiated regional culture based on ecological principles and *eco-cultural* values. He argued that the performance of eco-cultural architecture should meet locally specific needs and socio-cultural systems. Chappells & Shove (2005) and Dessein *et al.*'s (2015), interpretation of the eco-cultural approach for sustainability was the most profound. They tried to overcome the modern view and considered society and nature as two equal entities. They presented cultural aspects as one of four circles of sustainability that also includes economics, environment and social factors. Moreover, Dessein *et al.* (2015) classified cultural indicators and their relationships to sustainable development into three themes: "in, for and as" sustainable development.

The "in" represent the role of culture in sustainability. This considers culture as more tangible and functional rather than an intangible heritage and sentiment approach (Wu et al., 2016). Culture "for" sustainable development becomes the framework, context and regulator for the other three pillars. Culture "as" sustainable development sees culture as an essential foundation for integrating achieving and assessing sustainability.

Dessein *et al.* (2015) pointed out that existing culturally sensitive indicators are limited. However, defining the quantifiable and measurable cultural sustainability indicators can be challenging (Ewing & Handy, 2009). For instance, the indicators affecting the built environment vary even in a singular context. People with diverse values and ethics interact differently with mixed factors across context and regions (Jenkins, Smith, & Wang, 2006). They also change and evolve slowly within the same context over long periods of time (Rapoport, 1969). This is more noticeable with modernisation; where some vernacular architecture forms have stopped being used, yet, the characteristics that once defined it remains (Jenkins *et al.*2006). Due to these challenges with culturally related indicators, studies have largely focussed on the quantitative approaches and physically tangible aspects of building and urban sustainability. Thus, this gap persists as a result of the abandonment of deep consideration of socio-cultural sustainability for developing a culturally responsive design.

The headline literature reviewed for this study are summarised in Table 1. Since the publication of the World Commission on Environment and Development (WCED) report in 1987, the discussion was mainly confined to the economic and natural parts of developments. Even though the UN report of 1987 already pointed out that progress towards eco-cultural sustainable development requires the promotion of socially and culturally determined values and indicators that encourage ecological practices (Brundtland, 1987). It is only recently that research debate branched out to sociocultural issues within the built environment (Chiu, 2004). Moreover, recent decades witnessed fundamental changes in the prevailing social view towards the built environment (Wu et al., 2016), thus reflected in the emergence of sustainability in building assessment tools.

129 Table 1: Literature review summary

Title	Author(s) / year	Source	Main themes
Architecture and Identity: responses to cultural and technological change	Abel (2000; 1993)	*Editorial book*	Examines the possibility for authentic regional architecture by placing eco-culture in the centre of focus of the design process. Abel presented historical records of how local culture shaped architecture as much as the local environment did.
Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment	Chappells & Shove (2005)	*Journal Of Building Research & Information.*	Promoted debate about the indoor environment and associated ways of life, In order to avoid social and technical trajectories that are ultimately unsustainable. This paper aimed to inspire and initiate a discussion by demonstrating that comfort is a highly negotiable socio-cultural construct.
Culture in, for and as sustainable development: Conclusions from the COST Action IS1007 Investigating Cultural Sustainability	Dessein *et al.* (2015)	*Editorial book*	Conclusion from the COST Action project that investigated cultural sustainability in the built environment
Incorporating culture into sustainable development: A cultural sustainability index framework for green buildings	(Wu *et al.*2016)	*Journal of Sustainable Development*	Added cultural sustainability for green buildings by recognising the three roles of culture in sustainable development as the fourth pillar for sustainability.
Redefining architecture to accommodate cultural difference: designing for cultural sustainability	(Rapoport, 2006)	*Editorial book*	Discussed the status of vernacular architecture in the 21 century and asserting that people have very different attitudes and ideas in response to varied physical environments. These responses vary from place to place because of changes and differences in the interplay of social., cultural, ritual, economic andphysical factors.
The three dimensions: defining sustainable development	(UNIDO, 2005)	*Assessment framework*	The main framework presented by the United Nations asserting sustainability as 3 pillars (social, environmental and economic) that became widely accepted among researchers and among working frameworks of various countries and industries
Social and Cultural Sustainability: Criteria, Indicators, Verifier Variables for Measurement and Maps for Visualization to Support Planning	(Axelsson *et al.*2013)	*Journal of the Human Environment*	Argue that policies on the economic use of natural resources require consideration to social and cultural values. In order to make those concrete in a planning context, this paper interpreted social and cultural criteria, identified indicators and, matched these with verified variables.
Conceptualizing the built environment as a social-ecological system	(Moffatt & Kohler, 2008)	*Journal of Building Research & Information*	Argued that formulating a unified theory of the built environment required that the built environment be understood as a complex social-ecological system.
Sustainable architecture, design and housing	(Keitsch 2012; Abidin *et al.*2008)	*Sustainable Development*	Argued that sustainable architecture should challenge new and ingenious architectural design at various levels. Examples include establishing a harmonious, long-lasting relationship between the inhabitants and their surrounding.
Various/ building assessment criteria and framework development/ the role of socio-cultural aspects in sustainability	(Alsubeh, 2013; Mahmoud, Zayed, & Fahmy, 2019; Olakitan Atanda, 2019)	*Sustainable Cities and Society*	This research quantified the environmental impacts of building construction with debate around a framework for developing domestic sustainable building and assessment criteria and Indicators.

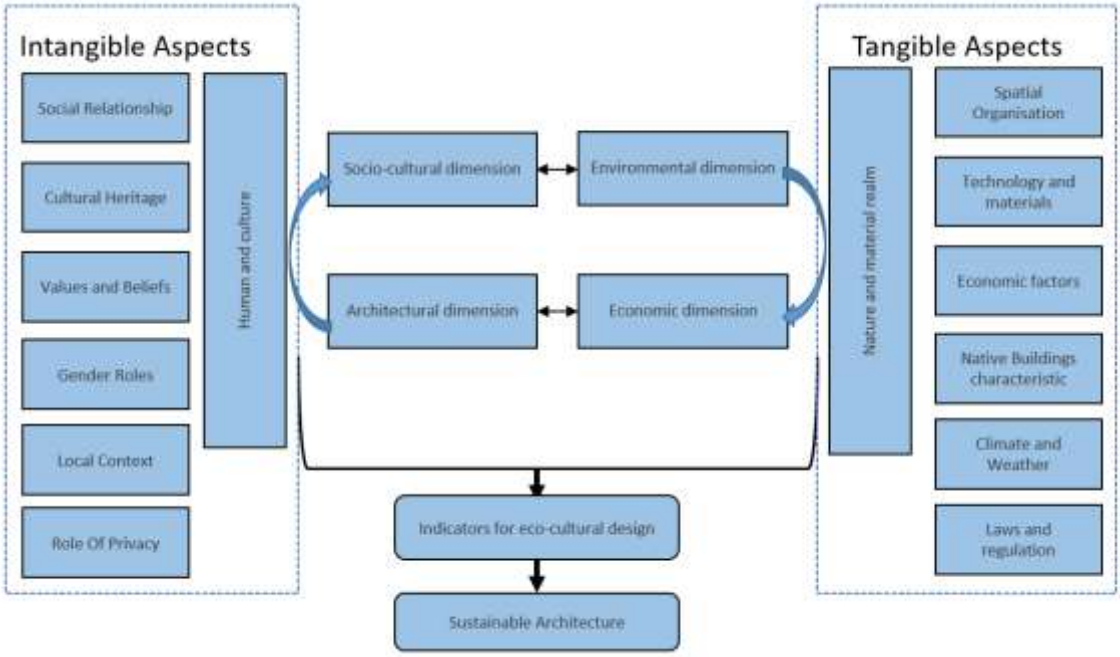
130

Table 2 presents a summary of eco-cultural indicators found within the current literature. The review included papers investigating influences of sustainable build environment (Danja, Dalibi, & Safarov, 2017; Dhahri & Omri, 2018; Guengerich, 2014; Mahdavi & Yarmand, 2013; Michiani & Asano, 2016; Mizrak & Erkenez, 2014; Teng, Mu, Wang, Xu, & Liu, 2019; Verma & Raghubanshi, 2018) and lesson from vernacular architecture (Adwan & Abu Muhsen, 2016; Agung Budi Sardjono, Gagoek Hardiman, 2016; Alves, 2017; Hărmănescu & Enache, 2016; Kamalipour & Zaroudi, 2014; Pocock, Steckler, & Hanzalova, 2016; Weber, 2013). With a few exceptions, these indicators were considered essential, but many were not objectively measured or investigated. Their importance was merely asserted against concerns about the environmental characteristics of architecture and the importance of including culture within future research.

Table 2: Indicators for vernacular architecture found in literature

Aspect	Identified Indicators	Measurement metrics
Social Sustainability	Structure of society. Social relations. Lifestyle. Behaviour habits. Governance system. Profession and employment. Behaviour habits. External influences. History of the society	Quantitative and /or qualitative approach Direct survey and interviews
Cultural Sustainability	Values. Customs. Belief systems. Privacy, Flexibility of use. Role of aesthetics. Colours. Privacy. Gender role. Cultural relevance. Dwelling functionality.	Theoretical background on spatial planning/ Space Syntax and policies relation
Environmental Sustainability	Geographical area. Landscape available technologies, available materials Climate and weather. Location geography. Energy performance. Thermal comfort. Indoor environment (ventilation and light). Waste and recycling.	Observation of physical conditions and building material. Empirical studies. Lab work computer simulation
Economic sustainability	Running bills, construction costs. Maintenance. Life cycle.	Observation of the residents' habits. Questionnaire /interview. Case study/samples and comparison of chosen samples.

The literature on vernacular, regional and sustainable architecture mainly points to factors that could inform the physical aspects of architecture, including climatic and bioclimatic architecture, passive design, environmental psychology (Weber 2013; Foruzanmehr and Vellinga 2011; Olesen *et al.*2011). Yet, Oliver (2007); and (Rapoport, 2006) established that the tangible and intangible are inseparable in creating contemporary and vernacular architecture alike and thus are essential to be considered for a regional and eco-cultural approach. Therefore, architecture should be perceived as the physical incarnation of the cultural and social world. Figure 1 illustrates the mechanism and the relationship that bounds the tangible and intangible side of architecture.



151 Figure 1: Conceptual model of the eco-cultural system that places the built environment as a
152 result of interaction between people and nature

153

154 Table 3 summarises the main sustainability assessment tools in comparison with the Jordanian green
155 guide – relevant to the case study sites (JSBC 2011; IIS 2012; BRE 2016; USGBC 2014; JNBC 2013).
156 These tools have some bias toward physical metrics related to energy, environment and resources.
157 Socio-cultural indicators were implied rather than explicit. Therefore, the highlighted knowledge and
158 practice gaps for socio-cultural integration are also apparent in current in building assessment tools.
159 Further, the physical metrics, do not establish the building in its context or its development. The
160 natural environment and climate have indeed shaped new architectural practice but fall short of
161 considering the regional and cultural influences. This explains the increasing homogeneity in
162 architectural globally, with similar solutions now found from around the globe. In addition, the user
163 needs and requirements including their socio-cultural identity, though difficult to capture or measure
164 in all instance, are increasingly lost in the milieu of combined 'sustainability' and modernism.

165 Therefore, the review of building assessment tools and literature produced a database of indicators
166 (Table 4). Those that were duplicated or purely quantitative with no apparent relationship to socio-
167 cultural factors and were excluded.

