INDUSTRY PERCEPTIONS OF SUSTAINABLE DESIGN AND CONSTRUCTION PRACTICES IN KUWAIT

Dalya ISMAEL[1] and Tripp SHEALY[2]

ABSTRACT

To better meet global sustainable development goals will require more focus on Arab countries like Kuwait, which contribute one and a half times more global greenhouse gas emissions per capita than the United States. Buildings contribute more than half of these emissions. Rating systems like LEED and BREEAM can help reduce energy emissions from buildings globally when used during construction, but these rating systems are not entirely applicable to Kuwait as they are not tailored for its geographic climate and social context, and there is currently no rating system tailored for energy efficient and environmentally sustainable buildings. The research presented in this paper measures the industry's perceptions about sustainable design and construction practices in Kuwait. A synthesized list of sustainable design and construction principles were developed from the six most common rating systems globally that are currently being used in the Arab region. Construction professionals (n = 131) from Kuwait were asked in a qualitative survey which sustainable design principles and construction practices are the most applicable but are not being implemented. The majority of professionals responded that sustainable practices related to water use reduction and renewable energy sources are most applicable but are not currently being implemented. They also responded that sustainable practices related to bicycle facilities, green roofs, and rainwater harvesting are not applicable but are currently being implemented. The lack of training and limited awareness of the benefits of sustainable design and construction may be contributing to the lack of sustainable practices. As a whole, professionals in Kuwait appear to undervalue sustainable design and construction practices that promote environmental sustainability. This study provides a benchmark, indicating a lack of shared viewpoints and illustrates the need for more common objectives and the need for training among design and construction professionals in the region.

KEYWORDS

sustainable construction, rating systems, perceptions, industry professionals, Kuwait.

1. Graduate Research Assistant, Department of Civil and Environmental Engineering, Virginia Tech, Blacksburg, VA 24060; email: dalya88@vt.edu

2. Assistant Professor, Department of Civil and Environmental Engineering, Virginia Tech, Blacksburg, VA 24060; email: tshealy@vt.edu

INTRODUCTION

Kuwait is a small, oil-rich country in the Middle East, between Iraq and Saudi Arabia, but has one of the world's largest oil reserves. In the last 20 years, Kuwait's population has grown by 137% (The World Bank, 2016), leading to an increase in demand for new buildings and infrastructure services. Kuwait is now a leader in the region for construction development (AlSanad et al., 2011). The number of construction permits rose 40% between 2007 and 2011 (Altoryman, 2014) and housing units increased by about 400% (Kuwait Central Statistical Bureau, 2018).

Unfortunately, Kuwait compared to other countries in the Middle East and North African region (referred to as MENA), is one of the least committed to sustainable design and construction with the lowest rate of buildings in the region certified by third-party sustainability rating systems (AlSanad, 2015).

The last 20 years of available data from The World Bank (2016) about Kuwait indicates high environmental impacts, high energy use, increased air pollution, and waste creation. There was a 145% increase in carbon dioxide emissions and a 16% increase in electric power consumption per capita over the last 20 years (The World Bank, 2016). These rising emissions could partly be because Kuwait relies on desalination to produce potable water, which further contributes to electricity use and carbon emissions (Darwish, Al-Awadhi, & Darwish, 2008). The annual landfill waste of Kuwait's construction industry has also doubled from 6,658,413 tons in 2009 to 12,103,364 tons in 2014 (Kuwait Central Statistical Bureau, 2018). These environmental impacts exceeded consumption per capita compared to countries like the United States.

Kuwait is not alone in contributing to high environmental impacts, in fact, many other countries in the MENA region have had an increase in energy consumption. Overall, the MENA region in the past 20 years has increased total carbon dioxide emissions due to energy use by around 114% and per capita by 44% (The World Bank, 2016). While this region currently only contributes nearly six percent of the world's carbon dioxide emissions, the trend suggests the region will continue to become a larger contributor of global emissions in the near future (World Energy Council, 2011).

While the global trend emphasizes sustainability (Xia, Zuo, Peng, & Yongjian, 2014), Kuwait and the MENA region lag behind. The United States Green Building Council (USGBC) has announced the top ten countries outside the United States that are contributing significantly to sustainable building design and construction globally. China is on top of the list, followed by Canada and India, and only one country from the MENA region, the United Arab Emirates, is listed in tenth place (USGBC, 2016). While the term sustainable design and construction can vary widely, in this context, the term means contribute buildings and infrastructures to improve the well-being of people and the planet for generations (Parkin, 2000). The term sustainable design and construction builds from the landmark Brundtland Report (1987) that defines sustainability as the ability to ensure the well-being of current and future generations within the limits of the natural world.

A possible obstacle to more sustainable design and construction in the MENA region and specifically Kuwait is the high energy subsidization by the government. Nearly 85% of electricity costs are subsidized (AlSanad, 2015). Another possibility is education and training related to sustainable design and construction in the local industry (Pitts & Lord, 2007). Additional possibilities include the lack of integration between projects, lack of life-cycle costing, and insufficient technical information for sustainable products (Sustainable Building Task Force, 2001).

Countries like Kuwait need guidance to deliver more economic, socially, and environmentally sustainable buildings.

Rating systems for sustainable design and construction are one approach to provide guidance (Doan et al., 2017). They are designed to assist decision makers by providing a framework with precise criteria for assessing varying aspects of buildings or infrastructure (Bernardi, Carlucci, Cornaro, & Bohne, 2017). A few of their many benefits include reduced maintenance costs, improved employee productivity, and reduced health and safety costs (Ries, Bilec, Gokhan, & Needy, 2006). At the moment, there are only two buildings in Kuwait certified by a third-party rating system Leadership in Energy and Environmental Design (LEED) and a few others in the certification process. Since there is no rating system tailored for Kuwait's context, rating systems like LEED that are currently being used might not be the most beneficial given the local geographic region and social context. For instance, energy and water-related credits constitute approximately 40% of the possible points on the LEED rating scale, but those aspects might not motivate industry professionals in Kuwait because energy and water are subsidized. Some credits are also not applicable to Kuwait due to its extremely hot weather, such as bicycle facilities and walking proximity to other services, while other credits related to cultural aspects and historical sites that are a high priority in the MENA region are missing.

