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Sabie, Khalid Kamil, Pitts, Adrian and Nicholls, Richard

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Sustainability Assessment Methods for the Gulf Region

Khalid Kamil Sabie

University of Huddersfield

Email address of corresponding author: a.pitts@hud.ac.uk

Adrian Pitts, PhD

University of Huddersfield

Richard Nicholls

University of Huddersfield

ABSTRACT

This paper describes the development of a sustainability assessment framework designed to be used in the Gulf Region, which is an area which has experienced large scale building development and also a region in which sustainability assessment is not yet widely used. The complexity and time resources needed to apply existing methods act as a deterrent to active use. Three well-known methods available at the time of the study were investigated in some detail. These were: BREEAM Gulf; Green Building Council LEED; and Estidama Pearl. Cross comparisons of the factors involved in each method were carried out on several levels including: theoretical comparison; practical development and usability; compliance with regulations and standards; and ability to achieve synchronization. A considerable degree of compatibility was found to exist between the methods, particularly if focused on key criteria. As a result a new and specific framework was developed which grouped 24 indicators under five principal headings: site/location, biodiversity and accessibility; energy; water; occupant well-being; and resources and wastes. This new framework was then evaluated by testing with practitioners resulting in confirmation of 20 out of the 24 indicators, and identification of suitable benchmarks.

INTRODUCTION

The Arabian Peninsula is located in a hyper-arid zone, apart from the oil and gas there are minimal natural resources (Galbraith 2008) and the volume of construction work in the region, and Dubai in particular, has been unprecedented. There are impacts on many levels: economic; regional investment; and more specifically on the real estate sector. Dubai in particular has developed some astounding architecture and demonstrates inspiring achievements in form, scale, and budget. However and consequently, the construction industry has laid a heavy burden on natural resources (Al Marashi, 2006).

The Gulf region countries as a group are popularly referred to as the 'The Gulf Cooperation Council' (GCC) countries, consisting of: Saudi Arabia, Bahrain, Kuwait, Qatar, the United Arab Emirates, and Oman, with a total population estimated as 46.8 million. At the regional level, the characteristics that are common to the six countries reflect their similar rapid economic expansion, but they also originate from the fact that power generation in the six countries is mainly oil and gas based.

The energy sector, has played a crucial role in the socio-economic development of the GCC countries and also plays a significant role in economic growth and in development of policies towards environmental and sustainability issues in the GCC (Al Zubaidi, 2007).

Meanwhile sustainable buildings construction is still very limited in the region compared to the total building market and as a consequence, their cumulative impact on the reduction of ecological footprint is currently almost negligible. Recognizing the poor ecological situation, a study by Lahn, Stevens and Preston (2012) estimated a 29% potential energy saving in the building sector by 2025 (the

Author A is a research student in the Department of Architecture and 3D Design, University of Huddersfield, UK; author B is Professor of Sustainable Architecture in the Department of Architecture and 3D Design, University of Huddersfield, UK; and author C is a Senior Lecturer in the Department of Architecture and 3D Design, University of Huddersfield, UK.

highest among all sectors potential savings) if effective efficiency measures were followed. There is a however reluctance to take up environmental assessment methods in the region; barriers encountered are varied in their type and magnitude. A general lack of understanding, and the level of complexity found in the methods are attitudes reflecting the main issues of concern. There is a need to develop more sophisticated targeted evaluation techniques and to limit the number of prescribed indicators to those of high sensitivity in a more effective basic environmental assessment for buildings in the Gulf region.

An analysis of a previous questionnaire distributed to 120 practitioners in the Gulf region, concluded that 78% had concerns about the difficulty in quantifying the benefits of green buildings and problems with the evaluation documentation process (Salama and Hana, 2010). It was also concluded that the construction industry in the UAE was witnessing a growing awareness of sustainability but the inconsistency of the responses reflected a blurred awareness of the key concepts of green building.

The Emirates Green Building Council (GBC) encourages the use of any recognized green building rating method as a means to creating a more sustainable built environment. There are several methods in the global market place as well as several methods commonly used in the United Arab Emirates (UAE). In the sections below a description of the commonly used methods is given together with a critique followed by the explanation of how an alternative assessment framework was developed, which was devised to be more straightforward to use and addressed the main needs expressed by professionals.