Table 3. Comparative summary of four sustainable assessment methods

Scheme	BREEAM	LEED	CASBEE	SBTool	Jordan Green building guide
Institution	Build research Establishment (BRE)	Us green building council (USGBC)	Japan Sustainable Building Consortium (JSBC) and Institute for Building Environment and Energy Conservation （IBEC）	International Initiative for Sustainable Built Environment (IIS)	Royal Jordanian Scientific Society (RJSS) and Jordan Building Council (JBC)
Country of Origin	United Kingdome	USA	Japan	International	Jordan
Type of Scheme	Checklist scheme and Rating system on the form of Excel Pre-assessment estimators	Green building guide and rating system on the form of PDF format and Excel Checklists	Assessment Software and Technical Manuals	Software and rating system	Design guide and suggestions for passive design. Non-mandatory rating system
Stages of Evaluation	Design phase (outline And detailed designs)	Planning, design and Completion phases	Planning, design and Completion phases	Design phase (outline and detailed designs)	Planning, design
Scale of focus	Building and Neighbourhood scale new, refurbished and existing	Buildings and Neighbourhood and district. New, refurbished and existing	Building, Neighbourhood, district And city. New and existing	Buildings Neighbourhood And district. New, refurbished and existing	Building and site level New constructions only
Rating approach	Pre-weighted categories	Additive credits	BEE ranking chart based on ratio ranking	Logarithm weighting system	Pre-credited categories
Main categories and weighting	Governance 8 Social and Economic 31 Resources and Energy 47 Land Use and Ecology 18 Transport and Movement 15	Smart location and linkage 41 Neighbourhood pattern and design 28 Green Infrastructure and buildings 31 Innovation & Design Process 6 Regional Priority Credits 4	Resources and Environment Social Location and Pattern and Design Transportation and Mobility Innovation and Economic Which consist of 80 sub-criteria which are further re-categorised into two main groups: Q (Quality) and L (Loadings). $BEE = \frac{(\text{BuildingEnvironmentalQuality})}{(\text{BuildingEnvironmentalLoadings})}$	Site Selection, Project planning& Development 7.6 Energy and Resource Consumption 21 Environmental loadings 25.2 Indoor Environment Quality 21 Service quality 15.1 Social & Economic aspects 5 Cultural & perceptual Aspects 5 (-+5% based on context and third-party requirement)	Green Building management 20 Site Sustainability 24 Water Efficiency 110 Energy Efficiency 98 Healthy Indoor Environment 24 Materials & Resources 32

Performance Rating Scale	Outstanding = 35% Excellent = 70-84% Very good = 55 - 69% Good = 40 - 54% Pass = 25 - 39%	Platinum = 80% Gold = 60-79% Silver = 50- 59% Certified = 40 -49%	Poor: BEE <0.5 Fairy Poor: BEE = 0.5–1.0 Good: BEE = 1–1.5 Very good: BEE = 1.5–3; or BEE ≥3 and Q < 50 Excellent: BEE ≥3 and Q ≤ 50	-1 Poor 0 1 3 5 Excellent	Green Building A= 80% B =70 - 79% C = 60 - 69% D = 50- 59%
Sub-categories	Management; Health & Wellbeing; Energy; Transport Water; Materials; Land Use and Ecology Waste; Pollution; Innovation (additional)	Sustainable Sites Water Efficiency Energy and Atmosphere Materials and Resources Indoor Environmental quality -Innovation and Design Process -Regional Priority credits	Natural environmental; quality in urban development; service function for the designated area; contribution to the local community (history, culture, scenery and revitalisation); environmental impact on microclimates, façade; landscape; social infrastructure; management of the local environment	Urban form, Land use and infrastructure; Ecology and biodiversity; Energy and Water; Materials and waste; Comfort of outdoor areas; Safety; Amenities Mobility; Local and cultural identity; Employment promotion and investment	Site design; Land use; Transportation; Building envelope; Renewable energy; Natural lighting/lighting; Water; material; Waste reduction; Energy efficiency; Waste management
Eco-cultural related indicators	Economic impact, Demographic needs, services and amenities, Public realm, Utilities, Green infrastructure, Local Parking, Local Vernacular, Inclusive design, internal environment.	Smart location, proximity between work and housing; reduces car need, neighbourhood pattern and design; walkable streets, compact Development, Connected and Open Community; Mixed-Use Centres, Parking, Access to Recreation Facilities,	Natural environmental quality in urban development; service function for the designated area; contribution to the local community (history, culture, scenery and revitalisation); environmental impact on microclimates, façade and landscape; social infrastructure; management of the local society, security and safety measures	Facilities, Footpath, health and Safety, Affordability, local engagement in the design process, context analysis, building layout, cultural heritage and identity.	None

Table 4: Main indicators and categories for the formation of an Eco-cultural design process

Dimension	Indicators from assessment frameworks and tools	Indicators from literature review
Social	Safety in the streets	Values and Customs.
	Proximity to services, facilities and amenities	Social relationships (naighbourhood).
	Public transportation	Systems of belief
	Walkable Streets	History and Vernacular architecture
	Public spaces	
	Heritage valuation (Local vernacular) and landscapes	
	Quality of housing	
	Parks and facilities	
	Childcare services	
	Elderly and disable consideration	
	Demographic needs and priorities	
	Acoustics and noise	
	Lighting	
Economic	Economic viability	Economic conditions
	Local economy	Affordability of house
	Employability	Laws and regulation
	Taxes	
	Economic impact	
	Training and skills	
Environmental	Natural land use	Climate and weather
	Compact and mix-used development	Energy saving
	Reuse of urban areas	Recycled materials
	Built environment rehabilitation	High technology
	Air quality	Water saving and harvesting
	Energy efficiency	Active systems
	Renewable energy	Passive design
	Passive solar planning	Geography and location
	Centralized management of energy	Available materials.
	Consumption and quality of water	Available technology
	Management of wastewater	
	Adapting to climate change	
	Sustainable materials	
	Recycling	
	Construction and demolition waste	
	Management of urban solid waste	

3.0 Method

The aim and objectives of the research require the involvement and perspective of the participants in a way which may not be easily achieved if a quantitative method was employed. An eco-cultural approach requires the understanding of views, perceptions, experiences, feelings and beliefs of the inhabitants involved. A wholly quantitative approach often fails to fully explore these aspects (Amaratunga, Newton, Baldry, & Sarshar, 2002; Atanda & Öztürk, 2018). Few qualitative studies have used interviews with stakeholders (Alsubeh, 2013; Atanda, J.O. and Öztürk, A, 2018; Mahmoud *et al.*2019). Stakeholder's participation in these studies is typically limited to experts and policymakers. Also, reliance on quantitative data and findings ignored context-sensitive reactions of the participants.

Therefore, a qualitative approach that builds on previous quantitative findings and that can bridge the gap between the tangible and intangible relationship of the sustainable built environment was necessary. Thus, a qualitative deductive approach was utilised as follows: 1. Literature review to define

and classify existing indicators, sustainability assessment tools and design quality schemes. 2. Establish and refine the theoretical model and indicators into user-defined eco-cultural indicators. This was achieved using case studies and interviewing residents in the case study areas. Then, participants' views on these indicators were coded, clustered and analysed to determine the relative value or ascribed importance of the indicators. Figure 2 outlines the research design for this paper.

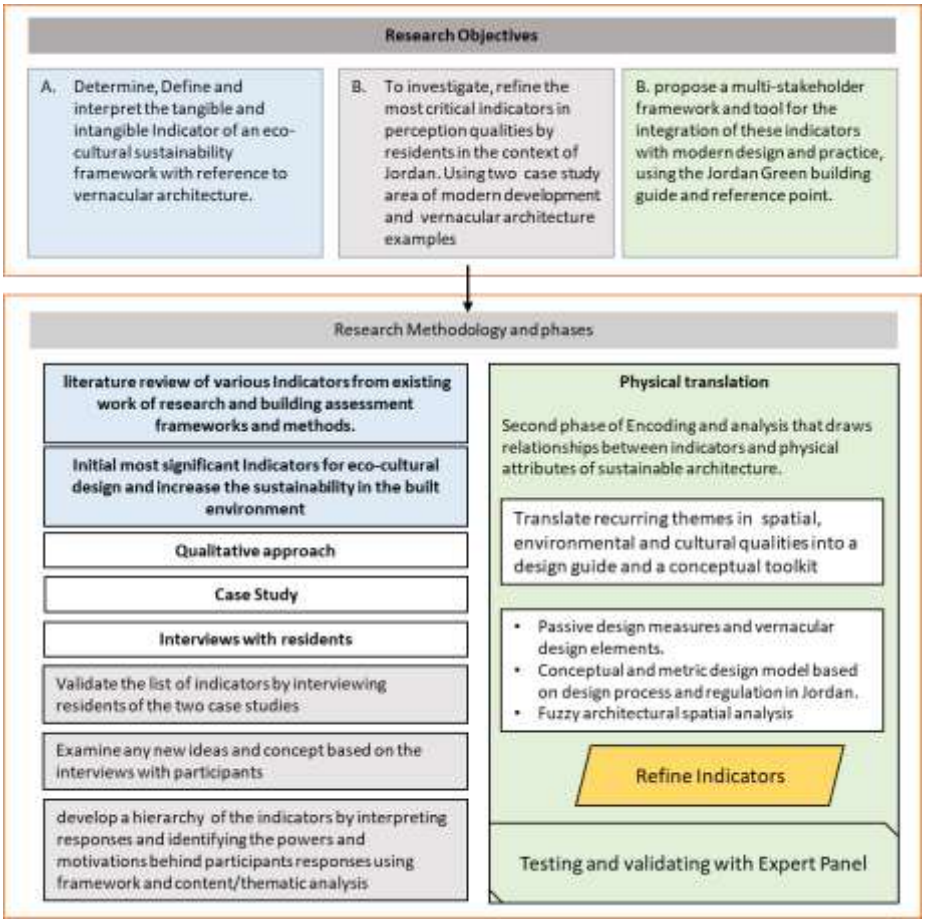


Figure 2: Research design

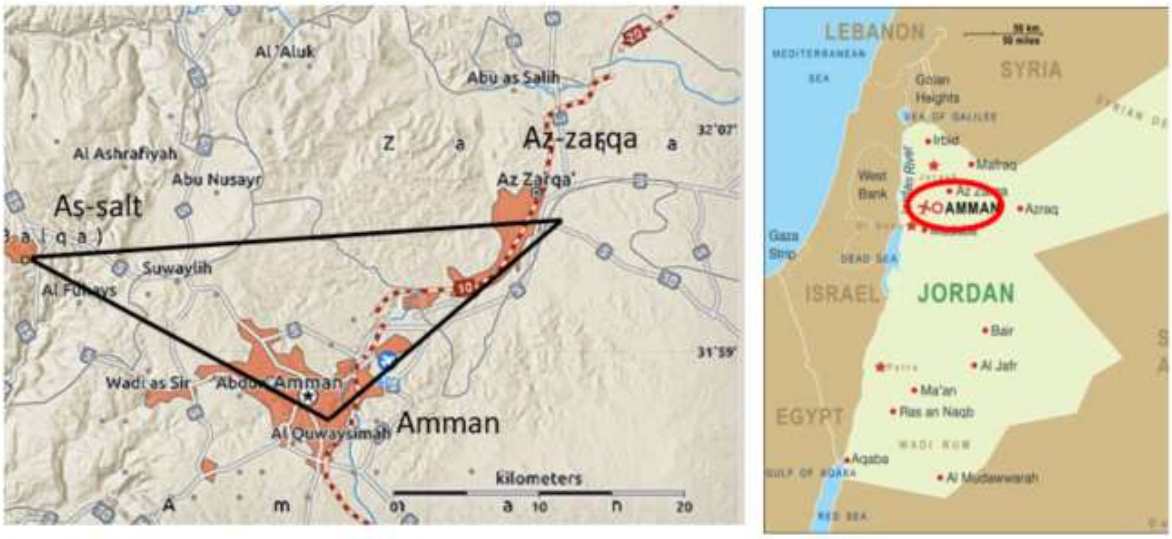
3.1 Case study

Focused research must be representative of a broader set of cases in order to provide insight into a broader socio-cultural context (Yin, 2009). Therefore, two cases were selected in Jordan to represent the modern and historic approach to housing development: the pilot phase of the newly developed project of King Abdullah Bin Abdul Aziz city and the old downtown area of As-Salt city (Figure 3). These comparative cases exemplify and provide a general understanding about the built environment within a context, in this case, Jordan. By construction, the typical case is also a representative case of that context (Yin, 2009). Typical cases serve an exploratory role. Here, the cases are selected based on a set of descriptive characteristics and then probed for causal relationships. This is represented by choosing two cities to be as representative as possible of contemporary Jordanian life. With the choice of contemporary and historic development necessary to achieve spatial-temporal changes in architecture, relationships between inhabitants and their perceptions about their built environment (see Table 5).