Industry professionals in regions like North America and Europe already recognize that sustainable buildings are financially beneficial because they offer increased property value (Blumberg, 2012; Dermisi, 2009), a longer project life cycle, and can improve occupant productivity (World Green Building Council, 2013). At the same time, these buildings provide societal benefits, reduce strain on local infrastructure by conserving water, and create better air and water quality (World Green Building Council, 2013). The long-term objective is to encourage similar adoption of these practices among building professionals in Kuwait and the entire MENA region.

The purpose of this research is to better understand the perceptions about sustainable design and construction among industry professionals in Kuwait and shed light on barriers keeping Kuwait from adopting tools, rating systems, and processes that contribute to more global sustainable design and construction practices. The research begins with a review of sustainable construction practices and provides an overview of the construction industry in the MENA region and specifically Kuwait. Current existing global rating systems are then used to develop a list of sustainable design principles and construction practices. This list was used to measure perceptions of industry professionals in the Kuwaiti construction industry. The method for developing the survey instrument are outlined in the methods sections. The results provide insight into perceptions of sustainable design and construction practices in the Kuwaiti construction market. By understanding these perceptions, future research can then begin to test interventions to change individual behavior among building professionals and market value to more quickly adopt applicable sustainable design principles and construction practices in the region.

BACKGROUND

Global organizations offer sustainable design guidelines and recommendations for international use, but they often lack specificity. For example, the United Nations Earth Summit, where international leaders meet to discuss global environmental issues, recommends 12 main design guidelines in Agenda 21 for consideration in international sustainable design and construction. The International Council for Research Innovation in Building and Construction (CIB) that facilitates international cooperation between governmental research institutes in the building and construction sector highlight seven principles for sustainable construction that can help assess and evaluate sustainable building elements. However, those international principles are for all types of sustainable construction and may not apply to all countries and contexts.

Rating systems typically have the same limitation. They may provide more detailed directives for sustainable design and construction practices; however, they are not universal and are typically designed with one country or global region in mind. Examples of rating systems that do not offer flexibility for different regions are the Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Building Research Establishment Environmental Assessment Method (BREEAM), Green Star, and Leadership in Energy and Environmental Design (LEED) (AlWaer, Sibley, & Lewis, 2008). Consequently, the decision-making process of choosing sustainable design principles and construction practices to implement can be a risky choice. Adopting a rating system intended for another country's local historical, financial, cultural, technological, social or climatic context may be less beneficial for a country that was not the original intended user (Attia & Dabaieh, 2013; Pocock, Steckler, & Hanzalova, 2016). Some design principles and construction practices are likely not applicable or increasingly challenging to meet. Additionally, countries like Kuwait have a distinctive culture, that focuses on introducing architectural designs and landmarks that strongly reflect its culture, and this may not be the case across all countries.

In addition to the lack of flexibility of many rating systems, other characteristics and perceptions of rating systems include the lack of comprehensiveness, no relative importance of performance, the limited attention to functional variations in different types of buildings, and the structure of points given to credits (AlWaer et al., 2008). The structure of points or weight given to credits in a rating system may not represent the greatest need in the region. Kuwait, for example, has specific critical issues that warrant custom sustainable design principles and construction practices to account for extreme heat. Extreme heat increases the time spent indoors, leading to high electricity consumption for air conditioning and other appliances, which contributes to more greenhouse gas emissions. A rating system specific to Kuwait should prioritize credits by weighting points assigned to insulation, energy efficient air-cooling equipment, passive cooling techniques, and indoor air quality. Currently, this all depends on the professionals' level of understanding and awareness towards what is applicable and their willingness to pursue new design principles and construction practices for their building projects.

In Kuwait, the majority of industry professionals have a low level of awareness about sustainability (AlSanad et al., 2011), which has an impact on the long-term performance of buildings and occupants. For example, many projects use recycled materials but do not consider that some of them could potentially emit volatile organic compounds (VOC) during or after installation (Pacheco-Torgal, Jalali, & Fucic, 2012). Part of the problem is that those responsible for the design and construction of buildings believe that their clients are more interested in other goals, such as reducing initial costs (Laustsen, 2008), or they neglect developing project sustainability goals (Mukherjee & Muga, 2010).

Existing perceptions may also result in low sustainability progress. A common perception in the construction industry is that sustainable buildings cost more than conventional buildings (Darko & Chan, 2016; Geng, Dong, Xue, & Fu, 2012; Sherwin, 2006). Sustainable buildings can include additional expensive technologies and higher labor costs (Geng et al., 2012), but the perceptions of increased cost are not always true. Sustainable buildings can save money, not just throughout the project's lifecycle by reducing energy and water consumption, and lowering long-term maintenance costs, but also with upfront costs, especially if strategies for sustainability are integrated at an early stage of project planning (World Green Building Council, 2013).

To encourage organizations to implement sustainable design principles and construction practices requires an understanding of what practices are being adopted in construction projects (Pearce, Shenoy, Fiori, & Winters, 2010) and professionals' perceptions of sustainability. In Ghana, the top barriers are resistance to cultural change, lack of commitment from government, and lack of professional knowledge (Ametepey, Aigbavboa, & Ansah, 2015). These barriers are not that different from perceived barriers in the United Kingdom more than a decade ago (Sourani & Sohail, 2011). Today, however, in more developed countries like the United States and the United Kingdom, stakeholders report having sufficient knowledge about sustainable design principles and construction practices and are also encouraged by their organizations to engage in sustainability-related topics (Ahn & Pearce, 2007). Literature is limited about the construction practices implemented in the MENA region, specifically Kuwait. This has resulted in a lack of consideration for local material availability and a lack of safety regulations for construction (Kartam et al., 2000), which has led to significant cost and time overruns within the residential market (Koushki & Kartam, 2004). A lack of consideration for sustainability may also contribute to similar adverse outcomes.

