LEGIBILITY OF NEIGHBOURHOOD PARK AND ITS IMPACT ON SOCIAL INTERACTION

Amine Moulay*, Norsidah Ujang, Mustafa Kamal M.S.

Faculty of Design and Architecture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding Author: Tel: +0601123728300, Email: archiamine@gmail.com

Abstract

Neighborhood parks have played a significant role to strengthen social interaction among urban residents. Today, parks continue to be built to fulfill the need for social interaction. However parks are not fully utilized to the users’ benefits. Nonetheless, studies have indicated that social interactions in public spaces within cities are not at a satisfactory level. There is a need to understand the design and functions of urban parks especially in their roles as a social integrator. In the urban design context, Legibility defined as the apparent clarity of the cityscape is an essential attribute in making places socially responsive. This paper examines park’s Legibility and its impact on social interaction within a neighborhood. The characteristics and elements associated with park Legibility were identified and correlated with their functions to support social interaction. The results discussed in this paper are based on a pilot questionnaire survey and a mental mapping exercise. The study was carried out among randomly selected residents in Precinct 8 and Precinct 9 in Putrajaya, Malaysia. These were clustered according to their socio-economic characteristics. Results indicated that there is a strong relationship between Legibility of the neighborhood parks and the social interaction among the park users. A clear structure of the setting, a good park accessibility, and less sight obstacles found within the parks influence residents outdoors activities which promote social interaction. Mental mapping results confirmed these findings. Furthermore, this study found that the intensity of social interaction within the neighborhood parks is as a result of the combination between the legibility attributes and certain critical density within the residential areas. The findings contribute in the development of park’s design to enhance social interactions in new residential areas. This will strengthen the social bonding among residents for the development of sustainable city and community.

Keywords: legibility, social interaction, neighbourhood parks.

1. Introduction:

Public open spaces are designed to fulfil human needs (Al-Bishawi and Ghadban., 2011), and social interaction is one of the most important one (Hatfield et al., 1994). Hence, neighbourhood parks as a crucial public open spaces for social activities, afford opportunities for contact which include proximity, and convenient access for public facilities, particularly in new residential areas (Azmi & Karim., 2012). The parks with green open spaces allow residents to sit, relax and meet each other (Peters et al., 2010). These will positively affect the residents’ quality of life by encouraging physical activities, social interaction and providing escape areas and enjoyment of nature (Brown et al., 2013).

On the other hand, despite all the efforts to promote parks in cities during the end of the last century, the increasing urban growth was accompanied with the weakness of the social cohesion in residential areas (Greenbaum., 1985). Various studies identified the lack of social interaction in a form of shared experiences between residents (Hari & Kujala., 2009). This situation was observed in many new residential
areas in various regions. One such case affected the neighbourhood parks in the city of Putrajaya, Malaysia which are the focus areas of this study. For urban designers, it is obvious that the physical environment is one of the main factors that influence residents’ outdoor activities. Thus, it naturally promotes the use of public spaces and increase social interaction (Gehl., 2009). Social interaction is influenced by the configuration of spaces that leads to numerous opportunities for social contact in public places (Lelevrier., 2013). Findings from previous studies raise a legitimate question: despite the presence of all the physical elements for social interaction and wellbeing in public parks, why there is still a lack of social interactions among the park users?

To deal with this issue, it is important to understand the core of urban design concern which is about making better places for people (Carmona., 2009). The concept of place deals with the relationships between human and land. It is constructed by the physical form, activity and meaning (Tuan., 1977). To comprehend what stimulate people to interact with their environment, it is central to primarily examine the concept of “sense of place”. Sense of place is the principal concept relating to place that describes the liaison between human beings and spatial settings (Jorgensen & Stedman, 2001). One of the important construct that define sense of place is “place identity” which refers to the bond between the personal identity and the physical environment (Proshansky., 1983). This bonding, goes through a mental construction process of the information received from the landscape, which is transformed in a cognitive image (Yeung., 1996). The clarity of this image is due to certain order and coherence of the physical environment structure. Therefore, it is fundamental to examine the influence of the clarity and legibility of parks on the residents’ personal bonding, physical activities and social interaction. However, in addition to the physical dimension, the personal bonding is also influenced by the psychological and social dimensions of a place.

This study examines the physical aspect of urban environment, focusing on “Legibility” of neighbourhood parks. Legibility is the characteristic of being clear enough to be understood (Lynch., 1960). Legible landscape means having easily recognized elements within a setting. It is determined by the quality of the built environment, its clarity, simplicity, continuity, rhythm and the dominance of unites over each other (Gehl., 1971). It is one of the main physical attributes that affects the frequency of park’s utilization (Karuppannan & Sivam., 2012), and encourage users to interact with each others. It strengthens the residents’ attention, clarifies their perception and their mental cognition towards public areas. This, promotes connectedness and social interaction among residents (Bounds., 2008). Several empirical studies focused on the relationships between the legibility of streets, markets and the social interaction (Ujang., 2012; Yeung., 1996; Karuppannan., 2012). However, few studies focus on legibility of neighbourhood parks within new residential areas and its impact on social interaction.

2. Research methodology

This preliminary study was conducted to determine the impact of park’s legibility on social interaction in the context of new residential areas. The context of the study is the city of Putrajaya, the new federal government administrative centre for Malaysia. The city is located at 25 Kilometres south of Kuala Lumpur with a population of 86 000 persons (Department of Statistics, Malaysia., 2013). Aiming to create healthy urban environment, the city was planned as a model for other future sustainable cities in the country. Neighbourhood parks in Precinct 8 and Precinct 9
were selected as the sample areas; according to the local plan (Perbadanan Putrajaya, 2002) Precincts 7, 8, 9 and 10 are the major residential area with complete public facilities and advantageous environment for living. Precinct 8 has a lower density (12814); it consists of attached single–unit housing. Precinct 9 has a much higher density with 41796 residents. Houses in this precinct consist of several high-rise condominiums (Inspection Report of Putrajaya, 2009, P 35). This study further examines the correlation between population density and the frequency of use of the neighbourhood parks. Yeung (1996) explained that functional factors such as the volume of people also have an impact on the level of legibility. This, because higher density of residents will provides greater utilisation, and allows more experiences. This has an impact on the landscape legibility.

Survey research is so far the best method available in the social research. It is commonly used as a mode of observation in social science and very efficient for exploratory, descriptive and explanatory purposes (Creswell, 2007). Hence, this study employed a close-ended and self-administered questionnaire to measure the impact of independent variables (Clear Structure, View Obstacles and Accessibility) on social interaction within the parks. In addition, a cognitive map exercise was conducted to confirm the survey results. Both methods had been adopted in various studies about parks’ legibility, their value for residents and social bonds (Shukur et al., 2012. Rasidi & al., 2012. Talen., 2010).

The survey questionnaire addressed the users’ feedback on the physical characteristics and elements of parks, and their level of social interaction by using a 5-point Likert- Scale. The survey involved fifty respondents (Ahmad Mahdzan., A 2007. The sample was selected randomly among a representative population, including Malay, Chinese, Indian and others according to the Department of Statistics (Malaysia, 2013). The age of respondents were 18 years old and above and they include both male and female samples.

It was observed that the park users were involved in various activities in different location of the parks. Therefore researcher has identified several points of the park to randomly choose the participants to ensure that there is an equal opportunity for them to be selected. The participants were asked to answer questions about the park’s legibility, especially Clarity of Structure, Views Obstacles and Accessibility. They were also asked about the intensity of social interaction occurring in the park and types of contact. This is to examine whether or not parks promote contact between users. A sketch mapping instruction was attached at the end of the questionnaire to support the results from the questionnaire survey. Respondents were asked to sketch and locate on a blank piece of paper the identifiable physical elements of their respective neighbourhood parks, indicating as much details elements as possible.

In order to identify legible elements and level of social interaction by respondents, results from both sketches mapping output and questionnaire survey were categorized. Based on the Likert scale description by Bernard (2000), the questionnaire survey results could be classified into four groups with an equal range (m=1.0), and the frequencies of the sketched mapping are into four groups also with an equal range of (f=4 for Precinct 8 & f=5 for Precinct 9) according to the 37 sketch maps collected from respondents. The classifications of the rating scales are as follows:
Table 2.1 Classification and Rating Scale for sketched mapping exercise

<table>
<thead>
<tr>
<th>Frequency (f): 37</th>
<th>Legibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>(f) Precinct 8 : (16)</td>
<td>13 - 16</td>
</tr>
<tr>
<td></td>
<td>9 – 12</td>
</tr>
<tr>
<td></td>
<td>5 – 8</td>
</tr>
<tr>
<td></td>
<td>0 - 4</td>
</tr>
<tr>
<td>(f) Precinct 9 : (21)</td>
<td>16 - 21</td>
</tr>
<tr>
<td></td>
<td>11 – 15</td>
</tr>
<tr>
<td></td>
<td>6 – 10</td>
</tr>
<tr>
<td></td>
<td>0 – 5</td>
</tr>
</tbody>
</table>

Table 2.2 Classification and Rating Scale for questionnaire survey

<table>
<thead>
<tr>
<th>Means (m)</th>
<th>Likert scale (description)</th>
<th>Legibility</th>
<th>Social Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 – 5.0</td>
<td>Strongly Agree</td>
<td>Highly identifiable</td>
<td>Strong SI</td>
</tr>
<tr>
<td>3.1 – 4.0</td>
<td>Agree</td>
<td>Moderately recognizable</td>
<td>Moderate SI</td>
</tr>
<tr>
<td>2.1 – 3.0</td>
<td>Disagree</td>
<td>Poorly recognizable</td>
<td>Weak SI</td>
</tr>
<tr>
<td>1.0 – 2.0</td>
<td>Strongly Disagree</td>
<td>Unrecognizable</td>
<td>None SI</td>
</tr>
</tbody>
</table>

Then, Cronbach’s Alpha was used to measure reliability of a set of items or a single uni-dimensional latent construct. The Cronbach α reliability coefficient was 0.742, which indicates the reliability of the questionnaire.

3. Results and analysis
   a. Demographic information

   There were slightly more female (58%) than male (42%) among the 50 respondents selected. The majority of the respondents were between 26 and 45 years old (62%) The lowest age group were the elderly above 66 years old (7%). As for the income of respondents the majority (68%) gain less than RM4000 per month. In terms of education, diploma and bachelor holders took the larger percentage respectively at 36% and 28%, with only 8% master holders. As for ethnicity, there were Malay (66%), Chinese (20%), Indian (10%) and others (4%).

   In addition to the density differences, the most striking feature between the two precincts is mainly the social class variation. The Precinct 9 contains the greater number of workers and middle class residents earning less than RM2000/month which constitute 72.2% and 70% of SPM holders. However, in the Precinct 8 lives an apparent upper class. 75% of respondents earn between RM 4000 and 6000, besides 58.9% of Master holders and 57.1% of Bachelor holders live in the Precinct 8.

b. Legibility of the neighbourhood parks

   Results from the questionnaire survey

   Crosstab statistics was used to identify and compare the legibility based on means scores between the Precincts 8 and Precinct 9. Table 3.1 shows the respondents’ feedback on the parks’ legibility through the main variables which are Clarity of Structure (Edges, Nodes, Landmarks, Paths and Districts); the Visual Obstacles and Accessibility. Accessibility was highly identifiable attribute for both parks with mean scores of (3.57 to 3.99). These scores were expected because of the many identifiable park entrances that are well integrated with the residential areas (five for the Precinct 9 and four the Precinct 8). Although the high level of accessibility was recorded for both parks, the park located in Precinct 8 recorded a lower level of users’ frequency.
There was rather a significant difference in visual obstacles variable; (m=2.71) for the Precinct 8, and (m=3.74) for Precinct 9. This trend can be associated with the design of the parks. In Precinct 9, the park is designed on a concave curve, which allows users to see the whole park from almost any single point. On the other hand, park in Precinct 8 is designed on a convex curve shape, which makes it difficult to see the whole park from a single point. Also, clear structure indicated a major difference between the two parks. Moderately recognizable elements was recorded in Precinct 9 park (m=3.92), and poorly recognizable in Precinct 8 park (m=3.00). The results indicated that park in Precinct 8 has significantly lower structure and view obstacles compared to Precinct 9 park. The Accessibility level in both parks is the same. These results suggest that park in the Precinct 8 is less legible than the park in the Precinct 9.

**Table 3.1 Legibility of Precinct 8 and Precinct 9 parks**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variables</th>
<th>Items</th>
<th>Mean</th>
<th>St D</th>
<th>Legibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Activities in the park can be seen from outside</td>
<td>Precinct 8</td>
<td>3.00</td>
<td>0.990</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The park is a very noticeable area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The location of the park is very convenient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are many gathering places</td>
<td>Precinct 9</td>
<td>3.92</td>
<td>0.746</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are many landscape elements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The walkways are very comfortable to use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activities in the park are so close from each other</td>
<td>Precinct 8</td>
<td>2.71</td>
<td>0.845</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I can see the whole park from a single point</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The face to face arrangement of the seating allow me to talk with others</td>
<td>Precinct 9</td>
<td>3.74</td>
<td>0.894</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The park has direct views with good ability to see</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are more than one entrance to access the park</td>
<td>Precinct 8</td>
<td>3.57</td>
<td>0.878</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Most of the area is suitable for walking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>People use the park frequently</td>
<td>Precinct 9</td>
<td>3.99</td>
<td>0.898</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The park is well connected with the residential area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**(b) Results from the sketched mapping exercise**

Table 3.2 ranks the five main components of Legibility namely Paths, Edges, Districts, Nodes and Landmarks, based on the mental maps sketched by the respondents. Results indicated that the park in the Precinct 8 is less legible than park in Precinct 9, with the main differences in Edges (P8: f=8; P9: f= 13) and Nodes (P8: f=6; P9: f= 11). Edges in the sketch mapping outcomes were identified by identifying the parks’ boundaries and the rest places. For the Nodes, researcher identified the strategic points like junctions between entrances and the park’s path, as points of orientations for users (see figure 3.1). Frome these figures, it is obvious that Edges
and Nodes in the Precinct 8 are poorly recognized compared to park in Precinct 9. This supports the results from the questionnaire survey.

**Table 3.2 Legibility of the Parks in Precincts 8 and Precinct 9**

<table>
<thead>
<tr>
<th>Items versus precincts</th>
<th>Precinct 8</th>
<th>Precinct 9</th>
<th>Frequency</th>
<th>Legibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge</td>
<td></td>
<td></td>
<td>8</td>
<td>Poorly recognizable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td>Node</td>
<td></td>
<td></td>
<td>6</td>
<td>Poorly recognizable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td>Landmark</td>
<td></td>
<td></td>
<td>12</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td>Path</td>
<td></td>
<td></td>
<td>12</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td>District</td>
<td></td>
<td></td>
<td>10</td>
<td>Moderately recognizable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>Highly identifiable</td>
</tr>
</tbody>
</table>

Figure 3.1 Sketch mapping outcomes from both parks
c. Social interaction within the neighbourhood parks

Table 3.3 shows the level of social interaction recorded in Precinct 8 and Precinct 9. The level of social interaction is measured based on the level of engagement and the ability of the parks to encourage contacts. Firstly, the users’ level of engagement could be determined by the duration of visit in the parks. Secondly, the study determined whether the parks promote isolation or contact through the length of meeting among the park users. The results indicate that the mean values of social interaction for both parks are ranging from 2.50 to 3.59. The intensity of meeting scored the highest mean values (m= 3.59) which is recorded in the Precinct 9. This result reflects a moderate social interaction. At the same time, the Precinct 8 park recorded a weak intensity of meeting (m=2.93). This score is contributed by the good resting opportunities and the variety of recreational interest. The duration of outdoor activities was relatively high for Precinct 9 (m=3.43) which reflects a moderate outdoor duration. On the other hand, the Precinct 8 recorded a weak outdoor duration with (m=2.50). These outcomes reflect a lower level of social interaction in Precinct 8 compare to the Precinct 9.

Table 3.3 Level of social interaction in parks

<table>
<thead>
<tr>
<th>Construct Variables</th>
<th>Items</th>
<th>Mean</th>
<th>St D</th>
<th>Social interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Interaction</td>
<td>I participate in many activities within the park</td>
<td>Precinct 8</td>
<td>2.50</td>
<td>1.041</td>
</tr>
<tr>
<td></td>
<td>The park is quiet and reflect a peaceful ambience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The park offers good resting opportunities</td>
<td>Precinct 9</td>
<td>3.43</td>
<td>1.145</td>
</tr>
<tr>
<td></td>
<td>The park allows more conversing opportunities between residents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are variety of recreational interest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Types of contact</td>
<td>Many occasions for greeting</td>
<td>Precinct 8</td>
<td>2.93</td>
<td>1.049</td>
</tr>
<tr>
<td></td>
<td>An occasional discussion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A friendly discussion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A warm discussion</td>
<td>Precinct 9</td>
<td>3.59</td>
<td>0.976</td>
</tr>
</tbody>
</table>

d. Correlations between density and social interaction

Partial correlation test was performed to describe the strength and direction of the linear relationship between the level of density in the two precincts and social interaction within the parks. This statistical procedure allows the researcher to control and remove the influence of other variables on park legibility, measured in this study.

Table 3.4 indicates that park legibility and density were positively correlated with social interaction. The bi-variate correlation between density and park activities r(50) = .60, p < .001, types of contact r(50) = .61, p < .001 were statistically significant. A partial correlation was then computed between density and social interaction, holding constant for park legibility variables. If park’s legibility variables are the principal determinant of social interaction, the partial correlation between density and social interaction should not be significant. The results suggest that there is a significant
positive correlation between density and social interaction, even after controlling park legibility variables $r(50) = .50, p < .001$ and $r(50) = .51, p < .001$,

<table>
<thead>
<tr>
<th></th>
<th>Clear structure</th>
<th>View obstacles</th>
<th>Accessibility</th>
<th>Density</th>
<th>Partial correlation for Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Park activities</td>
<td>.703***</td>
<td>.682***</td>
<td>.439***</td>
<td>.599***</td>
<td>.503***</td>
</tr>
<tr>
<td>2. Types of contact</td>
<td>-.662***</td>
<td>-.689***</td>
<td>-.623***</td>
<td>.612***</td>
<td>.509***</td>
</tr>
</tbody>
</table>

* p < .05. ** p < .01. *** p < .001

conventional definition (> .500 = strong correlation)

Discussions

The first objective of this study was to determine elements that support the legibility of neighbourhood parks and its impact on social interaction. The second objective was to determine whether or not density of the neighbourhood has a positive impact on the intensity of social interaction. A statistical procedure was computed to examine the correlations between independent and dependent variables. Descriptive statistics were computed to determine the impact of park’s legibility on social interaction, and inferential statistics to determine whether or not density has a positive impact on the intensity of social interaction. This study found that park legibility is influenced by various physical elements. For instance, the accessibility of the parks was influenced by the presence of several entrances (Precinct 8 has four and Precinct 9 has five) which connect the parks with the residential areas; thus increases the users’ frequency of visits. Visual obstacles decreased within integrated activities in the park. The more activities are segregated, the more visual obstacles occur. Finally clarity of structure of the park which makes the landscape elements easily identified by users is highly influenced by the landscape cues (paths, edges, districts, nodes, landmarks) and the coherence of its structure. The factors that influence the legibility of the physical elements found in this study were in accordance with Yeung (1996), who states that accessibility and proximity have an impact on the level of legibility. Gehl (2009) stated that a public space should be designed based on the integrated activities rather than segregate activities to avoid the problem of sight obstacles. In this regards, and based on the famous empirical work of Lynch (1960) this study reaffirms the important role of the apparent clarity of structure which is the core criteria of legibility.

The study further examined the correlation between legibility, social interaction and density. Results as shown in (Table 3.4) indicate that a strong correlation was recorded between social interaction and park legibility. This was supported by Gehl (1971) who claimed that legibility of a city is determined by the quality of the built environment, which influences residents outdoors activities. Karuppannan & Sivam (2012) also stated that legibility is one of the main physical attributes that affects the frequency of park’s utilization, and encourage users to interact with each other. On the other hand, a partial correlation between density and social interaction revealed that legibility variables are not the principal determinant of social interaction. Results indicated that there is a significant positive correlation between density and social interaction. This finding is supported by other studies which stated that density of
population and perceived density have a high relationship with social interaction level. (Argent., 2008) and (Neutens et al., 2012)

There is a limitation found in this study. Due to the broad concept of physical elements, legibility is also determined by several other physical attributes that affect the utilisation of open space including parks such as image of places, permeability, comfort, maintenance, activities and facilities, safety etc (Karuppannan & Sivam., 2012). For that, a more comprehensive study on physical environment is needed to reach a sustainable level of social interaction in residential areas.

**Conclusion**

One of the urban design objectives is to create better places in cities, in order to support the greater aim of sustainability within cities. This study focuses on legibility of neighbourhood parks as an important factor in social spaces particularly within new residential areas. This paper has examined the relationships between park’s legibility, social interaction and density of population. It was an attempt as various other studies, to solve the issues of lack of social interaction and lack of park utilisation within neighbourhood residential areas, although the presence of apparent well designed parks. Findings indicated that the legibility of parks positively influenced the duration of park use, which promotes social interaction and group activities among residents.

When landscape elements are easily identifiable with a relative order and structure coherence, it allows residents to have a functional sense of place, strengthen their place identity and familiarity with the urban elements, which lead to develop and promote environmental and cultural sustainability. Legibility of parks in addition to certain critical level of density may increase the residents’ feeling of connection to their neighbourhood, strengthen the community cohesion and may participate in certain percentage to reduce the cultural gap between ethnic groups by providing places of mingling.

Neighbourhood parks can serve as a meeting point; provide opportunities par excellence for exchange between residents, then promoting social interaction within new urban residential areas. This can be achieved by giving a special attention to spatial configuration and elements of parks, especially its legibility. However, the results of this study are not conclusive due to the pilot study sampling. A larger sample size will provide more reliability and validity. These findings aim to strengthen social bonding in new residential areas, promote social contacts and promote a more sensitive approach towards the planning and design of public parks and address the value and the importance of park’s legibility.

**Acknowledgement**

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ECO-PUBLIC ART IN PURSUIT OF A SUSTAINABLE GREEN CITY AND PUBLIC SPACE

Syamim Azhari¹, Khalilah Zakariya²* and Norzalifa Zainal Abidin³

¹ Corresponding Author, Master’s Student (MSc. in Built Environment), International Islamic University, Malaysia
E-mail: syamimazhari@yahoo.com

² Asst. Prof., Dept. of Landscape Architecture, International Islamic University, Malaysia
E-mail: khalilah@iium.edu.my

³ Asst. Prof., Dept. of Applied Arts & Design, International Islamic University, Malaysia
E-mail: norzalifa@iium.edu.com

Abstract

Public art is an artwork or any visible component of art that embraces creativity and meaning, sited in public space. The emergence of public art in public space covers activities extending from functional, decorative, iconic, interpretive, integrated, ephemeral or temporary installation of artworks. Over the past thirty years, artists, designers and city planners have discussed and acknowledged the values and roles of public art that contribute to the public’s well-being. Public art involves the artist in creating the artworks and the public to participate, whether directly and indirectly. The contributions of public art from the aspects of social, cultural and economic perspectives have been well noted in public art projects and publications. However, studies that examine the environmental contributions of public art to the city are still very minimal. The aim of this paper is to review the existing public art and eco-public art projects and analyse how they can contribute to the environmental sustainability through their contents and process. The study is conducted through a literature review of books, journal articles and online resources, focusing on the sustainability, awareness and environmental values perceived and associated towards eco-public art. The findings outline the relationships of public art in public space and how it may lead to encourage further directions to contribute to the dialogue between art and the public, and environmental sustainability through public art programmes. This is essential in determining future directions of how public art might be approached towards achieving greener cities.

Keywords: Public art, Sustainability, Environment, Green, Public space
Introduction

Throughout the years, there is an increasing concern for the environmental issues in relation to global warming caused by rapid urbanization, lack of green spaces and also climate change. These issues have resulted in many efforts by the governments and authorities to overcome these problems, such as by promoting the “Green City” and “Go Green” concept, conferences on environmental issues, and drafting and promoting new policies and guidelines on sustainable development. The term “sustainable” and “green city” are no longer new to the built environment. It has been advocated by civic leaders, authorities, developers, architects and landscape architects, planners, business owners, universities and the public in recent years. It is an emerging global phenomenon for many countries including Malaysia. Green city and sustainability are two closely related terms. Big cities government such as in Seattle, New York, San Francisco, Vancouver, and Frankfurt are among the cities that have developed and implemented their sustainability policies which leads to their aims to achieve Green City.

The concerns on environmental issues in Malaysia have frequently appeared in the local newspaper headlines. Therefore, few steps have been adopted by the Government to encourage the sustainability concept within their area and be responsive to the demand for more beneficial environmental and social protection such as to impulse the professional bodies and developers to take proactive actions towards it. National Landscape Policy (NLP) by National Landscape Department is a guidelines produced to strive the landscape development. With the intention of becoming a ‘Beautiful Garden Nation’ by 2020, their aim is estimated to boost the country towards a total quality living environment, as well as highlighting Malaysia’s unique landscape identity (National Landscape Policy, 2011).

Earlier this year in January 2014, the mayor of Kuala Lumpur, Datuk Ahmad Phesal Talib, stated in a local newspaper that the city council aims to transform Kuala Lumpur into a greener city by introducing the concept of “Jungle in the City”. In making the city green, the Kuala Lumpur City Hall (DBKL) will establish a smart partnership with the Forest Research Institute of Malaysia (FRIM) (News Straits Time, January 2013).

However, despite these numerous efforts by the Malaysian government together with the non-governmental organization (NGO), environmental awareness and responsibility actually comes back to the public as the citizens of the city. The guidelines and policies are basically meant for the professionals, for instance
developers, planners or architects. Whereby in this case, the public lacks awareness and exposure about it. This happens for many reasons, such as the public’s attitude, lack of exposure and lack of appreciation on environmental issues and sustainability, which in return make them care less about the environment.