Table 5 Overview of the two case studies.

Quality	*King Abdulla City in Zarqa*	*Salt City Historic Centre*
Size of population	3605 Inhabitant (during the time of the fieldwork)	No data about inhabited vernacular dwellings
Dwelling typology	Detached, semi-detached and row houses and apartments blokes	Detached, semi-detached, and courtyard vernacular dwellings
Type of case	New urban development	Historic town centre
Data source	Mawared Company (the developer and operator)	Various online data format and from As-Salt city council
Building material	Concrete and stone cladding use of local building forms, with modern features	Mud and stone houses with concrete renovation or additions. Use of vernacular building forms. With historic features
Zone and Climate	Jordan Badia (Desert) region and climate	Jordan highland region and climate
Economy	Industry, commerce and military-based employment	Tourism, agriculture and services

Figure 3: Relative location of King Abdulla in Zarqa, As-Salt and Amman the capital of Jordan (JOBGB, 2012)



3.2 Participant sampling

Participants were recruited using an exponential non-discriminative snowball sampling technique including knocking on doors, interviewing people at mosques and using the network of friends and family. This technique allowed for the collection of data in a cost and time-effective manner as well as reaching the hidden population (Creswell, 2011; Jamshed, 2014) especially in the case of As-Salt city where the number of inhabitants in vernacular buildings is unknown. Participants had to be current residents within the case study areas, over 18 and of any gender, employment, or economic background. Participants filled out a recruiting questionnaire to gather their socio-demographic characteristics (age, gender, education, work), provide information and characteristics of their current dwellings and give ethical consent. 81 participants were interviewed from the two case study areas (50 from the pilot phase of King Abdulla city and 31 from As-Salt City historic centre) during 29-04-2018 to 27-05-2018. Table 6 summarises the demographic characteristics of the participants.

215 Table 6 Demographic summary of participants

	King Abdulla City		As-Salt City	
Number Sampled	50		31	
	Total number	As percent	Total number	As percent
Gender				
Male	24	47%	15	48%
Female	26	53%	16	52%
Age				
24 or younger	5	10%	5	16%
25-34	15	29%	4	13%
35-44	14	27%	4	13%
45-54	9	18%	1	3%
55-64	6	8%	8	26%
55-65	2	4%	6	19%
65-74	1	2%	2	6%
75 and older	1	2%	1	3%
Family Size (Adults)				
2	25	49%	13	42%
3	6	12%	8	26%
4	11	22%	8	26%
5	5	10%	0	0%
6	2	4%	0	0%
7	2	4%	0	0%
Children				
0	6	12%	16	46%
1	17	33%	3	10%
2	11	22%	6	19%
3	9	18%	3	10%
4	7	14%	1	3%
5	1	2%	1	3%
Type of dwelling				
apartment complex	20	41%	5	16%
Row house	5	10%	4	13%
Semi-detached house	15	29%	10	32%
Single Detached house	10	20%	12	39%
Education level				
Doctorate degree	1	2%	0	0%
Master's degree	3	6%	0	0%
Bachelor's degree	18	35%	4	13%
High school	6	12%	9	29%
Collage/technical training	10	20%	1	3%
Until high school	13	25%	15	49%
No schooling (illiterate)	0	0%	2	6%
Employment				
Employed for wages	17	33%	6	20%
Military	5	10%	0	0%
Unemployed	2	4%	2	6%
Retired	6	12%	5	16%
Self-employed	8	16%	5	16%
Stay in house parent	9	18%	10	32%
Student	4	8%	3	10%
Ownership				
Work housing	5	10%	0	0%
Living with extended family	1	2%	0	0%

	King Abdulla City		As-Salt City	
Own it	38	75%	21	68%
Rent it	7	14%	10	32%

Whilst the participants were randomly sampled, their age, gender and dwelling types were monitored to avoid significant bias toward specific groups. For example; when there were significant interviews with participants living in apartment blocks, efforts were made to recruit participants in other dwelling typologies whilst maintaining the overall sample size and demographics. Access to other data was facilitated by Mawared Co and As-Salt City Council.

3.3. Protocol and measures

The protocol utilised open-ended and semi-structured questions during home visits. Before beginning the interview, the researcher read an introduction and asked for consent in order to record both the voice and the demographic data of the participants. No names were collected and participants' transcript and recording were coded using alphabets and numbers (e.g. A1 for King Abdulla City; B1 for As-Salt City). All interviews were conducted in the Arabic language. They were recorded using digital recorders and then interpreted and transcribed to English.

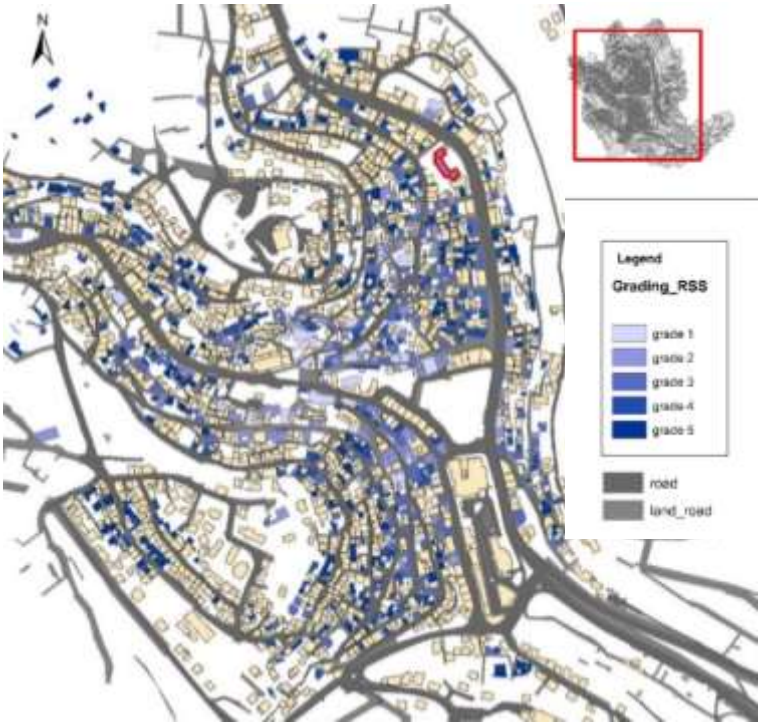


Figure 4a: Zones of the pilot Phase in King Abdulla City (Personal communication from Mawared Company, 3rd May 2018)
Figure 4b: Census of the most notable remaining vernacular buildings in As-Salt city centre assigned into grades based on their condition, aesthetics and value as tourist attractions. (Darker blue shade indicates more important buildings, yellow are newer or not assessed buildings) (Personal communication from Salt City Department of Planning 15th May 2018)

While interviewing, participants were prompted with follow-up questions and explanations. Follow-up questions were asked to gather more details about how the factors facilitate or hinder their experience and perception of the local built environment. Suggestions for improvement were also inquired (Table 7). Data collection was performed by the main researcher and with the aid of two trained assistants (NQ, MY). The study protocol and questions were pre-approved by the University's ethics committee.

250 Table 7: Variables explored in the study and structure of the interview guide

Type of indicator	*Description and illustration*	*Question*
1.0 *Background/demographics*	Standard background information such as Gender, Age, Education, Marital Status, Employment Family Size	Consent to interview. Check the data copied from the Questionnaire.
2.0 Cultural Indicators	To elicit a description of the user's experience, behaviours, what a person has done or is doing within a built environment. In which ways would culture be reflected in buildings and advantages/disadvantages of the building towards cultural identity	What do you like …? To what extent …? Where do you ….?
3.0 House organization and space arrangement	To understand spatial arrangement of elements in dwellings in relation to lifestyle, social relation, family structure	What do you believe/know about…? Have you made any changes in …?
4.0 Vernacular architecture related metrics	Figure out aspects of vernacular architecture that made it sustainable and culturally appropriate.	In which ways would culture be in aid of sustainable design?
	To elicit the reactions to a certain quality or metrics of space, What the participants feel besides what he thinks	Advantages/disadvantages of the vernacular buildings towards cultural identity?
5.0 Sustainability Indicators	Level of user satisfaction based on the building sustainable features Attitude towards satisfaction & accessibility within green buildings indicators	Do you feel about …? What do you know about…?
6.0 Social Interaction, relationships and planning	Sharing ideas/strategies for sustainable building practices on neighbourhood level to improve sustainable building practices.	Reflect your own experience about neighbourhood social interaction
7.0 Economic indicators	The relationship of socio-economic factors with sustainable elements of buildings (their cost and preference)	Which qualities would you choose? To what extent would factors e.g. cost determine these choices?
Various Indicators	To determine facts and information about the indicator.	Rank the following…? Survey rating questions

251

3.4 Data analysis

Data analysis was guided by framework analysis which sits within a broad family of analytical methods often termed thematic analysis or qualitative content analysis (Gale *et al.*2013). Data analysis followed the work of Braun and Clarke (2006); Gale *et al.* (2013) and Ritchie and Spencer (2002). Framework analysis allowed for the use of indicators as a base that allows themes and concepts to emerge. It also supported both deductive and inductive approaches that allow for the unexpected and permits more socio-culture-located responses from interviewees. To analyse the interviews, data from transcripts were inputted to Nvivo 12. Transcripts were subject to multiple rounds of coding and analysis. In the deductive approach, codes were selected during the literature review phase (see section 2.2); in the inductive approach, codes and themes are created from the data through coding and refinement process (Gale et al., 2013). More concepts and categorizations emerged based on textual comments, keywords and ideas that participants expressed during the interview discussions.