The purpose of this research is to understand industry perceptions of sustainable design principles and construction practices in Kuwait. This research also helps develop an understanding about which principles of sustainable design and construction practices industry perceives as highly applicable and which principles and practices industry perceives as having been already implemented. The discussion and conclusion sections of this paper offer recommendations for greater adoption and more consideration for sustainable practices in the future. The research presented in the paper also adds to the growing body of literature about how global perceptions of sustainability influence local design and construction practices.

RESEARCH QUESTIONS

Five specific research questions contribute to help explain industry perceptions of sustainable design and construction practices in Kuwait:

1. What are the perceived barriers to more sustainable buildings in Kuwait?
2. What sustainable design principles and construction practices are perceived as *applicable* but are *not being implemented*?
3. What sustainable design principles and construction practices are perceived as *not applicable* but *are being implemented*?
4. What function of sustainable design and construction is perceived as the highest priority for the Kuwait building industry: to conserve or restore the environment, contribute to increased value for people, or provide financial benefit based on the perceived degree of applicability and degree of implementation?
5. Do significant differences exist in perceived value among professional groups (architects, site engineers, and project managers)?

The expectation is that the low rate of progress towards sustainability in the Kuwaiti construction industry is, in part, due to a perception among industry professionals that sustainable design and construction costs more and this limits the adoption of these principles practices. The expectation is that cost is perceived to be higher because sustainable design principles and construction practices that are not relevant or applicable to Kuwait may be implemented, thus adding unnecessary costs and leading to negative perceptions about sustainable design and construction. Conversely, some practices that are applicable to the region may not be perceived as being implemented. The expectation is to find that design principles and construction practices related to elements of finance and people to be of higher priority than those related to the environment. Yet, differences in priority likely exist between various professional groups, like architects, site engineers, and project managers. The expectation is to find differences in opinion and perceived value about sustainable design principles and construction practices among these groups of professionals.

METHODS

A survey instrument consisting of two sections was developed and validated to measure industry professionals' perceptions of sustainable design principles and construction practices. The purpose of the survey instrument was to measure perceived barriers to more sustainable buildings in Kuwait, understand the sustainable design and construction principles that are perceived as applicable and not applicable, and gauge which are believed to be implemented.

The first section of the survey included demographic questions, such as years of experience, job position, and type of organization. Another set of three questions asked respondents to describe their perceived level of awareness about the benefits of sustainable design and construction in Kuwait, the current percentage of projects in their organization that includes sustainable design and construction elements, and to identify top reasons for the contribution towards sustainable design and construction nationally. The possible reasons, obtained from literature, included: sustainable design and construction risks are more difficult to manage compared to conventional building design and construction projects (Robichaud & Anantatmula, 2011), high governmental energy and water subsidies discourage consideration for sustainable design and construction practices, professionals do not understand the negative impacts of conventional design and construction practices, there is little organizational support to develop the skills needed for sustainable design and construction practices, higher cost compared to conventional design and construction (Darko & Chan, 2016), and little awareness or knowledge of sustainable benefits (AlSanad, 2015). Whether experts or novices in sustainable design and construction, the purpose of the survey was to measure perceived industry barriers and develop an understanding of the perceived applicability of sustainable design and construction principles. Understanding their perceptions could potentially be the cause for the lack of sustainable development in the country.

Section two included a synthesized list of sustainable design principles and construction practices asking respondents to indicate using two Likert scales the degree of applicability and implementation (1 = very low degree of current applicability/implementation and 5 = very high degree of current applicability/implementation). A Likert scale was used because of its ability to distinguish the extent of perceived applicability and implementation. This ordinal scale offers more choice than a binary response and offers the ability to aggregate responses compared to open-ended questions that introduce interpretation bias. This list was developed by first developing a list of rating systems for sustainable construction globally (Table 1). Rating systems used in certifications for buildings in the MENA region were then chosen to compare elements of

TABLE 1. Rating systems used to guide the design of survey questions for industry professionals.

Number	Rating System	Categories	Certification Levels	Organization
1	Leadership in Energy and Environmental Design (LEED)	Location & Transportation, Sustainable Sites, Water Efficiency, Energy & Atmosphere, Material & Resources, Indoor Environmental Quality, Innovation, & Regional Priority	Certified Silver Gold Platinum	U.S. Green Building Council (USGBC)
2	Building Research Establishment Environmental Assessment Method (BREEAM)	Energy, Health & Wellbeing, Innovation, Land Use, Materials, Management, Pollution, Transport, Waste, & Water	Pass Good Very Good Excellent Outstanding	United Kingdom Building Research Establishment
3	The Pearl Building Rating System (PBRS)	Integrated Development Process, Natural Systems, Livable Buildings, Precious Water, Resourceful Energy, Stewarding Materials & Innovating Practice	1 Pearl 2 Pearl 3 Pearl 4 Pearl 5 Pearl	Department of Urban Planning and Municipalities
4	The Green Pyramid Rating System (GPRS)	Sustainable Sites Development, Water Saving, Energy Efficiency & Environment, Materials Selection & Construction System, Indoor Environmental Quality, Innovation & Design Process, & Recycling of Solid Waste.	Silver Pyramid Golden Pyramid Green Pyramid	Egyptian Green Building Council
5	The Global Sustainability Assessment System (GSAS)	Urban Connectivity, Site, Energy, Water, Materials, Indoor/Outdoor Environment, Cultural & Financial Value, & Management & Operations.	Level 0 Level 1 Level 2 Level 3	Gulf Organization for Research and Development (GORD)
6	The ARZ Building Rating System	Energy Performance, Thermal Energy, Electrical Energy, Building Envelope, Materials, Indoor Air Quality, Operations & Management, Water Conservation, & Bonus.	Certified Bronze Silver Gold	Lebanon Green Building Council (LGBC)

design and construction practices. For example, LEED has certified projects in Kuwait and the U.A.E., so it was included in the cross-sectional comparison. In total, six rating systems were used in the development of survey questions. Design principles and construction practices that appeared in any of the rating systems were included in the survey. Elements of sustainable design and construction that were redundant across two or more rating systems were combined into a single element. The appendix lists the synthesized design principles and construction practices used in the survey.