Further discussion about sustainability and green city, the public plays an important role to this contribution. However, the concern here is on how the public can be more appreciative and become more aware about the environment, towards having a greater understanding on their role as inhabitants of the city. The aim of this paper is to examine how public art programs could be seen to contribute to environmental sustainability. Public art has been increasingly accepted as a creative approach in public space to engage and evoke user experience. From this potential, how can public art be the medium to inspire the dialogue between the public, art and environment? Analytical reviews of the existing public art projects with environmental concerns or approaches are applied to obtain the findings on how eco-public art can contribute towards a sustainable city and public space.

2.1 Public Art

For the past twenty five years, public art is known as a term described as sculpture or installations that are sited in public space (Lacy, 1995). Some people distinguish public art as “art in public space” (Shaffery, 2010). Today, it has become incredibly various, covering activities extending from functional, decorative, iconic, interpretive, integrated, ephemeral or temporary installation artworks. Literature on public art includes a wide range of theoretical perspectives. It is an evaluation of art (Hall & Robertson 2001) and has been seen to fulfil variety of aims and functions of its context, such as improving or providing the aesthetics of building design, developing sites for tourism, place making, and promoting community development and people engagement (Seixas, 2013). The concept of public art has appeared in writings that deals with the relationship between the people or artist artwork positioned in the public space to create visually stimulating environment. Essentially, it integrates the concepts of ‘public’ and ‘art’ (Hui 2003). According to Bertsche (2013), “public art is defined as an arena of city planning and development that has potential both engage the public and promote social sustainability, and also create a positive image for cities, and it increasingly tries to serve both of these functions”. In addition, public art have been seen as a part of
Based on these definitions, it can be derived that public art is an artwork or any visible component of art that embraces diversity and creativity, sited at any public space or place, either permanent, temporary or project-based. It can be in any form of artwork, not limited to scale or size, specified materials, colour or form. It involves the process of engaging professional artist, creative crafts, people’s or citizens creating artworks in response to a place. It may or may not have functions to its context.

2.2 Eco-Public Art

Eco-public art came from the combination and overlapping of the word “eco art” and “public art”. Eco art abbreviate from the term of ecological art also known as eco-friendly art, or green art (Robinson, 2008). It is not a new phenomenon as it is a form of art that seeks to address environmental issues. Eco Art South Florida, an organization to catalyse the development of South Florida as a main centre for ecological art (Eco Art) practice, defines eco art as “melds aspects of environmental art, activist art and community animation/mobilization art with engineering and science-originated processes of avoiding/restoring damaged ecosystems” (What is EcoArt, http://ecoartsofla.org/ecoart-and-ecoartists/what-is-ecoart/, 2007). In addition, eco art is grounded by the concept of relationship that not merely focuses on physical and biological trails, but also cultural, political and historical aspects of communities or ecological. It also emphasises on the inter-relationships within the communities. (Wallen, 2012). It is closely allied with the principles of stewardship to enliven the
ecosystems we inhabit and contribute to their renewal and long-term vitality. Besides, new sustainable linkages can be created by promoting eco art as an approach in public space. This paper focuses on the concept and principles of eco art in the context of the urban environment. Therefore, the approaches of protecting and restoring damaged ecosystem would differ to the urban city context.

Eco public art integrates the concept of arts and ecological friendly approach as a means of developing awareness in improving human relationship with nature through visual arts and experience (Robinson, 2008). The engagement of the public with the public art, aims to address the environmental issues, thus contribute to promote sustainable environment (Cross, 2012; Dimopulous, 2006; Ibrahim, 2011). Therefore, implementation of public art programmes in creating environmental awareness must consider the principles of eco-art by means of the selection of material used, time-based, function and the concept of sustainability. Eco public art criteria must follows the ecological friendly principle as below (Robinson, 2008):

i. Materials that can be recycled, reused and reduced
ii. By considering the life cycle of the product
iii. Post-consumer recycle materials
iv. Environment friendly: non toxic
v. Energy efficiency
vi. The used of raw materials
vii. The used of sustainable material

2.3 Environmental Sustainability

The term environmental sustainability refers to two major key words: environment and sustainability. These two major key words, particularly ‘sustainability’, have been a vast topic to be discuss among the civic leader, business owners, universities and some the public themselves (Bostwick, 2008). Paehlke (2003) and Sutton (2004) agreed that environmental sustainability can be defined as the process of maintaining practices and factors that contribute to a quality of the physical environment for future generations. While Morelli (2003) explains further, whereby he defined environmental sustainability as a condition of a balance, resilience, and the interconnectedness that allows present human society to fulfil their needs while neither exceeding the capability of its surrounding ecosystems to continue to restore necessary services to satisfy those needs nor by our actions decreasing biological diversity. This means that decision and actions
in city planning and development need to reduce the negative impact to the environment for the needs of future generations.

3.0 Public Art and Eco Public Art Projects: A Review

In Malaysia, the exposure on implementing eco public art is still at the early stage. Most of the public art programmes are focusing on the role of public art to creatively promote the image of the city, enliven the surrounding environment of public space, city beautification, enhancing people’s experience on how they feel about their environment, and for urban regeneration (Shin, 1994; Harvest, 2004; Mustafa, 2009). Due to that the limitation of eco public art projects in Malaysia, the project review cover not only from Malaysia but other interactive public art project in other countries as well.

3.1 Project Review 1: Georgetown Steel Rod Sculpture, Penang, Malaysia

The ‘Marking George Town Steel Rod Sculptures’ is a collection of caricatures placed on historic streets of George Town by the company, *Sculpture at Work* (refer to Fig.2 & 3). By using only steel rod as the material and bare wall as the background, the idea of featuring cartoons and caricatures with a storyline is to bring back the local history and culture for the public to rejuvenate and can easily understood the message by all age levels. Apparently, this public street art have been accepted and received great response from the public. Although this public art installation is not considered as eco-public art, however, the creative idea of bringing the history as we were reading a comic throughout the streets can be implemented in future eco-public art installations. Apart from not only attracts people to read and take photos, this steel rod art installation have also touch the public emotions and heart. The message are not too long, informative and the expressions of the character are varies and funny, which actually a very good example of how art can actually educate people through it.
3.2 Project Review 2: Creepy Head Planter, Chicago

Placed along Chicago's Lower Michigan Avenue, the 14 giant head planters was an idea from Plant Green Ideas, Chicago. It is not-for-profit public art project committed to sustainability.

According to Sharene Shariatzadeh, executive director of Chicago Cultural Mile Association, the main purpose of this public art installation is to change public mind-sets and to evoke new way of thinking and appreciating the environment that further will encourage a dialogue and thought in regards to a healthier and greener world. (The Wall Street Journal Online, 2013). The sculptural heads were constructed locally while the greenery materials and other plants material were donated by Ball Horticultural and Costa Farms. This also signified that the process of creating the public art also considered environmental values. Their big size which equals to 11 feet tall each, features a unique theme and message create. Positive message printed on the back of the neck such as “limit showers to six minutes” and “ride a bike” promotes an eco-friendly life tips to the public. According to Robin Malpass, the co-founder of Green Plant Ideas, the most outstanding and eye-catching sculpture will offer educational content that will put together the actions of public who passes along Michigan Avenue to be more concern on the environment (Chicago Impact Website, 2013).

Striving for environmental sustainability and green city, the planter sculptures were constructed and crafted from sustainable materials, recycled concrete and aluminium, self-water their foliage hair-dos through rain storage.
Figure 4 below are the images of planter head sculpture placed along Michigan’s Avenue, installed and created by Plant Green Ideas, Chicago. Each of the sculpture are unique by themselves as each of them have different design and green life-style tips behind the head. Function as planters, various plants were planted on top of the head and also acts as a rain storage.

3.2 Project Review 3: Chop Stick, Indianapolis, USA, 2012

This project have been listed as the eco-public art project by Curating City (Australia), a database of eco-public art project. This functional eco-public art project was initiated in February 2011. It was commissioned by the Indianapolis Museum of Art and is located within the recently open 100 Acres Virginia B. Fairbanks Art & Nature Park.

Chop Stick comprises a 100-foot Yellow Poplar tree suspended horizontally across a small kiosk that has been entirely constructed from the tree itself (Curating Cities Website, 2014). The construction began around August 2011 and it was completed in June 2012. The aims of the project was to create a structure and a surrounding environment in which use value and aesthetic value of all the harvested material that could be used. It is sought to facilitate further enjoyment of the surrounding sculpture park, create a fun environment for children, and offer another dimension to the Park’s efforts to encourage people to contemplate their relationship to the environment.

This project is considered as a huge scale of public art installations. It is indirect public art programs to educate the public on how waste product from logging activities can be utilized and used back to produce a magnificent functional structure. Furthermore, it also encourage the public awareness to value the natural resources
which we depend on in our daily lives. All parts of the yellow poplar tree we fully utilised in constructing the components and the structure of the kiosk, benches, swings and table resulting to minimal impact of toxic used material / products as it was derived from the tree itself and all have maintained a very raw appearance in terms of their shape and surface. Overall, the used of raw and eco-friendly material plus minimal wastage, has actually contribute to strive for the green and sustainable environment.

Figure 5 and 6 below shows the overview of the sculpture park and swing that attached to the main structure of the tree. In Figure 5, the position of the kiosk is placed at the end of the tree trunk to provide balance and support for the whole structure. As we go further, the swing is on the middle of the structure while table and chairs with hanging light fixtures at the tree branches at the other end of the tree trunk.

**Figure 5: Overall view of the suspended tree sculpture. (Source: Curating Cities)**

**Figure 6: Adults and children playing the swings (Source: Curating Cities)**

**Project Review 4: The Blue Tree, Houston, USA**

This temporary public art project was lead by an artist named Konstantin Dimopoulos (bluetreetexas.org Website, 2014). In response to the loss of millions trees during the drought 2011 and aftermath Hurricane Ike, the aim of this project is to highlight the importance of trees to every human lives. The Blue Trees installations in Houston include, the large stands of crepe myrtles between Allen Parkway and Memorial Drive at Waugh Drive; the trees at the historic Houston Parks and Recreation Department Gragg Building; and a solitary tree at the Houston Arts Alliance offices. Together with the help of public volunteers, the idea was to paint a group of crepe myrtles tree trunk in blue colour to create the contrast between the vibrant colour and the nature colour of the tree. Trees were paint in blue colour by using the biologically-safe, water-based ultramarine mineral pigments which is ecological friendly.
Dimopoulos provides a visual platform with the intent to attract the public. The idea was to transform living trees into blue giants to bring attention and curiosity of the public of what is currently happening. It is sought to be the objects of attention and then leads to appreciation. With the six month period of this temporary work, the tree will revert back to its natural condition. Over time, the blue colour will be fade and washed away by the rain. The feedback for this project was very good. Public participation were at the best level. Initially, the involvement of the public were only the volunteers that concerned about the environment. However, this projects had successfully draws the public attention to the issue that have been highlighted thus together involved in the making of the art installation as few of the same art installation have been applied to other cities even countries as well such as Melbourne, Australia and Vancouver, Canada and are scheduled for New York City, Miami and Paris as well. The magnificent living outdoor art project, blue trees stimulate conversation, interest and enthusiasm in each their host cities. It is said to be fun, curiosity, interesting outdoor project that can bring excitement and interest of a place where there were installed.

Figure 7: A group of Myrtle trees painted in Blue at Houston Parks. (Source: Bluetreetexas.org)

Figure 8: A group of volunteers that involves and cooperate in Blue Tree Project. (Source: Bluetreetexas.org)

Analysis & Discussion
Analysis of project reviews
Table 1 below shows the comparison of the 4 projects reviews. Main aspects and criteria have been listed below to compare the differences and similarities of both public art and eco-public art project to be analyse further towards creating sustainable green city and public space.
## Table 1: Comparison of the project reviews

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Name</th>
<th>Creepy Head Planter</th>
<th>Chop-Stick</th>
<th>The Blue Tree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Categories</strong></td>
<td>Steel Rod Sculpture</td>
<td>Eco-Public Art</td>
<td>Eco-Public Art</td>
<td>Environmental Art</td>
</tr>
<tr>
<td>Time</td>
<td>Permanent</td>
<td>Permanent</td>
<td>Permanent</td>
<td>Temporary (6 months)</td>
</tr>
<tr>
<td>Location</td>
<td>Streets</td>
<td>Streets</td>
<td>Nature Park</td>
<td>Public space &amp; park</td>
</tr>
<tr>
<td><strong>Proposed / Function / aims</strong></td>
<td>• To bring back the local history and culture</td>
<td>Create awareness to the public on environmental issues and sustainability</td>
<td>To create an environment in which the use of harvested material is mobilised &amp; encourage people to contemplate their relationship to the environment (indirect education).</td>
<td>Create awareness to highlight the importance of trees to every human lives. Address deforestation issues</td>
</tr>
<tr>
<td>Materials</td>
<td>Steel Rod</td>
<td>Sustainable materials, recycled concrete and aluminium, non-toxic paint.</td>
<td>Raw material form Yellow Poplar tree</td>
<td>Blue paint : biologically-safe, water-based ultramarine mineral pigments which is ecological friendly</td>
</tr>
<tr>
<td>Form of Art</td>
<td>3D art installation</td>
<td>Sculpture</td>
<td>3D Installation</td>
<td>Painting</td>
</tr>
<tr>
<td>Approach</td>
<td>• Short &amp; Simple message</td>
<td>Education and awareness</td>
<td>Waste &amp; Reduction Management</td>
<td>Eco-friendly material</td>
</tr>
<tr>
<td></td>
<td>• Storyline</td>
<td>• Simple message</td>
<td>• Recycle material</td>
<td>Awareness on environmental issues</td>
</tr>
<tr>
<td></td>
<td>Informative, Unique &amp; attractive</td>
<td>• Eye-catching sculpture</td>
<td>• Sustainable design</td>
<td>Public involvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sustainable material</td>
<td>• Indirect education</td>
<td>Eye-catching environmental art</td>
</tr>
<tr>
<td>Public’s feedback</td>
<td>• Positive feedback</td>
<td>• Higher level of awareness by the public towards environmental issues</td>
<td>•</td>
<td>• Increase number of public involvement</td>
</tr>
<tr>
<td></td>
<td>• Attracts both foreign and local tourists alike</td>
<td>• Message easily understood</td>
<td>•</td>
<td>• Higher concern on the importance of trees and environment issues</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Attract not only local citizens but tourist</td>
</tr>
</tbody>
</table>

Based on the comparison tabulated above, there are similarities of ecological contribution by public art programs and installations to the environment and how the public does contributes to this. Most of the installation approached is said to tackle the
public first, by creating awareness on environment issues or through educational way. Each of every projects have their own message to deliver. As what can be seen, the eye-catching art form (aesthetic), simple/direct message are the main factor that can attract the public or contribute to the successful of a project. Apart from that, the materials used were also part of the important and major aspects to consider in promoting sustainable environment which eco-friendly material, recycled and low impact to the environment issues are closely related.

**Eco-Public Art and its relation to Environmental Sustainability**

Discussions on eco-public art often refers to promoting sustainability via public art. Not only that, *Curating Cities*, a Non-Government Organisation in Australia intend to do a five-year research project that examines how the arts can generate environmentally beneficial behavioural change and influence the development.

While environmental sustainability is the main aim to achieve, ecological friendly methods is a good approach to be included in this process. Furthermore, involving the community members together in the process of public art design, selection and implementation can lead to a successful of a project and offer more appreciation for the public (Doss, 2003 and Hope, 2005). Therefore, eco-public art has potentials to create a better dialogue in integrating the involvement of the public through art as an education and green medium in promoting sustainable environment.

**Conclusion**

Having said earlier in this paper, the main issue was to tackle the lack of concern and awareness of the public towards the environment even promoting a sustainable development. Therefore, Eco-Public Art acts as the visual medium, the tools, and also a form of knowledge to overcome the issues as initial steps of promoting the green city concept. As attitude and behaviour is the major problem, thus, the approach of introducing Eco-Public Art in Malaysia is seen to be the best. This is due to most of the people or public are more concern and attracted to something that they can see, touch and visualize and have a high level of aesthetics value. In public space, people tend to think, remember, understand, learn and take actions with things that can attract them when addressing issues such as sustainability compared to something that are written, for instance the NLP report whereby they are not interested to read them at all. This paper has reveals the list of potential criteria of eco public art that can promotes the
sense of awareness, which are art that is eye-catching or nice to see, have direct message concerning on anything relates to the environment, the form of art must not be too abstract, and selection of the materials should be based on eco-friendly criteria to make the art sustainable themselves. This elements will be the major elements of creating or introducing the of Eco-Public art in Malaysia focusing at the public area. This approaches of having a series of eco-art at the public area will directly or indirectly integrates the public to get involve whether just to see the art, to understand, to feel or to experience and these may lead to a step forward to bring the public close to be more appreciative and become more concern about the environment. This Eco-Public Art may seems as a baby steps effort but it can actually bring and realizing the huge hope of achieving a sustainable green cities and public space achievable.

References


A CRITICAL REVIEW OF LITERATURE ON URBAN SPRAWL AND COMPACT DEVELOPMENT IN THE CONTEXT OF URBAN GROWTH MANAGEMENT IN KUALA LUMPUR

Malik Asghar Naeem¹, Shuhana Shamsuddin², Ahmad Bashri Sulaiman²

¹ Visiting Scholar, MIT-UTM Malaysia Sustainable Cities Program (MSCP), Institute Sultan Iskandar, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia
² Affiliation of other Author, Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Kuala Lumpur

Rapid pace of urbanization is a phenomenon witnessed globally. In the 1800’s, only 3% of the world population lived in the cities. In the 1950’s, the percentage reached around 30%. At the present time, it is more than 50% of the population and the prediction indicates that probably two third of the world’s population will live in cities by the year 2030. Although urbanization has its own benefits such as job provision opportunities that is helping in reducing poverty, it increases tremendous demand for extra land to accommodate the population as well as the demand for civic amenities such as energy, water, sanitation, education, health etc. Malaysia is one of the few Asian countries that have more urbanized population (72.8% of total population). The ever increasing population in Kuala Lumpur is putting immense pressure not only on urban land, but also on agricultural land in the periphery and other natural resources. It is also causing high energy consumption for commuting, more time taken for commuting, and increased pollution due to vehicular emissions. New city forms such as compact development has been suggested as a response to unsustainable urban development. This paper traces and critically reviews the literature on compact city development as a solution to urban sprawl and analyses the policies and strategies adopted by the regulatory authorizes in Kuala Lumpur to contain urban sprawl by gaining compact development. This paper also engenders a debate if compact development is necessary for Kuala Lumpur and can it curb urban sprawl.

Keywords: urbanization; sustainable urban development; urban sprawl; compact development; Kuala Lumpur; Malaysia

Introduction

The concept of ‘Sustainable Development’ earned far-reaching recognition and acceptance after its appearance in Brundtland Commission report titled “Our Common Future” published in 1987 (WCED, 1987). It has gained the status of an important target to be achieved by any kind of development to make the present as well as the future better economically, environmentally and socially and all the key stakeholders are striving for the goal of sustainable development (Reid, 1995). Cities
as the hub of economic growth, centres of innovation, entrepreneurship and emblems of social and cultural values also need to traverse the same path of sustainable development. The policy makers, therefore, have been exploring the ways for sustainable urban form (Sorensen, Marcotullio, & Grant, 2004). However, some factors are causing contradiction to the paradigm such as ever increasing population and extensive use of irreparable natural resources.

Rapid pace of urbanization is a phenomenon witnessed globally, especially in Asia. In the 1800’s, only 3% of the world population lived in the cities. In the 1950’s, the percentage reached around 30%. At the present time, it is more than 50% of the population and the prediction indicates that probably two third of the world’s population will live in cities by the year 2030. Although urbanization has its own benefits such as job provision opportunities that is helping in reducing poverty, it increases tremendous demand for extra land to accommodate the growing population as well as the demand for civic amenities such as energy, water, sanitation, education, health etc. (United Nations, 2013).

Malaysia is one of a few Asian countries that have more urbanized population (72.8% of total population) than that of the rural and it is experiencing an annual urban growth rate of 2.49%. Kuala Lumpur, the capital and the most populous city of Malaysia, has a population of 1.55 million. The city has been referred by Rimmer and Dick (2009) as “mini-Los Angeles” because of following the foot prints of Los Angeles in terms of sprawled type of urban development. The Kuala Lumpur and the nearby major conurbations had a population of about 3.1 million in 1990 that rose to 5.96 million in 2009 (in 19 years) with a growth rate of 3.55% per annum. However, the expansion of the urban area witnessed a higher percentage increase than that of population. The urban area expanded from 621 Square Km in 1990 to remarkable 1555 square km in 2009. The annual growth remained equal to 4.9 percent (The World Bank, 2011).

The ever increasing population in Kuala Lumpur because of rural-urban migration and natural growth is causing expansion of the city and putting immense pressure not only on urban land, but also on agricultural land in the periphery and other natural resources. It is also causing high energy consumption for commuting, more time taken for commuting, and increased pollution due to vehicular emissions (Tachieva, G., 2010). The phenomenon of urban sprawl, therefore, is making the development unsustainable and needs immediate attention. Urban sprawl is one of the key barriers to green house gas (GHG) reductions and making the cities green in Malaysia (World Bank, 2011). There are a plethora of costs associated with urban sprawl such as psychic costs, excess travel/congestion, energy costs, environmental costs, inflated costs of infrastructure/services, loss of open spaces, and down town
decay (Ewing, 1994). Kuala Lumpur, like any other city having sprawled type of development, is facing the same agonies. New city forms such as new urbanism and compact cities have been suggested as a response to unsustainable urban development (UN-Habitat, 2009, Govt. of Malaysia, 2006). Regulatory policies have a potential to play a vital role in achieving the goal of compact and sustainable cities (United Nations, 2013). It is therefore, important to explore the policies and strategies that are in place or being formulated for limiting the linear growth of the city and understand the practical issues related to implementation of those policies in Kuala Lumpur.

Urban Sprawl and Its Impacts

The phenomenon of urban sprawl started in the 2nd half of the 20th century. It is a form of urban development characterized by a number of indicators such as low density of housing and commercial buildings, excessive use of privately owned automobiles, lack of public transport, segregated development based on race and economic status occurring in the shape of gated communities on the fringe of the city, congestion, environmental degradation, and lacking the sense of a community among the residents (Squires, 2002; Lang, 2000; Downs, 1999; Garru, 1991; Katz and Bradley, 1999; Rusk 1999). A number of theories such as ‘natural evolution theory, monocentric city model (Alonso, 1964), flight from blight theory by Mieszkowski and Mills (1993) attempted to explain the phenomenon and causes of urban sprawl.

The built-up area or floor space in a city can be provided by two ways, either by expanding outwards i.e. horizontal growth or by increasing the density of existing area (densification). The growth of a city is heavily influenced by two kind of critical forces that work opposite to each other i.e. centrifugal forces and centripetal forces (The World Bank, 2011).

The centrifugal forces cause expansion of the cities that happens at the periphery. It leads to horizontal growth of the city. The growth of the built-up area is more than that of the requirements to accommodate the population due to natural growth. A number of forces that cause expansion of the city away from the centre include, increase in economic activities in the periphery of the city, availability of low cost land, the cultural values that attach more preference to living in low density areas and construction of express ways that make commuting easy and less time consuming. A look at the form of the urban areas of the twentieth century cities indicates that development of cities was dominated by the centrifugal forces, especially in America and Australia (The World Bank, 2011).

Centripetal forces are opposite to the centrifugal forces and cause densification of the urban core, vertical growth of the city, higher density and compact urban form. The development in the 21st century cities are under the influence of centripetal
forces. The forces that compel the compact urban growth are increase in energy cost that makes long commuting from centre to the periphery very expensive, value of the time in the modern competitive life, changes in planning policies and investment by regulatory authorities in efficient and economical public transportation system that does not cause congestion and heavy pollution even in high density areas (The World Bank, 2011).

Increased car ownership rate and permissive government policies that did not pay much attention to urban sprawl have been pointed out as the key contributing factors to urban sprawl in American cities (UN-Habitat, 2009). Most of the Asian cities seem to be following the footprints of the American cities. For example, till 1980, China was known as the kingdom of bicycles. Bicycle industry was thriving in the country during this era. Every second person in China owned and used a bicycle. At peak hours roads were flooded with bikes. However, since 1994 government started encouraging people buy local cars to give a boost to the local car industry, resultantly replacing the bicycle with cars (Zhou and Yu, 2011). Ever increasing car ownership that eventually leads to congestions, pollution and suburban growth is a phenomenon observed in Malaysia as well. Kuala Lumpur city is witnessing the registration of 1000 new vehicles every day. Only 20% of the journeys are made by public transport in the city (Dudman, 2014).

The anti-sprawl sentiments and campaigns can be traced in different times in history, the first one initiated in 1920 in Britain by the literary and artistic elites. The second campaign against sprawl emerged in the United States after World War II. At this juncture, most of the Americans were having quarter an acre or even larger houses in the periphery of the urban area. It is believed that the third phase of anti-sprawl started in 1970 approached its zenith in 1990 (Bruegmann, 2005).

The phenomenon of sprawl has been experienced by almost all those cities of the world that gained some prosperity (Bruegmann, 2005). However, a study by Newman and Kenworthy (1999) finds out that European cities are denser and compact as compared to cities in North America. The density in European cities ranges 40-60 persons per hectare in contrast to that of in American cities having a density of fewer than 20 persons per hectare. European cities are following a number of strategies to achieve the goal of compact and sustainable city form such as refill and urban re-development, strict limit on building outside of specified urban area, a large scale public acquisition and land ownership and willingness to invest in infrastructure for public transportation (Wheeler and Beatley, 2004).