Framework analysis advocates the use of long tables for arranging data by comparing and contrasting information (Ritchie & Spencer, 2002). Krueger and Casey (2000) advocated the use of words, context, internal consistency, frequency, intensity of comments and how specific are participants as a mean for interpreting coded data in order to conduct a thematic analysis. As suggested and used by Sandelowski (2001) and Ferrer, Ruiz, & Mars (2015), qualitative findings are backed by quantitative counts of the interviewees discussing eco-cultural factors and extensiveness of comments. When an indicator was mentioned by less than 25% of the participants it was referred to as “few”, when 25% to 50% discussed it the word “some” was used, when between 50% and 75%, “many” and finally “most” was used when more than 75% of the participants discussed that indicator (*see* Table 9).

273 Table 8 Dwelling characteristics of the participants

	King Abdulla City					As-Salt City centre				
	Apartments complex	Other (Terraced house)	Semi-Detached house	Single Detached house	Grand Total	Apartments complex	Other types	Semi-Detached house	Single Detached house	Grand Total
Total	21	4	15	10	50	5	4	10	12	31
Ownership										
Borrow it (work housing)		4			5					
Own it	15		14	9	38	4		7	10	21
Rent it	5		1	2	7	1	4	3	2	10
Number of Bedrooms										
1						2		1	1	4
2	7	1	3		10	2	4	7	5	18
3	16	3	11	6	35	1		2	6	9
4	1		1	2	4					
Number of Living rooms										
1	16	4	2	1	21	2	4	8	9	23
2	8		12	5	26	3		2	3	8
3			1	2	3					
Number of Bathrooms										
1		2		1	3	4	4	10	8	26
2	21	2	9	2	34	1			4	5
3	1		6	6	13					
Area ($m^{2)}$										
<100	3		2		5					
100-120	13	4	1		19				1	1
120-150	6		4	1	11	1	4	2	2	9
150-180			1	4	5			1		1
180-200			2	2	4					
>200			3	1	4	1				1
Unknown						1		6	6	13
Family size (Total)										
2		2	2		2		4			4

3	4	2	6		10			3	4	7
4	4		1	2	7	4		1	3	8
5	4		5	1	10			3	3	6
6	6		4	2	12	1		1	1	3
7	3			1	4			1		1
8	2			2	4			1	1	2
Family size (Children)										
0	4	2			6	3	4	3	7	17
1	5	2	9	3	17			1	2	3
2	7		1	2	10	1		2	3	6
3	4		3	1	8	1		2		3
4	3		3	1	7			1		1
5				1	1					
Family size (Adults)										
2	9	3	11	3	25	1	4	6	2	13
3	3	1	3		7	1		3	4	8
4	6		2	3	11	3			5	8
5	3			2	5			1	1	2
6	2				2					
7	1			1	2					
The dwelling had a garden						The dwelling had a garden (or an inner court)				
No	17	2	3	1		5	4	3	5	16
Yes	7	2	15	9	33		7	7	15	15
The dwelling had a separate entrance										
No	17	2			18	3		1		4
Yes	7	2	15	10	32	2	4	9	12	27
Changes have been made to the house										
No	7	1	7	5	23	1		1		2
Yes	17	3	7	4	28	4	4	9	12	29

274

275 Table 9 The main indicators influencing eco-cultural sustainability in residential buildings
276 * (+) or (-) positive or negative effect of the Indicator on quality of architecture based on participant perception.

Main Eco-cultural Aspect	Eco-cultural category	For almost all (75–100%)	For a lot of (50–75%)	For some (25–50%)	For a few (0–25%)
Cultural Aspects	Aesthetic and visual Impact	The feeling of density and crowdedness (-) Relevance to vernacular architecture (+)	Continuity between buildings style (massing, typology, details and materials) (+) The use of mud as a material (-)	Green areas and trees (+) Cleanliness (+)	-
	Role of privacy and dwelling typology	Separate detach access to dwelling (+) Private outdoor zones (+) Not enough visual privacy in principal areas of the dwelling. (-) Private access to interiors of the dwelling (+) Hierarchy of zones and segregation between guests and family space (+)	Small room size (-) Not enough space for furniture (-)	A place to grow plants (+) The living area is part of circulation (-) Joint kitchen with a living room or dining area with a living room (-)	Efficiency of vertical transportation system and spatial efficiency (+)
	Controllability and adaptability	The ability to make an addition to the exterior (+) The ability to customise their dwelling (+)	Potential for horizontal or vertical extensions (+) Constraints imposed by structure, floor-to-floor heights and local authority (-)	-	Local control of mechanical systems, natural ventilation and sunlight through windows (-) Adaptability to future changes in the type of energy consumed (+)
Social Aspects	Design for social interaction	Interactive or overlooking dwelling entrances (+) Outdoor spaces and parks (+) Frequency of service of local public transportation (+)	Community or social centre (+) Walkable sidewalks with no obstacles (+) The parking spaces are far from the building entrance (-) Higher boundary walls around the property (+)	-	outdoor spaces overlook children's playing area (+) Street and traffic safety (-) Crime prevention and security inside and outside dwellings (-).
	Neighbours rights and regional loads	Limited access to daylight or ventilation by adjacent property (-) Impact of the construction process on residents and commercial facility users (-)	-	Privacy in internal and semi-outdoor areas (+) Balconies overlooking each other's or adjacent windows (-)	-

Main Eco-cultural Aspect	Eco-cultural category	For almost all (75–100%)	For a lot of (50–75%)	For some (25–50%)	For a few (0–25%)
		Degree of light pollution caused by building exterior lighting systems (-)			
Economic Aspects	Affordability and affordable dwelling.	Distinctions between affordable housing and low cost and low-quality construction (-) Durability of key materials (+) Low operating and maintenance cost (+)	-	Durability of the building envelope (+) Ability to perform maintenance over a long-term period (+)	Affordability of residential rental or cost levels (+) The negative impact of the project on land values of adjacent properties (-)
environmental aspects	Indoor environment	Effectiveness of natural ventilation during various seasons (+) Low thermal comfort and energy performance (-) Insulation (+)	Impact of orientation and topography of the site on the solar potential of buildings (+) Appropriate daylighting in primary occupancy areas (+) Control of glare from daylighting (+) Poor noise transmission through the exterior envelope (-)	Importance of mechanical heating and cooling systems (+)	Passive measures and energy saving (+)
	Outdoor environment quality	The use of renewable energy systems (+) Green spaces and vegetation (+)	Recycled and locally sourced materials (+) Water management and rainwater harvesting (+)	Noise conditions (-) Reduced car and parking footprint	Flood risk (-) Air quality conditions (pollution) (-)

277

4.0 Results

During the interviews, the conceptual set of eco-cultural indicators and associated issues were discussed. Participants' demographic and dwelling characteristics were captured (Table 8). It is pertinent to discuss the relevance of the eco-cultural indicators and main recurring themes based on the interviews with users and inhabitant in the Jordanian context. Therefore, each eco-cultural category was compared with the participant's dwelling characteristics and demographics to obtain the degree of their importance in the context of Jordanian residential new construction.

The eco-cultural framework itself is structured along the three aspects of sustainability in addition to the fourth cultural one. Each aspect is followed by a series of more practice-related indicators detailing components of eco-cultural buildings. The framework steps through what tangible and intangible indicators buildings react to and how they affect and inform each other's (Figure 6). The framework concludes with a discussion of overall strategies linking tangible and intangible aspects of the sustainable build environment (table 12). Attention was given to users' expectations and perceptions of a positive sustainable environment. The topics centred on the interrelationships between the four main themes. Participants were also asked to present examples or alternatives or solutions to the issued raised. Findings are supported by comments made during the interviews. Table 9 summarises the findings.

However, this framework is not meant to be comprehensive by using many examples. The aim is not to list all possible interpretation methods but to list those which explain the indicator. The same interpretation method can appear within multiple categories for this reason. The emphasis is on illustrating the point and view of the interviews and on allowing the reader to understand the dimensions of eco-cultural design.

It was found that the scope of eco-cultural sustainability indicators differs from the existing sustainability assessment frameworks and tools, primarily because of the differences in the user's perception of an ideal sustainable built environment. Moreover, context-specific issues in Jordan have resulted in unique challenges which have contributed to the final composition of the list of indicators. This means that the assessment weights and credit allocation for eco-cultural indicators should and will diverge from other assessment frameworks. The participants' responses also illustrate additional criteria to the ones identified in literature which would be important for integration into the Jordanian Green Guide for sustainable residential buildings. This tool and design guide will be further built on in future work. The findings are discussed thoroughly in the following sections under the 'four' sustainability dimensions: cultural, social, environmental and economic.

4.1 Cultural Dimensions

4.1.1 Aesthetics and visual Impact: materials, space and form

For most participants from both cases, the quality of building materials and the visual impact were cultural determinants for whether the building was deemed "good for today's standards" or "durable" and sustainable. Participants from the King Abdulla city discussed the use of both modern or modern-looking elements and vernacular materials, quality of materials and build and in particular the use of stone. In total 34 out of 50 participants in King Abdulla and 24 out of 31 in Salt city mentioned at least one aspect of aesthetics and associate cultural value.

For most of Salt city participants, their aesthetic preferences were geared more towards the vernacular elements of architecture. They highlight how vernacular architectural elements can even help with passive and sustainable measures in architecture. For instance, long narrow windows for

more indirect sunlight, the use of plants around the building, the presence of a courtyard to create self-shaded areas and over-hangs on top of balconies and windows. B05 who is a 45-54 years old female, married and living with her family of 5 in a detached vernacular house explained:

> *Vernacular houses like this one have more greenery around them and look closer to the environment than other non-vernacular houses. They were built using natural materials, have nicer bigger windows and courtyards with trees and water fountains that helps to make the house cooler in summer and thick walls that kept it warmer in winter….*

4.1.2 Role of privacy and dwelling type

For most participants, privacy was one of the most recurring themes that people expressed during the interviews. They considered privacy to be deeply connected to the dwelling form, layout and cultural norms. Participants discussed privacy in interweaved relationships to segregation between genders, guests and hospitality. Participants also connected privacy to other tangible indicators like; dwelling typology, private outdoor spaces and internal circulation. *Many* participants interpreted privacy as being "concealed", "hidden" and being "sheltered "in their house. This will provide them with the comfort and freedom to perform their daily life away from the prying eyes of neighbours or street dwellers. This freedom includes the ability of family members to move around the dwelling while guests are there, especially if the guests are males from outside of the family, otherwise, women need to stay in dignified clothing the entire time if they had to share spaces. So, it is important for the guest-hosting area and the entrance of the house to provide this privacy and freedom of movement. Participant A36 who is a 25-35 female, employed and lives in an apartment block compared:

> *The apartment where she lives now compared to her old one: "In the house, the bedrooms used to open directly to the living room, there was no hall or corridor to separate that and it was rather uncomfortable, it was noisy and you never feel like you have your room, although we did have another guest room and this room was just for family members I still find that uncomfortable…."*

The participants considered that even a new house should consider the room size and room numbers; at least have three bedrooms (one separate from other rooms and near the entrance so guests do not see private areas), two separate living areas, dining area with the kitchen is a bonus. Participants living in apartments in King Abdulla city reported having fewer bedrooms compared to before and other especially functioned spaces like guest rooms or entrance halls were missing. There were also comments about the density and crowdedness of developments. They linked this to privacy as participant A11 who is 35-44 years old male and lives in an apartment with his 4 children and wife puts it when commenting on the photographs of buildings in the area:

> *"I didn't like that in the apartments. There are a lot of people living there, the number of apartments seems high there. Although the third building has nice balconies and seems to have a garage for the car and looks much nicer than the first and second buildings but still an apartment block but with better finishing materials. …. Having so many people living in the same building is a new thing to our society people used to live in a single-family house. Having a building with few apartments is alright but just not too many families …… that is why I choose the second building because it looks like it has fewer apartment numbers and more space around it……"*