Before distributing the survey, the content was validated using a small group of industry professionals in Kuwait. Based on the professionals' feedback, some questions in section one were modified to improve clarity. Mainly, rewording questions and deleting redundancy. Related to the second section, another comment was to have the degree of applicability and degree of current implementation columns next to each other instead of below each other to reduce the time to complete the survey.

Survey distribution

The survey was distributed by email and in-person. Industry professionals were recruited from both the private and public sector of the Kuwaiti design or construction industry. All architecture design firms and construction companies in Kuwait were initially contacted to identify industry professionals working in the private sector willing to participate in the survey. Contacts for professionals were identified through emails to publicly listed email addresses on company websites and subsequent follow-up emails to administrative staff to develop a contact list. The criteria for participating was that industry professionals needed to be familiar with the current state of practice in Kuwait's design and construction market. Public sector professionals were identified through emailing publicly available email addresses associated with government departments that handle engineering and construction for the country. Using a similar process to identify private industry contact information, subsequent emails with administrative staff helped create a list of industry professionals with engineering and design background. In total, 195 industry professionals in Kuwait agreed to participate. Out of the 195 distributed surveys, 131 responded (67%).

Data analysis

To identify the sustainable practices perceived as applicable but lacking implementation and vice versa, the survey responses were clustered into two different groups. The first group was named as "high degree of applicability and low degree of implementation." These were the principles and practices where 50% or more of respondents agreed 'high' or 'very high' applicability and 'low' or 'very low' degree of implementation. The same was done for the second group which was named "low degree of applicability and high degree of implementation."

To answer what are the perceived barriers to more sustainable buildings in Kuwait, the top ten reasons by frequency of being chosen for the low rate of progress are listed in the results. Similarly, to answer what sustainable design principles and construction practices are perceived as *applicable* but are *not being implemented* and which are perceived as *not applicable* but *are being implemented*, the top ten design principles and construction practices by frequency of being chosen are listed. Individual elements were clustered by their primary function, to either conserve or restore the environment, contribute to increased value for downstream users, or provide financial benefit for professionals. These clusters of elements were used to answer what function of sustainable design and construction is perceived as the highest priority for the Kuwait building industry. A one-way ANOVA test with Tukey post-hoc pairwise comparison was used to measure a significant difference between these clusters of elements related to conserving or restoring the environment, contributing to increased value for downstream users, or providing financial benefits for professionals. A one-way ANOVA test with Tukey post-hoc pairwise comparison was used because this statistical approach allows for the testing of multiple variables and produces fewer type one errors compared to multiple two-sample t-tests. An alpha of 0.05 was used to indicate a minimum level of significant difference. To measure the significant difference in response among architects, site engineers, and project managers, a Fisher's Exact Test was used to compare perceptions of high degree of applicability, and a Pearson's Chi-Squared Test was used to compare high degree of current implementation. A Fisher's Exact test and a Pearson's Chi-Squared Test were used to ensure that there are nonrandom associations between the professional groups and that the observed differences between them were not by chance. A Fisher's Exact test was used when comparing perceived applicability because the data were categorical and unequally distributed between architects, site engineers, and project managers. A Pearson's Chi-Squared Test was used when comparing perceived implementation because the data were categorical and more equally distributed among respondents.

RESULTS

The number of survey respondents classified by professional groups is summarized in Table 2. Project managers and site engineers were nearly equal in number and comprise the majority of respondents. Almost half of the respondents (45%) indicated they have more than ten years of industry experience, 28% between 5–10 years, and 27% with less than five years. The types of organizations represented include 27% as the contractor, 25% as the client or client representative, and 18% as the design consultant. The remaining 30% was divided among subcontractors and suppliers. The typical project type was grouped as either residential, commercial/office, or industrial. Of the 131 respondents 17% work in the residential industry, 27% in the commercial industry, 29% in the industrial industry and 26% in all three.

In addition, the survey asked for their level of awareness about sustainability. Only 19% of the respondents stated that their knowledge about sustainable design and construction practices is "Good," 41% said "Moderate," and the remaining 40% chose "Poor" or "Very Poor." The majority (84%) were not accredited by any organization for sustainable design or construction practices.

Respondents were also asked about the status of sustainable design and construction building projects in their current company. Nearly half of the participants (47%) stated that their company hardly integrates sustainable design or construction practices in their projects (between 1%–19% of their company's current projects). Only 3% of professionals stated their

TABLE 2. Number of participants classified by job title.

Professional Group	Number of Responses (%)
Project Managers	49 (40)
Site Engineers	53 (43)
Architects	20 (16)

TABLE 3. Reported reasons for the low rate of progress towards sustainability in the Kuwaiti design and construction industry.

Reasons	Number of Responses (%)	
Little awareness or knowledge about the benefits of sustainable design and construction	68	(51.9)
Higher cost compared to conventional design and construction practices	56	(42.7)
Stakeholders do not understand the negative impacts of conventional design and construction practices	52	(39.7)
No organizational support to develop the skills needed for sustainable design and construction practices	33	(25.2)
There are high governmental energy and water subsidies	22	(16.8)
Sustainable design and construction risks are more difficult to manage	10	(7.6)

Note: More than one choice was allowed.

company incorporates sustainable design principles or construction practices 80 to 100% into their current design or construction projects.

What are the perceived barriers to more sustainable buildings in Kuwait?

Based on the perceptions of industry professionals, the low rate of progress towards sustainable design and construction in Kuwait is mainly due to lack of awareness or knowledge of benefits (51.9%), and the perceived higher cost compared to conventional buildings (42.7%). Table 3 lists the top ten reported reasons for the low rate of progress.

What sustainable design principles and construction practices are perceived as applicable but are not being implemented?

Table 4 includes the top 10 sustainable design principles and construction practices that are perceived by industry professionals as applicable to Kuwait but currently lack implementation. The sustainable design principles and construction practices with the highest levels of agreement between professionals are water use reduction, green building training and skills development, use of renewable energy sources, amenities that control emissions and pollutants, waste recycling, air quality management, and using recycled materials. These sustainable practices are agreed on by nearly three-quarters of the respondents.

What sustainable design principles and construction practices are perceived as not applicable but are being implemented?