Although urban sprawl has some advantages such as it makes cheap land available to accommodate urbanization (Kahn, 2001), it could be one of the symbol of prosperity and adds value to social life of those prosperous families who can afford to
live in big lot size houses in the periphery of the city (Brueckner, 2000; Nelson & Duncan, 1995). There are a plethora of costs associated with urban sprawl such as psychic costs, excess travel/congestion, energy costs, environmental costs, inflated costs of infrastructure/services, loss of open spaces, and downtown decay (Ewing, 1994). Kuala Lumpur, like any other city having sprawled type of development, is facing the same agonies. New city forms such as new urbanism and compact cities have been suggested as a response to unsustainable urban development (UN-Habitat, 2009). Compact city form has been considered as the one that can produce positive results in terms of environmental, social and economic aspects of a built-up area (Hillman, 1996, Thomas & Cousins, 1996, Frey 1999). Regulatory policies have a potential to play a vital role in achieving the goal of compact and sustainable cities (United Nations, 2013). It is therefore, important to explore the policies that are in place or being formulated for limiting the unnecessary growth of the city and understand the practical issues related to implementation of those policies in Kuala Lumpur.

Compact city and Its Characteristics

Compact city approach is an antidote to the sprawling development. The word “Compact City” was coined by George Dantzig & Thomas Saaty in 1973 in their book entitled Compact City: A Plan for a Livable Urban Environment.

It has been suggested that a sustainable city “must be of a form and scale appropriate to walking, cycling and efficient public transport and with a compactness that encourages social interaction” (Elkin et al., 1991). Most of the literature defining compact city talks about its fundamental characteristics namely, mixed use development, emphasis on public transportation, urban regeneration, strict control on development outside the city boundary, and pedestrian friendly pavements (Breheny, 2001; Arbury, 2005). The best and replicable examples of compact cities produced as an evidence are Curitiba (Brazil), Singapore, Hong Kong (China), Freiburg (Germany), and Portland (USA).

Curitiba, a metropolitan city with a population of 1.6 millions in Brazil, stands out as one of the excellent example of compact and sustainable cities in the World. It provides a great lesson for the planners from the industrialized as well as the developing world. The key lessons to be learnt are to prefer public transportation and integrate pedestrian and bicycle paths in the road network and transportation plan (Rabinovitch and Leitman, 2004)

Amsterdam is another example of compact city. This paradigm was welcomed and adopted by the Dutch planners and authorities in early 1980s. Compact city policies are an integral part of spatial policy of the country in order to tackle the issues
of uncontrolled urban sprawl (Van der Valk, 2002). Provision of efficient public transport and reduction in use of privately owned cars through increasing the cost of travel by car, parking fee, providing comfortable shuttle buses, and increasing the bus-only lane to make the public transportation fast and attractive, are the key strategies to make cities compact, efficient and green.

Availability of financial resources seems to be one of the biggest challenges faced by the governments in following the compact city policies, especially for provision of infrastructure for public transport, and acquisition of expensive land. But such huge investments are outweighed by the benefits to be achieved in the long run in terms of reduction in energy consumption cost, and environmental pollution cost that is causing severe climate change problems (Tachieva, 2010).

Effective land management policies have been determined the most critical factor for building sustainable cities. This goal can be achieved only when the city government has a commitment to sustainability, knowledge and understanding of the effects of density, infrastructure, zoning and transportation alternatives effecting emission and sustainable development. The local authorities also need a skilful and prudent use of planning tools such as zoning, minimum lot size, floor area ratio and height limits for achieving the goal of compact and sustainable city (The World Bank, 2013).

Culture, other than physical urban form and regulatory policies, also plays an important role in sustainability of cities. Culture provides the basis for political and economic behaviour. It shapes our attitudes and brings it into action (Rana and Piracha, 2007).

Choe (2007) points out the East Asian cities are compact and have been developed to be in harmony with nature. He argues that sprawl and segregation of land uses observed in cities in the west are the reflections of their culture. The people in East Asia still hold the places of common use such as public baths and shrines and they know how to live in compact environment. The author contends that the western cities, especially the American cities, have been profoundly following the urban form characterized by very low density, segregated land use, and huge network of expressways are switching to the compact city paradigm adopted much earlier by the East Asian countries especially, Korea and Japan.

**Indicators for Evaluating the Performance of Compact Cities**

Critical importance is attached to Indicators that could be employed to measure the performance of the compact cities in an international setting. The absence of such comparing indicators makes the concept of compact city more vague and abstract. Indicators also help in benchmarking and setting future goals. The policy/decision
makers can monitor the impact of policies with the help of such indicators. However, measuring compactness itself and identifying the relevant indicators is very complex.

**Density** is one of the most frequently used indicators for monitoring the progress of compact cities (See for example, Demsey et al., 2010; Fouchier, 2004; Burton, 2002; DETR, 1998). Gross density, gross residential density, net density and net residential density are the various forms of density indicator. The density of population, employment or other urban activity on a certain piece of land is very important for gauging the efficiency of the land use. It is also important to know about the density of population in various pockets of the city.

The percentage of ‘infill/refill’ or ‘redevelopment’ taking place in a year in certain built-up area is also used as one of the indicators for measuring compactness. Some of the other indicators of compactness include the vacancy rate of housing and office building stocks. The share of apartments/condominiums (multi-family housing) also indicates intensity of the land use. A higher share of single detached dwellings in a city indicates to a sprawled development.

**Proximity** is the other indicator used for gauging compactness. This indicator is related to spatial distribution of various urban activities. Contiguity, different from proximity, also helps monitor if the development is continuous or haphazard leaving patches of undeveloped land in the overall constructed area. Travel distances and time taken in a city relating to home-to-work, leisure and shopping area the tools to measure the proximity. Longer distance and more time taken is an indication of a sprawling nature of development.

**Public transport** and compact city approach are intertwined. Low dependence on car is the basic identity of compact development. The indicator for measuring the performance of a public transport system in a city is the percentage of people using it in comparison to those of riding cars. Erwing et al. (2008) used the percentage of people using public transport for commuting as well as the percentage of people going for work on foot to measure the urban sprawl.

The availability of public transportation system including (i) length of public transport lines (ii) number of bus stations. However these indicators are unable to portray the true picture of mobility as it does not tell who are using the public transportation (urban residents or visitors etc). It has therefore suggested that distance to transit and destination are the good indicators to captures the efficiency of public transportation.

**Accessibility** to services and jobs means that people can approach services for daily use, such as grocery shops, clinics, restaurants, and local jobs in the neighborhood within a walking distance or by a public transport in a short time.
Mixed land use is also an important indicator of compact development. It has been defined by Churchman (1999) as the area which has dwelling units along with local shops and offices within about half kilometer radius of tram service. However, there cannot be found any clear definition of what constitutes mixed land use. Shibata et al. (2010); and Lucas and Rossi-Hansberg (2002) explain mixed land use neighborhoods as the ones where people live as well as work in the nearby area. But, again the question is what is meant by nearby, is it 01km, 2km or 5km?

There can be found a number of approaches suggested by Burton (2002) for measuring accessibility to services and jobs. For example, balance between jobs and residents ratio of residential to non-residential urban land, number of key facilities (banks, clinics, restaurants, grocery stores etc) per 1000 residents. Although not applicable in developing countries, Burton (2002) even used postcode sectors to ascertain the availability of facilities available in certain sectors as well as to differentiate the availability of the services in various sectors based on postcode. However, it is hard to find any recommended standard or yardstick for suitable ratios, percentages that could be used for measuring accessibility in different areas.

Distances between local services and jobs have been suggested as another indicator for measuring accessibility. Kaido and Kwon (2008) use the percentage of housing units having access to local services within 500 meters. Similarly, percentage of inhabitants in a certain area having access to neighbourhood shopping and access to public elementary school in one mile has been used as one of the indicators of accessibility ultimately denoting a compact development. In contrast to that Shibata et al. (2010) used 200 meter radius as a distance within which the daily-use facilities should be available. The noticeable difference in above-mentioned standards of distance is context specific. The later study was conducted in Japan that has the cities with highest densities in the world. This situation again gives birth to the question of what is a suitable standard to be followed.

There are a variety of initiatives relevant to sustainable and compact cities that provided a set of indicators for measuring the effectiveness of compact city policies such as ‘The urban audit’, ‘The Global City Indicators Program(GCIP)’, ‘The Cities Data Book (CDB)’, and ‘The Global Urban Indicators(GUI)’ however, based on the previous literature review, OECD (2012) has proposed a set of 18 core compact city indicators, although meant for European cities, have the potential to be applied to measure the effectiveness of compact city policies given in the following Table 1.
Table 1: Compact city indicators

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<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>Description</th>
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<tr>
<td>Indicators related to compactness</td>
<td>1 Population and urban land growth</td>
<td>Annual growth rate of population and urban land within a metropolitan area</td>
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<td></td>
<td>2 Population density on urban land</td>
<td>Population over the surface of urban land within a metropolitan area</td>
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<td></td>
<td>3 Retrofitting existing urban land</td>
<td>Share of urban development that occurs on existing urban land rather than on greenfield land</td>
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<tr>
<td></td>
<td>4 Intensive use of buildings</td>
<td>Vacancy rates of housing and offices</td>
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<td></td>
<td>5 Housing form</td>
<td>Share of multi-family houses in total housing units</td>
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<td></td>
<td>6 Trip distance</td>
<td>Average trip distance for commuting/all trips</td>
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<tr>
<td></td>
<td>7 Urban land cover</td>
<td>Share of urban land in a metropolitan area</td>
</tr>
<tr>
<td>Urban areas linked by public transport systems</td>
<td>8 Trips using public transport</td>
<td>Share of trips using public transport (for commuting/or all trips) in total trips</td>
</tr>
<tr>
<td></td>
<td>9 Proximity to public transport</td>
<td>Share of population (and/or employment) within walking distance (e.g. 500 metres) of public transport stations in total population</td>
</tr>
<tr>
<td>Accessibility to local services and jobs</td>
<td>10 Matching jobs and homes</td>
<td>Balance between jobs and homes at the neighbourhood scale</td>
</tr>
<tr>
<td></td>
<td>11 Matching local services and homes</td>
<td>Balance between local services and homes at the neighbourhood scale</td>
</tr>
<tr>
<td></td>
<td>12 Proximity to local services</td>
<td>Share of population within walking distance (e.g. 500 metres) of local services</td>
</tr>
<tr>
<td></td>
<td>13 Trips on foot and by bicycle</td>
<td>Share of trips on foot and by bicycle (for commuting/or all trips) in total trips</td>
</tr>
<tr>
<td>Indicators related to the impact of compact city policies</td>
<td>14 Public space and green areas</td>
<td>Share of population within walking distance (e.g. 500 metres) of green space accessible to the public</td>
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<tr>
<td></td>
<td>15 Transport energy use</td>
<td>Transport energy consumption per capita</td>
</tr>
<tr>
<td></td>
<td>16 Residential energy use</td>
<td>Residential energy consumption per capita</td>
</tr>
<tr>
<td>Social</td>
<td>17 Affordability</td>
<td>Share of household expenditure on housing and transport in total household expenditure</td>
</tr>
<tr>
<td>Economic</td>
<td>18 Public service</td>
<td>Expenditure on maintaining urban infrastructure (roads, water facilities, etc.) per capita</td>
</tr>
</tbody>
</table>

Sources: OECD (2012)

Issues Identified and Compact City Strategies Suggested for Kuala Lumpur

The Kuala Lumpur city core witnessed a decline in population with the increase in prosperity of residents, in line with the phenomenon occurring in other cities around the world. The urban sprawl also occurred because of high land prices in the city core as well as the high living cost. The good quality environment, affordable housing prices and low living costs can be enumerated as the pull factors for outward migration to the districts of Gombak and Petaling in the neighbouring Selangor state (Syafie, 2004). The availability of good road network and public rail transit provided an impetus to urban sprawl. A strategy suggested by The National Physical Plan (NPP) to overcome the issue puts emphasis on concentration in existing urban area as well as in the Kuala Lumpur conurbation. A regional plan to be prepared, as suggested in the national physical plan, is meant for outlining the integrated development of the region.
The National Physical Plan and National Urbanization Policy provided a foundation for the preparation of Kuala Lumpur Structure Plan 2020 and Kuala Lumpur City Plan 2020 (in the process of receiving endorsement from the concerned minister). The later document is the core one providing strategies for contained urban management in the city. It puts more emphasis on increasing density and provision for mixed-use, especially in the centre of the city. The local plan (Kuala Lumpur City Plan 2020) spells out high priority for infill development as well as encourages redevelopment of existing but deteriorated dwellings into high density and good quality housing. KL Sentral Project is one of the best examples of infill development characterized by high density, mixed land use (residential, commercial and office buildings) and the focus point of public transit (Teriman et al., 2009).

Integration of land use with mass transit network is the chief constituent of sustainable and compact urban development. It is evident from the fact that rail network for urban as well as suburban areas has expanded since 1990 and now it connects different district regions with 200 km of rail track (Bunnel et. al., 2002). The targets set by KLSP 1984 for transportation especially for LRT system have successfully been achieved. However, a significant modal shift from private cars to public transport could not be achieved mainly due to lack of integration between rail-based stations and poor availability and frequency of feeder buses (Kuala Lumpur Structure Plan 2020).

The ratio of registered cars and motorcycles has been recorded at the figure of 985.7 per 1000 population in the year 2000 and cars account for 56.5 percent of all motorized trips in KL. Some of the key reasons for a common use of cars in city centre are easy availability of parking space and low cost of long term parking. However, the cheap price of fuel and the motor vehicles could be included as the other factors making cars as a preferred mode of transportation (Kuala Lumpur Structure Plan 2020).

The 10th National Physical Plan envisages an expansion in the Light Rail Transit (LRT) in KL, provision of high capacity mass rapid transit system, feeder buses, and covered walkways as some of the initiatives to achieve the objective of concentrated and compact growth. (Government of Malaysia, Economic Planning Unit, 2010). The Kuala Lumpur city government has identified 66 points within 400 meter radius of transit stations to be developed with high density and mixed land use in order to achieve the goal of transit-oriented compact development.

Although cycle ways have been provided in some of the new housing areas and recreational spaces, there use is very limited. The already provided cycle lanes attract illegal encroachments and usually are being utilized for street car parking.
Although targets set by KLSP 1984 for adequate provision of housing have been achieved as indicated by sharp decline in squatter units, from 40930 in 1980 to 23970 in 1998, provision of affordable housing is still a daunting challenge faced by the city government. The low cost housing (public housing) is mainly provided by the government as well as through 30% quota in privately developed housing schemes. Use of cheap construction material and lack of proper maintenance heavily cost the age of building and general environmental conditions in public housing. The future housing demand to accommodate the future projected population to be 2.2 million by 2020 has been estimated to be 626,315 dwelling units of low cost, medium and high costs. The strategies are to increase the density of city center along with the other four strategic growth zones(Wangsa Maju – Maluri, Sentul – Menjalara, Damansara – Pechala, Bukit Jalil – Seputeh, Bandar Tun Razak - Sungai Besi) except Damansara-Penchala zone that is proposed to be kept as low density area and given the status of international zone. The overall density suggested by KLCP 2020 is 9600 persons per km2. It has been criticized and pointed out as a very high density that is incompatible with the vision of making the city a vibrant and livable. The density suggested in the plan is in contradiction to National Physical Plan that suggests the density of the city to be 25 persons per hectare (2500 person per Km2). With such a high density it will be ranked among the top twenty cities having the highest density. But, on the other hand, there a number of cities with a density of more than 15000 persons per square km, such as Shenzen (China), Seoul (S. Korea), Taepi (Taiwan), Beijing (china) that are functioning very well.

Open spaces, recreational and sports facilities are represented by only 6.5 percent of total land. The available open space percentage further goes down if the privately owned golf courses are excluded. The existing percentage of open space translates to 0.36 ha per 1000 population that is far below the target of 2 ha per 1000 population given in urban policy. Moreover, the existing ratio of open space to urban population is even lower than some of other well-planned cities of world such as London (4 hec per 1000 people), Melbourne (2hec ) and Toronoto (2hec) (CGG Response DKLCP2020).

The availability of services and facilities within a walking distance, a core indicator for measuring compact development, has not been taken into account in the KL city development plan 2020. Similarly, it neither mentions of current energy consumption by transportation nor sets any target for reducing the energy consumption through provision of public transportation, as envisioned in the plan. With all policies and strategies enshrined in the Urban Policy (2006), National Physical Plan 2 (2010), Kuala Lumpur Structure Plan 2020 and KL City Plan 2020 (draft), achieving the goal of compact development and avoiding the emergence of a mega city comprising KL
federal territory and conurbation remains debatable without the preservation of agricultural use of land around the cities in close proximity to Kuala Lumpur federal territory.

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SUSTAINABLE ENVIRONMENTAL MANAGEMENT: THE ENVIRONMENTAL EDUCATION IMPERATIVES IN ILORIN, NIGERIA

Oluremi Akinrogba Akindele

Ladoke Akintola University of Technology, Urban and Regional Planning Department, PMB 4000, Ogbomoso, Oyo State, Nigeria.

This study appraised the significance of environmental education to the overall goal of sustainable environmental management in Ilorin west, Nigeria. A structured questionnaire was administered to 347 residents using multi stage sampling technique to 12 electoral wards within the study area. Chi square was used to explain the difference in environmental literacy level and environmental quality among the wards, while regression analysis was used to explain the relationship between environmental education and environmental management. A moderately low level of environmental education as well as environmental management practices was observed to follow similar distribution among the wards. There was observed a reliable relationship (R= .817, R²= .668) between environmental education and environmental management. Aggressive public enlightenment as well as integration of environmental education into school syllabus is hoped to improve environmental education and by implication environmental management practices.

Keywords: sustainability environmental education, literacy, environmental management

Abbreviations:

NESREA National Environment standards and Regulatory Enforcement Agency
FEPA Federal Environmental Protection Agency
KWEPA Kwara State Environmental Protection Agency
EIA Environmental Impact Assessment
UNESCO United Nations Education Scientific and Cultural Organizations
UNEP United Nations Environmental Programme
AGR Average growth rate
LUD Land Use Decree

Introduction

Despite the proliferation of very many and often times; duplicated agencies overlapping in function and operations, members of the society still display ignorance or non-compliant attitude towards the use and management of the
environment. Thus, the crisis of environmental sustainability and quality largely remains a crisis of knowledge (Agbola et al, 1996). Over the years, the problems of urban environmental quality have been tackled from legislative, administrative and technical perspectives but they still persist (Abegunde and Omisore, 2003). Generally, environmental conditions all over the country has reached crisis stage and has defied all planning measure used in recent years. Due to urbanization, many cities have had to battle with avoidable environmental problems like flood, deforestation, soil erosion, refuse and sewage disposal among others. This would have been avoided had it been that all the stakeholders are mentally and practically concerned.

The identification of the role of environmental education occasioned the first inter-governmental conference on environmental education organized by the United Nations Education, Scientific, and Cultural Organization (UNESCO) in cooperation with the U.N. Environment Programme (UNEP) in Tbilisi, (UNESCO, 1978). There, it was established that: “the basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment” (World Commission on Environment and Development ; The Brundtland commission ,1987). Environmental literacy can therefore be viewed as the outcome of a process of education about the environment; although there is yet no consensus among scholars.

Global environmental problems of shrinking natural resources, pollution and population growth has challenged the ways people live, their knowledge of the environment and their ability to sustain the environment (Adibe, 1998). Increased knowledge about the environment is assumed to have great propensity to change environmental attitudes and quality, as both environmental knowledge and attitudes are assumed to influence environmental policy. With the interdependence of knowledge and attitudes, the low level of environmental literacy has disturbing implications for environmental policy (Arcury, 1990).

Ecological literacy is a foundational part of the desired environmental knowledge and skill set of an environmentally literate person. Environmental literacy embraces both ecological literacy and environmental citizenship to produce ecologically
and environmentally literate citizenry which has the capacity and skills to assess, predict, and manage environmental risk and social resilience; which is the cornerstone of any successful plan to implement solutions for long-term environmental sustainability. Thus, an increase in the level of environmental literacy has the propensity to increase environmental quality and peoples’ attitude of ‘best practices’ towards their environment.

The environmental changes due to human activities have put the survival of man in danger. Further preservation of the environment is an imperative, which may only be fostered by man through standard or good practices; of which environmental literacy is a sine-qua-non. It is therefore essential to educate the masses of their necessary roles to preserve the quality of the environment and strategies to prevent the situation from worsening further. Environmental management starts with man himself. This is where environmental literacy and education comes into play. If environmental management measures have not been as efficient as opined; largely because of human behaviour or residents’ lack of cooperation with the formulated policies then, much remains to study: how much do people know about their general and local environment? Which segment of the society is the real culprit? What has the level of environmental literacy impacted on the quality of the environment? And what ways can environmental literacy improve in our society? The answers to these and sundry questions is the thesis of this study. This study therefore assesses the level of environmental literacy and its implications for environmental quality in Ilorin West, Nigeria; with the view to proffering recommendations for improved environmental literacy to anticipate a better environment.

Environmental Sustainability: An Overview

Over the years, environmental sustainability has received scholarly attention (Lundqvist, 2007). Several definitions and descriptions of the subject have evolved (Evans et al, 2007, Rasoolimanash et al, 2011, Zeemering, 2014). In all the literature descriptions environmental sustainability is suggested to be the conservation of the natural environment to make it last forever. The discussions were based on the fact that all the survival support of the floral, faunal biotic and abiotic components of the earth is ultimately dependent on the natural environment. Therefore the conditions to create and maintain natural environment that exists in productive harmony, permits the fulfilling of the social, economic and other requirements of the present and future
generations. Scholars often limit approaches to sustainable environment to issues of resource management efficiency, conservation, energy conservation and alternative energy source, conservation of natural resources, hazardous waste recycling, green city, green building effort, bicycle ridership program, urban forestry and so on (Portney, 2003, Jepson, 2004, Conroy, 2006, Saha and Paterson, 2008). The list seems endless but environmental education is a necessary interphase to make all the approaches fluid, comprehensible, and inspiring to stakeholders, whose partnership is a sina-qua-non to the implementation of other approaches.

Research Methodology

The political ward stratification (12: Adewole, Ajikobi, Alanamu, Baboko, Wara Egbejila, Magaji Ngeri, Odota, Ogidi, Oko-Erin, Oloje, Ubandawaki and Zarumi.) of the city was adopted. After a reconnaissance survey, a structured questionnaire was administered pro-rata to a total of 347 (0.12% of total projected population (301281), at 2.5% AGR) residents, systematically sampled across the wards; eliciting information on residents’ environmental literacy level and the quality of their environment. Participant observation and interviews were conducted where appropriate. Secondary data were obtained from relevant published and unpublished materials as well as local and state agencies. The quantitative data were analysed, largely summarized with the aid of likert scaling. Data regarding perception in this study was collected using the structured questionnaire in ordinal ranking form. Respondents had to rank between: ‘very much satisfied’, ‘very satisfied’, ‘just satisfied’, ‘not satisfied’ and ‘not at all satisfied’. These ranks were allotted weights in descending order of the way they have been listed. In essence, ‘4’ was allotted to very much satisfied as the rank of highest value, and in that order, 3, 2, 1 and 0 were allotted to the rest four ranks. The choice of 4-0 in this scaling is based on the assumption that ‘not at all satisfied’ rank should not be presented as contributing to the positive assessment of housing condition. Each of the listed basic knowledge were variables assessed using this scale. It follows that, for each ward, the number of respondents multiplied by 4 is the maximum point achievable from each variable. This was used to standardize the weighing of the responses from the residents. The total score for each variable, divided by the maximum point achievable multiplied by 100 becomes the standardized score for each variable. Since the answers will be different because of the difference in the individual mean of the variables, a mean
average was computed for use as general mean for all the variables on the table. Thus, each composite figure is given by:

\[
\frac{\sum_{i=1}^{N_1} d_i + \sum_{i=1}^{N_2} e_i + \sum_{i=1}^{N_3} m_i}{\sum_{i=1}^{N_1} D_i + \sum_{i=1}^{N_2} E_i + \sum_{i=1}^{N_3} M_i} \times 100\%
\]

where: \( N_1, N_2 \) and \( N_3 \) are the variables selected for scaling, \( d, e \) and \( m \) are the actual score of the variables and \( D, E, M \) are the maximum point that may be scored by the variables.

Descriptive and inferential statistics were used to explain the observations. Chi-square was used to explain the variations in environmental literacy and quality and environmental literacy, among the sampled wards. Regression analysis was used to explain the relationship between environmental literacy and quality.

**Discussion of Findings**

The data collected from field survey were analysed with the aid of statistical package for social scientists (SPSS). A pattern of observation produced the inferences drawn in the subsequent discussions under the subheadings like the level of environmental education, environmental quality, their relationship and lessons for sustainable environmental management. The data were standardised using a method reminiscent of likert scaling as described in the methodology so that each variable is measured over ten, and are added up as a composite for further parametric analysis.

**Level of Environmental Education.**

Measuring the level of environmental education was not a very easy task as residents are of various categories in terms of age, socio-economic status, previous level of exposure to formal and informal learning, and accessibility to knowledge facilitating facilities. Nevertheless, the basic and the most popular codes and regulations were used as indicators for the test. Knowledge and usage of laws such as URP decree 88 of 1992, Land use act of 1978, building regulations and standards, standards guiding petro fillings station, sign post, bill boards, and sewerage system among others were tested.

Testing the knowledge of residents about the existing environmental laws involved the harvesting of the component parts of such law that directly affects their
daily living. For instance the aspects of the regulations considered basic for average residents knowledge of the laws includes: the time of sanitation exercise, reserved public spaces, prohibition to dump solid waste, compliance possession of certificate of occupancy, land registration and building development permit among others as contained in FEPA, NESREA and URP codes and decrees. Most of the data were collected in nominal and ordinal forms which were converted to ratio and interval scales respectively using cross-tabulation and likert scaling. Values on the table have been standardized to compare to 10. These are scaled and added together for analysis clarity and for the consideration of parametric analysis. Thus each ward is graded against 10 for both knowing and using the environmental information. Knowledge is weighed separately from usage but weights of variables relating to each knowledge are added together to form a composite.