It is important to pursue development and integration of sustainability assessment at this period in history and some argue for intervention from governments to legislate for sustainable buildings and to create design and construction strategies to minimize the environmental impact of new building construction activity. In Kuwait, a survey indicated that 88% of respondents agreed that rules and legislation from government are required to enforce the concept of green buildings (Al Sanad, Gale, and Edwards, 2011). Another survey, concerned with evaluation of new residential building codes in the UAE, showed that using such codes could reduce the CO₂ emissions of buildings by 50% (Radhi, 2010).

EXISTING ASSESSMENT METHODS

Assessment tools for environmental analysis of buildings and their surroundings come in many shapes and forms. Some address single issues such as energy use/carbon dioxide production or indoor air quality, whilst others incorporate a wide range of issues under an umbrella tool. The criticism that can be leveled at the latter when it results in a single figure outcome or single rating is that the overall rating compares dissimilar things. This criticism can be partly dealt with by using weighting systems between sub-categories that are agreed across issue boundaries and which can be periodically adjusted. Nevertheless it is the case that most countries have opted to use an overall assessment system as the notion of a single descriptor/evaluation has more public appeal. Over the years a large number of assessment systems have been developed in different countries. Some are prescriptive requiring answers to a large but defined set of questions; some are more flexible. The categorisation can also arise from whether the method is aimed at design features and operation (LEED, BREEAM) or whether dealing with life cycle assessment in great detail such as the German Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), the Dutch EcoQuantum, or North American ATHENA. Methods also exist that are wider in scope and more dynamic, such as SBTool (developed by the IISBE organisation from the earlier GBTool). SBTool uses a toolkit approach from which users select relevant issues to suit their building type and location. The Living Building Challenge (LBC) which comprises seven performance categories: place, water, energy, health & happiness, materials, equity, and beauty, takes the approach to a different level by focusing on 'imperatives' which can be applied to a wide range of projects and which are updated in response to the market and current state of knowledge.

In this study a wide range of options were considered from which it was decided to focus on three examples of the design-led assessment, two of which have been widely used around the world and have established a place in the market. To these was added a more recently developed local GCC tool. A wide range of assessment methods and tools were examined for use in the study and three well-known options which could be applied were identified.

The reasons for choosing the three methods with their indicators for evaluation were: they are the most common methods in the Gulf region and are recommended by the UAE GBC; they had the ability to offer comparisons and benchmarking; they evaluated whole buildings and not only building parts; they provided a label and third party certification; there was a credible responsible organization behind

the label; and they could be applied in different countries or were designed for cross-border application.

BREEAM Gulf 2008

BREEAM (the Building Research Establishment Environmental Assessment Method) was the first assessment system, launched in 1990, to offer an environmental label for buildings. BREEAM Systems are voluntary, consensus-based, and market-driven. Different schemes of BREEAM exist around the world and have been adapted to suit the regions in which they are to be used and to reflect differences in standard practice or cultures (Saunders, 2008). For international projects seeking evaluation under the BREEAM scheme, they should initially use BREEAM Bespoke International. This also allows an opportunity for the client to appoint a local consultant/expert to research the local codes and standards for the particular country/region. The Building Research Establishment uses this information to devise a set of final criteria to be used by the assessor to carry out the assessment on that particular building.

BREEAM Gulf was developed in collaboration with a variety of large organizations based in Qatar, Abu Dhabi and Dubai, with its objective to assist the construction industry in the region to achieve higher levels of sustainability and to recognize local context and issues (BREEAM, 2008).

LEED v.3 2009

LEED (Leadership in Energy and Environmental Design) is owned and administered by the US Green Building Council (USGBC). The method is flexible and can be applied to all building types: commercial, residential and entire neighborhood communities; and works throughout the building lifecycle: design and construction, operations and maintenance. LEED was identified by the Dubai authorities as a 'tool' to implement the region's sustainability ambitions in a systematic manner, with the aim of an end-product that could be officially certified and therefore, internationally recognized. The Green Building Certification Institute (GBCI) was established in 2008 as a separately incorporated entity with the support of the U.S. Green Building Council for project registration and certification. LEED addresses several different project scopes for different building types; the latest version is version 4 which was released in late 2013; the version used in this analysis however was version 3 from 2009.