Several sustainable design principles and construction practices that professionals perceived as not applicable to Kuwait but are currently being implemented are shown in Table 5. The

TABLE 4. Sustainable design principles and construction practices agreed among industry professionals that are applicable but are currently not being implemented in Kuwait.

Rank	Applicable design principles and construction practices not being implemented	Percentage Agreement
1	Water use reduction	88.7%
2	Sustainable building training and skills development	87.2%
3	Renewable energy sources (production)	87.0%
4	Amenities that control emissions and pollutants	83.9%
5	Employing waste recycling on site	81.5%
6	Construction air quality management	80.5%
7	Using recycled materials	76.4%
8	Ecological strategies	73.7%
9	Rapidly renewable materials	73.1%
10	Redevelopment of contaminated land	71.3%

Note: Results include the credits where there was 50% or more agreement between the professionals.

most predominate are bicycle facilities, green roofs, and rainwater harvesting with nearly 20% of respondents agreeing. Implementing sustainable practices and features that are not applicable to the country may discourage professionals since that may lead to unnecessary costs and no benefits.

TABLE 5. Sustainable design principles and construction practices agreed among industry professionals that are not applicable but are currently being implemented in Kuwait.

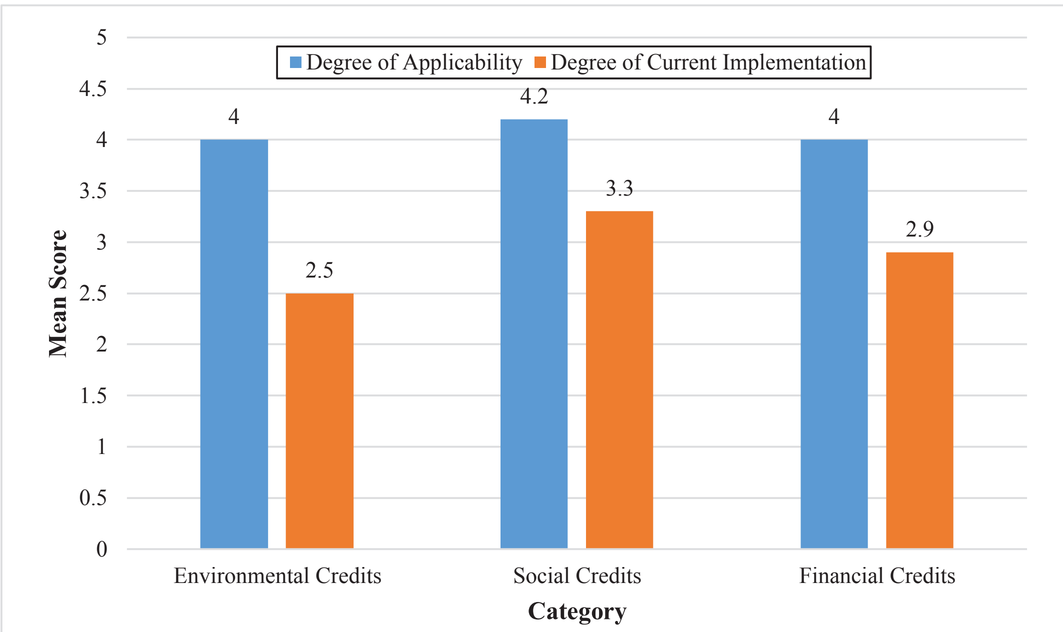
Rank	Not applicable sustainable design principles and construction practices being implemented	Percentage Agreement
1	Bicycle facilities	32.6%
2	Green roofs	20.8%
3	Rainwater harvesting	19.9%
4	Flood risk management	16.1%
5	Proximity to amenities	12.8%
6	Material fabricated on site	12.2%
7	Elevator power saving	9.9%
8	Protect or restore habitat	9.8%
9	Fossil fuel conservation	9.4%
10	Employing waste recycling workers on site	8.9%

What function of sustainable design and construction is perceived as the highest priority for the Kuwait building industry: to conserve or restore the environment, contribute to increased value for people, or provide financial benefit based on the perceived degree of applicability and degree of implementation?

To answer this question, sustainable design and construction practices were grouped into categories according to their intended function to conserve or restore the environment, contribute to increased value for people, either now or in the future, or provide financial benefit. Industry professionals believe principles and practices broadly contributing to increased value for people (i.e., social sustainability) are perceived as more applicable for Kuwait compared to principles and practices to conserve or enhance the environment (e.g., environmental sustainability). These professionals also believe that principles and practices broadly related to social sustainability are the most implemented.

The difference between the degree of applicability and degree of implementation in all the three categories is statistically significant as determined by one-way ANOVA ($p < 0.001$) Post-hoc pairwise comparisons indicate that sustainable practices broadly related to increased value for people are significantly higher than the other two means broadly related to conserving or restoring the environment ($p = 0.033$) and providing financial benefits ($p = 0.023$). There is no difference between practices related to environmental sustainability and financial sustainability in the degree of applicability, but all pairwise comparisons for the degree of current implementation were significant ($p < 0.001$ for each). The mean score for implementing principles and practices that increase value for people were significantly higher than conserving or restoring the environment and providing financial benefit.

FIGURE 1. Comparison of overall mean scores for sustainable design and construction practices categorized by their intended function to conserve or restore the environment, contribute to increased value for people, or provide financial benefit according to their degree of applicability and degree of implementation (scores ranges from 1 = 0% to 5 = 100%).



Do significant differences exist in perceived value among professional groups (architects, site engineers, and project managers)?

Sustainable design principles and construction practices that are significantly different ($p < 0.05$) in terms of perceived degree of applicability and perceived degree of implementation between professional groups are listed in Tables 6 and 7. Table 6 lists five design principles that varied in terms of perceived applicability between project managers, site engineers, and architects. Specifically, project managers and site engineers perceive all five sustainable practices as highly applicable whereas the majority of architects do not.

TABLE 6. Significant differences in degree of the perceived applicability between professional groups ($p < 0.05$).