Table 1: Knowledge and usage of basic environmental codes and regulations

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<tr>
<td>FEPA</td>
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<td>5.2</td>
<td>5.2</td>
<td>4.4</td>
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<td>Zoning regulation</td>
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<td>5.3</td>
<td>5.9</td>
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<td>3.2</td>
<td>4.1</td>
<td>4.7</td>
<td>4.46</td>
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<td>Mean</td>
<td>2.44</td>
<td>6.06</td>
<td>4.65</td>
<td>5.13</td>
<td>5.06</td>
<td>7.18</td>
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<td>6.36</td>
<td>4.1</td>
<td>2.91</td>
<td>4.73</td>
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</tr>
</tbody>
</table>

Source: Author’s computation 2014
Key: 1 - Adewole, 2 - Ajikobi, 3 - Alanamu, 4 - Baboko, 5 - Warra-Egbejila, 6 - MagajiNgeri, 7 - Odota, 8 - Ogidi, 9 - Oko Erin, 10 - Oloje, 11 - Ubandawaki, 12 - Zarumi.

It is considered appropriate to point out that the general observation suggests that residents have poor knowledge of codes and regulations governing their environment and hardly use them. Most of the wards scored lower that the pass-mark (5) and the mean. Worse still, in the composite formation for the scores, many residents with ‘head knowledge’ of these regulations know them only for its beauty; they are not committed in any way to a constructive and sustainable use of the same. Rules regarding EIA, petrol filling station, sign post and setback to the road are relatively popular among the residents, probably because these are prerequisite to obtaining planning approval from the relevant authorities. The rest rules are not popular among them probably due to age and the strategic location of the agency’s office. However,
regardless of the popularity, and the pressure mounted by the respective agencies enforcing the rules, residents do not know the significance of the rules and neither would they apply anyone on their own if not enforced.

It is appalling that very many city dwellers are not really interested in the knowledge of environmental codes around private properties. Until one is suggested to them they hardly remember one of codes, regulations or laws on their environment on their own. Their inability to feel the presence of the government in terms of adequate facility provision and services keeps in them a ‘psyche’ that they are on their own. A large percentage of the respondents are aware of the existence of the Governmental agencies dealing with different aspects of the environment only when they need to get things done through them. Once the developers are through, they don’t care about their other functions. For instance only few are aware of FEPA (Federal Environmental Protection Agencies). This may be because of the presence of billboards and media signage that points to the agencies in the city.

NESREA scored 2.75, implying that so many respondents don’t even know that NESREA (National Environment standards and Regulatory Enforcement Agency) exists. They therefore erect sign posts indiscriminately without consideration for the traffic comfort of the area. Relatively, more respondents (5.72, 5.35) knew about town planners due to the pressures they mount during development control activities but they are not clear about all their functions and regulations and what codes and laws they are supposed to enforce. Although many of the sampled respondents know that there are some sort of codes yet cannot tell the exact setback from the road or airspace. Very many respondents know next to nothing about EIA (Environmental Impact Assessment). Probably due to the age of the law, only few educated older people know that land use act of 1978 exists.

It is shocking to observe that many developers do not know why setback to the road is necessary or what it is needed for. A lot of petrol filling station developers do not know why he should adhere to space standard and service radii regulations that are relevant to their built filling stations. They left everything to the decision of the architect, town planner or worse still politicians who got the approval for them either through tidy or untidy means. Many don’t even know that billboards, signposts, sewerage are regulated by the government. All these connote a very low level of conscious participation of residents in environmental management. There is less mental, psychological, practical, time and financial commitments to environmental
management; which is extremely inimical to environmental management sustainability.

<table>
<thead>
<tr>
<th>Variable</th>
<th>X</th>
<th>P.</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEPA</td>
<td>26.380</td>
<td>.009</td>
<td>Significant</td>
</tr>
<tr>
<td>NESREA</td>
<td>24.191</td>
<td>.019</td>
<td>Significant</td>
</tr>
<tr>
<td>URP decree 88 of 1992</td>
<td>36.823</td>
<td>.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Land Use Act of 1978</td>
<td>18.182</td>
<td>.110</td>
<td>Not Significant</td>
</tr>
<tr>
<td>EIA Decree</td>
<td>36.294</td>
<td>.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Building regulations and standards</td>
<td>13.035</td>
<td>.005</td>
<td>Significant</td>
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<td>Petrol filling station</td>
<td>93.910</td>
<td>.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Bill boards</td>
<td>83.429</td>
<td>.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Sign Post</td>
<td>47.279</td>
<td>.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Sewerage System</td>
<td>10.276</td>
<td>.592</td>
<td>Not significant</td>
</tr>
<tr>
<td>Back</td>
<td>15.390</td>
<td>.221</td>
<td>Not significant</td>
</tr>
<tr>
<td>Environmental management</td>
<td>25.511</td>
<td>.013</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Source: Author’s computation 2011

Environmental education level varies across the wards. However, all the wards exude similar characteristics in terms of their knowledge of land use act of 1978, rules for sewerage system and minimum setback to the road. From the data presented on table 1, most of the residents still do not register their land, depicting that they either do not know or use land use act of 1978. On the other hand, most of the respondents share similar attitude to sewerage system and road setback. There is a whole lot of differences when wards are compared on the basis of other variables. This implies that the level of environmental education differs from ward to ward. This may affect their environmental management practices.

**Environmental Management**

Each of the variables listed in the table is a composite of few variables. Likert scaling described in the methodology is used to summarise them. Toilet, bathroom, kitchen and laundry are considered basic housing facilities in the study. The rating was informed by availability and adequacy in terms of location within the building, level of dilapidation, number of users and size. Facilities considered to be basic for the community are: water supply, road, sewerage system and electricity. The residents rated these facilities based on their availability, functionality the present condition and adequacy. Incidence of landscape was measured basically through the available area left for green planting. Quality of waste management was rated by incidence of floor littering (the higher the littering the lower the score) incidence of blocked sewerage...
channel. Morbidity talks about the rate at which people in the neighbourhood fall ill due to environment related diseases. Households were rated through such variables as: incidence of environment related disease such as malaria, typhoid, diarrhoea, cholera and dysentery, percentage persons who broke down with symptoms of such diseases in the last three months and the number and the percentage household hospitalized in the last six months.

Table 3: Environmental management assessment

| Quality of | Ward | Mea
|-----------|------|-----
| Basic Housing Facilities | 6.0 | 5.3 | 5.4 | 4.3 | 3.6 | 4.1 | 4.7 | 5.6 | 4.8 | 3.4 | 3.6 | 4.6 | 4.62 |
| Community Facilities | 4.2 | 4.4 | 4.0 | 3.6 | 4.3 | 5.6 | 5.6 | 4.5 | 5.7 | 4.6 | 4.5 | 4.5 | 4.79 |
| Landscape Incidence | 0.5 | 5.5 | 3.0 | 4.5 | 4.0 | 6.5 | 2.0 | 4.7 | 5.5 | 3.0 | 0.0 | 4.0 | 3.60 |
| Solid Waste Management | 3.4 | 5.7 | 5.1 | 4.3 | 5.3 | 4.3 | 3.7 | 7.0 | 4.5 | 3.3 | 4.1 | 3.5 | 4.50 |
| Sewerage management | 2.0 | 4.5 | 5.5 | 4.5 | 5.5 | 6.0 | 3.5 | 0.5 | 7.0 | 3.0 | 2.5 | 4.5 | 4.08 |
| Morbidity | 1.5 | 6.4 | 6.4 | 4.4 | 5.9 | 5.4 | 3.5 | 1.5 | 5.9 | 5.9 | 1.5 | 6.4 | 4.56 |
| Motorized Accessibility | 1.5 | 5.4 | 5.4 | 5.0 | 5.4 | 6.9 | 3.5 | 1.5 | 8.9 | 4.5 | 2.0 | 5.4 | 4.62 |
| Sanitation | 5.2 | 5.2 | 5.2 | 5.2 | 4.3 | 4.2 | 7.7 | 4.7 | 1.0 | 9.3 | 4.6 | 7.7 | 5.2 | 5.43 |
| Economic Value | 4.3 | 5.2 | 5.3 | 4.3 | 4.8 | 4.8 | 6.7 | 6.3 | 1.0 | 7.7 | 3.9 | 5.8 | 5.3 | 5.05 |
| Environmental characteristics | 4.4 | 7.4 | 4.4 | 3.4 | 5.4 | 6.9 | 6.9 | 1.5 | 5.3 | 6.4 | 5.9 | 5.9 | 5.32 |
| Aesthetics | 3.0 | 4.5 | 4.7 | 5.8 | 5.2 | 4.1 | 3.5 | 3.0 | 5.8 | 4.8 | 2.6 | 4.7 | 4.31 |
| Mean | 3.24 | 5.41 | 4.95 | 4.66 | 4.87 | 5.81 | 4.63 | 2.89 | 6.4 | 4.31 | 4.01 | 4.91 | 4.01 |

Source: Author’s computation 2014
Key: 1-Adewole, 2-Ajikobi, 3-Alanamu, 4-Baboko, 5-Warra-Egbejila, 6-Magaji Ngeri, 7-Odota, 8-Ogidi, 9-Oko Erin, 10-Oloje, 11-Ubandawaki, 12-Zarumi.

On the residents’ scale of priority, business-like neighbourhood of high economic value tops the list (5.05 and 5.32 respectively). The third composite that scored higher than average and relative to others was sanitation (5.43). Residents seem not to worry about the aesthetic value of their environment. They are somewhat committed to the elemental sanitation and probably the reason they embrace other good practices in their environment is to support its economic value. Planners and policy makers in their environmental design may want to make plans that are economically responsive, for a more wilful residents’ participation in environmental management. The degree of motorized accessibility either by road, organized footpath, unorganized path or not accessible at all was measured. Residents’ perception of environmental sanitation was ranked as very much adequate, adequate or not adequate. Economic value includes such indices as land value, rental value, threshold of population, land use mix, and business prospects. Environmental
characteristics may be calm, noisy, rowdy, stinking, beautiful, lively, business-like and dull among others. Respondents rated these parameters and they are all summarized into a composite using the likert scaling.

Table 4: X² Test of difference in environmental management practices

<table>
<thead>
<tr>
<th>Variable</th>
<th>X</th>
<th>P.</th>
<th>Remark</th>
</tr>
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<tbody>
<tr>
<td>Basic Housing Facilities</td>
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<td>.031</td>
<td>Significant</td>
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<td>Community Facilities</td>
<td>47.135</td>
<td>.101</td>
<td>Not Significant</td>
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<tr>
<td>Landscape Incidence</td>
<td>57.222</td>
<td>.014</td>
<td>Significant</td>
</tr>
<tr>
<td>Solid Waste Management</td>
<td>26.711</td>
<td>.318</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sewerage Management</td>
<td>20.708</td>
<td>.656</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Morbidity</td>
<td>9.066</td>
<td>.697</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Motorized Accessibility</td>
<td>15.814</td>
<td>.200</td>
<td>Not Significant</td>
</tr>
<tr>
<td>Sanitation</td>
<td>28.783</td>
<td>.004</td>
<td>Significant</td>
</tr>
<tr>
<td>Economic Value</td>
<td>67.114</td>
<td>.000</td>
<td>Significant</td>
</tr>
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<td>Environmental characteristics</td>
<td>47.457</td>
<td>.003</td>
<td>Significant</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>23.971</td>
<td>.033</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Source: Author’s computation 2014

The chi-square analysis reveals that wards are similar to each other in terms of level of community facilities solid waste management, sewerage management morbidity and motorized accessibility all of which are municipal responsibilities. For most of the environmental components that are individually controlled; for example, landscape incidence, basic housing facilities, sanitation economic value and aesthetics, there are differences which are statistically significant. This would mean that environmental management practices are better at some areas than others which may be dependent on the level of environmental education.

Electricity is a problem in most parts of the country, so it adds only a little weight to the composite of ‘basic community facility’. However, it is relatively better in Ilorin because of the presence of the national station in the city. The fact that many residents rates it high is not quite surprising. Most residents depends on personally made wells for domestic water use; perhaps because of the irregular and sometimes absent setback to the road and worse still the vandalism of the existing utility lines which now have made it impossible to connect water pipes to homes. Several buildings especially in the downtown are inaccessible by road or motorized transportation making it difficult to enjoy basic utilities and services. There is poor landscape development in many areas (3.6) sampled.

Studying tables 1 and 2, the attitude of residents to environmental education and the elemental environmental management seem to follow a similar pattern. There is a generally low level of both environmental education and environmental management
practices. Wards that exhibit a relatively high level of environmental education seem to be having a better environment. This raises the hypothesis: is there a reliable relationship between environmental education and sustainable environmental management?

**Relationship Environmental Education and Environmental Management**

The mean value of environmental education was regressed on those of environmental management and the result is presented on table 3. With the F value of 23.133 and P value of .000 and having a regression coefficient of joint correlation of .817 at 95% confidence level; it may be concluded that there is a reliable relationship between the two. The coefficient of determination \( R^2 = .668 \) suggests that there is 66.8% overlap between environmental quality and literacy. This implies that environmental education plays a vital role in sustainable environmental management. Although there are other factors of environmental management left unaccounted for, environmental education has the propensity up to 66.8% to influence sustainable environmental management.

<table>
<thead>
<tr>
<th>SN</th>
<th>Dependent</th>
<th>Independent</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>P.Value</th>
<th>B</th>
<th>P.Value</th>
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<tbody>
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<td>1</td>
<td>Environmental</td>
<td>Environmental</td>
<td>.817</td>
<td>.668</td>
<td>23.133</td>
<td>.000</td>
<td>47.143</td>
<td>.007</td>
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<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.18</td>
<td>.084</td>
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</tbody>
</table>

Source: Author’s computation 2014

Calibrating the model therefore, we have:

\[ y = a + bx + e \]

Where:  
- \( y \) = Dependent variable (Environment quality)  
- \( a \) = Constant  
- \( b \) = Regression coefficient of the Independent variable  
- \( X \) = Environmental literacy (Independent variable)

The relationship is therefore given by:

Environmental management = 47.143 + 1.18 (Environmental education) + e

From the equation above, a unit increase in environmental law usage will produce a corresponding 1.18 improvement in sustainable environmental management. The planning implication is that a significant improvement in environmental literacy is indispensable to improving environmental management in the study area. Public awareness such as environment related programs in indigenous
language or dialect and advertisement among others; and the inclusion of environmental education in school curriculum are ways of reducing environmental degradation.

**Recommendation and Conclusion**

The level of environmental education and environmental management followed a somewhat similar pattern across the 12 twelve wards of the study area. The study showed poor level of environmental education as well environmental management. According to Olurin (2006), the environmental problems faced today in cities is critically dependent on the stage of development, level of affluence and government policies on the environmental issues. To this end, the study recommends improvement in environmental education.

The study showed a poor level of environmental knowledge and usage cutting across all the wards sampled. This would mean that different category of residents in terms of socio-economic status are involved. Public campaign should be carried out among these various groups by government and other environmental agencies; differently targeting them. For instance different environmental campaign style would be suitable for different language, dialects, uneducated and the educated residents. Dissemination of information should be made sensitive to this need across any community. Because of the general low level of environmental education, learning would be more sustainable if environmental education is integrated into school curricula and pedagogical process.

A cue can be taken from the activities of Wisconsin, USA and Lagos State Government of Nigeria who have endeavoured to include environmental education into the school curricula of both the primary and secondary schools. Various activities are lined up to teach the children about the effects of various activities have on the environments and the ways in managing and sustaining the environment. Books are shared among students and pupils showing the various effects of man’s activities which are illustrated in form of cartoon characters which are easier to understand and remembered by the children. These illustrations and stories are published and distributed to schools within the state and other children magazines around in collaborations with various corporate bodies and NGOs. Also, competition such as drawing, painting, and compositions for primary and essay for secondary schools are
created for the students to participate in with rewards given to them to encourage them in knowing more about the environment.

**Acknowledgement**

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Creativity in learning is as important as literacy. Children prosper best in a broad curriculum that celebrates their various abilities. The current formal education system aims to realize what children can do over a very narrow spectrum of achievement. Though formal education is necessary for child development, it is not sufficient in inspiring creativity. The structured and examination oriented nature of formal education can stifle critical thinking, creativity and extinguish curiosity. Oppositely, informal learning is a continuous process that occurs in a variety of places that stimulates, provokes, engage and spark creativity in children. Unfortunately, very little research highlights the relationship between informal learning and environment. Even less present the potential of informal learning settings from a design perspective. These informal learning settings which include urban centres speak to parts of children’s being that otherwise remain disengaged. Many factors inhibit children from urban centres thereby limiting the possibility for educational exploration to formal environments.

This paper presents part of the literature of an on-going study of informal learning for children in their urban environment. It discusses the relationship between play, informal learning and the urban environment. An agreement is made for play and exploration in the urban environment as the missing link for creativity and informal learning in urban environments. It further highlights the importance of play and discusses the implication of play deprivation and its consequences.

**Keywords and phrases:** creativity, informal learning, development, play, urban environment, exploration

**Children’s creativity and environment**

Many writers have contributed to the discourse on creativity for the past 60 years nonetheless, the definitions are not straightforward. However there is a general consensus among theorists that imagination, originality, productivity, problem solving and the production of a valuable outcome constitute the creative process. Definitions of
creativity differ most strikingly in attempts that identify creativity as a human characteristic and those that distinguish creative people from others. Professor Ken Robinson presents a ‘democratic’ view to creativity in relation to education. “All people are capable of creative achievement in some area of activity, provided that the conditions are right and they have acquired the relevant knowledge and skills” (Robinson, 1999). So many may confuse creativity to be the same as intelligence however, theorist have shown creativity to be distinct (Sharp, 2004). One of several myths of creativity is that it is an in-born trait, limited to the talented few. For this, many children miss the opportunity to develop their creativity because of a lack of encouragement and support from the places they exist in (Sharp, 2004).

Research showed that different factors such as formation of interests (Cohen, 1999), motivation (Fasko, 2006) and the culture one grows up within (Super and Harkness, 1999) can impact children’s creativity. Can a stimulating physical environment enhance children’s creativity? Theorists believe that the physical environment that children grow up within strongly influences their problem solving and creative thinking abilities. With reference to Professor Ken Robinson democratic view of creativity, the element in focus is ‘providing the right condition’. Mellou (1996) mentions a creative environment as one of three aspects for nurturing young children’s creativity. Most theories of child development view young children as highly creative, with a natural tendency to fantasise, experiment and explore their environment hence, the fundamental to the creative environment is the encouragement of children’s play. Play is strongly featured in many of the discussions about creativity in young children. Imaginative play (especially role play) and free choice of activities would seem to be key components of the early childhood setting in relation to creativity. Both creativity and play requires imagination, insight, problem solving, divergent thinking, an ability to experience emotion and to make choices (Russ, 2003). Russ (1996) has also developed a model to explain the relationship between creativity and psychological processes. This model suggests that personality traits, emotional processes and cognitive abilities are part of the creativity and psychological processes. On the other hand, like Russ’s model, other researchers also state that the physical environment is a complex and healthy environment for the physical, cognitive/intellectual and socio-emotional development (Boldermann et al., 2006; Brownson et al., 2001; Caplan & Harrison, 1993; Spencer & Woolley, 2000; Striniste & Moore, 1989), of children however; children’s independent mobility and place exploration have become increasingly constrained in urban environments (Bartlett et al. 1999; Chawla, 2002; Gorlitz et al, 1998; Hart, 2002; Katz, 2004) thereby restricting the creative process within children in the urban environment.

Two key issues raised by Runco (1990) concerning the environment in early
childhood settings are firstly, the stimulation for play offered by children’s physical environment is important. This includes the size and layout of outdoor spaces, the quality of equipment and materials, and access to varied and new environments through place exploration. Secondly is the need for children to be given sufficient and sustained periods of time in which to develop their creativity. Several research focus is on the development of creativity in formal educational settings. However, it is often forgotten that children exist in various environments. Many urban children today are unable to meet their needs for independent and stimulating play and exploration of their urban environment (Chawla, 2002; Hart, 2002) due to a lack of environmental affordance. Since children living in city centres spend most of their time indoors due to worsening environmental conditions coupled with negative parental perceptions of the urban environment, opportunity for play and creativity cannot have a significant role in their developmental process (Marcus, 1998; Moore & Wong, 1997).

**Informal learning and environment**

Leadbeater (2000) states, the formal learning system is seen as institutionalized training, which represents compulsory education that involves children spending hours sitting in a structured and controlled environment doing clerical work in a daily basis. Rather than the development of capacities, education is perceived as an acquisition of knowledge with minimal practical application in real life experience. The prevalent opinion of education within the formal school environment is a limitation to knowledge and its application through various modes of exploration and affirmation of knowledge accumulated. This continuous limitation stunts exploration and creative thinking and ideas among children in their physical environment.

Coffield (2000) argued that the term ‘informal’ is associated with so many other features of learning situations – such as behaviour, discourse, dress, arts, crafting, social inclusion etc. – ‘that its colloquial application as a descriptor of learning contexts and should not be seen separate from formal learning as both are intertwined. However, Coffield further emphasises on informal learning as a necessity to learning as a whole.

Though formal education is important, there are several ramifications to prolonged hours of control imposed by today’s school systems. The finding from Meador (1992) highlighted that children are apparently more creative before they enter kindergarten. This leads to the question of whether their experiences in kindergarten (formalising their learning process) somehow caused the decline. Though it can be argued that physical education, critical thinking or problem solving is incorporated into school curriculums, it is not sufficient for the amount of physical activity need by children and could result in disruptive behaviour (Robinson 1990). Furthermore, the European Union has often shown the importance of informal learning "to encourage cooperation
and effective measures for validation of learning, which is crucial for building bridges between formal forms of learning, learning in the environment...” (ECDVT, 2007). Children’s learning through, play in the outdoor environment, is often trivialised and placed low on the funding agenda of cities” (Hart, 2002, p. 136).

Marsick et. al (1990) point out that informal learning outcomes depend, in part, on the degree of consciousness or awareness with which one attends to learning and the environment that brings learning opportunities. They further that formal learning opportunities heighten awareness but are divorced from real life action. Like many other writers on informal learning, they also state that for informal learning to be beneficial, it should be linked to something that involves some conscious attention, reflection and direction for example, meaningful job opportunities, some premeditated activity, etc. (Marsick et. al, 1990). For this reason, informal learning is often written about in the perspective of adult learning. Dale and Bell (1999) in their article ‘Informal and incidental learning in the workplace’. It can be argued that such premeditated activity that results in learning can happen for children in a similar manner by observation. For example, a child can learn how to make a dish; or picking-up an artistic technique from a street artist. Though a counter argument can be made for learning similar skills in a formal environment, it is clear that there is an element of ‘freedom’ that better engages children in informal environments. Furthermore, looking at the environment as a facilitator that provides a wide variety of activities for children to choose from expands further their learning experience from the limiting ‘classroom’ environment and in many cases, further validate formal education.

Ordinarily informal learning takes place beyond the classroom setting where there is a strong sense of freedom or non-structure– on the street, in youth clubs and settlement houses, in residential facilities and faith settings, as well as in schools and colleges (Jeffs and Smith, 1990). With regard to schools, it occurs in environments with minimal supervision such as: in corridors, dining halls, playgrounds, and public spaces during breaks and before and after formal lessons where times and venues are not fixed.

At present, researchers have focused their investigation to schools, homes, neighbourhoods and nature; and in that order. There is also increasing attention on the environment for independent mobility between the school, home and neighbourhoods. It is often forgotten that children exist and learn beyond these spaces thereby limiting learning opportunities to only these environments.

The importance of environment to informal learning

Children develop an understanding of themselves through interactions with events and materials within the environment (Piaget, 1962). They live continuously in the here and now of experience; feasting upon nuances of colour, light, sound, odour, and touch.
Their responses to the environment are immediate and inseparable from the sources of stimulation around them. Informal learning is an unending process fuelled by curiosity and discovery; as such, new experiences are attacked with earnest. For a child almost every experience is new, therefore informal learning takes place all the time and in all environment and is not limited to one institution or environment but is "guided by the decisions made on what we value and the places supported to perpetuate what we value" (Barnard, 1980). Although it is a complex process, children do not need to be forced to learn; they are motivated by their own desire to make sense of their world.

According to (Bredekamp, 1987), children perceive a world that can be measured and calibrated and one that is felt with playful imagination. Being sensory oriented, they learn about the physical and social world in which they live through playful interactions with other objects and people. To them, outdoor environments should be physical environments that offer moderate levels of readily available stimulation (Striniste & Moore, 1989). While outdoors, children have more freedom of movement, thus enabling them to develop their visual and motor abilities (Cosco, 2006; Pica, 1997). The outdoor environment’s variable and less constraining qualities provide more opportunities for learning than indoor environments for children to make decisions, solve problems, and stimulate creative thinking (Burdeette & Whitaker, 2005) through play. Opportunities for independent mobility help develop children’s sense of wonder and imagination (Pica, 1997). Developmentally designed outdoor spaces lend themselves to spontaneous interaction, while offering children a chance to adjust to individual differences. Outdoor environments set the stage for children’s playful exploration, construction, and problem invention and solving. These playful exploratory experiences develop children’s scientific curiosity to create realistic theory about the world (Natural Learning Initiative, 2007).

**Play: The missing link between informal learning for children and the urban environment**

One of the views in education is a dichotomy involved in presenting play and learning in an ‘either, or’ relationship when there is a third possibility of once enhancing the other (Figure 1, left). There’s a similar but slightly less simplistic view that learning and play form a continuum, where more time spent in play means less spent in learning, and vice versa (Figure 1, right).

![Figure 1: The dichotomy between learning and play (left). View that learning and play form a continuum (right). Adopted from Hyde and Rugg, (2014).](image)
These views appear to translate into everyday life for both primary care givers and the children themselves. Under constant supervision, they fear playing during classroom hours which are ‘allocated for learning’ and only feel the freedom to play beyond the formal environment.