Participants A16 who is a 44-54 years old female and live a detached house with her family of 5 said:

> *… I mean we still have this culture of houses to be closed into itself and not be so exposed for people in the outside, to have much control for privacy which is a shared point with traditional houses. Covered windows, balconies are not so exposed and so are the other floor, it's a shared point with most houses here in Jordan. Some houses the kitchen would be open to the living space which I don't like,*

Participated stated that visual overcrowding, noise, ventilation and sunlight levels are always affected when living in multi-apartment blocks where "too many" families live. According to interviewees, proximity and setbacks from other buildings and adequate green spaces were repeatedly associated with sustainable practice, image and reduced sense of privacy. Participants A47, a 25-34 years old female, married and living in an apartment with her husband and two children said:

> *…I would guess sustainable buildings would have a fewer number of apartments than non-sustainable ones... it would also have a good space between it and the other buildings in the neighbourhood to have optimal ventilation and sunlight and so you can plant trees between them...*

4.1.3 Adaptability and controllability

47% of the participants in King Abdulla city and *most* of the participants in Salt city have made changes to their houses (Table 8). These modifications were related either to enhancing the privacy in the dwelling, making it more suitable to their lifestyle and to increase the value of their residence. Changes include: enclosing the balcony completely or covering it with plants, metal or wooden arabesque, adding a divider or a separator to increase the privacy and segregation between bedrooms and guest reception area of the house like the living room or dining area or dividing living areas into two – one for family, the other for guests. It was also found that most of the residents living in apartments considered it inadequate for meeting their expectations. This included dissatisfaction with the number of functional rooms. The interviewees needed more bedrooms and additional living areas as well as spaces for studying and hosting guests rather than the more contemporary one big hall or an L-shaped living area. Table 10a & 10b highlight the most recurring physical changes made or planned to be made by residents alongside the accompanying reasons (some participants made two or more changes).

Table 10a: Types and reasons for changes to the original interior layout In King Abdulla city

Recurring changes in vernacular house	Reason	Related indicators	Type of indicator
Closing the balcony or terrace with walls	To create an additional room or increase indoor space	Circulation and house organization	Tangible
Add a divider between the living room and the corridor leading to bedrooms	Segregation of family members and guests To create an additional room or increase indoor space	Privacy and house organization	Intangible
Adding thermal Insulation	To help repel heat or cold	Environmental measures/ thermal comfort	Tangible
Increase the area of the balcony by building a slap near it	Have a terrace	Semi-outdoor spaces	Tangible
Adding a screen on the balcony or windows	To provide more visual privacy	Privacy	Intangible
Adding solar power panels	reduce unwanted sun rays	Environment/ thermal comfort	Tangible

Table 10b: Types and reasons for changes to the original interior layout in As-Salt city

Recurring changes in vernacular house	Reason	Related indicators	Type of indicator
General renovations	Poor condition of the house	Physical Parameter	Tangible

Covering the internal stonework with plaster	For renovation purposes	Materials	Tangible
Covering the internal courtyard roof with a new slap	To create an additional room or increase indoor space	Circulation and house Organization	Tangible
Closing the balcony or terrace with walls		Semi-outdoor spaces	Tangible
Add a new partition between big rooms	Privacy and segregation of family members and guests	Privacy and segregation	Intangible
Build a new room	To create an additional room or increase indoor space	Circulation and house Organization	Tangible
Adding an extra bathroom	Needed bathroom		Tangible/intangible
Changing the use of one of the rooms	To provide more privacy and noise control	Privacy/ noise	Intangible

4.2 Social Dimensions

4.2.1 Design for social interaction and accessibility

For *most* participants, the social image of sustainability relied on the availability of exterior spaces for social interaction. These aspects are considered in a limited way in assessment tools. They are discussed in isolation from each other and often ignore the direct relationship between the tangible and intangible aspects. This shows the need to reflect on the relationship between the indoor and form/exterior in association with people's social practices and lifestyle in order to avoid socio-cultural and technical clash that is eventually unsustainable. A10 who is a male 45-54 years old married male and lives in a single-detached house with his family of 6 explained:

> *…. not much goes for social interaction, entrances are far from each other and it is hard to catch neighbours, we are waiting for our attached neighbour to come and join us…*

A50 who is a male age 25-35 and lives with his wife and child in a terrace house said:

> *Our buildings are without sidewalk while other buildings in the same area have huge ones! Also parks and garages! I think the developer did a bad job planning the lots here, they could have made it better and more organized than it is and plan where each entrance of each lot is located, to be far from main roads in a way that provides security, interaction and privacy for each adjacent lot….*

B29 is 24 years old, single and lives with his parents and siblings in a single-detached house said about living in a vernacular neighbourhood:

> *Old houses certainly gave more chances for people to meet and to be closer and more intimate, even between neighbours.*

On another hand, availability of services and walkability played more role in social provision of the community. A11 who is a male age 25-34 and lives in a semi-detached house describe:

> *…. this development is still rather new with not many services and empty land lots and construction sites that make the air rather dusty from building material particles. Distance from services and markets can be challenging and does not encourage you to go and walk as you will always have to use the car for shopping for grocery, also for some part of the area the sidewalks are really in a bad condition with people taking them over and planting bushes and shrubs that obstacle the way.*

Salt city residents did not face these issues as the site contained many old established squares and wide stairs. B02 who is a 55-64 female said:

> *Living here gives peace of mind and I like the idea of living in a place with history and connected to my heritage. It makes me feel more bonded to the place and history of the city. The location is good being central and has a lot of advantage where you don't have to own a car or pay for transport to work, school or the market. Nothing specific I didn't like.*

4.3 Economic Dimensions

Non-conventional or rarely studied economic aspects assert the difference between the affordability of housing and affordable housing (Pocock *et al.*2016). Most apartment blocks in King Abdulla city were built as part of a government scheme to provide more affordable homes. The scheme was not successful and *many* participants had bad views and attitude toward such schemes. A26 who is a below 25 years old male living in a detached house said:

> *This project was supposed to be for lower-income citizens, but land prices and apartments are too expensive for them...I would not mind a bit expensive house if it was going to be more durable and sustainable.*

For most of the participants in Salt city, their main concern was the durability and maintenance cost for their old traditional houses. B24 who is 25-34 years old female living in a semi-detached house with her family explained:

> *Maintenance work: fixing the ceiling, adding tiles to prevent water from coming in, paintwork and so on. Even if we have the money now, we don't feel encouraged to do it as it won't last long. It was less than a year since we did the ceiling and look, paint is falling off already.*

More than a few interviewees mentioned the negative impact that the new developments were having on the value (including rental) of their dwellings. In Salt city, the recent renovation and public works encouraged landlords to increase rent prices which affected many families and threatened them to leave and for many vernacular houses to sit empty and degrade due to the cycle of negligence. In King Abdulla city, prices went up sharply in recent years which affected the moving-in rate and thus social relations worsened. It also encouraged anti-social behaviours that endangered the project. The government also lowered the prices for the remaining units which led to the value for all the units that were sold previously to go down, creating a long list of people waiting compensation.

4.4 Environmental aspects

Nearly all the residents discussed environmental dimensions in relation to interior living qualities, external landscaping, or the use of high technology products and materials. *Most of* the participants discussed the need for good natural ventilation and sunlight and the indicators for achieving this included: orientation, window size and location of opening. Participants in King Abdulla city spoke about poor thermal comfort and energy systems. They linked poor thermal comfort to insulation methods and absence of central mechanical heating and cooling systems. Participants from Salt city praised how convenient their dwellings are in providing thermal comfort and energy saving. They linked it to good earth materials and passive measures of orientation, thermal walls and shading. B3 who is a 65-74 years old male and lives in a single detached house with his wife said:

> *Materials and methods of construction played the major role in regulating temperature. This house has very thick walls, this made it suitable for both hot summer and cold winter. The courtyard used to help in cooling too, sadly after we added the roof it's been hotter in summertime …*

A05 who is a male living in a semi-detached house with his family of three said:

> *A building that may use renewable energy sources like solar power, or which its utility bill is low compared to other type of buildings. Allows enough sunlight, a lot of green areas, recycling grey water too…*

Participants were divided in the matter of using recycled or more expensive sustainable materials and gave their approval subject to the quality or price of these high-performance materials. A07 who is a 25-34 years old male living with his wife and child in an apartment block said:

> …If these materials make the house more sustainable then of course I would agree…

5.0 Discussion

It was observed that socio-cultural indicators dominated participant's perspective and image of sustainability. Cultural indicators in the built environment were frequently discussed in relationship to planning, internal environment and heritage relevance. For example, participants discussed the image of sustainability and its relationship with the quality of materials, design and even aesthetics. Bennetts *et al*. (2003), made the same remark about how the image of cultural sustainability in architecture is "highly contextual" and influenced with mostly shapes and materials. However, studies such as Satterfield *et al.* (2013), Plieninger *et al.* (2013) and Wu *et al.* (2016) limit cultural sustainability to the presence of cultural and spiritual facilities and the need to preserve current heritage buildings.

Most of the participants reported that vernacular architectural elements were more aesthetically appealing and performed better, stating that they are suitable for both local culture and climate. This aligns with previous research that asserts the bioclimatic potential of vernacular architecture (e.g. Memmott and Keys 2015; Eyüce 2007; Al-Sallal 2017; Weber 2013). Chiesa and Grosso, (2017) also found visual aspects to enhance satisfaction and the socio-cultural experiences of people in housing. Al-Sallal (2017); Weber (2013) went further which vernacular elements possess both a socio-cultural and environmental function. Many participants make little distinctions between vernacular and sustainable architecture. For example, the architectural design of the building envelope in vernacular architecture reflected not only aesthetic concerns but also performance (e.g. thermal performance).

Many participants also discussed the visual impact of multi-apartment blocks and described feelings of density and crowdedness. UNISCO, BREEAM and LEED all encourage high density mixed developments as a cornerstone for sustainable development (Ameen, Mourshed, & Li, 2015). Yet, few studies discussed occupant perception of density. Bradecki *et al.* (2017); Dave (2011) concluded that the feeling of high density is related to typology rather than being an issue of how many people are living within one square km or unit space. This aligns with what this study found; that perception of density is related to buildings form, typology, location of windows and setbacks. Nearly all the participants discussed how ventilation and natural sunlight in the dwelling could be affected by nearby buildings. Especially those who are living in multi-level apartments. This in part gears towards the association between tangible factors like window sizing with socio-cultural indicators and satisfaction levels.

For almost all the participants, privacy was the most important cultural trait that a dwelling must have. This transcends the inner part of the house to semi-open and semi-private outdoor zones like the garden, balconies and terraces. Participants also pointed out various vernacular elements that serve a dual function of environmental controller and privacy enhancer. The city of Salt has introverted planforms comprising of a series of rooms built around a central courtyard that is usually open to the sky. This type of plan satisfies cultural conditions while being a flexible space that can be adapted to the changing requirements of a large family. It also suits climatic conditions for passive cooling and

enhanced ventilation. Balbo (2013) found similar dual properties at the vernacular urban design level and this study confirms this at the typology-social level for modern occupants. Many participants also affirmed that functionality and circulation are also important. So far, consideration of these two factors is limited to distribution, communications and quality of the design rather than environmental requirements (Chiesa & Grosso, 2017). Not considering functional and environmental components together during the preliminary design phases may result in significant user changes and adjustments to the building post-construction at delayed, higher costs, time and disruption to the occupants.