	Perceptions of High Degree of Applicability			
	Project Manager *n* (%)	Site Engineer *n* (%)	Architect *n* (%)	*p*-value
Green roofs				**0.008**[a]
Low (<50%)	15 (31)	9 (18)	13 (68)	
Average (50%)	5 (10)	14 (28)	4 (21)	
High (>50%)	29 (59)	28 (55)	2 (11)	
Environmental tobacco smoke control				**0.005**[a]
Low (<50%)	1 (2.0)	1 (2)	10 (56)	
Average (50%)	2 (4)	14 (27)	5 (28)	
High (>50%)	46 (94)	37 (71)	3 (17)	
Water metering				**0.044**[a]
Low (<50%)	1 (2)	0 (0)	9 (45)	
Average (50%)	3 (6)	13 (25)	7 (35)	
High (>50%)	44 (92)	40 (76)	4 (20)	
Acoustic performance				**0.027**[a]
Low (<50%)	3 (6)	8 (15)	9 (50)	
Average (50%)	7 (14)	10 (19)	5 (28)	
High (>50%)	39 (80)	35 (66)	4 (22)	
Intelligent building control system				**0.006**[a]
Low (<50%)	2 (4)	1 (2)	11 (58)	
Average (50%)	0 (0)	10 (19)	3 (16)	
High (>50%)	46 (96)	42 (79)	5 (26)	

[a]*p*-values were generated by Fisher's Exact Test and percentages are rounded to the nearest integer.

TABLE 7. Significant differences in perceptions of the degree of perceived current implementation between professional groups ($p < 0.05$).

	Perceptions of High Degree of Current Implementation			
	Project Manager *n* (%)	Site Engineer *n* (%)	Architect *n* (%)	*p*-value
Containers for site material waste				**0.001**[b]
Low (<50%)	16 (33)	22 (42)	12 (60.0)	
Average (50%)	6 (12)	10 (19)	8 (40.0)	
High (>50%)	27 (55)	20 (39)	0 (0.0)	
Environmental tobacco smoke control				**0.022**[b]
Low (<50%)	13 (27)	29 (55)	10 (56)	
Average (50%)	13 (27)	11 (21)	5 (28)	
High (>50%)	23 (47)	13 (25)	3 (17)	
Health & safety & welfare regulations				**0.011**[b]
Low (<50%)	12 (25)	15 (28)	9 (47)	
Average (50%)	4 (8)	11 (21)	6 (32)	
High (>50%)	33 (67)	27 (51)	4 (21)	
Optimized use of natural light				**0.025**[b]
Low (<50%)	18 (37)	26 (49)	13 (68)	
Average (50%)	22 (45)	12 (23)	2 (11)	
High (>50%)	9 (18)	15 (28)	4 (21)	

[b]*P*-values were generated by Pearson Chi-square Test and percentages are rounded to the nearest integer.

Perceptions between professional groups also varied in terms of current implementation for four design principles and construction practices as shown in Table 7. Nearly 50% of project managers perceive that containers for site material waste, smoke control, and health, safety and welfare regulations have a high degree of current implementation, whereas architects perceive these practices have a low degree of implementation.

DISCUSSION

One of the barriers to adopting more sustainable design principles and construction practices in Kuwait is the perceived high initial cost by professionals. Based on a study of 61 barriers, the two highest mentioned barriers globally in 36 articles was also lack of education and awareness and the higher costs of constructing sustainably (Darko & Chan, 2016). The same appears to be true in Kuwait. Yet, perceptions about cost contradict several global studies that indicate buildings and infrastructure that include sustainable design principles and construction practices are less expensive than conventional buildings in the long run (Kats, 2003; Venkataraman & Cheng, 2018; World Green Building Council, 2013).

Kuwait is highly profit-focused and predominately relies on traditional design-bid-build delivery methods, which means that design and construction contracts for new buildings and infrastructure are usually offered to the organization with the lowest bid price (AlSanad, 2015). Since sustainable design and construction is perceived as having higher costs, this likely discourages organizations from adopting these principles and practices on their own. After the bidding process may be an opportunity for project managers to value engineer sustainable design and construction practices into projects. For example, the United States based Portland General Electric and the engineering firm Burns & McDonnell were able to still meet sustainable design and construction requirements listed in the Envision Rating Systems for Sustainable Infrastructure during the construction of a wind turbine facility even after the hard bidding process was complete (McWhirter & Shealy, 2018). In fact, Burns & McDonnell's value engineering reduced the overall cost of the project.

Among professionals in Kuwait, several sustainable design principles and construction practices were perceived as not applicable, yet some believed they were being implemented, in particular, green roofs and rainwater harvesting. Including design features like green roofs and rainwater harvesting in a country that receives only two to five inches of rain a year is likely to cause negative perceptions of sustainable design and construction because of the added cost without added benefit. Other design strategies like passive cooling or technologies like photovoltaic panels that generate energy would likely bring more value as high temperatures and sunshine persist year-round.

Professionals recognize the need for more education and awareness of sustainable design principles and construction practices. One approach to help professionals prioritize sustainable design principles and construction practices is through a sustainability rating system that is fitting for Kuwait's geographic location, priorities, and heritage. Based on respondents' perceptions of the most applicable design principles and construction practices, the rating system that includes the most design principles and construction practices is the Pearl Building Rating Systems (PBRS). Nine out of the top ten design principles and construction practices are included in PBRS. Sustainable design principles and construction practices that are intended to conserve or restore the environment compose 38.5% of the total possible points in PBRS. Providing more points to environmental credits may have a positive effect by nudging more consideration to conserve or restore the environment in this region. However, increasing the weight of environmental credits could deter adoption in the context of a lack of perceived applicability. Future research can begin to explore the effects of credit weighting among these decision tools (Shealy & Klotz, 2017).

Perceptions about sustainable design and construction practices appear to vary by profession in Kuwait. Design concepts like acoustic performance or intelligent building control system are possibly new and therefore come with inherent risk for construction professionals who have little prior experience which could be the reason for varied responses between architects and site engineers. Changes in project delivery methods, such as integrated project delivery (IPD), where professionals come together to share their body of knowledge may help in reducing perceived risk (Rahman & Kumaraswamy, 2005) and encourage systems thinking (Rubenstein-Montano et al., 2001). As a result, teams will be able to assess a wide range of impacts of sustainable design and construction practices across interconnected systems (Meadows, 2008) leading to better outcomes for the project (Ranaweera & Crawford, 2010). IPD has also shown that building connections between team members and enhancing team dynamics increases team flexibility (Lianying, Jing, & Shuguo, 2013).