Pearl 2010

The Pearl Rating System was a key initiative of the Abu Dhabi Urban Planning Council (UPC) under the title Estidama (which means 'sustainability' in Arabic) and is a comprehensive rating system. Pearl was released early in April 2010 to provide a sustainability assessment program that aimed to be robust and tailored to the United Arab Emirates in terms of culture and climate. The system covers four pillars of sustainability: environmental, economic, cultural and social. The Pearl system aimed to address the sustainability of a given development throughout its lifecycle from design through construction to operation. The system provides design guidance and detailed requirements for rating a project's potential performance (Estidama, 2010). It is however, like the others, a complex assessment to implement.

RESEARCH PROCESS

The aim of this research has been to develop a suitable sustainability assessment framework for office building relevant to the local context and priorities of the Gulf region. The research used 'Mixed Methods Sequential Exploratory Design' as a research methodology. The purpose of this exploratory sequential design was to develop and test a simple but reliable assessment framework and to generate design parameters. The first stage of the study was a qualitative exploration of theories regarding local context constraints and assessment method practices in the Gulf region. The second, quantitative stage followed-up on the findings from the qualitative stage for the purpose of examining the findings from multiple perspectives. Alternative sources and methods were used to compare, validate, and triangulate results and to examine processes/experiences along with outcomes. Comparative analysis data, case study and self-administered questionnaire were the main elements of the quantitative research.

The main task in the research was to choose and formulate the most appropriate 'indicator set',

which considered the building's performance in relation to the local environment, culture and economy, as well as business goals. Furthermore, it was the intention to limit the number of indicators in the proposed framework to encourage take-up. Fernández-Sánchez and Rodríguez-López (2010) proposed a methodology used here, based on the identification of sustainability indicators by considering sustainability as opportunities for the project and on the establishment of indicators for measuring and controlling these opportunities. A framework would be essential for linking the vision and goals to the evaluation methodology and the indicators that are to be selected. The initial step was to choose the most appropriate criteria for the indicator set. Alwaer and Clements-Croome (2010) suggested four hierarchical categories of indicators to facilitate the selection process: *Pre-requisite* (Mandatory) indicators which are compliant with standards, regulations and quantified minimum targets; *Desired* indicators: ideal targets for building performance beyond the minimum required by regulations and codes of practice, to include the users vision; *Inspiring indicators*: goals and visions set by client: referring to long term mission and values; *Non-active indicators* or *non-applicable indicators* (the scope of this research project does not require these, and are thus ignored in the analysis). They should also be:

- Representative: Assist in informing choice in design decisions.
- Reasonably simple: Be usable by anyone, including professional designers and lay users with a simple and clear interface.
- Sensitive to change: Be flexible, multipurpose and generic in nature, and useable on many different types of buildings. Therefore enduring and persisting.
- Time resilient: Reflect specific aspects that could have impacts on sustainable buildings for current and future developments.
- Quantitative: Be quantifiable and scientifically valid (quantitative aspects or qualitative converted to quantitative).
- Accurate: Accurately/objectively measure progress towards sustainable development goals.
- Cost-Effective: Be cost effective but give value.
- Accessible: Data accessibility should be made easy and not constrain the process.

A methodology of five design sequential stages was employed: Stage 1 - Critical selection of aspects and indicators; Stage 2 - Structuring of the framework and refinement of selected indicators through comparative review of three existing sustainability assessment methods; Stage 3 - Structuring of the framework and refinement of selected indicators through a case study building study and comparative analysis; Stage 4 - Validation of the framework and indicators through questionnaire survey to local sustainable buildings industry professional; Stage 5 - Results analysis.