However, many theories and child specialist today have investigated that a strong link exists between play and learning in any environment through play exploration. Therefore, children need to be facilitated and exposed to different possibilities for play in all possible environment to build the socio-emotional and cognitive learning capacity. According to Hughes (1999), “Play is freely chosen, personally directed, intrinsically motivated behaviour that actively engages a child”. According to National Play Needs, NPF (2000) it is also described as fun or serious. Through play children explore social, material and imaginary worlds and their relationship with them, elaborating all the while a flexible range of responses to the challenges they encounter (NPF, 2000). Because play is an impulse and is intentional only in being about what interests children themselves, it is accompanied by the ‘freedom’ to choose an interest unmotivated by reward (which cannot be argued for formal learning). It is in this state of freedom and intentional interest that informal learning in children can happen. Play often, though not always, implies a sense of fun for the child. But it can also be serious, in two senses (NPF, 2000). The child may feel serious while playing, and/or the content of the play may be serious, that is, not trivial or light-hearted. Much free play is reflective. Play is as much in the approach as in the activity - a way of doing anything or nothing (NPF, 2000).

Theorists concur that the role of play in child development is under-explored. However, the theories and findings do allow some reasonably firm proposals about the contribution play makes to learning, health and well-being. Referring to the turn of the 20th century in Hall’s Recapitulation Theory (1904), and supported and developed in the 1970’s, (Lorenz 1972, Bruner 1972, Bruner and others 1976, and Sylva 1977), play now features as an important consideration in the current rapid development of the brain sciences and the flood of neurobiological data (Hughes 1999). Citing Huttenlocher’s work on brain imaging technology, Sutton-Smith (1997) states that in the first ten years of life, human children have at least twice the synaptic capacity as children over ten, whilst Bennet et al. (1964), Rosenzweig et al. (1971, 1972) and Zuckerman (1969, 1984), link this ‘plasticity’ to the effects of enriched environments (NPF, 2000). This increasing understanding of the working of the brain is also leading to a reassessment of what is now called emotional intelligence (Goleman 1996). It is also giving rise to suggestions that play in young children may have a critical role in the enlargement of brain capacity (NPF, 2000). Below is a conceptual framework on the relationship between play, learning and urban environment.
The importance of play in development and informal learning must not be underestimated. Informal learning is a by-product of play and is, as such, considered inseparable from it. Play is a key element in children learning to appreciate, assess and take calculated risks, which is fundamental to the development of confidence and abilities in childhood (NPF, 2000). Children seek out opportunities for risk-taking and it is the responsibility of play provision to respond with exciting and stimulating environments that balance risks appropriately (NPF, 2000). Adults tend to devalue play as frivolous, and unproductive; considering it merely for its amusement value; an opportunity to vent energy. Rarely is it linked with the concept of learning. In actuality, it is a vital and critical part of a child's development, being linked with creativity, informal and language learning, problem solving and the development of social roles. Taken individually, no single theory adequately explains the rich diversity and benefits of play or even accounts for the constructive and imaginative play that exists. Even reading and writing are governed by playful experiences, in that the abilities are learned by handling objects and talking about them. The essential qualities of play that differentiate it from work or leisure is that it is: pleasurable, has no extrinsic goals, is spontaneous and voluntary and it involves active engagement by the participant. There is a poverty of play opportunities in the general environment, and it is the responsibility of the community to ensure that all children have access to rich, stimulating
environments that are free from unacceptable risk, and thereby offer children the opportunity to explore both themselves and the world, through their freely chosen play (NPF, 2000).

Current state of play and exploration in urban environments

Cities afford diversity and complexity. They offer risk, danger, and adventure. In large urban centres changes can be rapid, unpredictable, or continuous, and can offer social, cultural, economic, and political diversity, as well as other qualities such as different types of built forms, natural environments, anonymity, novelty and 'strangeness,' and danger. Urban environments have a "complex sensory dimension, geographical differentiation, setting selectability, ambience, public accessibility and changeability" (Proshansky, 1978, pp. 160-169). Holcomb (1977), for example, speculated that cities provide stimulation for children's development in similar ways as nature. She suggested that most of the desirable qualities of the woods, such as changeability, seasonability, spaciousness, unpredictability, secrecy and mystery, manipulability (loose parts), irregularity, variety, and collectability, can be found in urban settings as well. She believed “that it is quite possible for the urban child ... to grow into a fully functioning, happy human...” (Holcomb, 1977, p. 33). Thus, exposure to the urban environment is a positive experience for children because it is a tremendous source of stimulation and exploration.

On the other hand, urbanisation and the disengagement of public investment have raised a host of issues for children’s use of public urban spaces, including: layout of cities, traffic flow issues, crime, parental fears, and increased commercialization of children’s play-space. Instead, city centre living in developing countries is advocated for a combination of economic and cultural factors with high demands on employment. Given the high densities of city centre development, the majority of properties available are apartments for foreign investors and high income groups, offices buildings, and commercial developments. For the benefit of bringing people back to the city centre, governments in many developed and developing countries have opted for wider roads, increased subsidies on cars, to give way to people entering the city via motor vehicle due to separated land uses. The consequences of such actions are the absence and marginalisation of children from the city centre’s urban environment which would otherwise hold tremendous possibilities for various types of learning in particular, informal learning. The absence of all demographics form city centre spaces has led to intergenerational gaps and social stratification in cities (Chawla, 2002) reducing the possibility for children to learn from the activities of others and to develop their skills. Worst of all, these issues that arise in urban environments have destroyed the possibility for play and exploration for children in the urban environment. Those impacted the most
are children living in urban environments as they are under constant supervision without freedom.

**Play deprivation and its consequences**

Research in the field of neurology shows that in very young children, early play experiences have a crucial role in the cognitive development of all young children, and add weight to the argument that play continues to have a role in cognitive development throughout childhood. “*The new scientific research... does suggest, though, that a radically deprived environment could cause damage... a brain can physically expand and contract and change depending on experience*”. (Gopnik, Meltzoff and Kuhl 1999).

Extensive studies on the US High/Scope approach to early childhood education (Schweinhart and Weikart 1997) and the more recent Swiss Government-funded research in Zurich (Hüttenmoser and Degen-Zimmermann 1995), referring to what they describe as ‘battery children’, attribute play deprivation symptoms to a lack of play, resulting from traffic and parental fears of predatory adults (NPF, 2000). They go on to describe ‘battery children’ as whinny and habitually aggressive. By the age of five they are emotionally and socially repressed, find it difficult to mix, fall behind with school work and are at a much greater risk of obesity (NPF, 2000).

According to studies by Balbernue, (1999), the effects of stress, trauma and low levels of stimulation on brain development will be reflected in an inability to link up fully those neural connections and pathways which will be needed for later learning. There are also some agreements on the possible ramifications of deprivation of play. Researchers agree that a lack of play could lead to: poor motor tasks, lower levels of physical activity, poorer ability to deal with stressful or traumatic situations and events, poorer ability to assess and manage risk and poorer social skills, leading to difficulties in negotiating social situations, such as dealing with conflict and cultural difference, reduced possibility (NPF, 2000). In school and educational settings, a lack of play potentially impairs concentration in the classroom, and can deny children the chance to apply their learning in concrete situations. Finally, it could be argued that children who never have the chance to try out a range of activities may have undiscovered or latent talents, abilities that might have developed if the ‘right condition’, encouragement and support had been available (Robinson, 1999 and NPF, 2000).

**Conclusion**

This research topic was selected to understand and highlight the importance of having children in the urban spaces for their development. At present, there is no consideration of quality spaces for children in urban environments and there is no emphasis on the learning benefits the urban environment could have for informal
learning. The study advocates a better environment in urban environments for all by considering one often marginalised from urban spaces. Bringing children to public space strengthens their sense of belonging and awareness and improves well-being not only to the children but to the community as a whole. It also promotes the idea of quality environmental design for all as designing for children includes bridging intergenerational gaps and blurring the lines of social stratification.

Furthermore, the research done on the inclusion of children in public spaces is not profound enough for action to be taken on how to improve urban environments for children in the cities. This research presents the possibility of outdoor urban environment spaces as educational spaces that can promote play, exploration, curiosity and creativity among children thus, creating intellectuals with strong critical thinking and problem solving skills.

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References


INTEGRATING GEODESIGN AND CONVENTIONAL SPATIAL ANALYSIS METHODS IN EVALUATING COMPACT CITY DEVELOPMENT

Ahmed Owaid¹ and Soheil Sabri²

¹,² Centre for Innovative Planning and Development (CiPD), Universiti Teknologi Malaysia/Faculty of Built Environment, Malaysia
E-mail: ¹arc.aah@gmail.com, ²soheil@utm.my

Improving and evaluation of development plans is an essential to ensure a better planning and design practice. During the last decades, urban areas developments have been spreading in an irrepressible manner with massive population movement in cities leading to one of the common seen problems, urban sprawl. Compact City development is an urban design and planning concept that is noted to be very useful to ensure the sustainability of future urban development. This concept is proposed to overcome environmental, economic and social problems caused by urban sprawl. However, the outcomes and impacts of compact city development in an urban area are not clear if using the conventional spatial analysis methods for evaluation. This study intends to improve and advance the process and methodology of assessing compact city development taking benefit from the new emerging concept of GeoDesign and integrating this concept with GIS analysis techniques. The study formulates a conceptual framework to ensure a sustainable development in an urban area based on Compact City concept. As a result, this study highlights the urban development 2D and 3D indicators associated with the underpinning theory. Ultimately, the study illustrates how a composite sustainability index map can be improved by GeoDesign approach for evaluating the compact city development.

Keywords: Compact City Development; GeoDesign; Spatial Analysis; Composite Sustainability Index

Introduction

Development Plan evaluation and assessment is an essential and it can contribute to a better planning practice, the plans should be evaluated to achieve desired goals and objectives. Increasing number of researches has explained on the process of sustainable development principles, particularly at the city level. In addition, a high number of scholars have explained urban sustainability implementing and measuring from various aspects (Olgu, 2004).

To achieve the desired goals and objectives of development planning, control
development programs as well as evaluating alternatives that are in line with current and future scenarios, an effective planning approach is required. For long time, Geographic information system (GIS) technology has been practiced in planning activities, which basically include plans preparation as well as development control (Johar et al., 2003).

Indicators have engaged an extensive range of interest, and this has led to development of a great number of quite successful urban sustainability assessment practices. Subsequently, this research has proposed a set of sustainability indicators with giving them different values according to their importance for the sustainability under each scenario. The most recent use of 2D GIS indicator-based comparative urban sustainability assessment is to develop composite sustainability index maps. As Meadows noted (1998), indicators originate from values and they generate values; consequently, the major benefit of an indicator based model for comparative urban sustainability assessment is the quantifiability of the comparative sustainability levels.

Despite many advantages, conventional methods of GIS application do not provide a realistic physical representation of the city or development being studied. However, three dimensions (3D) views of the city are key tools for increasing understanding and improving communication. 3D visualization and analysis of environmental properties is an efficient way of assessing the impacts of urban projects. So, the three-dimensional geographical information system (3D GIS) is well adapted to help in sustainable urban planning (Trung et al., 2007).

Additionally, the representation of built forms within GIS remains simplistic, usually consisting of 2D footprints. This makes it difficult to conduct neighbourhood, city or regional scale assessments that take into account important characteristics of design proposals (Flaxman, 2009). On the other hand, Compact City development as an urban design and planning concept, which its design aspects can be represented using 3D indicators, while 2D indicators are useful to show the planning aspects. As such a concept like GeoDesign can incorporate both of these two components to improve the planning and design process as well as its evaluation.

GeoDesign is a planning and design approach which tightly combines the formation of a design proposal with impact analysis informed by geographic context (Flaxman, 2010). Furthermore, Abukhater and Walker (2010) noted that GeoDesign is a growing concept for a practice that combines GIS techniques with design and to develop advanced tools for urban design, planning, architecture and community development. In other words, GeoDesign brings geographic analysis into the design process, where initial design sketches are promptly examined for suitability against a many of database layers representing a diversity of physical and social factors for the spatial extent of the project.
GeoDesign has the ability to evaluate development plans through GIS analysis models and its product of urban design through 3D GeoDesign visualization. So far, GeoDesign has not been applied for evaluating the compact city development so this study is going to develop a framework for this purpose. As a result, the evaluation of Compact City development can be carried out more effectively through GeoDesign by improving both Compact City plans and the planning process.

**GeoDesign Approach**

Environmental understanding and decision making has a long history of involving GIS technology. Planners, scientists, policy makers and others worldwide depend on GIS for data management and analysis. However, new levels of complexity are required to face the challenges of our natural and human environments. As a result, the development of GeoDesign theory, tools, and concepts had been pursued actively by a dedicated group of people (ESRI, 2010).

Flaxman (2010) defines GeoDesign as a planning and design approach which tightly combines the formation of a design proposal with impact analysis informed by geographic context. In other words, the capability of creating compute-intensive simulations by modern GIS of the impacts of design scenarios delivers an additional dimension to the conventional planning process, with its focus on visual display and insight. GeoDesign is planning process informed by scientific knowledge of how the world works, expressed in GIS-based simulations (Goodchild, 2010).

GeoDesign is not a re-establishment of the old methods of overlay mapping, but a method of using, combining and adapting the tools of GIS to very diverse frameworks. Batty (2013) in his paper in defining GeoDesign highlights following items: using design in science as well as science in design, building on powerful and new procedures in addition to rational chains of reasoning, prescription and predictions. Although GeoDesign is still an inaccurately defined term, it has been established to contain the following essential elements: Sketching, Spatially informed models, Fast feedback, Iteration and 3D visualization (Abukhater and Walker, 2010; Dangermond, 2009; Goodchild, 2010 and Wheeler, 2010).

Abukhater and Walker (2010) explained that GeoDesign is an art practice because it includes components of sketching and design. It is a science because it includes components of analysis and modelling. GeoDesign improves cooperation, monitoring of implications, scenario creation, continuing feedback, and appraisal and selection of optimal designs that reflect a society's desires and visions for the future (Figure 1).
The Application of GeoDesign in Compact City

Sustainable development is the key goal of the planners and decision makers today and hence we need to develop advanced geospatial technologies along with design process to achieve this goal (Dangermond, 2009). However, the aim of compact city policies is to address integrated urban policy goals, or urban sustainability goals (economic viability, environmental quality, social equity, etc.). Compact city policies are expected to play a role in meeting these goals because, by influencing the use of space in cities, they can substantially improve cities’ environmental, social and economic performance (OECD, 2012). GeoDesign has the potential to improve design and planning process and hence it remains inevitable to pursue the concept.

GeoDesign approach combines GIS and 3D urban models and embed the 3D models in the surrounding landscape that is characterized by GIS data, to contextualize the urban area that is undergoing sustainability assessment. The ability to visualize part of the city that is undergoing the development or regeneration within the wider city context is likely to improve engagement with the communication tool and bring a greater level of involvement from all participants in the planning process (Levy, 1995).

Compact city evaluation becomes more efficient when innovative techniques and new technologies are used to help develop more context-sensitive plans and support a more flexible, collaborative planning process. An increasingly powerful part of this help comes from tools for GeoDesign. Accordingly, GeoDesign is leading to improve the evaluation and sustainability assessment of the future development by the comprehensive counting of the compact city concept criteria including 2D and 3D criteria.
Compact City Development

Many literatures on planning from 1990 onwards emphases on compact city concept as a concept intended to achieve development sustainability within the urban environment and to pawn the observed negative environmental, economic and social effects of urban sprawl (Arbury, 2006). According to Burton (2000), Compact City is generally a high density, mixed uses city, providing an effective public transit systems and measures that encourage cycling and walking. As a result, by intensification of development within boundaries of the city, problems associated with urban sprawl can be avoided, addressing unsustainability of sprawled developments.

In Europe, a major keystone was the "Green Paper on the Urban Environment" published by the European Commission in 1990, which introduced the concept of the "compact city" as the archetypal sustainable urban form for European cities. According to Thomas and Cousins (1996) first impressions suggest an intense medieval city with clearly invisible limits, and where the hubbub of daily activity is limited within the city's boundaries. It is the product of a certain form, scale, and mix of activities (Burton and Williams, 1996). In addition, Breheny (1993) provides an appropriate summary of the Compact City as a mixed uses, high density city, where development is encouraged within the existing urban areas and without any development outside its boundary.

Generally, Burton (2002) identified three aspects of the compact city: a high density development, mixed land uses, and a high degree of intensification. The first two characteristics are associated with the city form of compact development while the third one is related to the process of making the development more compact. As a result, high compactness cities can only be attained by a practice of making existing development more dense, and encouraging people to live in in urban areas of higher densities of intensifying cities (Williams et. al., 1996). Various approaches of intensification have proposed in an effort to repeat the apparently desirable development of high density cores of old European cities, such redevelopment of existing buildings or previously developed areas at higher densities, development of undeveloped urban areas, additions and extensions, and conversions and subdivisions (Williams, 1999).

Burton (2002) has specified that the task of measuring urban compactness includes three processes. Firstly, describing and identifying the numerous aspects of urban compactness which is the main focus of this section. Second process is to develop indicators for measuring each of these aspects which will be carried out by this section of the research to involve urban planning and design indicators including 2D and 3D indicators. Thirdly, calculating and reviewing the measure of indicators.

Based on the literature, this study proposes a set of core compact city indicators
including 2D criteria and 3D criteria that are considered essential for analysing compact city sustainability assessment at the city centre level or metropolitan. As Compact City development is an urban design and planning concept, design aspects of this concept are represented by proposing 3D indictors while 2D indictors represent planning aspect indicators. However, table 1 represents the proposed criteria for compact city sustainability assessment.

**Table 1: The proposed Criteria for Compact City Sustainability Assessment.**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicators</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density and Proximity</td>
<td>• High Density of Population</td>
<td>• gross density (persons per hectare)</td>
</tr>
<tr>
<td></td>
<td>• High-density sub-centers</td>
<td>• net density (dwellings per hectare)</td>
</tr>
<tr>
<td></td>
<td>• High Density of built form</td>
<td>• Density of Population by buildings</td>
</tr>
<tr>
<td></td>
<td>• Density of built form</td>
<td>• Buildings proximity</td>
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<td></td>
<td></td>
<td>• Mono-centric or polycentric urban structure</td>
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<tr>
<td></td>
<td></td>
<td>• Buildings high</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Floor Space</td>
</tr>
<tr>
<td>Diversity</td>
<td>• Horizontal mix of uses</td>
<td>• Mixed residential and commercial uses.</td>
</tr>
<tr>
<td></td>
<td>• Provision of facilities</td>
<td>• building types</td>
</tr>
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<td></td>
<td></td>
<td>• urban functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Quantity of “Key” facilities</td>
</tr>
<tr>
<td>Degree of Intensification</td>
<td>• increase in development (Infill development)</td>
<td>• Number of population increased</td>
</tr>
<tr>
<td></td>
<td>• Increase in population (re-urbanization)</td>
<td>• number of dwellings completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• percentage change in dwellings</td>
</tr>
<tr>
<td>Transit Oriented Development</td>
<td>• Proximity to public transport</td>
<td>• Share of population or employment within walking distance (&lt;400m)</td>
</tr>
<tr>
<td>(TOD)</td>
<td>• Mixed land uses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Density of Population</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Density of built form</td>
<td></td>
</tr>
</tbody>
</table>
### Destination Accessibility
- Matching jobs and homes
- Proximity to local services
- Public space and green areas

### Design
- urban spatial structure
- Street network
- Building design
- Street width
- compact building design
- building setbacks
- Buildings Shadow coverage
- sidewalk coverage
- pedestrian crossings
- presence of street landscape

### Affordability
- Affordable and multi choices housing
- Percentage of affordable housing
- Types of housing


In order to assess sustainability levels of an urban development, the available tools and methods of conventional spatial analysis are not enough for implementing these indicators in the process of future development evaluation. As a result, this study proposed a methodology that combines GIS spatial analysis with GeoDesign approach to develop composite sustainability index maps and 3D GeoDesign visualization models. Therefore, figure 2 represents the conceptual framework of GeoDesign application in Compact City Development that has been adopted in this study.
GeoDesign can create better sustainability assessment based on Compact city concept through improving the evaluation final results and the assessment process. The research results are better because they are based on more accurate and complete utilization of Compact City development criteria. According to Abukhater and Walker (2010), GeoDesign provides information about a plan's implications very early in the planning process, when plans still exist only as sketches and ideas. GeoDesign does not necessarily replace the more thorough, careful analysis that needs to follow as policies are written, budgets are drafted, and service capacities are engineered.

One of the best practices of GeoDesign can be learned from Honolulu city planners (2012) which represent the application of Transit Oriented Development (TOD) with GeoDesign to develop a light rail transit (LRT) to avoid traffic congestion, control urban sprawl and accommodate the demands of the growing population. The city GIS department applied the concept of GeoDesign by incorporating geographic analysis with design to effectively analyse, compare and visualize different scenarios of TOD. The team recognized three main models that are required for the TOD GeoDesign process including urban growth, walkability, and densification models. Figure 3 shows the models of TOD GeoDesign of the city of Honolulu, US. Although, this model implement the key elements of GeoDesign including sketching, spatially informed models, fast feedback, iteration and 3d visualization, it ignores urban form 3D criteria analysis which is the main focus of the
proposed framework by this paper. The 3D visualization of GeoDesign in this example is used to incorporate public participation in the planning process while the proposed framework is to conduct 3D analysis of urban design criteria to ensure high levels of sustainability by any present or future development.

Figure 3: An example of the application of GeoDesign in Transit Oriented Development (TOD). (Source: ESRI, 2013).

Conclusion

This research demonstrates that it is possible to develop a viable sustainability assessment model through the use of suitable theories and methods. Compact City development concept is an urban design and planning concept that is noted to be very useful concept to ensure the sustainability of future urban development and overcome environmental, economic and social problems caused by urban sprawl.

Accordingly, this research have investigated the criteria of sustainable development related to planning and urban form by considering planning indictors (2D indictors) and urban form indictors (3D indicators) to ensure inclusive implementation of the characteristics for involved theories of our study. Obviously, the work concluded that assessment of urban development sustainability by considering planning and design criteria can enhance the results of simulated analysis and reduces the possibilities for disregarding any of the related measures of the involved sustainable development concept.
This framework can be used in various applications. It is intended to implement this conceptual framework to measure the sustainability levels of Iskandar Malaysia development based on the comprehensive development plan (2006-2025). In addition, transport planning can be advanced by the established framework of this research to measure Transit Oriented Development (TOD). This integration allows planners and decision makers to investigate the feasibility of the proposed public transport system and evaluate its performance before the plans being built.

References


DECONSTRUCTION OF THE IDEA OF PLAY
AND IT’S SPATIAL IMPLICATION

John F. Bobby Saragih¹

¹ Ph.D. Student in Architecture Dept, University of Indonesia, Indonesia

Email : bsaragih@binus.edu

The Child development expert said that playground is very important for childhood development. But in the other side, the limitation of playground is often used as one of the causes of negative behaviour of children. Even though children have any strategy to play, as when the children play on the streets, drainage, in the area of the cemetery or at the side of the rail, those place can be used as a spatial for play for children. The phenomenon of children that playing on the non formal playground, not only dominated by children who live in the private housing with high population density. It also seen in children who live in the formal housing with planned area which also has been designed to have a special place for play. For children, playground concept is different from adults. Referring to the etymology of the word of play, deconstruction of the idea of play and its spatial implication needs to be done. With qualitative methods and grounded theory based, this research produced a new concept of playground from architecture perspective, where playground is not static with dimensions, zoning and range to children living, it can be dynamic.

Keywords: : play; playground; children; deconstruction; spatial

Introduction

What is play? The problem with the play is that we are unclear as to what it is, what it is good for, how it is originated and how it evolved explain (M. Burghardt,2005). To understanding of play depending on who uses it Dichotomy of play as a verb or a noun still a thing that is often debated: "perhaps the play is best used as an adverb; not as a name of a class of activities, nor as distinguished by the accompanying the mood, but to describe how under what conditions and an action is performed. (Susanna Millar,1968).

The phenomenon shows that children can play anytime and anywhere, they cross time and place. In the adult perspective, when children playing on the formal play space like play ground it is a natural thing, but when they played on the informal space, like street, drainage it is something that is not fair. What about the children? does they also have the same perspective? the phenomenon to be something interesting to know, especially when associated with the question: how is the form? and how places are formed interpreted as a playground? This thinking is based on a
A study conducted in Canada. A Canadian study concluded that the behaviour believed to occur in a place is an important component of the places meaning by Genereux, Ward & Russell, 1983. They showed twenty places to WHO observers were asked: 1 Why might one go there? 2 What dose might be here? 3 What activities probably occur here? Utilization of informal play space as a playground showed that assess children differently to an object, the child reads a different marker (Robert Gifford, 1996).

Hamid P (2004), through his research, concluded that most of the children in town, they playing in informal space (street, drainage or parking area). Symptoms of children are not interested to using a playground who prepared by developer also evidenced by Nani Zara (2002) who conducted research on the two formal Housing in Depok and Bogor. By using the quantitative method whit 27 respondents, her found that most (56%) children are not using the playground as a space to play, they are more pleasure from playing in the street in front of their house or yard. In children who live in Bogor, show the same phenomenon, the research found that about 60% of children would rather play in the streets. This phenomenon is also found in Perummas III Tangerang, research by John FB Saragih (2005) found that: some of children use the street as a spatial for play. However, further research conducted by John FB. Saragih (2012) in Tangerang also prove that some of children who lived in Medang Lestari Housing used streets, rice fields, drainage as their spatial for play, even the community has been provide play equipment.

**Research Question:**

Referring to the research above, issues related to the urban playground in the urban area are generally more prominent in: more of children playing in informal spatial. Therefore, research on the play architecture is part of an effort to develop a theory about the relationship of architecture and play. Therefore, goal of this research is to investigate the concept of children perspective about spatial for play, this research focused on the question : How children construct spatial for play? This study focuses on the depth meaning of the perpetrators and the product of his actions.