In the sphere of social wellbeing, a lot of participants discussed the layout of dwellings for social interaction. While some of the participants connected wellbeing to the walkability of streets and presence of public spaces, the latter are the only aspects that are considered in assessment tools and literature like (Al-Jamea, 2014; Awadh, 2017; Olakitan Atanda, 2019). Where the relation and position of buildings and dwellings relative to one another are typically considered in a limited indirect way. Few participants mentioned the walkability of streets and sideways as an important factor. This was combined with their need for services and amenities to encourage inhabitants to meet and socialise. In sustainability assessment tools and research, the focus is geared towards urban and neighbourhood design that gives priority to safety, security, inclusivity and cultural facilities (Ewing and Handy 2009; Åhman 2013). On the other hand, participants' responses showed that outdoor design qualities and walkability come first in participant's perceptions of their social realm. Many participants stated that community centres and facilities are not as important as a good quality outdoor space with a design that respects all residents' privacy, access to ventilation, solar rights and services. They regarded the condition of sidewalks, presence of trees, landscaping, shading elements and connection to services as main encouragements to choose to walk rather than drive. This shows the need to reflect on the relationship between the indoor and form/exterior in association with people's social practices and lifestyle in order to avoid a socio-cultural and technical clash that promotes unsustainability.

Few participants connected sustainability and housing quality to economics. Nearly all live in the apartment blocks that were built as part of an affordable housing scheme. The affordable housing scheme failed due to selling all of the units due to its low quality, limited marketing and reports of the developers being involved in corruption. Non-conventional sustainable economic studies assert that affordability of housing and affordable housing, are not the same thing (Anacker, 2019). Moreover, sustainability assessment methods usually fail to differentiate this important aspect and its role for holistic sustainable design. Chiu 2004; Axelsson et al. 2013 emphasised bioclimatic, thermal comfort and energy performance of the dwelling. Although participants living in the multi-apartment affordable apartments praised their thermal performance, their discussion was more focused on build quality, lack of privacy, typology and high-density feel. Many explicitly expressed their plans to move out once they could afford something better. In conventional architectural practice, sustainability and affordable housing have rarely been considered alongside each other. Sustainability and affordability are often negatively correlated with each other because "more sustainable" often means "less affordable" (Friedman, 2012). Neighbourhood amenities such as access to services, pedestrian safety, access to complete streets and quality housing standards have important roles in determining the affordability of living in sustainable neighbourhoods (Friedman, 2012)Participants who can spend money on their dwellings are more likely to have more favourable attitudes. Therefore, there should be access to a diverse range of affordable housing typologies (e.g., high-rise and low-rise, detached or semi-detached, mixed-use or multi-functional buildings, etc.) rather than just one apartment type such as is the case in King Abdulla city.

Shirazi and Keivani (2017); Aksamija *et al.* (2015) highlighted the main features for social sustainability that also includes aspects like energy efficiency, thermal comfort, a healthy internal environment,

presence of trees and attention to the overall quality of life. Interestingly, participants interpreted eco-cultural indicators in two ways: (a) sustainable site and form and; (b) indoor spatial and environmental quality. The indoor environmental quality links local culture and values mainly with indoor spatial layout. Responses also focused on thermal comfort related factors such as daylight and ventilation. and how they affect the occupant's comfort and wellbeing. The sustainable site is concerned by how appropriate the public realm is for socialising, and how much privacy is achieved in semi-private and private zones. These aspects are currently considered in a limited way in assessment tools. They are often considered in isolation and ignore the direct relationship between the tangible and intangible aspects. These links also exercise the influence of culture as a medium that gives both the social and tangible environment – natural and built their characteristics. The physical environment can be seen in heritage buildings, nature, landscapes and the fauna and flora. The social environment is lifestyle, local traditions passed down generations, religion and beliefs. For this reason, this understanding of sustainability also involves recognising how socio-cultural aspects have and should still shape the physical built and natural environments. Figure 5 summarises the findings on the qualities and issues that accompany each type of dwelling relative to scale. Moving away from each side indicates the increase or decrease in the presence of these qualities. For example, a detached type of house provides more privacy for a family but is less affordable than an apartment or other types of dwelling.

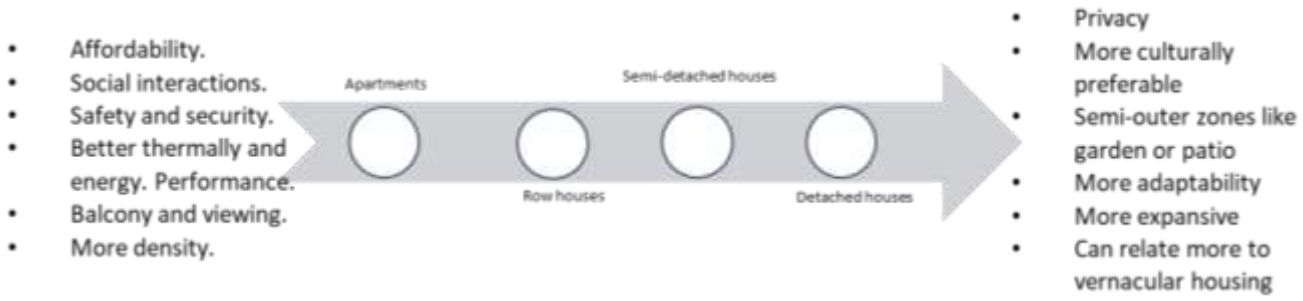


Figure 5: Strength of metrics relative to the dwelling typology according to participants.

The findings highlight the connections participants made between intangible socio-cultural factors and how they can be translated into tangible architectural elements such as space, form and resource use and thermal performance. Tangible and intangible design metrics are important for fulfilling these needs, for instance: privacy can be achieved by the size, position and orientation of openings and space, whilst thermal comfort can be achieved with traditional building materials and thermal mass. Therefore, the findings confirm that there is a need for better integration of the cultural aspects of architecture to the three dimensions of sustainability during the design, planning and implementation of housing schemes. Cultural metrics should be integrated holistically bearing in mind that this would differ per location and context.

Table 12 summarises the findings. Figure 6 consolidates this to propose a visual represented of the theoretical framework. The framework itself is structured along the three aspects of sustainability alongside a fourth aspect: culture. The categories and indicators represent practice-related components of eco-cultural architecture. Lines connect indicators that directly influence one another. Lines represent the relationships between themes and indicators in the contexts of space and envelope of buildings. These categories and relationships were conceptualised based on the participants' viewpoints towards sustainability and quality issues concerned with new and vernacular residential dwellings. This framework integrates tangible and intangible indicators: placing value on the historical, contemporary or a hybrid contemporary-historic built environment. It will be used to propose a new eco-cultural assessment system for Jordanian residential buildings but can also be applied to deliver improved regional and sustainable developments in similar contexts.

5.0 Conclusion and future work

This research aimed to inform the 'fourth' sustainable development approach by proposing a theoretical eco-cultural framework based on a coherent set of interrelated tangible and intangible indicators. The findings from the primary research were underpinned by literature which found that existing sustainability frameworks, assessment tools and guides fell short of integration cultural aspects and needs. This study employed interviews with current residents in two case study areas to assess stakeholders' perspective and identify indicators for holistic sustainability. This approach was only used in a limited way with professional stakeholders in Olakitan study (2019) and within the research of heritage conservation like in the work of Ashley *et al.* (2015). It was also found that most frameworks for assessing sustainability in the built environment focus on the environmental criteria and the assessment tools rarely incorporate the cultural criteria categories and indicators. The lack of understanding regarding socio-cultural criteria was evident due to its intangibility and complexity. This study makes a significant theoretical and practical contribution in that it bridges this gap by proposing tangible metrics relating to intangible cultural factors so that this can be easily and effectively incorporated into existing design assessment tools, guides and standards. The next step is to test and validate the findings when incorporated into the Jordanian Green Building Guide and evaluate the outcomes with design and planning professionals.

The outcome of this research has several significant implementations for future practices and research:

- It is observed that user input could be better incorporated with better satisfaction impact in existing assessment methods. It would help to improve the sustainability of housing schemes if the user needs and requirements are considered e.g. to reduce material waste due to user changes and adaptations.
- The sample size needs to be extended to include more experts and building users in order to strengthen the quality and validity of the data. The study also needs to measure the relevant categories and indicators by the experts to back up results obtained from users.
- This work is situated in Jordan, but the outputs are scalable. Therefore, there is scope to apply and refine the findings for other contexts.
- Future work will investigate weightings and scales for the indicators to serve as a useful benchmarking measure in sustainability assessment tools.

Table 12 Interpreting eco-cultural indicators into physical and ecological measures

Socio-cultural category	Socio-cultural indicators	Physical interpretation	Ecological Advantage
Aesthetic and visual Impact	Relevance to vernacular architecture	Vernacular Architectural elements, Stone use as material,	Reduced direct glare and excess sunshine but allow for more light against the typical wide or rectangular windows. Stigma against earth and mud materials Narrow long windows, stone material, arches and vaults Shared or private courts to regulate temperature and create shaded zones.
	The feeling of density and crowdedness	Number of apartments in the building The proximity of dwellings from each other's Setbacks and empty spaces. Density/m2.	Units and dwelling have the best advantage of sunshine, views, wind patterns for indoor environment The number of dwellings that share access between flats 8 or fewer (2 flats X4 floors).
	Continuity between buildings style	Materials Architectural elements, Colours, Special treatments Similar massing and typology within one zone.	-
	Green areas and trees	Presence of tree lines and vegetation around the house and in streets	Reduce heat, ensure evaporation and reduce solar gains on streets
Role of privacy and dwelling typology	Private access to dwelling and Private outdoor zones	Relationships of dwellings entrances. Grouping units to take advantage of typography Arranging units to create shaded mutual or private outdoor zones Enclosing adjacent private outdoor areas with boundary walls.	Creating self-shaded and narrow alleys to reduce heat gains on dwellings Protecting indoor zones from external noise and air pollution
	Ensure privacy in all principle areas inside the house. Hierarchy of zones and rooms from guest reception to communal and finally to bedrooms.	The spatial arrangement of quiet zones and living activities inside the house. Treatments for walls, floors and windows (materials and thicknesses).	Thermal zoning to enhance thermal comfort and energy efficiency.
	Dwelling typology and properties.	Minimum requirement for room dimensions for furniture use.	-

Socio-cultural category	Socio-cultural indicators	Physical interpretation	Ecological Advantage
		Living and other communal areas of the house are not necessary for circulation.	
Controllability and adaptability	The ability to make an addition to the exterior Potential for horizontal or vertical extension the structure. Local control of mechanical systems, natural ventilation and sunlight through windows.	Ability to control movable shading device and windows opening range. Ability to add more horizontal of vertical fixation for better passive design. Adaptability to future changes in the type of energy consumed including adding solar panels.	Renewable energy sources compatibility Passive heating and cooling measures
Design for social interaction Neighbours rights and regional loads	Interactive or overlooking dwelling entrances Boundary walls around property. Outdoor spaces overlook children's playing area	Covered, semi-open (shaded) and open spaces relative to the total area of the house/building/neighbourhood. Orientation and relationship of these spaces with the house and other nearby buildings.	Units group on a way to maximise beneficial solar gains.