Arising from the evaluation, it was clear that all three methods required a high level of professionalism in sustainable design knowledge to be effectively used. The time and cost associated with this specialized knowledge is an important consideration. Moreover, the time required for documentation production is long and even though online submission is possible, the response time from the organisations is relatively lengthy. Typically four to six months is required for complete processing the applications; local experts' opinions suggest that it is usually longer, which also hinders acceptance in the marketplace. Also found as a result of the questionnaire was that the culture of the building industry relied on quick decisions. Credits within the assessment schemes that required substantial effort to be documented and which used external expertise, resulted in extra cost and time for the applicant, and this was one of the major criticisms. The survey also revealed that cost of assessment and documentation was a difficulty as was lack of awareness of the benefits. It was also found that expanding the range of issues in the methods, would also act as a disincentive to use.

The analysis showed that there was a good degree of commonality in approach of the three methods. The compatibility ratio among all the credits of the methods is high when related to the full data set: 65.2% for BREEAM Gulf and 77.27% for LEED. And in spite of the expanded structure of Pearl in covering more phases of the life cycle, cultural themes of sustainability, natural systems and compliance with the Abu Dhabi plan 2030; the method showed 55.86% compatibility. This gives confidence in being able to define a reduced set of key indicators in a new framework.

DETAILED DEVELOPMENT OF FRAMEWORK

Thirty LEED certified projects in UAE, representing 90% of all LEED certified projects in the Gulf region up to August 2012, were analysed and evaluated and compared to BREEAM and Pearl at the same time. The projects were mostly offices, offices combined with industrial premises, and hotels; ratings achieved fell into the following categories: platinum 10%; gold 46.6%; silver 36.7%; and certified 6.7%. This thirty-project analysis provided a basis for understanding which indicators would be of most value from the wide range to be found if every credit from all three systems were combined.

In order to limit the number of indicators in the proposed new framework to the most relevant and significant, a prioritization process was required. Areas of assessment that were common to all evaluation processes were immediately designated for inclusion in the proposed framework. For the remainder, an analysis was made to determine what priorities would be selected if considered relevant to the following: the most severe local problems; local governmental and stakeholder objectives; mandatory rules and regulations of authorities; Gulf region environmental practices; and regional priorities and synergistic strategies. The sections below indicate in more detail the activities carried out.

Theoretical comparison: To characterize the essence of the three methods, the evaluative framework for environmental management approaches developed by Baumann and Cowell (1999) was adopted to structure the frameworks of the three methods. The purpose of using a framework is to give a better understanding of the context structure with recognized terminology and methodology.

Review of criteria addressed by area-context priorities: To allow review information for each of the three applicable assessment methods, by using the local context priorities drivers for sustainable design, seven criteria were identified: applicability, development, usability, system maturity, technical content, measurability & verification and communicability (Fowler and Rauch, 2006).

Comparison of methods standards and regulations: This aspect investigated and compared each of the three methods to show the level of compliance with standards and regulations on international, regional and local levels.

Comparison of methods impact categories/indicators: To examine the degree of synchronization and the potential for harmonization; since the same elements sometimes appear in different categories in the three methods a direct credit points allocation comparison can be difficult if not impossible (Smith et al, 2006). Accordingly, to allow for more objective comparison and to minimize internal systematic biases associated with the benchmarking of a comparative study, a system of harmonization was employed in which some aspects were reclassified. Figure 1 illustrates the outcomes following the harmonization process by comparing the allocation of weighting from the three methods across ten categories into which the indicators were allocated.

Information and findings from the theoretical and synchronized comparison revealed that the three methods were important in stimulating the market for sustainable building in the Gulf region and that the existence of more than one method could create competitive practices that might enhance the industry. None of methods were fully compatible with regional requirements, particularly in addressing criteria of some environmental issues, or in providing practical applicability to deal with regional contextual issues.

The detailed comparisons were then informed by analysis of their application to a case study building: one for which detailed design information was available and which had already achieved a high classification in LEED. The total number of sustainability certified new buildings up to July 2012 was thirty; two of them having LEED platinum certifications; the case study building was chosen to be one of these: the ESAB Middle East FZE office building. Space does not permit a detailed description of the case study analysis; however it enabled the choice of indicators to be substantiated.