**Research Methodology:**

In accordance with research that focuses on the question of meaning in depth both the perpetrators and the product of his actions and to gain a deep understanding of the research data obtained by participant observation, in-depth interviews and group discussions with the scientific background of the research method that allows to be done is a qualitative method.
Background Theory:

Plato recognized that play influenced the way children developed as adults, and proposed to regulate play for social ends (Armand D’Angour, 2013), Aristotle said that play in children is need some movement to chase laziness from their body (Mihai Spariosu, 1991), they concluded that play just as an activity that has a practical value that is used as a medium to improve certain skills and abilities in children. The nature of 'practice / practical' doing meaningful, active, an understanding that is more verbs (verb). For Plato and Aristotle, play is part of work, leading to physical work, play is labouring physics.

Meanwhile, based on philosophical reflection, Irina Verenikina (2003) launched armchair theories as a conclusion to the classical theories of play. Starting in 1873, Friedrich Schiller and Herbert Spencer started playing and produce relevant research Surplus Energy Theory: Play is the result of a surplus of energy that exists because the young are freed from the business of self-preservation through the activities of Reviews their parents. Subsequently, Karl Groos, 1896,, a philosopher, issued Preparation for Adulthood Theory and In 1900, Maurice Lazarus, a poet, issued Recreation Theory opposite of Surplus Energy Theory, play where the goal is to restore energy that has been drained while working. In 1904, G. Stanley Hall, a psychologist, gave rise Recapitulation Theory. All of these thoughts play concludes as labouring activities that focus on physics. George Scarlett (2005) in his book : Children's Play.

Play then, is more aptly defined as playing. It is a verb more than it is a noun. As a verb, playing is something one experiences and make happen. It need not be looked for any particular place, at any particular time or at any particular group. At any place, at any time, or in any group, playing may break out, even when it is least expected.

Understanding continues to evolve even become the dominant paradigm to make the play as labouring physics of the emerging spatial implementation manifested in a very empirical playground, which was known as a playground, from the traditional to the modern. The play area is known as a formal playground.

When children play on the informal space understanding is still in a big question, whether the spatial referred to as a playground or not. To understand that we need a new paradigm, understanding play as a verb ending in grouping played as laboring physics. And finally, a redefinition of the classical theories of play begins from the emergence of the idea of playing a human in Homo Luden. Huizinga (1938) defines
Play is free, is in fact freedom:

_Summing up the formal characteristics of play we might call it a free activity standing quite consciously outside “ordinary” life as being “not serious”, but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. Kit proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means._ (Huizinga in Roger Caillois, 2001)

Huizinga submitted new paradigm seems to try to deconstruct the idea of play presented by Plato and Aristotle. Huizinga saw more than physical but it requires an element of mind (mind)

Thought to play a labouring mind reinforced by research conducted by Brian Sutton Smith (2001), in his book The ambiguity of Play deconstructing the idea of the play is delivered by its predecessor. Smith concluded that the best way to define the play by play of the rhetoric:

_play should be conceptualized as about Progress (largely meaning cognition); or about fate (games of chance); about power (sport contest); about identity (festivals); about self or narcissism (peak experience)_

For Smith, the play is not just a physical activity, because in the end a lot of things related to playing that appears not in the form of physical activity.

In addition, to understand the children who play on informal space required efforts to understand the true meaning of play, deconstruction of the idea of play becomes important. Derrida's deconstruction method introduces a way or method to read text, the denial of the opposition speech / writing, no / no, pure / polluted and ultimately rejection of a single truth or logos itself. Deconstruction is active antithesis of everything that has been achieved literary criticism that the values and traditional concepts have been accepted widely.

Play, which has the root word playe (middle English) and plega (old English) that have meaning to frolic (Eric Patridge, 1966). Meanwhile frolic itself has meaning joyous, cheerfully. Noting the definition, it seems understandable that play is
something that is happy, full of joy, exultation events. Excited is something that is associated with feelings, something that is psychic. From the etymology of the word is seen that apparently dominated by the idea of playing more to the things that are mental, it is seen from the feelings that arise when children play, is excited.

**Spatial For Play: Ecological Model Approach**

Research conducted by Nor Fadzila Aziz and Ismail Said, 2011, which refers to the Ecological Models by Owen, N., et al. (2000) provide knowledge about the presence of children in a particular spatial to play, this research ultimately reveals that there are three patterns of interaction that influence children to choose to play outside that individuals, social and physical environments.

<table>
<thead>
<tr>
<th>Table 2: Main factors influencing children's use of outdoor environments</th>
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<tbody>
<tr>
<td><strong>Category</strong></td>
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<tr>
<td>Individual factors</td>
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<tr>
<td>Physical factors</td>
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<td>Social factors</td>
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Resources : Nor Fadzila Aziz and Ismail Said, 2011

Ecological Models is one way to understand the interrelationships between living things with their environment. Ecological Models suggested by Owen, N., et al. (2000); there are unique interactions between individuals and their social and physical environments that may influence children's use of outdoor environments and their behaviour such as physical activities. This model developed to help understand the specific problems in relation to a particular setting or context. Referring to the table
above and the few studies that have been conducted, the factors influencing the child to be present in the play area can be classified as follows in the table below. Broadly speaking, several factors disclosed are: psychological distinction affection and experience, familiarity and proximity with a place Challenging play equipment

**Locus:**

Medang Lestari Housing is one of formal housing developed by PT. Masa Kreasi. The housing located in Medang Village, District Pagedangan, Tangerang, In terms of concept development, this housing is classified as low-income housing. 

![Figure 1: Location of Medang Lestari Housing - Tangerang](image)

![Figure 2: Typical of Housing](image)
Table 1: Number of Children in RW 02 Medang Lestari

<table>
<thead>
<tr>
<th>Area</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT 01</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>RT 02</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>RT 03</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>RT 04</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>RT 05</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>RT 06</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>RT 07</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>90</strong></td>
<td><strong>53</strong></td>
</tr>
</tbody>
</table>

Result and Discussion:

Indicator of Playing:

To understand whether children feel happy in their activities, we can see the indicator:

1. **Laugh**

   James Sully in his Essay On Laughter in suggested that laughter acts as a sign of Play (Susanna Miller, 1972).

![Figure 3: Children laugh while playing](image)

2. **Repeatedly**

   The other indicator of playing is the activity carried out repeatedly, this principle appear because of the element of pleasure, something of pleasure potential to be repeated. Sigmund Freud, 1920, Beyond the Pleasure Principle. This phenomenon encountered in the life of children playing in Medang Lestari Housing.
3. Freely

In addition to these indicators, Sutton Smith (1997) gives the definition of play, namely:

*the play is about having fun, being outdoors, being with friends. Choosing freely, not working, pretending, enacting fantasy and drama and playing games. Furthermore, we learn that is not about preparing for the future*

what is conveyed by Sutton Smith looks of what the children done in Medang Lestari Housing, they really enjoy each game that they done with unrestricted free with directives or instructions of those who are around them.

"... we play near the rice field ... play ball on the dirt ... free and exciting ... " 
( Faiz , 10 years old )

"... If Friday usually fishing.... a lot of fish ..." "... Really exciting ..." 
(Fadil,10 years old )

4. Seriously

What is perceived by the children in Medang Lestari Housing show that what they do in the play is done with a serious and earnest, seriousness is evident from the existence of certain rules that apply in play and the rules obeyed by the whole child. Arthur and Emili S (2010) in The Penguin Dictionary of Psychology in a dictionary, said the concept of play involving diversion and recreation, an activity that is done seriously.

5. Collective

Children are more often seen playing is done together and are very rare to find a game that is done individually, average every game the minimum is done by 3-4 children, the number of participants playing most commonly found in the game of
football. Phenomena play a collective is in line with what is delivered by Sutton Smith, the play is about having fun, being outdoors, being with friends.

The phenomenon of children's play in Medang Lestari Housing corroborate the results of research conducted Barrie Thorne (1993) which shows that play in the environment of neighbourhood differ with school, groups formed in neighbourhood growing niche to be more mixed by gender and by the aged than of children's groups at school.

He absence of a clear dichotomy between the games boys and girls made possible by several contributing factors including the attitudes of parents, media and culture. The attitude of the parents who tend to provide distance constraints play in girls makes them prefer to play that are spatially close to the house, they tend to not care about the type of games that exist. Phenomenon found in Medang Lestari Housing was not fully agree with what was said by Lytton and Romney (1991) which says that: parents enforce boys and women differently in terms of play, parents tend to steer his son to play 'like real boys and avoid acting like girls' while girls are directed to 'avoid boyish behaviour and act in feminist'. The difference in understanding is possible because the media (TV) has a major role, some TV broadcast showing how women have equal opportunity to play. Meanwhile, the cultural constraints that tend to be a dichotomy between men and women do not seem to be obvious in Medang Lestari Housing. This is possible because they are in a very heterogeneous cultural environment, there is no dominant culture play in the lives of children. Matlyn (1987) says that 'some girls love rough play and some boys hate it', but despite the rarity of behavioural sex differences, both the males and females believe that they are more different than they actually

Physics:

Refers to several studies, psychology, health, environment and architecture with the topic of play, looking to play as physical activity. The impact of these conditions, the play is more seen as something empirical and standardized. This understanding
becomes a truth, in the end the play ground should be planned in a certain position, with a certain area and certain equipment, so untruth planning will result in low levels of attendance of children using the facility as presented by Rutt & Coleman (2005) low activity in children because of an error made possible by planning, both in scale micro and macro scale.

**Decreases in activity could, to some degree, be Attributed to issues related to town planning and the built environment.**

The dominant paradigm shows that the play is something that is very standardized. Specifically related to Ecological Models it is seen that the things that affect the child to be present in a spatial play more due to factors that physically based, especially in places that are already available to play.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Physical factor</th>
<th>Comfort Concern</th>
<th>Afford Concern</th>
<th>Safety Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual factor</td>
<td></td>
<td>psychological affection and distinction experiences</td>
<td>familiarity and proximity with a place</td>
<td>Challenging play equipment</td>
</tr>
<tr>
<td>Children’s preferences to engage with active play in particular settings are influenced by their psychological affection and distinction experiences with those settings (Andel, J.V., 1990).</td>
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<tr>
<td>Children have a propensity to repeat their visit to a place which gave them good experiences and psychological affections (Veitch, J., et al., 2006).</td>
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<tr>
<td>Children’s familiarity and proximity with a place become an important determinant of outdoor play (Castonguay, G., &amp; Jutras, S., 2009).</td>
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<tr>
<td>Physical factors</td>
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<tr>
<td>Challenging play equipment is an important factor that attracts children to play outdoors (Hart, C.H., &amp; Sheehan, R., 1986; Veitch, J., et al., 2008).</td>
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<tr>
<td>Places that attract more children are those that offer the greatest variety of affordances for active play (Castonguay, G., &amp; Jutras, S., 2010).</td>
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<tr>
<td>Parental safety concerns became the main factors that restricted children’s autonomous mobility to play in the outdoor environments independently (Blakeley, K.S., 1994; Prezza, M., 2007).</td>
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<tr>
<td>Parental safety concerns mainly related to the fears of strangers, teenagers and road traffic (Veitch, et al, 2008; Castonguay, G., &amp; Jutras, S., 2010).</td>
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<tr>
<td>Children are much more likely to play outdoors if they have friends or other children of the same age to play with. These factors show the importance of social interaction in children’s outdoor play, children may avoid places where their play is disrupted or where there are bullied by other children (Andel, J.V. (1990).</td>
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<td></td>
</tr>
<tr>
<td>Social factors</td>
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<tr>
<td>Social interaction between mothers was an important part in establishing local ‘norms’ about how far away from home and for how long children should be allowed to play ( Valentine, G., &amp; McKendrick, J. (1997)</td>
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</tbody>
</table>

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Metaphysics:

Metaphysical thinking is thinking about things outside of physical existence (reality) is present not because it is physical. Aristotle mentions something that is examining matters that are beyond physics as first philosophy (prote philosophic) to distinguish it from both the discipline of philosophy that examines the nature of things physics. Descartes states that the general understanding of the space is divided into two, namely: Objective materialistic, something containing considered space reality, is palpable and Spiritualistic Subjective, space is present in human perception. This understanding ultimately delivers more to the architecture of the things that are physical and measurable. Particulars are said to have attributes, like : size, shape, colour, location, and two Particulars may have some such attributes in common. So that non-physical factors are not a major reason in the form of space, which ultimately delivers some understanding as was stated by Foucault with Heterotopia and Triatno YH with Tropotopia. This three-dimensional space with interesting things to be understood, because the phenomenon shows that there are spaces formed not because of physical factors, but non-physical factors.

<table>
<thead>
<tr>
<th>Nama Alasan</th>
<th>Physic factor</th>
<th>Metaphysic factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eja</td>
<td>familiarity and proximity with a place, Challenging play equipment, variety of affordances, Safety concern related road Traffic, Safety concern related strangers, teenagers, bullied by other children.</td>
<td>psychological affection and distinction experiences</td>
</tr>
<tr>
<td>Fajar</td>
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<tr>
<td>Fadil</td>
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</table>

Nama Alasan: Pada saat ia memberi alasan mengapa ia bermain bola dilapangan RW 02, ia menjawab :

"...sering main di sini ...

"... tempatnya luas...

"... banyak temannya ...

"... ada permainannya ...

"... nggak ada mobil lewat...

"... ada tamannya ( pohon )...

Nama Alasan: Pada saat ia memberi alasan mengapa ia bermain layangan di tanah merah, ia menjawab :

"...banyak angin...

"...Jus...

"... tidak nyangkut di pohon...

"...enak berbangga...

"...ada temannya...

"...ramai, seru...

Nama Alasan: Pada saat ia memberi alasan mengapa ia bermain ( memancing ikan ) di kali , ia menjawab :

"... diajak teman...

"... banyak ikannya...

"... ramai... bias nambah seru...

"...kalinya cetek...

"... bisa ditangkap pakai tangan...
Conclusion:

By the time, when children is present in a spatial, there are things that trigger attraction so the children uses it as a spatial for play. Previous research says that it is because of the interest factor in the perception of affordances that children as presented by Gibson, JJ (1986); Heft, H. (1988); Kytta, M., (2002,2004). Affordances refer to the functional properties of the environments offering a child to actively interact with the environment. Meanwhile Ecological Models by Owen, N., et al. (2000) showed that individual factors, spatial and social be the attraction at the time of the child choosing to play in a certain spatial, especially the spatial planned. But the phenomenon in Medang Lestari Housing showed that in addition to physical factors, then there is a metaphysical factors that actually makes a child using the spatial for play, a factor of freedom, excited and surprise were raised by the appeal of spatial became more dominant, especially on in formal spatial, like street. This understanding will help us understand why children may be present in the in formal spatial, like street, drainage, rail train, at the funeral even though the trash. Spatial reality formed in the minds of children with metaphysical factors as the originator.

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Highlands is a globally important resource on earth that is rich in natural and cultural heritage. In the present, Cameron Highlands are increasingly developed in order to cater the need of socio-economic. Developed area are usually associated with the increase of traffic sound which dominates the environment. Therefore, besides other environmental degradation such as soil erosion, forest fragmentation, sedimentation, air pollution and water pollution, highlands soundscape has changed drastically due to the human intervention. Soundscape is perceived as sound of the environment of an area as a whole that comprises of several individual sounds. On the contrary, sound is mostly being acknowledged in the context of ‘noise’ that instantaneously gives a negative impression. People perceived the environment is usually associated with the visual aspect, whereas acoustic also plays an important role. In this research, the relation of soundscape and landscape is to be focused. The aim of this study is to assess the soundscape and landscape influence on highland environment. Thus, the objective is to investigate the level of sound and identifying relation between soundscape and landscape features at selected landscape area. It is hoped that this study will provide awareness and understanding on highland soundscape as part of sustainable development.

Keywords: soundscape; landscape features; outdoor open space; highland environment

Introduction

In the past, the pioneering of the term and study on ‘Soundscape’ was established by Schafer (1977). It is an effort to view sound in a different dimension from the context of ‘noise’, in order to create a better quality of life. In the late 1960s, The World Soundscape Project (WSP) was introduced by Schafer. It is an innovative approach of acoustic ecology on the sound of environment and impact of technology. It is towards achieving the soundscape equilibrium where there is harmonization between human community and sound of the environment (Westerkamp, 1999).
The soundscape have been researched but limited compared to sound in the context of noise. The perception of sound that direct to the term ‘noise’, imply negative impression (Jennings & Cain, 2013). The studies on noise in relation to the noise level have focused on physical and mental health, whereby, in many events it is related to a particular intruding sound (De Coensel & Botteldooren, 2007). De Ruiter pointed out that a better acoustic comfort does not necessarily achieve through the reduction of noise level (see Kang & Zhang, 2010). The action of reduction or elimination of noise is insufficient for the improvement of the urban environment and in turn might create anxiety and other problems (Raimbault & Dubois, 2005). The soundscape research acquires a more holistic approach (De Coensel & Botteldooren, 2007), and has started to be discussed in other countries in order to improve the quality of city life (Yang & Kang, 2005), in consideration to the urban environment.

Highland is a natural environment that has high level of sensitivity towards development due to its topography. The sensitivity of the highland environment should be higher compared to in the city as it being known for its natural entity, hence, the negative impact of development is of more concerned. There are a few well known highlands in Malaysia for instance Genting Highlands, Cameron Highlands and Fraser Hills. Each highland has its own identity such as Genting Highland that developed into Theme Park as its main attraction. Cameron Highlands and Fraser Hills are more towards heritage and nature-based attraction. Cameron Highlands that is rich in natural and cultural heritage are being exploited as hills resort for the needs of socio-economy as noted by Kumaran and Ainuddin in Chan (2006). Several researches on Cameron Highlands have been conducted looking into the environmental degradation due to development (Chan, 2006). Table 1 shows the percentage of land use change in Cameron Highland from year 1947 to year 1997. Cameron highlands has led to rapid urbanization especially the township of Tanah Rata and Brinchang as major tourist resort (Chan, 2006).

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<tbody>
<tr>
<td>Forest</td>
<td>95%</td>
<td>78%</td>
<td>76%</td>
<td>73%</td>
<td>72%</td>
<td>62%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1.7%</td>
<td>2.4%</td>
<td>3.8%</td>
<td>9.3%</td>
<td>10.2%</td>
<td>17.8%</td>
</tr>
<tr>
<td>Tea &amp; Orchards</td>
<td>2.7%</td>
<td>8.9%</td>
<td>10.8%</td>
<td>9.7%</td>
<td>9.5%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Urban/Housing</td>
<td>0.6%</td>
<td>10.7%</td>
<td>9.4%</td>
<td>8.0%</td>
<td>8.3%</td>
<td>12.7%</td>
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Cameron Highlands undergo various human intervention and development that degraded the environmental values (Chan, 2006). Research by Ahadi Iskandar Ismail et al. (2011) stated that the Cameron Highlands land use changes from densely forested areas into agricultural and urban areas is in line with the temperature increment. This was based on the analysis between climate data and land use data of Cameron Highlands for a period of 36 years (1970 - 2006) showed that there was a rise in temperature of around 0.9°C in the MARDI station and a 0.1°C rise near the Tanah Rata station. Several environmental degradation are visually perceived for instance deforestation, landslides, sedimentation, soil erosion and water pollution. The development does not exclude the changes on sound of the environment. Road developed for access has been one of concern matter for the Malayan Nature Society (Salleh, 1992). Increased in traffic has led to high noise exposure. Sound pollution is an ever-growing problem occurs in many other urban environments in the world as the environment becomes increasingly dense (Raimbault & Dubois, 2005). Solution regarding urban problems of noise management can be through implementation of variations in the soundscape to create more positive and pleasant sound ambient environments (Raimbault & Dubois, 2005).

Considering the rapid expansion of development at town of Cameron Highland, the outdoor open space provided will be the focus of this study on the assessment of soundscape. The aim of this study is to assess and identify the influence factors of soundscape at outdoor open space in Cameron Highlands environment. Based on the aim, the objectives of the study are:

i. To investigate the level of acoustic quality in selected landscape area.
ii. To identify relation between the soundscape elements and landscape features of selected landscape areas

**Soundscape and Landscape of Highlands**

Soundscape involves the context in which the sounds is derived from that it can be perceived and experience. The context in which the space characteristic such as function influence the sound generated and size or shape influence the sound exposure (Meng et al., 2013). The context in outdoor constitutes as landscape are inseparable with sound in order to understand the soundscape. Several researches have been done in order to see the relationship between landscape and soundscape perception (Liu et al., 2013; Marry & Defrance, 2013). Research by Violland et al. (2002) done in order to see the degree of the urban environment (visual) and its influence on the type of sounds (audio). Carles et al. (2009) research look into the congruency between perceived sounds with landscape. Haverkamp (2007) stated that there is a relation between perception of sound and other senses. The expectation of
people in experiencing an environment depended on the compatibility between the perceived landscape and sounds together.

The previous research and recent research acknowledged the changes in the urban environment soundscape. Most of the research focus within the urban area, for instance, urban public open space (Yang & Kang, 2005; Kang & Zhang, 2010; Yu & Kang, 2011; Marry & Defrance, 2013), Urban residential area (Skanberg & Ohrstrom, 2002; Yu & Kang, 2011) and underground shopping streets (Meng et al., 2013). Urban soundscape emerges naturally replacing the loss or overlapping the existing sound, as a result of the intention development and activities that take place in the public area. Over time, urban soundscapes have evolved, which in many cases road traffic noise dominates the soundscape, often implying impoverishment of the urban living environment (De Coensel & Botteldooren, 2007). An area that undergoing through urbanization will change the soundscape as new sounds will be generated while others were being masked or disappear. The urban public spaces are the preferred area for soundscape research as it is a place created for the public enjoyment. As urban environment usually associated with noise pollution, therefore, soundscape is an approach that views into the overall perspectives of the environment sounds. Within the urban environment, provision of outdoor open space is a necessity for the public. It is a place where people spend time and utilize the provided facilities such as for recreation purposes. Although it is meant to be for the public’s enjoyment either through the built environment or natural setting, the sounds perceived influence the experience of a place. The surrounded development exposed an area with various sounds from the surrounding context as well as within the area itself.

Meanwhile, the Highland environment is one of the places where nature can be embrace. The attraction has encouraged development as in to support the tourist industry. This help in the economy of highlander. Development is expected in order to ensure the prosperity of highlands. As acknowledged by Clifton in Chan (2006), being a place of natural identity and uniqueness, the continuous development and changes of land use has transformed it into a more urban like area. A place sensitive to the touch of human exposes highlands to various environmental degradation. A place that was once devoid of development is rapidly expanded through manifestation of land. Highlands also is one of the essential natural components that contribute to the well-being environment of the city dwellers through its functions and aesthetic values undergo various human intervention and development that changes the soundscape. It is being dominated by the sound of development, hence, became part of the identity.
Methodology

Sampling Area

For this study, Cameron Highlands is chosen due to its nature-based attraction and rapid development. The township of Tanah Rata which is the administrative centre of Cameron Highlands and the main attraction for the tourist has been selected. Tanah Rata is undergoing high development due to administrative purposes. Being the centre of development, the provision of recreational areas are situated within close proximity which are open to public and has easy access. Within the township of Tanah Rata, the landscape area selected were outdoor open space that provide recreational activities through its natural and man-made setting that exist in the center of development. Three landscape areas were selected; Site A- Taman Pertabalan (TP); Site B- Bus Station Pocket Park (BS); Site C- Undulating Landscape (S) located within close proximity from one another but of different features (see Figure 1 and Table 3).

![Figure 1: Plan of Tanah Rata](Source: Pelan Induk Landskap Majlis Daerah Cameron Highlands Pahang Darul Makmur)

<table>
<thead>
<tr>
<th>Sites</th>
<th>Images</th>
<th>Description</th>
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</table>
| Site A: Taman Pertabalan     | ![Image](http://example.com/image1.jpg) | -Sunken Landscape  
-Active and Passive activities |
| Site B: Bus Station Pocket Park | ![Image](http://example.com/image2.jpg) | -Flat Landscape  
-Passive activities         |
| Site C: Undulating Landscape | ![Image](http://example.com/image3.jpg) | -Undulating Landscape  
-Passive activities         |
**Sampling Activity**

Noise measurement was performed according to Planning Guidelines for Environmental Noise Limit and Control, 2007, using Sound Level Meter (SLM) Cirrus ‘Optimus Green’ for environmental noise which complies with Class 1 Standard. In addition, temperature and relative humidity were measured using Delta OHM HD32.3. One point of reference was located at each selected landscape areas. SLM attached with wind protector was placed on a tripod stand at a height of 1.2 m above ground. The parameters measured were $L_{Aeq}$, $L_{Amax}$ and $L_{Amin}$ included the observation of soundscape elements at selected landscape areas.

Measurements were taken from 0900 hours to 1700 hours for daytime (eight hours) and 2050/2200 hours to 2150/2300 hours for night-time (one hour) for six days at each locations, comprising of three (3) days of holidays and three (3) days of non-holidays. The sampling activities were selected between those days in order to observe the relation so sound level during high traffic day and normal traffic day. In addition, observation of activity, landscape features and the types as well as numbers of vehicles passing through the area were also identified and recorded.

**Results and Discussions**

**Noise Evaluation During Daytime**

Referring to Figure 2, the total number of vehicles TP (PH), 12,053 units and TP (W), 10,631 units make the difference of 1,422 units. There is a decrease by 957 units vehicles between BS (PH), 11,551 units and BS (W), 12,508 units. Same goes to the total number of vehicles for S (PH), 10,774 units and S (W), 12,034 units with the dropped of 1,260 units. TP has higher total number of vehicles during Public Holiday than Weekday. In opposition to TP, BS and S has higher total number of vehicles during Weekday than Public Holiday. The differences are not as significant due to the continuous day of Public Holiday and Weekday. People have the inclination to extend their vacation.