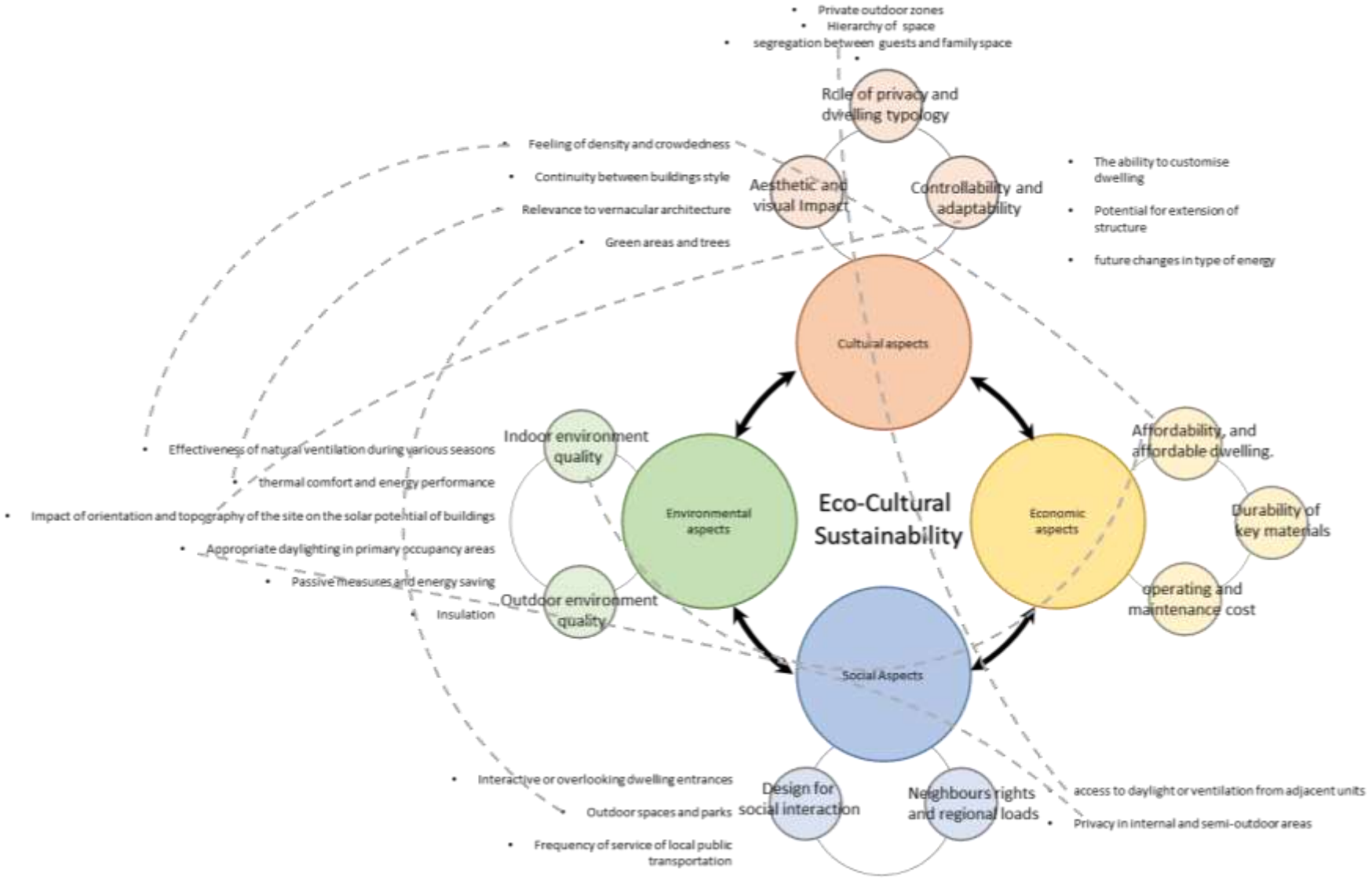


Figure 6: Theoretical framework of the relationships between the main indicators and categories of an eco-cultural design

References

Abel, C. (1993). Eco-culture, development and architecture. *Knowledge and Policy*, *6*(3–4), 10–28.

Abel, C. (2000). *Architecture and Identity: responses to cultural and technological change*. Routledge.

Abergel, T., Dean, B., & Dulac, J. (2017). Towards a zero-emission, efficient andresilient buildings and construction sector: Global Status Report 2017. *UN Environment and International Energy Agency: Paris, France*.

Abidin, S. Z., Sigurjonsson, J., Liem, A., & Keitsch, M. (2008). On the role of formgiving in design. In *DS 46: Proceedings of E&PDE 2008, the 10th International Conference on Engineering and Product Design Education, Barcelona, Spain, 04.-05.09. 2008* (pp. 365–370).

Adwan, J., & Abu Muhsen, M. (2016). The Bioclimatic Design Strategies andthe Application in the Traditional Courtyard Buildings in the Climate of Middle East. *Civil and Environmental Research*, *8*(1), 27–29.

Agung Budi Sardjono, Gagoek Hardiman, E. P. (2016). Characteristics of Traditional Houses in the Old Town of Kudus City Indonesia. *International Journal of Scientific and Research Publications*, *6*(2). Retrieved from www.ijsrp.org/research-paper-0216.php?rp=P505081

Åhman, H. (2013). Social sustainability–society at the intersection of development and maintenance. *Local Environment*, *18*(10), 1153–1166.

Aksamija, A., Haymaker, J., & Aminmansour, A. (2015). of Architectural Research.

Al-Jamea, M. (2014). Towards social and cultural sustainability in the designs of contemporary Saudi houses. *Int J Sustain Hum Dev*, *2*(1), 35–43.

Al-Sallal, K. A. (2017). Learning sustainability from Arab gulf vernacular architecture. In *Mediterranean Green Buildings & Renewable Energy* (pp. 885–897). Springer.

Al Rabady, R. (2013). Creative cities through local heritage revival: a perspective from Jordan/Madaba. *International Journal of Heritage Studies*, *19*(3), 288–303. https://doi.org/10.1080/13527258.2012.659673

Alsubeh, M. A. (2013). A strategic framework for sustainable construction in Jordan. *Civil and Environmental Research*, *3*(2), 102–107.

Alves, S. (2017). The Sustainable Heritage of Vernacular Architecture: The Historic Center of Oporto. *Procedia Environmental Sciences*, *38*, 187–195. https://doi.org/10.1016/J.PROENV.2017.03.105

Amaratunga, D., Newton, R., Baldry, D., & Sarshar, M. (2002). Quantitative and qualitative research in the built environment: application of “mixed” research approach. *Work Study*, *51*(1), 17–31. https://doi.org/10.1108/00438020210415488

Ameen, R. F. M., Mourshed, M., & Li, H. (2015). A critical review of environmental assessment tools for sustainable urban design. *Environmental Impact Assessment Review*, *55*, 110–125. https://doi.org/https://doi.org/10.1016/j.eiar.2015.07.006

Anacker, K. B. (2019). Introduction: housing affordability and affordable housing. Taylor & Francis.

Ashley, K. S., Osmani, M., Emmitt, S., Mallinson, M., & Mallinson, H. (2015). Assessing stakeholders' perspectives towards the conservation of the built heritage of Suakin, Sudan. *International Journal of Heritage Studies*, *21*(7), 674–697.

Atanda, J. O., & Öztürk, A. (2018). Social Sustainable Assessment Tool Development Approach. Retrieved from https://www.mdpi.com/2071-1050/9/1/68/html

Awadh, O. (2017). Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis. *Journal of Building Engineering*, *11*, 25–29. https://doi.org/https://doi.org/10.1016/j.jobe.2017.03.010

Axelsson, R., Angelstam, P., Degerman, E., Teitelbaum, S., Andersson, K., Elbakidze, M., & Drotz, M. K. (2013). Social and cultural sustainability: Criteria, indicators, verifier variables for measurement and maps for visualization to support planning. *Ambio*, *42*(2), 215–228.

Balbo, R. (2013). A lesson in urban design from Dakhleh Oasis. In *Lessons from Vernacular Architecture* (pp. 55–66). Routledge.

Bennetts, H., Radford, A., & Williamson, T. (2003). *Understanding sustainable architecture*. Taylor & Francis.

Böhringer, C., & Jochem, P. E. P. (2007). Measuring the immeasurable — A survey of sustainability indices. *Ecological Economics*, *63*(1), 1–8. https://doi.org/https://doi.org/10.1016/j.ecolecon.2007.03.008

Bradecki, T., Swoboda, J., Nowak, K., & Dziechciarz, K. (2017). Models for Experimental High Density Housing. In *IOP Conference Series: Materials Science and Engineering* (Vol. 245, p. 52025). IOP Publishing.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

BRE. (2016). BREEAM International New Construction 2016. *SD233*, *1*(0).

Brown, R., & Maudlin, D. (2011). Concepts of vernacular architecture. *The Handbook of Architectural Theory, London, Sage Publications*, 340–355.

Brundtland, G. H. (1987). World commission on environment and development (1987): Our common future. *World Commission for Environment and Development*.

Cassell, C., Buehring, A., Symon, G., Johnson, P., & Bishop, V. (2005). Qualitative management research: a thematic analysis of interviews with stakeholders in the field. *Benchmarking Good Practices in Qualitative Management Research: Final Report*.

Chappells, H., & Shove, E. (2005). Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment. *Building Research & Information*, *33*(1), 32–40.

Chiesa, G., & Grosso, M. (2017). An environmental technological approach to architectural programming for school facilities. In *Mediterranean Green Buildings & Renewable Energy* (pp. 701–715). Springer.

Chiu, R. L. H. (2004). Socio-cultural sustainability of housing: a conceptual exploration. *Housing, Theory and Society*, *21*(2), 65–76.

Creswell, J. W. (2011). *Designing and conducting mixed methods research*. (V. L. Plano Clark, Ed.) (2nd ed.). Los Angeles, Calif. : Los Angeles, Calif. .

Cutaia, F. (2016). The Use of Landscape Indicators in Environmental Assessment. In *Strategic Environmental Assessment: Integrating Landscape and Urban Planning* (pp. 29–43). Springer.

Danja, I. I., Dalibi, S. G., & Safarov, A. (2017). Factors Shaping Vernacular Architecture of Northern Nigeria. *Journal of Buildings and Sustainability*, *1*(1).

Dave, S. (2011). Neighbourhood density and social sustainability in cities of developing countries. *Sustainable Development*, *19*(3), 189–205.

Dessein, J., Soini, K., Fairclough, G., Horlings, L., Battaglini, E., Birkeland, I., … Stylianou-Lambert, T. (2015). *Culture in, for and as sustainable development: Conclusions from the COST Action IS1007 Investigating Cultural Sustainability*. University of Jyväskylä.

Dhahri, S., & Omri, A. (2018). Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say? *World Development*, *106*, 64–77. https://doi.org/https://doi.org/10.1016/j.worlddev.2018.01.008

Ewing, R., & Handy, S. (2009). Measuring the Unmeasurable: Urban Design Qualities Related to Walkability. *Journal of Urban Design*, *14*(1), 65–84. https://doi.org/10.1080/13574800802451155

Eyüce, A. (2007). LEARNING FROM THE VERNACULAR: Sustainable Planning and Design. *Open House International*, *32*(4).