Some rating systems like the Envision Rating System for Sustainable Infrastructure have incorporated a systems thinking approach in their tool (McWhirter & Shealy, 2018). Encouraging such thinking is especially important for developing countries that are new to sustainable design and construction because synergistic benefits may emerge among components or systems working together that are greater than either system or component by themselves (Sheffield et al., 2012). For example, integrated energy-efficient building design involves systems thinking and decision-making across several domains (Kanagaraj & Mahalingam, 2011).

Social behaviors and economic incentives in Kuwait may be leading to low environmental prioritization

Kuwait's governmental subsidies make energy extremely inexpensive for almost all market sectors. Consumers are charged a fixed amount of about 1 cent/kWh whereas the actual cost is around 10 cents/kWh to produce the energy (Darwish et al., 2008). Industry professionals in Kuwait likely overlook or discount the possible energy or water savings available through sustainable design and construction practices because of these subsidies. Lack of consideration when designing buildings and infrastructure creates locks in energy and water use for years to comes, even if these subsidies were to be reduced and energy and water become more expensive in the region (Moerenhout, 2018).

Such subsidies for energy are not given in other countries like the United States that have been pursuing sustainable design and construction for longer periods of time. The financial burden of energy use creates a viable return on investment and likely increases motivation for energy efficient design compared to countries like Kuwait. Besides adjusting subsidy rates, another approach to motivate industry adoption might be through modifications of points structures of national rating systems (Shealy et al., 2016). For instance, framing risk differently can have an effect on design consideration for sustainability (Ismael & Shealy, 2018b).

Changes downstream among users can also have an effect but also requires shifts in behavior, society (Hoffman & Henn, 2008), priorities, and lifestyle (Wilson & Dowlatabadi, 2007). For example, social behaviors in Kuwaiti culture work against sustainable development. One reason is the extremely hot climate, with temperatures reaching up to 130°F in mid-summer time which encourages people to seek comfort indoors, consuming more energy through air-conditioning and lighting. More focus in designing community open spaces on the north facing façade of buildings or tree-shaded parks using high solar reflective materials might encourage more time spent outdoors and reduce high dependence on electricity (Chen et al., 2016). If people understand how their everyday lifestyle choices can have negative impacts, they can begin to see their energy contribution as something they can manage rather than merely accept (Hoffman & Henn, 2008).

How industry perceptions in Kuwait compare to perceptions in the United States more than a decade ago

The U.S. building industry began implementing sustainable design principles and construction practices decades ago (Bourdeau, 1999). Initial industry barriers to adopting sustainable design principles and construction practices in the United States were similar to what Kuwait is experiencing today. Barriers such as the perceived upfront cost for sustainable design, lack of awareness about the benefits of sustainable construction, and an industry mentality for added external indicators of sustainability. Yet, at times, less appropriate sustainable design (e.g. solar panels without first investing in energy reduction measures) (Corbett & Muthulingam, 2007) contributed to slow adoption for nearly two decades (Y. Ahn, Pearce, Wang, & Wang, 2013; Jacomit, Silva, & Granja, 2009; Tollin, 2011). Today, however, there are more than 80,000 buildings certified by the United States Green Building Council's LEED rating system (Shutters & Tufts, 2016). LEED-certified buildings have a higher market value (Dermisi, 2009). Sustainable design and construction are included in request for proposals. Meeting LEED or Envision requirements adds very little to upfront costs for buildings or infrastructure, respectively (Dial, Smith, & Rosca, Jr., 2014; Mapp, Nobe, & Dunbar, 2011). Certification programs continue to evolve to become more stringent as the United States' market adopts more sustainable design principles and construction practices as industry standards.

Sustainable design in Kuwait is still in its infancy. A similar path for Kuwait compared to the United States means another decade or two before industry and market trends for sustainable design and construction reach status quo. Waiting another decade or two will further exacerbate local and global challenges for the environment and society. The barriers the United States faced are similar to those Kuwait is now experiencing today, which are predominately behavioral, not technical. In other words, engineers know how to design energy efficient buildings and infrastructure that improve air quality and enhance the local community but are not doing so at the pace or scale to have a long-term impact on environmental or societal challenges (N.A.E., 2018). Recent advances in behavioral decision science can help Kuwait more quickly overcome these barriers compared to the United States. The next subsection outlines one approach to merging engineering for sustainability and behavioral science. Adopting principles and concepts from behavioral science has led to advances in other fields like medicine (Johnson & Goldstein, 2003), insurance (Johnson, 1993), real estate (Genesove & Mayer, 2001), and financial investments (Thaler & Benartzi, 2004).

Choice architecture as an approach to nudge industry professionals towards more sustainable design

To help industry professionals make better decisions about design and construction practices, both researchers and practitioners can look to behavioral science (Shealy & Klotz, 2017). A better understanding of how decisions are made can inform the development of better tools and processes (Johnson et al., 2012). Choice architecture is one approach. It refers to the fact that there are always several ways to present choices to a decision-maker and this presentation influences how decision makers create preferences and ultimately make decisions (Anderson, 2010). Just as an attractive staircase in the atrium of an office building will increase the chances that workers will walk one or two levels up, rather than taking the elevator. A well-designed decision environment will increase the chances that decision-makers will not fall prey to poor decisions (Weber & Johnson, 2009).

Some examples of choice architecture applied to construction engineering and management decisions include the modification of rating systems (Ismael & Shealy, 2018a), embedding life cycle costs into decision options (Saad & Hegazy, 2015), and re-framing risk (Shealy, Ismael, Hartmann, & Buiten, 2017) and uncertainty (Buiten, Hartmann, & Meer, 2016) to appear more favorable. For instance, shifting the cognitive focus from the price of managerial intervention toward improved performance for a capital project between the Dutch Highway and Waterways Agency and a Dutch contractor removed status quo bias, which led to more realistic expectations and opportunities for the return on investment (Delgado & Shealy, 2017). Similarly, presenting uncertainty as an embedded attribute of each design option rather than a separate item mediates risky choice (Shealy et al., 2017).