The sound level illustrated by Figure 3 during Public Holidays. Throughout the 8 hours period, the sound level for BS is around 57 to 73 dBA. The sound level TP (PH) and S (PH) were almost the same that is within the range of 48 to 58 dBA. There is a difference of sound level measurement shown for BS (PH). The influence of the site context that support minimal passive activity (sitting and waiting) and site surrounding (primary road, secondary road and shops/buildings) influence the urge to utilize the site. Therefore, its main sound source is basically produced by vehicles. On the other hand, TP (PH) with facilities that accommodate active and passive activities encouraged people to use the site. Same goes to S (PH), although the facilities
provided is basically for passive activities. TP even though near to the primary road, the landscape features of sunken topography act as a barrier to the vehicle sound. S that is slightly further from the primary road and has undulating landform influences the sound level. Overall, the main sound source for BS that is from vehicles influence its high sound level. Whereas, TP and S sound level were mainly influenced by sound sources from human and vehicles.

The sound level shown by Figure 4 for BS on Weekdays throughout the 8 hours measurement indicated around 57 to 75 dBA. BS sound level is higher than TP and S. For both sites, the sound levels are TP (W), 48 to 62 dBA and S (W), 47 to 60 dBA. Significant dissimilarity can be observed in graph 4.35, whereby the BS (W) sound level is higher and clear gap from TP (W) and S (W) graph line can be seen. BS (W) main sound source is from the vehicle particularly from the primary road. There are not many activities conducted at this site due to its location wise and landscape elements (lack of shades). Main sound sources of human and vehicles can be distinguished at TP (W) and S (W). Landscape elements (hardscapes - playground, seat, picnic table; softscapes - vegetation) that stimulate activities and provide cooling environment influence the production of various sounds thus create vibrant soundscape.

![Figure 2](image_url)

**Figure 2:** Taman Pertabalan (TP), Bus Station Pocket Park (BS) and Undulating Landscape (S) total number of vehicles at daytime of Public Holiday (PH) and Weekday (W).
Figure 3: Taman Pertabalan, TP(PH), Bus Station Pocket Park, BS(PH) and Undulating Landscape, S(PH) sound level (Laeq/dBA).

Figure 4: Taman Pertabalan, TP(W), Bus Station Pocket Park, BS(W) and Undulating Landscape, S(W) sound level (Laeq/dBA).
Noise Evaluation During Night-time

The Figure 5 shows the increase in the total number of vehicles during night-time of Public Holiday. Total number of vehicles for TP (PH, n), 1,168 units is higher than TP (W, n), 1,027 units by 141 units. An increase of 363 units between BS (PH, n), 1,190 units and BS (W, n), 827 units. As for S (PH, n), 1,232 units and S (W, n), 1,020 units there is an increase of 212 units. In the night-time of Public Holiday, there is increase in the total number of vehicles at the three sites. During night-time of Public Holiday, there is higher tendency for people to continue outdoor activities.

Referring to Figure 6, the sound level for BS (PH, n) is around 53 to 64 dBA, while TP (PH, n) and S (PH, n) is around 47 to 55 dBA. During night-time of Public Holiday, the BS has a vibrant environment. Its location that is easily access and in close proximity to the facilities (shops) act as a place for waiting, sitting or viewing. Therefore, human sound is one of the main sound sources besides vehicle sound. As for the TP and S, no significant human activity to trigger human sound as main sound source. Hence, the main sound source for both sites was dominated by vehicle sound.

Figure 7 illustrated the night-time sound level during Weekday. The TP (W, n) and S (W, n) sound level is around 47 to 55 dBA. The sound level for BS (W, n) is about 53 to 65 dBA. The graph line for BS (W, n) shows significant fluctuation that suggests that the quieter environment make the sound level easily affected by vehicle sound. Although it is night-time of Weekday, BS sound level is significantly influenced by the vehicle sound. The sound level of BS (W, n) is higher due to the location that is near to the primary road. Besides that, the landscape features of the site’s ground level that is almost the same as road level gives high exposure to the vehicle sound. The vehicle sound that is the main sound source has the ability to surge the sound level.

![Figure 5: Taman Pertabalan (TP), Bus Station Pocket Park (BS) and Undulating Landscape (S) total number of vehicles at night-time of Public Holiday (PH) and Weekday (W).](image)
Summary

Based on the overall discussion on the physical aspects of soundscape assessment, the main sound source of Tanah Rata was mainly generated by the vehicles. During the daytime of Public Holiday, the sound of vehicles and human sound dominated the Taman Pertabalan and Undulating Landscape. Whereas, Bus Station Pocket Park is dominated by vehicles sound. Site context that is consist of the administrative centre and others in accordance to the town function influence on the increased of traffic. The sites location and landscape features influenced the sound level. As for Taman Pertabalan, the sunken landscape along the primary road acts as a sound barrier. Thus, it decreased the perceived sound by vehicle. This applied to Undulating Landscape as well in consideration to the site location further from the primary road. Meanwhile, Bus Station Pocket Park received high vehicle sound exposure by being in close proximity with the primary road, bus station and taxi station. Therefore, the sound level of Bus Station Pocket Park is higher than other sites during daytime and night-time.

The purpose and function of outdoor open space influence the sound sources.
Taman Pertabalan being a recreational area that provides active and passive activity encourages people to utilize especially during the holiday. Undulating Landscape that support passive activities encouraged people to enjoy the view from higher landform. Bus Station Pocket Park has fewer people utilizing it especially during daytime due to the high sound exposure of road traffic and location wise. Beside that, the density and types of vegetation planted plays a role as sound barrier and provide shades. It also enhances the natural environment while reducing the sound level. The vegetation that surrounded and planted within the site helps in cooling the environment. Although, the landscape elements (softscape - vegetation/ water) have the potential in cooling an environment, the temperature and relative humidity has no significant influences on the sound level. The cool environment is able to attract people in utilizing the site, thus contributing to the sound sources. Bus Station Pocket Park has the least vegetation due to its smaller size and location as not to block view of the road.

Sound level measurement is not restricted to just traffic sound but comprises of whole sounds. Urban landscape areas deal with complex soundscape as it involves with various sound sources. Throughout the discussions, it is ascertained that the soundscape of highland environment at Tanah Rata is declining as the dominated sound of vehicles being identified. In the future research, besides objective approach (Physical), there is a need to look into the subjective approach (Psychological) to understand the people’s perception and relation to highlands soundscape that is considered as a sensitive area.

Acknowledgement

This research was funded by University of Malaya Research Grant (UMRG) under the project number RP009B-13SUS on “Landscape Identity of Cameron Highlands Hill Station: Cultural Landscape and Soundscape”.

References


Exhibition on Noise Control Engineering (Inter-Noise 2007).
III

GREEN BUILDING, CONSTRUCTION AND PROJECT MANAGEMENT
INTEGRATING THE PRINCIPLES OF SUSTAINABILITY AND PROJECT MANAGEMENT AT THE EARLY STAGES OF CONSTRUCTION PROJECTS

Manal Abd El Hamid¹, Sahar Sh. Hasan², Ibrahim Abd El- Rashied³, Samia Ali ⁴

¹Prof. of Construction Project Management, Housing and Building National Research Center, Dokky, Giza- Egypt, E-mail: hamidmanal@yahoo.com
²Lecturer assistant of Construction Project Management, Housing and Building National Research Center, Dokky- Giza, Egypt, E-mail: eng_sahar5@yahoo.com
³ Prof. of Construction Project Management, Faculty of Engineering- Ein Shams University, Abbassea-Cairo, Egypt, E-mail: ibrahim.sama@gmail.com
⁴Lecturer of Construction Project Management, Faculty of Engineering (Shoubra) - Banha University, shoubra-Cairo, Egypt, E-mail: samia277@hotmail.com

Sustainable construction (SC) is considerably new trend particularly in developing countries such as Egypt. So, applying project management (PM) to that new trend of construction requires the relevant stakeholders to consider the sustainability principles in implementing PM at the early phases of the project. This promotes for significant cost savings over time, and a unique marketing strategy. For construction projects, Feasibility stage (FS) is the first and most important stage before undertaking project design & construction and its effectiveness will affect directly the success of the project. A vast literature review revealed a number of essential elements that should be considered and a number of challenges that should be mitigated to integrate the principles of sustainability and PM in construction projects. Also, to investigate the current status for managing FS of SC projects in Egypt; such as the main benefits and barriers during managing FS of SC projects; the survey research method has been adopted and data were collected using designed structure questionnaire. This paper introduces a flowchart for applying PM Principles at the FS for SC projects. This flowchart outlines the necessary elements that enable project stakeholders to consider sustainability principles while making decisions in FS, also it justifies additional preplanning effort of sustainable construction projects. Additionally, the proposed flowchart provides a good base for projects that seek green accreditation to comply with Egyptian Green Pyramid Rating System (GPRS), and provides channels for overcoming the challenges of achieving SC project starting by FS. Consequently, the proposed flowchart works as a kick of for managing SC projects in its coming phases. Moreover, this paper provides several recommendations on how to enable project stakeholders overcoming the barriers of starting FS for SC projects in Egypt which will help for reducing cost and time overruns and increases the possibility of achieving SC.

Keywords: Sustainable construction; Feasibility stage; Project management; Framework of...
Introduction

Sustainable construction (SC) seeks for proper management to early embed all sustainability aspects into project life cycle. Proper management for feasibility stage (FS) should take into consideration during decision making all new determinates of sustainability in order to reduce the overall cost of a project throughout its life cycle (Kats, 2003). Many studies (Du Plessis, 2007; Lam et al., 2010; Shen et al., 2010; and Robuchaud and Anantatmula, 2011) have revealed that the higher costs and many of challenges can generally be alleviated by the inclusion of green aspects from the earliest stages of the project. Therefore, the need for this research has been arisen to study what are the significant elements in managing the FS of SC projects, and clarifying how it should be embedded in FS process through developing flow chart for managing FS for SC project to achieve the requirements and specifications of SC in Egypt. This outcome will reduce many obstacles of implementing SC, and will rationalize the excess effort during sustainable FS, which consequently will encourage project developers to start SC projects with clear steps and better awareness. To achieve this goal; this paper aims to achieve the following objectives: 1) Identifying the main key differences between traditional and SC projects, 2) Identifying the main elements and validating their importance for managing FS for SC which represent the core of proposed flowchart, and 3) Exploring the main benefits and barriers of managing FS for SC projects.

Methodology:

For achieving the research objectives; a theoretical study has been conducted through an intensive review of literature for managing SC project. The theoretical study is followed by a field study survey using a specially designed questionnaire distributed via a representative sample of experts of SC in Egypt.

Literature review and theoretical findings

This section aims to clarify the main terminologies, and then addresses the main areas in the theoretical study that was the base to come up with suggested elements followed by developing flowchart for managing FS of SC projects. Herewith, It will identify the differences between traditional and SC projects. Moreover, it will compare eight of studies related to strategies of managing SC projects to conclude the common categories of models for managing SC projects.
Terminologies

Reviewing the literature came up with some important definitions that need to be understood for the current research subject as follow: *Feasibility stage (FS)* is defined as the first and most important stage before undertaking project design and its effectiveness will affect directly the success of a project, this stage also includes defining and assessing the client’s need into a structural brief, and identifying all key stakeholders (shen et al., 2010). *Sustainable construction (SC)* is defined as one of the integral processes of sustainable development (SD) and it is seen as a holistic process aiming to restore and maintain harmony between the natural and the built environment (Du Plessis, 2007). While, *sustainable construction management (SCM)* is defined as management framework to help construction practitioners in tackling the issue of sustainability with a set of principles, tools and techniques that integrate sustainable development into major processes of decision making and practices (Eid, 2009). *Green Rating Systems (GRS)* is presented as an important tool in measuring and evaluating the environmental performance of a building; where these systems are used to evaluate and benchmark sustainability. There are several GRS worldwide apply differently in different climatic and geographical conditions, to meet local needs for each country (Adler et al., 2006). In Egypt, *Green Pyramid Rating System (GPRS)* is the green rating has been developed by the end of 2010 by the Egyptian Green Building Council (EGBC) to be applied for new buildings (http://www.hbrc.edu.eg). There are four levels for GPRS certification: 1) GPRS Certified, 2) Silver pyramid, 3) Golden Pyramid, and 4) Green Pyramid (the highest level). GPRS can offer a roadmap that lead to sustainability goals and help align requirements by focusing on recognizing performance in seven key areas: (1) Sustainable Site, Accessibility, Ecology (15%), 2) Energy Efficiency (25%), 3) Water Efficiency (30%), 4) Materials and Resources (10%), 5) Indoor Environmental Quality (10%), 6) Management (10%), and 7) Innovation and Added Value (Bonus). To focus on the unique practices of managing SC projects, next title will discuss briefly the key differences between traditional and SC.

**Traditional vs. Sustainable construction:**

It was necessary foremost to identify the main differences between traditional and SC; to spot more light on the new practices areas. Some studies have exposed to the differences between them (Du plessis, 2007; Kibert, 2005; Hwang and Tan, 2010). The researcher has defined the main differences in eleven key areas as shown in Table (1); which refer to the core behaviour of SC. Managing FS of SC should examine these additional issues consequently it will need more effort than the traditional one.

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<tr>
<th>element</th>
<th>Key Differences</th>
<th>Sustainable project life cycle</th>
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<tr>
<td>Project</td>
<td>1. Main goal of</td>
<td>The Main goal of project participation is minimum adverse</td>
</tr>
<tr>
<td>element</td>
<td>Key Differences</td>
<td>Sustainable project life cycle</td>
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<tr>
<td>scope</td>
<td>project participation</td>
<td>effect on the surrounding environment while achieving its financial.</td>
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<tr>
<td>2. Building Performance specifications</td>
<td>Defining building Performance specifications; allowing all stakeholders to share their experience and achieve the project sustainability goals in more creative ways.</td>
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<td>Integrated design</td>
<td>3. Design scope</td>
<td>Design charter is a workshop for generating and discussing ideas in the planning and design process when people need to cut across boundaries and work on a large, collaborative project. The design team examines the integration of all building components and systems through three main design features (indoor quality (lighting, HVAC), building material, layout), and determines how they best work together to save energy and reduce environmental impact. Participants in the design charter, including all project stakeholders will make early decisions related to project's location; orientation and envelope, interior spaces; and water needs; heating, ventilating, and air-conditioning (HVAC) …… Such early investigation will lead to the selection of the most suitable alternatives for different project criteria.</td>
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<td>4. Building Information Modelling (BIM)</td>
<td>Building Information Modelling (BIM) including energy modelling and simulations as effective tools in predicting project performance upon completion and assisting with project commissioning.</td>
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<td>5. Life Cycle Costing (LCC)</td>
<td>Life Cycle Costing (LCC) is the main cost evaluation approaches for project selection and development.</td>
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<td>6. Value Engineering (VE)</td>
<td>VE application matching the sustainable project development, particularly if implemented at the early stages of project formulation and design.</td>
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<td>Early Stakeholder involvement</td>
<td>7. Stakeholders</td>
<td>SC project involve many more players than just those traditionally identified, and should be early involved.</td>
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<td>Early Decision making priorities</td>
<td>8. Decision making criteria</td>
<td>It embraces not just technological responses, but also the non-technical aspects related to social, environmental, and economic sustainability.</td>
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<td>Early procurement strategies</td>
<td>9. contracts</td>
<td>SC tends to follow one form of a relational contract or another. Such forms of contracts include Integrated Project Delivery (IPD), Early Contractor Participation (ECP) or DA (Design Assist) where the Contractor is hired early, and his construction input is sought early through design progresses, thus eliminating the potential for change orders and fraudulent claims.</td>
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<td>10. Delivery systems</td>
<td>SC requires superlative communication; through delivery systems such as The design – build delivery system which is effective communication between project team members. Where it is carried out as a single entity, and a detailed integrated design process is employed at the start of the project. But least-cost delivery systems (design-bid-build); are unable to achieve effective communication since the design and construction are managed by two separate teams.</td>
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<td>11. Procurement</td>
<td>The implementation of the just in time (JIT) concept in traditional projects is not mandatory, While it is always good practice to apply this in green projects. Doing that will save both energy consumption and costs, this will help to achieve the corresponding credits in the rating systems. However, it requires a stable relation between the suppliers and the contractors.</td>
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Models and approaches for managing sustainable construction project

There are some models have been developed to manage SC projects. It is noticed that some models focus on project success factors and defining the performance indicators as assessment tools. While other models developed framework for management strategies. Although these studies have handled management of SC in different strategies, they agreed on some categories which should be managed effectively for implementing SC. The researcher has compared these studies and derived the common categories between them as shown in Table (2). By looking to this literature survey, it can be found that the most selected categories are: Environmental aspects 100%, then the Economical aspects and social aspects with equal share 50%, where they are the main principles of SD. While other elements are selected with about 38%. That because most of studies concentrated on indicators and parameters for project sustainability assessment not for how managing projects to deliver SC. That can be clear, when noticing that, the studies that use the Environmental, Economical, and social aspect; don't use the enablers and vice versa. While achieving SC project needs both assessment criteria and enablers for delivering these projects in feasible way. Therefore, this research is willing to fill in this gap by developing flowchart combing assessment criteria and enablers for delivering SC in sequential processes to be applied in sustainable FS.

Table (2): comparison between studies related to SC project management

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<td>Social aspects</td>
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<td>Stakeholder involvement</td>
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<td>Project design and sustainable procurement</td>
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<td>Project life cycle analysis</td>
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<td>Green Technology and Techniques</td>
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<td>Project scope</td>
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<tr>
<td>Guide and Benchmarking (GRS)</td>
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</table>

Elements for managing the sustainable feasibility stage

This paper has extracted the most effective elements for managing the sustainable
FS. This extraction based on the theoretical study reviewing the key differences between traditional and SC projects, the project success factors, challenges and mitigation strategies for managing SC project. These six suggested elements are set as following: (sustainable project scope, early stakeholder involvement, conceptual integrated design, procurement strategy for SC, Decision making considering sustainability priorities, and Archive data base for recording and documentation). These extracted elements are used to formulate a flowchart for purpose of managing sustainable FS, this is achieved by allocating these elements to the phases of FS, and then decomposed to sequential process represented as flowchart. The researcher has represented this conceptual framework in Fig.(1) as pre-step for developing the flow chart for managing FS of SC project.

Field study

The questionnaire has been designed to invite the consultants, project managers and contractors of SC projects to contribute to the hypothesis of the research with their expert views. Especially, this trend is still recent in Egypt and the number of experts is still limited. After the questionnaire has been designed, a pilot sample (5 experts) has been investigated and based on their response some adjustments were made. The designed questionnaire was distributed to 25 experts in Egyptian SC projects from March 2014 to June 2014. A total of 17 out of 25 questionnaires were returned and be ready to be analyzed (68 % response rate). This questionnaire has been developed to: 1) to validate the importance of the suggested elements for managing sustainable FS which were derived from the literature review, and 2) to identify the main benefits and barriers of managing FS for SC projects. Statistical analyses were performed using software (SPSS) V.16, the main statistical analysis used descriptive and correlation analysis.

Data analysis and discussion:

Sample profile:

The sample includes 11 consultants (64%), 3 project managers (18%) and 3 contractors (18%). All of the respondents have more than 5 years experience on SC projects 35% has (5-10) years experience. Those having experience between 11 to 15 years and less than 5 years represent 24%; and 18% has an experience over 15 years. This distribution reflects how recent is the practice of SC in Egypt.

Importance of elements for managing sustainable feasibility stage

Based on the deep literature review, this research has extracted six main elements to be represented in the main phases of sustainable FS. The respondents were asked to
rate to what extent it is important to study these six elements during FS of SC project.

Table (3): Importance degree for elements of sustainable feasibility stage

<table>
<thead>
<tr>
<th>No.</th>
<th>Elements of sustainable feasibility stage</th>
<th>Mean</th>
<th>Mode</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sustainable project scope, project vision, site selection, selected green rating system, …</td>
<td>3.82</td>
<td>4</td>
<td>0.39</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>Early stakeholder involvement Coordination and defining roles, Designation of Skilled team, …</td>
<td>3.47</td>
<td>4</td>
<td>0.87</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Conceptual integrated design. Integrated design processes, Environmental and social impacts, Sustainability matrix, life cycle analysis, life cycle cost, …</td>
<td>3.47</td>
<td>4</td>
<td>0.80</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Procurement strategy for sustainable construction. Innovative green technology, Contract and delivery method, Sustainability plan, Environmental procurement decisions, …</td>
<td>3.24</td>
<td>3</td>
<td>0.66</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>Decision making considering sustainability priorities.</td>
<td>3.29</td>
<td>3</td>
<td>0.59</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>Archive Data base for recording and documentation. Documentation process for each decision making process.</td>
<td>2.82</td>
<td>3</td>
<td>0.73</td>
<td>17</td>
</tr>
</tbody>
</table>

(1) Not important, (2) Fairly important, (3) Important, (4) Very important.

Table (3) illustrates the Mean value of scores ranges from 2.82 "Archive Data base for recording and documentation" to 3.82 "Sustainable project scope", with Mode values Four and Three (important and very important). Also, it can be noticed there is a small standard deviation ranges from 0.39 to 0.89; referring to the responses are clustered closely around the mean. To estimate the reliability of these elements; Cronbach's Alpha coefficient was calculated to determine how each element reflects the reliability of the scale of its importance by calculating the coefficient alpha after deleting each variable independently from the scale. The Cronbach’s Alpha for all elements is more than 0.7. Therefore, the information from the questionnaire survey is considered reliable (Cronbach, 1951).

Relation between suggested elements of FS and GPRS categories

To explore the effect of studying the suggested elements and achieving more credits for GPRS categories; A pearson Chi-square has been conducted and summarized in table (4) to measure the correlation between them. By analysing these data it is noticed that there are four elements affect on getting more credits in three of GPRS categories which are Energy, Water efficiency and Materials & Resources. It is remarkable to notice that both of project scope and integrated design and the correlated categories have been highly ranked. Also, the element of "Decision making considering sustainability priorities" has a significant relation with the category of "water efficiency". This can be attributed to the high credit points (30%) of water efficiency as category in GPRS. Moreover, the element of "Early stakeholder involvement" has a high significant association with category of "Materials and
resources”. It is a logic result; where assessing and studying this category requires the early views of all stakeholders. This result supports the importance and the feasibility of suggested elements.

**Table (4): Correlation between suggested elements and GRS categories.**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Pearson Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPRS Categories</td>
<td>1-Sustainable Scope</td>
</tr>
<tr>
<td>1. Sustainable Site, Accessibility, Ecology</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>2. Energy Efficiency</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>3. Water Efficiency</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>4. Materials and Resources</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>5. Indoor Environmental Quality</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>6. Management</td>
<td>Sig.(2-tailed)</td>
</tr>
<tr>
<td>7. Innovation and Added Value</td>
<td>Sig.(2-tailed)</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

**Relation between benefits and barriers of managing FS of SC project**

Understanding why it is necessary to manage sustainable FS efficiently will help to develop the proper management system during FS. On the other hand, identifying the challenges to achieve any of these benefits is crucial for bridging this gap during developing the management system during sustainable FS.

Therefore, a Pearson Chi-square correlation has been examined to identify the significant relation between each of them. Fig.2 shows the correlated barriers and benefits and the mean value of their significant impact (between brackets) according to the Likert scale from one to four.

It is noticed that two obstacles "**O7: Lack of information and absence of Data base of SC in Egypt**" and "**O10: Lack of awareness of SC cost savings**" have a significant correlation with four benefits. So it can be concluded that these barriers are responsible for hindering achieving the following benefits: **B1: Reducing total time and cost**, **B5: maximizing added value of the project**, **B8: selection of best alternatives**, and finally **B7: evaluate the methodology for achieving selected GRS**. This significant correlation refers to the importance of the necessity to overcome these barriers during developing the management system of sustainable FS in order to achieve these benefits. Moreover, this result supports the importance of suggested elements and their role for archiving the process of decision making (working as database), and considering the sustainable
priorities during making decisions.

<table>
<thead>
<tr>
<th>Benefits of managing sustainable FS</th>
<th>Correlated barriers</th>
<th>Barriers of managing sustainable FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1: Reducing total time and cost. (3.18)</td>
<td>O6, O7, O8, O10</td>
<td>O1: Lack of client demand and owner support (3.65), Insufficient time allocated for incorporating SC in feasibility stage (3.12).</td>
</tr>
<tr>
<td>B2: Considering the social, environmental, and economic impact of the project during making decision of starting project or not. (3.41)</td>
<td>O11, O12</td>
<td></td>
</tr>
<tr>
<td>B3: Maximize the role of life cycle cost and cost benefit analysis during decisions making. (3.24)</td>
<td>O16, O17</td>
<td>O4: Absence of government support and incentives in Egypt (3.47).</td>
</tr>
<tr>
<td>B4: Preparing the sustainable design criteria and mitigation measures for sustainability assessment. (3.53)</td>
<td>O1</td>
<td>O5: Lack of awareness of sustainable construction requirements (3.41).</td>
</tr>
<tr>
<td>B5: Maximizing the added value of the project. (3.12)</td>
<td>O7, O10</td>
<td>O6: Less environmental and social concerns at feasibility project stage (2.94).</td>
</tr>
<tr>
<td>B6: Applying sustainability throughout all project phases. (3.41)</td>
<td>O4, O8, O9, O13, O17</td>
<td>O7: Lack of information and absence of Data base of SC in Egypt (3.29).</td>
</tr>
<tr>
<td>B7: Explore and evaluate methodology for achieving selected GRS. (2.59)</td>
<td>O6, O7, O12, O13, O15</td>
<td>O8: Lack of knowledge of the methods for integrating sustainability principles during feasibility stage (3.18).</td>
</tr>
<tr>
<td>B8: Selection of best alternatives for achieving SC project within effective time and cost. (2.76)</td>
<td>O5, O7, O10, O16</td>
<td>O9: Lack of awareness and availability of local sustainable resources (3.24).</td>
</tr>
<tr>
<td>B9: Early involvement of all project stakeholders and commitment their views towards SC project. (3.53)</td>
<td>O2</td>
<td>O10: Lack of awareness of sustainable construction cost savings (3.12).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O11: Traditional culture and attitude (2.71).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O12: Difficulty to early integrate all project stakeholders with defined responsibilities (3.24).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O13: The fact that sustainability issues are largely procedural and highly initial cost (3.24).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O15: Lack of understanding the assessment tools and GRS for sustainable construction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O16: Lack of ability to transform environmental and social information into monetary values.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O17: The need for structured guidelines to manage feasibility stage for sustainable construction project.</td>
</tr>
</tbody>
</table>

Table 1: Correlated barriers and benefits of managing sustainable FS.