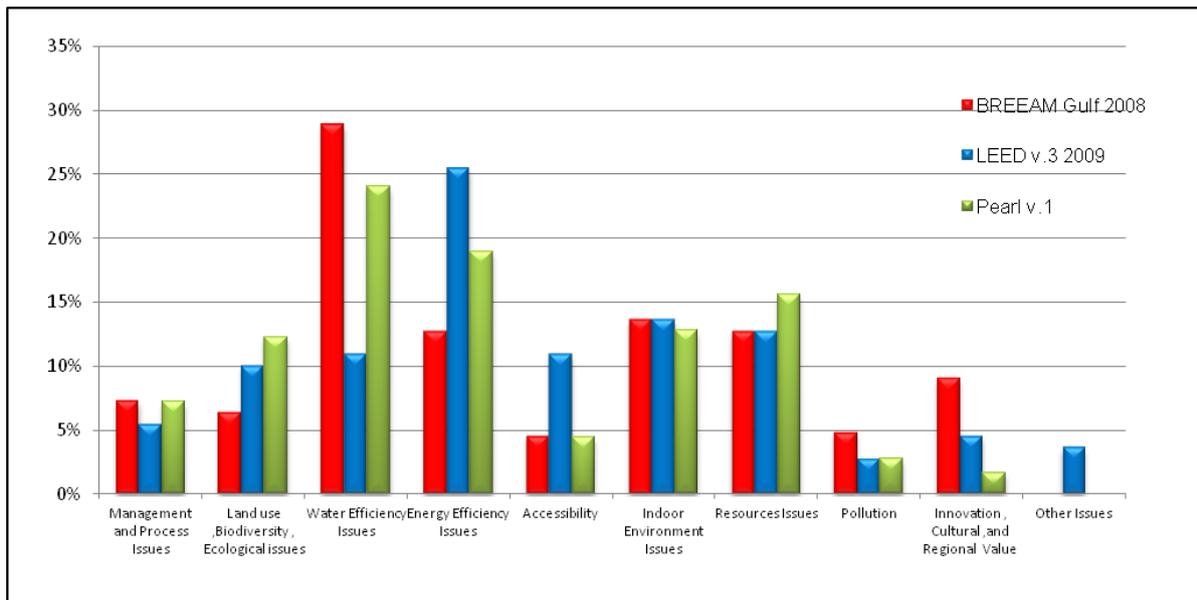


Figure 1 Comparisons of the synchronised and harmonized credit weightings for BREEAM, LEED and Pearl according to credit category.

GULF-REGION OFFICE-BUILDING SUSTAINABILITY ASSESSMENT FRAMEWORK

Arising from the various analyses, 24 indicators were initially chosen grouped under 5 main categories: Site Location Biodiversity & Accessibility; Energy; Water; Occupant Well-being; and Resources and Waste. The allocation of indicators was as follows:

Site location, biodiversity and accessibility (7 indicators): Site ecology; Construction pollution; Public Transport accessibility; Travel planning; Cycle facilities; Electric cars and car-pooling facilities; and Heat island effects on roof and other surfaces

Energy (5 indicators): Primary energy consumption for building operation; Commissioning; Energy monitoring; Ozone depletion/enhanced refrigerant management; and On-site power generation

Water (4 indicators): Interior water consumption; Exterior water consumption; Waste water technologies; Water consumption monitoring

Occupant Well-being (4 indicators): Indoor air quality; Thermal comfort; Smoking; and Emissions from materials.

Resources and Waste (4 indicators): Waste storage/recycling; Recycled construction materials; Locally sourced materials; and Construction site waste management.

SURVEY OF BUILDING PROFESSIONALS AND SELECTION OF INDICATORS

In order to validate the approach being used a survey of building professionals' attitudes was carried out using a questionnaire based on the assessment framework. In total 91 responses were received and 87 of those were deemed to be valid and answered all questions. Responses to key questions are shown in Table 1. The survey also asked participants to rank the importance of the proposed indicators on a scale of 1 to 4. It was also found 87% of industry professionals agreed that the proposed framework would be effective in enhancing performance of office buildings in the Gulf region.