Ferrer, S., Ruiz, T., & Mars, L. (2015). A qualitative study on the role of the built environment for short walking trips. *Transportation Research Part F: Traffic Psychology and Behaviour*, *33*, 141–160.

Ferriss, L. (2010). Environmental and cultural sustainability In the built environment: an evaluation of LEED for historic preservation. Massachusetts Institute of Technology.

Foruzanmehr, A., & Vellinga, M. (2011). Vernacular architecture: Questions of comfort and practicability. *Building Research and Information*, *39*(3), 274–285. https://doi.org/10.1080/09613218.2011.562368

Friedman, A. (2012). *Fundamentals of sustainable dwellings*. Island Press.

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, *13*(1), 117. https://doi.org/10.1186/1471-2288-13-117

Guengerich, A. (2014). The architect's signature: The social production of a residential landscape at Monte Viudo, Chachapoyas, Peru. *Journal of Anthropological Archaeology*, *34*, 1–16. https://doi.org/10.1016/J.JAA.2013.12.005

Guzmán, P. C., Roders, A. R. P., & Colenbrander, B. J. F. (2017a). Measuring links between cultural heritage management and sustainable urban development: An overview of global monitoring tools. *Cities*, *60*, 192–201. https://doi.org/https://doi.org/10.1016/j.cities.2016.09.005

Guzmán, P. C., Roders, A. R. P., & Colenbrander, B. J. F. (2017b). Measuring links between cultural heritage management and sustainable urban development: An overview of global monitoring tools. *Cities*, *60*, 192–201. https://doi.org/https://doi.org/10.1016/j.cities.2016.09.005

Haapio, A., & Viitaniemi, P. (2008). A critical review of building environmental assessment tools. *Environmental Impact Assessment Review*, *28*(7), 469–482. https://doi.org/https://ac.els-cdn.com/S0195925508000048/1-s2.0-S0195925508000048-main.pdf?_tid=48f87d2c-3f69-43cb-

b57c-28e4db4ad8b3&acdnat=1548165966_038aeef4c68179c036eeb53423d4b92c

Halicioglu, F. H. (2012). ANALYSIS OF VERNACULAR ARCHITECTURE IN TERMS OF SUSTAINABLE CONSIDERATIONS: THE CASE OF {\c{S}}{\.I}R{\.I}NCE VILLAGE IN WESTERN TURKEY. *ALAM CIPTA, International Journal of Sustainable Tropical Design Research and Practice*, *5*(2), 39–54.

Hărmănescu, M., & Enache, C. (2016). Vernacular and Technology. InBetween. *Procedia Environmental Sciences*, *32*, 412–419. https://doi.org/10.1016/J.PROENV.2016.03.047

Jamshed, S. (2014). Qualitative research method-interviewing and observation. *Journal of Basic and Clinical Pharmacy*, *5*(4), 87.

(JSBC), (2011). CASBEE for Cities Technical Manual. Japan Sustainable Building Consortium Tokyo.

Jenkins, P., Smith, H., & Wang, Y. P. (2006). *Planning and housing in the rapidly urbanising world*. Routledge.

Kamalipour, H., & Zaroudi, M. (2014). Sociocultural Context and Vernacular Housing Morphology: A Case Study. *Current Urban Studies*, *2*(3), 220–232. Retrieved from http://file.scirp.org/Html/7-1150054_50101.htm

Keitsch, M. (2012). Sustainable architecture, design and housing. *Sustainable Development*, *20*(3), 141–145.

Kırbaş, B., & Hızlı, N. (2016). Learning from Vernacular Architecture: Ecological Solutions in Traditional Erzurum Houses. *Procedia - Social and Behavioral Sciences*, *216*, 788–799. https://doi.org/10.1016/j.sbspro.2015.12.076

Krueger, R., & Casey, M. A. (2000). Focus Groups: A Practical Guide for Applied Research 3rd edition Sage Publications London.

Larsson, N., & Macias, M. (2012). Overview of the SBTool assessment framework. *The International Initiative for a Sustainable Built Environment (IiSBE) and Manuel Macias, UPM Spain*.

Lozano, R. (2011). The state of sustainability reporting in universities. *International Journal of Sustainability in Higher Education*, *12*(1), 67–78. https://doi.org/10.1108/14676371111098311

Mahdavi, M., & Yarmand, M. (2013). Rural-urban housing influencing changes in the physical-spaces of urban environment: A case of Hamidia City. *Journal of Geography and Regional Planning*, *6*(5), 200.

Mahmoud, S., Zayed, T., & Fahmy, M. (2019). Development of sustainability assessment tool for existing buildings. *Sustainable Cities and Society*, *44*, 99–119. https://doi.org/https://doi.org/10.1016/j.scs.2018.09.024

Mansour, O. E., & Radford, S. K. (2014). Green Building Perception Matrix, A Theoretical Framework. In *Proceedings of the Annual Architectural Research Symposium in Finland* (pp. 40–52).

Memmott, P., & Keys, C. (2015). Redefining architecture to accommodate cultural difference: designing for cultural sustainability. *Architectural Science Review*, *58*(4), 278–289. https://doi.org/10.1080/00038628.2015.1032210

Michiani, M. V., & Asano, J. (2016). Influence of inhabitant background on the physical changes of Banjarese houses: A case study in Kuin Utara settlement, Banjarmasin, Indonesia. *Frontiers of Architectural Research*, *5*(4), 412–424. Retrieved from

https://www.sciencedirect.com/science/article/pii/S2095263516300504

Mizrak, B., & Erkenez, S. (2014). Sustainable living and building indicators in Old Ağırnas and their interpretations for new practice and research. *Eco-Architecture V: Harmonisation between Architecture and Nature*, *142*, 161.

Moffatt, S., & Kohler, N. (2008). Conceptualizing the built environment as a social–ecological system. *Building Research & Information*, *36*(3), 248–268.

Mori, K., & Christodoulou, A. (2012). Review of sustainability indices and indicators: Towards a new City Sustainability Index (CSI). *Environmental Impact Assessment Review*, *32*(1), 94–106. https://doi.org/https://doi.org/10.1016/j.eiar.2011.06.001

Motealleh, P., Zolfaghari, M., & Parsaee, M. (2016). Investigating climate responsive solutions in vernacular architecture of Bushehr city. *HBRC Journal*. https://doi.org/10.1016/j.hbrcj.2016.08.001

Ness, B., Urbel-Piirsalu, E., Anderberg, S., & Olsson, L. (2007). Categorising tools for sustainability assessment. *Ecological Economics*, *60*(3), 498–508. https://doi.org/https://doi.org/10.1016/j.ecolecon.2006.07.023

Olakitan Atanda, J. (2019). Developing a social sustainability assessment framework. *Sustainable Cities and Society*, *44*, 237–252. https://doi.org/https://doi.org/10.1016/j.scs.2018.09.023

Olesen, G. G. H., Knudstrup, M.-A., Heiselberg, P., & Hansen, E. K. (2011). Measuring sustainable homes: a Mixed Methods approach.

Oliver, P. (2007). *Built to meet needs: Cultural issues in vernacular architecture*. Routledge.

Ozorhon, G., & Ozorhon, I. F. (2014). Learning from Mardin and Cumalıkızık: Turkish Vernacular Architecture in the Context of Sustainability. In *Arts* (Vol. 3, pp. 175–189). Multidisciplinary Digital Publishing Institute.

Pissourios, I. A. (2013). An interdisciplinary study on indicators: A comparative review of quality-of-life, macroeconomic, environmental, welfare and sustainability indicators. *Ecological Indicators*, *34*, 420–427. https://doi.org/https://doi.org/10.1016/j.ecolind.2013.06.008

Plieninger, T., Dijks, S., Oteros-Rozas, E., & Bieling, C. (2013). Assessing, mapping andquantifying cultural ecosystem services at community level. *Land Use Policy*, *33*, 118–129.

Pocock, J., Steckler, C., & Hanzalova, B. (2016). Improving Socially Sustainable Design and Construction in Developing Countries. *Procedia Engineering*, *145*, 288–295. https://doi.org/10.1016/j.proeng.2016.04.076

Rapoport, A. (1969). House form and culture.

Rapoport, A. (2006). Vernacular design as a model system. *L. Asquith and M. Vellinga (Ed. s), Vernacular Architecture in the Twenty-First Century (Theory, Education andPractice), Taylor and Francis, London, UK*, 179–198.

Ritchie, J., & Spencer, L. (2002). Qualitative data analysis for applied policy research. *The Qualitative Researcher's Companion*, *573*(2002), 305–329.

Sandelowski, M. (2001). Real qualitative researchers do not count: the use of numbers in qualitative research. *Research in Nursing & Health*, *24*(3), 230–240.

Satterfield, T., Gregory, R., Klain, S., Roberts, M., & Chan, K. M. (2013). Culture, intangibles and metrics in environmental management. *Journal of Environmental Management*, *117*, 103–114.

Shirazi, M. R., & Keivani, R. (2017). Critical reflections on the theory and practice of social sustainability in the built environment–a meta-analysis. *Local Environment*, *22*(12), 1526–1545.

Srinivasan, R. S., Braham, W. W., Campbell, D. E., & Curcija, D. C. (2011). SUSTAINABILITY ASSESSMENT FRAMEWORKS, EVALUATION TOOLS AND METRICS FOR BUILDINGS AND ITS ENVIRONMENT–A REVIEW 2. In *Proceedings of Building Simulation: 12th Conference of Intl Building Performance Simulation Association, 2011, Sydney*. Retrieved from http://www.ibpsa.org/proceedings/BS2011/P_1218.pdf

Teng, J., Mu, X., Wang, W., Xu, C., & Liu, W. (2019). Strategies for sustainable development of green buildings. *Sustainable Cities and Society*, *44*, 215–226. https://doi.org/https://doi.org/10.1016/j.scs.2018.09.038

UN, D. (2015). World urbanization prospects: The 2014 revision. *United Nations Department of Economics and Social Affairs, Population Division: New York, NY, USA*.

UNIDO (United Nations Industrial Development Organisation). (2005). *The Three Dimensions: defining sustainable development*.

USGBC. (2014). LEED v4 user guide. US Green Building Council Washington, DC.

Vallega, A. (2007). The role of culture in island sustainable development. *Ocean & Coastal Management*, *50*(5), 279–300.

Verma, P., & Raghubanshi, A. S. (2018). Urban sustainability indicators: Challenges and opportunities. *Ecological Indicators*, *93*, 282–291. https://doi.org/https://doi.org/10.1016/j.ecolind.2018.05.007

WCED, U. N. (1987). Our Common Future—The Brundtland Report. *Report of the World Commission on Environment and Development*.

Weber, W. (2013). *Lessons from vernacular architecture*. Routledge.

Wu, S. R., Fan, P., & Chen, J. (2016). Incorporating culture into sustainable development: A cultural sustainability index framework for green buildings. *Sustainable Development*, *24*(1), 64–76.

Yin, R. K. (2009). Case study research: Design and Methods. SAGE publications. *Thousand Oaks*.

Zhai, Z. J., & Previtali, J. M. (2010). Ancient vernacular architecture: characteristics categorization and energy performance evaluation. *Energy and Buildings*, *42*(3), 357–365.

Jordan National Building Council (JNBC), Jordan Green Building Guide. (2013) (in Arabic)

"دليل المباني الخضراء الأردني" (2013), الجمعية العلمية الملكية, و وزارة الأشغال العامة و الإسكان, و مجلس البناء الوطني الأردني. عمّان- الأردن