Similar techniques to reframe design and construction decisions for more sustainable buildings can be applied to the Kuwait industry. The results suggest industry professionals in Kuwait prioritize design and construction principles about people more than the environment. Re-framing the intended outcome of design principles that benefit the environment to also highlight the long-term benefit to people may help increase awareness and motivation to include these elements and practices in design and construction. In other words, shifting the focus from one attribute, the environment, to another, about people, may influence how professionals allocate their cognitive attention and influence design and construction decisions.

Another approach is to frame elements of rating systems to include intended goals. Goal framing is when subjects are urged to engage in some activity by describing the advantages (or disadvantages) of participating in the activity (Levin, Gaeth, Schreiber, & Lauriola, 2002). Thus, goal framing the benefits of action or inaction about design and construction for sustainability should increase consideration among engineering and construction decision makers. Goal framing is a popular approach in the field of environmental psychology because it can encourage pro-environmental behavior and lead to improved management of environmental problems (Steg & Vlek, 2009). Another study reframed information about biofuels and found it was effective to persuade people to contribute to the prevention and reduction of energy use (Van de Velde et al., 2010). Another benefit of goal framing is the effect does not appear to dissipate over time in multi-attribute decision tools like rating systems (Kim, Kim, & Marshall, 2014).

CONCLUSION

More focus needs to be placed on the MENA region to achieve sustainable design and construction goals globally. Countries like Kuwait that depend on high resources of capital are increasingly contributing to global sustainability challenges. Little progress is being made towards adopting sustainable design and developing construction practices relative to the pace seen in North America and Europe. The research presented in this paper highlights the main reasons for the slow progress of sustainable design and construction in Kuwait. By understanding how professionals in Kuwait perceive sustainable design and construction, especially those who are not experts in the field, researchers and practitioners can now begin to develop methods for corrective courses of action.

The results of this work suggest that the majority of industry professionals in Kuwait believe that the low rate of progress towards sustainable design and construction is due to the lack of awareness about sustainable design and construction benefits and the high upfront costs that sustainable design and construction requires. Many sustainable design principles and construction practices are perceived as highly applicable but lack implementation. More tailored rating systems might help guide these decision makers to incorporate more applicable design principles and construction practices. Based on industry perceptions about what is most of value to the region, the Pearl Building Rating Systems (PBRS) appears to best align with their preferences. Further modifications to the point structure of these rating systems may help nudge even more design changes. For instance, changing the default points to a perfect score and practitioners using the rating system lose points, rather than gain points, can have a significant effect on design outcomes (Shealy & Klotz, 2015).

While results presented in this paper provide a roadmap for understanding the building industry's perceptions about sustainability in Kuwait, the next step is a better understanding of how decisions are made in actual projects. Modifications to the request for proposal process, an increase in education, or support from organizations can have a large effect on sustainable design and construction integration. If choice architecture is applied to rating systems for sustainability, reframing environmentally related credits to appear like they also provide social benefits could be a targeted approach to change behavior among industry professionals in Kuwait because of their higher perceived focus on sustainable design practices that benefit down-stream users. Bridging behavioral decision science theories to the application in rating systems for sustainability has already shown progress among other decision instruments for sustainability in the U.S. (Harris et al., 2016; Shealy et al., 2016). The application of these strategies and observation of their effects is underexplored in other regions of the world, with varying cultures, beliefs, and social norms.

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APPENDIX: Synthesized list of sustainable design principles and construction practices

List of Sustainable Design Principles and Concepts	Rating Systems					
	LEED	BREEAM	PBRS	GPRS	GSAS	ARZ
Conserve or restore the environment						
Containers for site materials waste		✓		✓		✓
Employing waste recycling workers on site		✓		✓		✓
Remediation of contaminated land			✓			
Bicycle facilities	✓	✓				
Proximity to amenities					✓	
Light pollution reduction	✓	✓			✓	
Shading of adjacent properties					✓	
Amenities that control emissions & pollutants		✓		✓	✓	
Environmental tobacco smoke control	✓		✓	✓		
Ecological strategies		✓				✓
Energy metering (monitoring & reporting)	✓		✓	✓	✓	✓
Renewable energy production	✓		✓	✓		
Water use reduction	✓		✓	✓	✓	
Water metering	✓					
Water leak detection			✓	✓	✓	
Passive distillation systems				✓		✓
Water pollution		✓		✓	✓	
Fossil fuel conservation					✓	✓
Use of rapidly renewable materials			✓	✓		
Use of recycled materials			✓	✓	✓	✓
Elimination of exposure to toxic materials			✓	✓		
Rain water harvesting			✓	✓		
Green roofs	✓					✓

APPENDIX: *(Cont.)*

List of Sustainable Design Principles and Concepts	Rating Systems					
	LEED	BREEAM	PBRS	GPRS	GSAS	ARZ
Increased value or quality for people						
Construction air quality management			✓			
Acoustic performance	✓	✓	✓	✓	✓	✓
Optimized use of natural light						✓
Healthy ventilation delivery			✓	✓	✓	✓
Safe & secure environment			✓			✓
Innovative cultural & regional practices			✓	✓		
Health, safety & welfare regulations				✓		
Protect or restore habitat	✓		✓	✓	✓	
Respect sites of historic interest				✓		
Training and skills development		✓				
Control of health risks				✓		✓
Provide financial benefit now or in the future						
Sourcing of raw materials	✓					
Providing a periodic maintenance schedule				✓		✓
Use of regionally procured materials			✓	✓	✓	✓
Design for disassembly			✓		✓	
Intelligent building control system					✓	✓
Identified and separated storage areas				✓		
Use of higher durability materials			✓	✓		
Flood risk management		✓				
Design for materials reduction			✓			
Elevator power saving						✓
Materials fabricated on site				✓	✓	✓