One of the most important aspects of the survey was to confirm or exclude indicators and to check for availability of appropriate benchmarks or indicator-specific analytical tools in order that the value of the indicator could be calculated. A cut-off value of 3.0 was chosen as signifying the professionals' acceptance of the indicator. Table 2 shows the summary results and that four indicators were excluded. The determination of the availability of benchmarking/analysis tools was made easier by the previous comprehensive assessment of available methods for the Gulf Region. In two cases specific additional information to that normally used would be needed to enable the calculation, and in two further cases it was determined that a slightly modified version of the benchmark analysis would be required.

Table 1. Responses from Building Professionals to key questions about sustainability

Response to question	Sustainable Development is a very important concept and principle for the Gulf region countries	Sustainability assessment is an important issue for office building development in the Gulf region	Current design approaches adopted within the building industry in Gulf region countries are creating sustainability problems
Strongly agree	59 (67.9%)	50 (57.5%)	49 (56.4%)
Agree	25 (28.7%)	34 (39.1%)	32 (36.8%)
Disagree	1 (1.1%)	3 (3.4%)	4 (4.6%)
Strongly disagree	2 (2.3%)	0 (0%)	1 (1.1%)
No response	0 (0%)	0 (0%)	1 (1.1%)

Table 2. Gulf-region Office-building Sustainability Assessment Framework: confirmation of indicators to be used from survey and benchmarks
 (*= further information needed for benchmark use; **=modified benchmark)

Indicator	Rank weighting (out of 4)	Confirmed as included	Benchmark availability
Site ecology	3.91	Confirmed	Confirmed*
Construction pollution	3.67	Confirmed	Confirmed
Public transport access	3.55	Confirmed	Confirmed
Travel planning	3.40	Confirmed	Confirmed
Cycle facilities	2.93	Not confirmed	Excluded
Electric cars	2.84	Not confirmed	Excluded
Heat island effects	2.84	Not confirmed	Excluded
Minimise primary energy	3.83	Confirmed	Confirmed**
Commissioning	3.77	Confirmed	Confirmed
Energy monitoring	3.55	Confirmed	Confirmed
Ozone depl/refrigerants	3.54	Confirmed	Confirmed
On-site power generation	3.37	Confirmed	Confirmed**
Interior water use	3.94	Confirmed	Confirmed
Exterior water use	3.74	Confirmed	Confirmed
Waste water technologies	3.45	Confirmed	Confirmed
Water use monitoring	3.36	Confirmed	Confirmed
Indoor air quality	3.78	Confirmed	Confirmed
Thermal comfort	3.76	Confirmed	Confirmed
Smoking	3.71	Confirmed	Confirmed*
Emissions from materials	3.58	Confirmed	Confirmed
Waste storage/recycling	3.70	Confirmed	Confirmed
Recycled const. materials	3.43	Confirmed	Confirmed
Locally sourced materials	3.46	Confirmed	Confirmed
Const. site management	2.92	Not confirmed	Excluded

A further question concerned the respondents' perceptions regarding impact categories that affect sustainable design of office buildings. Energy and water at 97.7% and 93.4% respectively were the most frequently cited issues. Other categories scored as follows: occupant well-being 73.6%; site location and biodiversity 70.1%; resources and wastes 56.3%; and operation and maintenance 49.4%.

The impact of the survey results was to confirm the approach and scope of the new assessment method described in this paper and to encourage further research and development.

CONCLUSIONS

This paper has presented the key features of a research project designed to generate a new and more easily applied sustainability assessment framework suited to the circumstances of the Gulf Region. The Framework is well-founded being derived from a detailed analysis of available international methods but

enhanced by focusing on the key parameters that can be applied efficiently in the Gulf Region. Further analysis and evaluation is required to determine the most effective means to bring the system to the market-place and to assess any potential limitations of the Framework in practice. The data gathered from the professionals and from the study of the previously assessed thirty projects will permit the next stage – that of allocating a more sophisticated and justified weighting to each indicator, to be carried out.

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