Fig.(2): Correlated barriers and benefits of managing sustainable FS.

Managing SC project during FS:

Based on both theoretical and field study, the research has developed a flowchart for managing Sc project during FS. The proposed flowchart as illustrated in Fig.3 is divided into five phases: 1) Initiation, 2) Initial conceptual design, 3) Integrated sustainability plan, 4) Procurement issues, and finally 5) preparing Feasibility study...
report. For each phase, the required processes are identified, and key decisions are to be made (selected alternatives). These processes begin with the client's need to be defined and assessed, then the GRS to be selected. The statement of needs is then developed into a structural brief (business case) and all key stakeholders are identified with defined roles and responsibilities, also their needs are considered to be satisfied. Subsequently, team work is appointed. Then translating the business case to appropriate design solutions, followed by screening of potential design solutions to select the best sustainable solution by technical, Social & environmental and at the last economical assessment; the optimum design options that meet the sustainability requirement to be selected. Documentation and recording for decision making process is required for effective FS management. It is also necessary to secure the outline financial and time authority; with considering the integrated sustainable issues as agreed in phase three "integrated sustainability plan". The sustainable procurement plan will then be determined by studying the procurement alternatives for all financial, human, material and equipment resources throughout the project life cycle. Finally phase five, preparing the feasibility study report to be peer reviewed before delivering to the owner.

Conclusion:
This paper introduces a flowchart that facilitates managing FS for achieving SC project and being accredited by GPRS certificate, moreover it concerns overcoming the main barriers hindering the managing of sustainable FS. The divided sequential scheme represented by the flowchart enables the user to consider all the needed elements in their right order and to avoid the expecting risk as much as possible. This flowchart allows greater communication among all project stakeholders and illustrates the mechanism for making decisions in order to achieve SC. Also, it concerns with the decisions at design phase as well as procurement plan; where both need more sustainable assessment. Moreover this flowchart has embedded the documentation and recording for data base as a main process for each decision making; it aids as learned lessons for current and future projects. This approach makes the taken decisions explicit and transparent to all stakeholders. Hence, the successful implementation of this flow chart will recommend providing more requirements in addition to the traditional feasibility study requirements as following: 1) Team work specialties (human resources): require additional specialties, 2) Data collection and analysis (material resources): require additional data and more analysis. 3) Time duration for feasibility study; which is influenced by the complexity of the project and the time needed to complete specialized studies. For further studies, this flow chart can be computerized for more effective implementation.
Fig. (1): Conceptual Framework for developing flowchart for managing FS of SC project.

Fig. 3: Proposed flow chart for managing the FS for SC projects
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QUANTITY SURVEYORS IN GREEN CONSTRUCTION:
THREATS AND CHALLENGES

Roziha Binti Che Haron1, Azya binti Mat Rawi 2

1 Department of Quantity Surveying, KAED, International Islamic University Malaysia ([IIUM],
Malaysia.
Tel: 03- 61965265. Email: roziharon@iium.edu.my
2 Department of Quantity Surveying, KAED, International Islamic University Malaysia ([IIUM],
Malaysia

The wave of sustainable construction has created changes within the complex environment of
the construction industry. This globalization has led to a new paradigm of sustainable practice
resulting in a growing demand in green construction and sustainable development. Nevertheless,
since the understanding of sustainable construction in Malaysia is still in its
infancy, quantity surveyors are still struggling to respond to the green demand in order to
safeguard the relevancy and efficiency of the profession. Thus, this paper seeks to study the
practice of quantity surveyors in sustainable construction by focusing on how they face threats
and challenges. The paper identifies the current level of green knowledge and understanding
among quantity surveyors and the threats and challenges in managing sustainable projects. A
mixed method of data collection is carried out within Selangor, where a survey questionnaire
was distributed and several interview sessions were conducted. The findings show that quantity
surveyors have high environmental awareness and green consciousness, but are lacking in their
knowledge and understanding of the concept and implementation of green practices. They face
numerous challenges due to the lack of cost information regarding green material, equipment
and labor, and lack of knowledge on green technologies. To overcome the challenges a
cooperative responsibility of all stakeholders within the industry is needed since most of the
challenges are interrelated with various factors and forces.

Keywords: quantity surveying; sustainable construction; threats; challenges

Introduction

The globalisation of the construction industry has been a strategic trend in
developed and developing countries in Asia to boost up their financial and technical
superiority (Raftery, Pasadilla, Chiang, Hui, & S., 1998). In order to balance the impact
of construction activities on the environment, global concern for sustainable
construction has grown dramatically over the last decades (Hill & Bowen, 1997). Since
then, the demand for green projects has increased the concept of sustainability to
become an essential component in development.

Similar to traditional projects, green projects involve several stages ranging from
the initiation, funding, design, statutory approval, tendering, construction and up to the
risk allocation (Arbi, 1985; Wang, 1987; Sharif, 1996 cited by Abdul Rashid &
Morledge, 1998). Each stage of the construction procurement process requires proper
and systematic planning and management to ensure the success of the project.
Therefore, the capability of project team members is a critical factor for project success
(Anton, 1988; Belassi & Tukel, 1996; Davies, 2002; Fortune & White, 2006; Munns &
Bjeirmi, 1996; Pinto & Mantel, 1990; Pinto & Slevin, 1987).

Green construction has introduced a diversity of project team members. They are
comprised of qualified multi-disciplinary individuals or organisations responsible to
carry out their professional services within the project framework. Among others,
quantity surveyors are the primary cost consultants and contractual advisors. This profession is vital and contributes to the effectiveness of project teams concerning cost planning. This profession may be addressed differently in different contexts. They might be recognised as builders, economists, construction cost consultants or resource managers (RICS, 1986 cited in Male, 1990).

The primary role of quantity surveyors as generally perceived by others pertains to the project cost. Nevertheless, costing is not the only task carried out by quantity surveyors. Seeley (1984), Male (1990) and Fellows, Liu, and Fong (2003) highlighted the importance of quantity surveying in providing various financial management services and contractual advisory for construction projects. Today, together with the globalisation and growth of sustainability in construction industry, their work scopes have broadened. The dynamic and complex environment surrounding the construction industry has created market changes to this profession. Therefore, previous researchers have pointed out that quantity surveyors need to respond readily to these demands (Nkado & Meyer, 2001; Shen, Li, Shen, Drew, & Chung, 2003; Smith P., n.d.).

One of the factors that create changes within the complex environment of the construction industry is the wave of sustainable construction. According to Zainul Abidin (2010), the government has provided incentives to construction clients, especially developers to implement green concepts in their development. This effort has led to a growing demand for green construction and sustainable development. Construction players including quantity surveyors are responsible to respond to this demand (Shi, Ye, Lu, & Hu, 2014). Consequently, the changes in market demand and economic force changes in surveying practices. From the very beginning, quantity surveying has expanded from traditional practices to ensure the relevancy and sustainability of services to meet sophisticated client demands.

Research Background

Malaysia is undergoing rapid development. CIDB (2008) reported that a large number of Malaysian key economic sectors showed positive growth in 2007 with the construction sector leading all sectors at 4.6% (2006: -0.5%). This statistic indicates the significance of the construction sector in promoting national socioeconomic growth and economic development. The activities of the construction sector focus on “strengthening and enabling of the other sectors, while supporting social development and meeting the needs of basic infrastructure requirements” (CIDB, 2008, p. 14). The demand for the construction industry is derived from various economic sectors. This indicates that the construction industry constitutes a vital element for economic growth in the Malaysian economy as a whole.

Given its prominence in development, the construction sector is the major feeder of environmental pollution and land destruction. For the past few centuries, the earth temperature has gradually raised due to increases in greenhouse gas emissions (Mitchell, 1989; Casper, 2010). According to Meadows (2002), the greenhouse gases trapped within the earth’s atmosphere will heat the surface and lead to Global Warming. Acquaye and Duffy (2010) asserted that the emissions of greenhouse gases originate domestically from sources directly related to construction activities. Rohracher (2001) argued that construction of facilities contribute to significant ecological load for almost 40% of energy consumption and about 25% of material moved. Although construction facilities are important for the urbanisation in the promotion of socioeconomic development; it is also the major cause of global deterioration. Because of that, the idea
of sustainable construction is advocated to minimise the impact of construction on the environment.

Sustainability in construction is not a recent issue. The World Commission on Environment and Development (WCED, 1987) described sustainable construction as that which fulfils today’s needs without diminishing the ability of future generations to meet their own needs. The main content of the WCED report was to seek for international cooperation from countries under the United Nation to establish strategies for sustainable industrial development in a global context. It is a platform carried out through an international endeavour to protect the threatened future. The concept of sustainable construction has been globally acknowledged by most countries.

In Malaysia for example, since the last decade sustainability has become mainstream (CIDB, 2006). The Malaysian government offers initiatives to encourage environmentally friendly products and services that promote green technology (Abd. Hamid, Ghani, Mohd. Zain, Mohamad Kamar, & Abdul Rahim, 2009). In addition, the establishment of the Construction Industry Master Plan (CIMP) 2006-2015 highlights the need of a paradigm shift in the construction industry. It established a focus to transform the Malaysian construction industry into a world leader by 2015 by identifying the Master Plan consisting of seven Strategic Thrusts (ST).

This study tends to focus on the third and fourth ST, which are to strive for the highest standards of environmental practices and develop human resource capabilities and capacities in the construction industry. The launching of this strategic plan has developed these positive changes in the construction atmosphere. The concept of sustainability in construction has been introduced and is aggressively promoted. Stakeholders in the construction industry are aware of the accelerating deterioration of the human environment resulting from the construction industry. Moreover, sustainable development has opened new insights to the major construction players to increase their competitiveness within the industry.

Similar to other key professionals, quantity surveyors are struggling to enhance green practices to meet the industry demand. The combination of sustainable construction knowledge with core quantity surveying offers quantity surveyors opportunities to be at the forefront in promoting green awareness and leading changes (Seah, 2009). However, quantity surveyors continue to face various challenges and threats during the management of green project.

**Research Motivation**

The environment that surrounds the process of construction procurement is complex and dynamic. It contains a variety of elements and exchanges to respond to environmental forces and changes (Abdul Rashid, 2002). Urbanisation is a common unremitting phase in the construction industry. Thus, each element of the construction environment, including construction players has to readily respond to the global changes. Quantity surveyors also have to react to this change to secure the efficiency of the profession.

The sustainable age of construction is transformation the surveying profession. However, the competency of quantity surveyors in dealing with the challenges of industrial demand is often questioned (Dada & Jagboro, 2012). Quantity surveyors need to be more aware of sustainability issues. Accordingly, the Royal Institute of Chartered Surveyor (RICS), the international professional institution representing the global surveying profession worldwide, is concerned with sustainable construction.
Recently, RICS Asia organised the 13th Pacific Association of Quantity Surveyors Congress (PAQS 2009) with the theme of “Building the Future Together”. This event represented and promoted the concept of sustainability in development for the future generation. The congress was successfully held in Kuala Lumpur and attracted a participation of 484 Quantity Surveyors and Cost Engineers from 12 countries from throughout the Asia Pacific region (RICS Asia, 2009). One of the participants of the congress, Seah (2009) presented his research on “Sustainable Construction and the Impact on the Quantity Surveyors” The Deputy Chairman of Langdon & Seah Singapore Pte Ltd urged that the global wave of sustainable construction is a growth opportunity for quantity surveyors to merge from traditional roles. Seah highly encouraged an immediate response from quantity surveyors to the treats of green construction and to better cater for the changing demands of clients.

The evolution in quantity surveying due to industry challenges and global threats is a common issue. Brandon (1990) assessed the importance for quantity surveyors to acquire knowledge and improve skills in order to shift into a new field of works and scrutinise clients’ sophisticated needs. Hanid, et al., (2007) analysed several obstacles that quantity surveyors will face in order to develop the profession and extend their roles in various fields according to changes in the market. He further examined that the diversifying scope of work faced by quantity surveyors is a positive challenge for them to venture into another industry and expand their services.

The Quantity Surveyors Division of the Royal Institute of Chartered Surveyor (RICS) issued a report on the obstacles that quantity surveyors may face, which include changes in client’s demand, changes in the construction industry, changes in market forces and changes in the profession itself (Wilis & Willis, 1994). Elforgani and Ismail (2010) reported that the need for proficient design teams, including quantity surveyor in the green construction field is highly crucial. However, many researchers have identified that the major barriers faced by the project team or lack of education, skills and tools in managing a green project always affect the environmental performance goals of clients and did not meet their required objective (Carlisle, Brown, Foster, Bennett, & Sendler, 2004; Grund, 2005; Hwang & Ng, 2013; Lee & Egbu, 2006).

As a result, many researches have tended to focus on how to manage the challenges faced by the design team members especially in riding the global wave of sustainable construction. It has been proven that the success of the project can be fulfilled with the proper selection of competent design team members because it can increase the potential of the project to be delivered on time, within budget and exceed its minimum requirement (Graham P., 2010). Quantity surveyors are qualified professionals in all aspects of construction cost and contract administration.

In recent years, the concept of green construction has been rapidly growing. In response to the environmental awareness among stakeholders, the construction industry has been shifting into a new sustainable atmosphere. The practice of the industry players, including quantity surveyor has developed and evolved. In Malaysia, like other developing countries, the understanding of green construction is still in its infancy. Construction players such as quantity surveyors are still struggling to respond to the green demand. Therefore, it becomes highly imperative to study quantity surveying practices in green construction and identify their challenges, as studies on this area remain highly limited.
Quantity Surveying Practices in Sustainable Construction

The concept of sustainability within the green framework is a broad concept. Seng, Zainul Abidin, and Yusof (2008) identified over 200 definitions of sustainability. It has been expressed differently depending on different perspectives and objectives. The word sustainable itself brings the idea of constant, continuous and permanent. The Oxford Dictionary’s definition of sustainable is “able to be maintained at a certain rate or level” (Oxford, 2014). It implies the aspect of sustainability to be resistant to time (Md Zin, 1998). In other ways, it is also translated as durable to represent its addictive nature.

The concept of sustainability covers psychological, technical, social, cultural, and physical dimensions among others. However, this research focuses on the physical aspect of development. The most comprehensive and widely accepted definition of sustainable development is “… development that meets the needs of the present without compromising the ability of future generations to meet their own needs” which was firstly introduced in The Brundtland Commission (WCED, Report of the World Commission on Environment and Development: Our Common Future (Brundtland Report), 1987b, p. 43).

In general, sustainability in construction represents the optimum use of input for construction works to accomplish an efficient construction project that produce a considerable amount of harm to the environment.

According to Zainul Abidin (2010), one of the reasonable efforts to achieve sustainable development is by way of sustainable construction. Charles J. Kipert defined sustainable construction as the creation and responsible management of a healthy built environment by optimising the resources utilisation and applying ecological principles (Malik, 2002). This concept describes the guidelines to implement sustainable development in the construction process. Langston and Ding (2001) asserted that sustainable construction is the subset of sustainable development which shall be integrated along the processes of design, tendering, site planning and organization, material selection, recycling and waste management.

Sustainable construction underlines a different framework to achieve different underlying objectives. The approach itself requires changes and revision to suit the surrounding issues. Initially, sustainable construction emphasises on optimising the utilisation of scarce resources and energy, as an effort to reduce its impact on the environment. Later, attention changed to technical issues focusing on the materials, building components, technologies and efficient design. Nowadays, the outline of sustainable construction mainly emphasises on a big theme covering environment, economic and social aspects of human life and its ecosystem.

In Malaysia, the transformation of traditional construction works into a new paradigm of sustainable practice has become mainstream since the last decade (CIDB, 2006). The government has carried out various efforts ranging from awareness campaign, incentives, legal requirements and development plans to promote green technology, green products and green services (Abd. Hamid, Ghani, Mohd. Zain, Mohamad Kamar, & Abdul Rahim, 2009). Quantity-surveyors need to respond to the changing market forces. The combination of sustainable construction knowledge with core quantity surveying offers them the opportunity to be at the forefront in promoting green awareness and lead changes (Seah, 2009).

Quantity surveyors must positively adapt to the changes and perceive threats as opportunities. The following tasks are among the quantity surveyors’ extended roles within sustainable construction:
Green Costing

Quantity surveyors are recognised as the primary project cost consultants. Hence, they have to adopt the green knowledge and utilise changing technologies in their practice. In the preparation of cost planning, they have to allocate extra costs to obtaining green building certification (Seah, 2009). Their costing has to embrace the cost allotment that covers all possible aspects of construction. In green projects, the involvement of quantity surveyors at the early stage is crucial so that the preparation of green design is developed within the allocated budget. The surveyor’s role is essential to advise the designers on the parameters of prices, design efficiencies, design factors, and green requirement (Seah, 2009). This practice could be enhanced with value management practices and risk analysis.

Carbon Footprint

The important element of green building is to meet the requirement of carbon emission. Therefore, the preparation of a carbon footprint is essential to develop a carbon management strategy (Seah, 2009). According to Wiedmann and Minx (2008), carbon footprint is used by the building owner to measure and monitor the carbon emission between different properties. Hence, they can set targets and utilise the energy by eliminating the ineffective energy (DLSC, 2008 cited in Seah, 2009). If the quantity surveyors excel in preparation of the carbon footprint, they can create various carbon models for green development and enhance their cost plan model. This factor can be the benchmark for them to enhance their quality of services.

Life Cycle Costing

Life cycle costing (LCC) refers to the assessment of the total cost throughout its full lifespan, starting from development and construction phase and continuing until the disposal (McCraley, 1985). According to Woodward (1997), the process of life cycle costing involves the estimation of the total cost in its whole life for a range of various alternatives available. The practice of life cycle assessment was introduced in normal construction for the past few decades; however, it has been enhanced recently especially within the practice of sustainable construction. Seah (2009) argued that the practice of LCC will significantly grow in the following years and quantity surveyor as the cost expert are in the best position to lead the field.

Green Building Rating Assessment

In Malaysia, the Green Building Index is used as the green building rating system, which was established in 2009. There are four classifications of green credentials offered under the Green Building Index rating. The different targeted classifications achieve different GBI points. The score of GBI classification is shown in TABLE 1.1.

<table>
<thead>
<tr>
<th>POINTS</th>
<th>GBI RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>86+ points</td>
<td>Platinum</td>
</tr>
<tr>
<td>76 to 85 points</td>
<td>Gold</td>
</tr>
<tr>
<td>66 to 75 points</td>
<td>Silver</td>
</tr>
<tr>
<td>50 to 65 points</td>
<td>Certified</td>
</tr>
</tbody>
</table>
There is a paucity of green experts in Malaysia as green development remains in its infancy. Quantity surveyors could take the opportunity to learn about green building rating systems, to better provide professional advice to clients, especially in regards to costing and sustainable designs.

**Building Information Model (BIM)**

Building information modelling (BIM) is a recent development in the construction industry. According to Azhar (2011), this technology facilitates designers to visualise the building model within a simulation state of potential design, construction, or operational issues. The integration of building information model in sustainable construction is a benchmark to embrace the parameters necessary for performance calculations. The building information models enable to balance the use of energy and optimise the building design (Schlueter & Thesseling, 2009). The advancement of building information modelling system is used to store information regarding green points, carbon emission, costing and specification (Seah, 2009). Seah added that the other key advancement in BIM, known as Quantity Information Model (QIM), could enhance the quality of cost estimation.

**Green Procurement**

Green procurement is a mechanism developed under the Ministry of Energy, Green Technology and Water and Ministry of Finance. It is a joint effort with SIRIM (Malaysia’s research and standards development organisation). Green Procurement is a procurement manual, which includes procedures and standards to facilitate the procurement process green material and technologies (Chua & Oh., 2011). The requirement of Green procurement needs to be implemented in all government agencies, regardless of any industry therefore including construction sector. Quantity surveyors, as the professional contractual advisors within the industry, are in an ideal position to lead this chance. They must prepare themselves with sufficient knowledge on the said matter and they must able to be at the forefront in promoting green procurement.

Understanding the quantity surveying practice and its venture opportunity within sustainable construction is undeniably important. It is to ensure that the practitioners realise the incoming challenges and threats, so they are able to sustain the credibility of their works and profession. Therefore, this chapter has comprehensively described all aspects of quantity surveying practices within sustainable construction. It includes the status of the quantity surveying profession within the construction stakeholders, the framework of the quantity surveying profession and the quantity surveying practice in sustainable construction.

**Research Methodology**

To achieve the aim of the research, the methodology of this research was structurally planned to ensure a smooth process of gathering the desired data. Hence, primary and secondary data collections were conducted to acquire comprehensive data regarding the subject matter.

Firstly, a survey questionnaire from the established sample will be created and a pilot study undertaken. The survey questionnaire will embrace four main sections representing three research objectives including demographic information. The finalised questionnaire will be distributed within Selangor by means of personal delivery and electronic mail. Then, several interview sessions will be conducted to explore alternative solutions to achieve the third objective. The preliminary method used for
collecting data is through literature study. This method is applied to critically review and evaluate the current study on two bodies of knowledge, which are sustainable development and quantity surveying practices. The two methods of questionnaire distribution observed is personal delivery and via electronic mail.

Personal delivery: Survey questionnaire is distributed to one hundred and thirty (130) numbers of quantity surveyors targeting individual construction companies within Selangor. Eighty-five (85) respondents returned the questionnaire. For electronic mail: A questionnaire was prepared using “Google Docs”, which is an online survey application. This application allows users to create and manage any formatted documents allowing them to share the work online. It offers access to documents from anywhere and collaborate with others in real time. After the finalised questionnaire was confirmed, the link to the document was sent to four hundred and forty-two (442) targeted respondents via electronic mail and one hundred and one (101) electronic mails were replied. This constitutes a response rate 22.85% via electronic email. In summary, the total response rate of the survey questionnaire is 44.15 %. For interviews, eight (8) respondents were interviewed consisting of clients, contracting firms and consultation firms. The result shows that two respondents have experience, whereas the remaining six have no experience in managing green projects. The gathered data were analysed using SPSS (Statistical Package for Social Science) software and three methods of data analysis were conducted, namely a) Descriptive statistical method b) Inferential statistical methods and c) Explanatory data analysis.

The Current Level of Green Knowledge and Understanding among Quantity Surveyors

Evidence from literature indicates that the development of sustainable projects in Malaysia shows positive signs (Zainul Abidin N. , Sustainable Construction Practices in Malaysia, 2010). However, the environmental concern and green consciousness among the society and construction players is still questionable. For this research, the discussion on green awareness among quantity surveyors will be divided into three main aspects, namely a) Altruistic, b) Intrinsic and c) Extrinsic. The altruistic aspect of green construction knowledge and understanding indicates the environmental awareness and green concern among quantity surveyors.

The research finding shows that the altruistic knowledge and understanding among quantity surveyors is high. Their awareness on environmental protection is implemented in daily routines with the highest score. They also have general knowledge of green construction and highly agree that green construction needs to be aggressively promoted. As far as the psychological aspect is concerned, data shows that quantity surveyors are aware of the environmental issues and are highly concerned for environmental protection (Stern, Dietz, & Kalof, 1993). This finding is contrary to that of Zainul Abidin (2010) who found that green awareness and understanding of sustainable construction among Malaysian developers remains low. She said that at present, only large developers are pursuing the goals of sustainable developments, whereas others are more concerned with costs rather than environmental awareness.

Within the aspect of environmental knowledge, intrinsic aspects refer to acquaintance with green knowledge. The research found that the aspect of intrinsic knowledge among quantity surveyors is slightly lower compared to the altruistic aspect. This illustrates that the quantity surveyors are highly concerned with environmental protection, but are poorly motivated to acquire knowledge of green development. They lack education in green materials, equipment, and technologies. Grund (2005) pointed
out that the major barriers of sustainable construction are lack of green knowledge. Many agree that developers need external support to enhance their knowledge and improve their skills within green construction. Their present experience in managing normal projects is insufficient for them to handle the green construction project. In the context of environmental responsibility, extrinsic aspects refer to the attainment of a green knowledge because of a specific external force. The external force in this statement relates to work requirements or technical demand.

The research found that the extrinsic aspect of knowledge and understanding among quantity surveyors concerning green practices is higher than the intrinsic aspect, yet slightly lower than the altruistic aspect. This indicates that the quantity surveyors have a high green concern, yet they need external motivation to improve their knowledge and skills in the management of green projects. Quantity surveyors need to improve their knowledge and skill in green construction and other entities such as government, quantity surveying-related body, and organisation should provide initiatives to enhance their work performance within green practice.

The Threats and Challenges in Managing Sustainable Projects

In order to move into the new paradigm of sustainable community, many investors in Malaysia have started to invest in this kind of project. For the past few decades, the need for green construction is increasing from time to time.

Threats and challenges based on categories

There are six categories, namely (1) Planning related challenges, (2) Project related challenges, (3) Client related challenges, (4) Material, equipment and labour related challenges, (5) Project team related challenges and (6) External related challenges.

Planning related challenges

Planning of a construction project includes preparing an initial brief to the client until the preparation of tender documents. According to Hwang and Ng (2013), any failure during planning will result in construction conflict. The research found that quantity surveyors are facing many challenges due to the lengthy approval process for green technologies within the organisation and longer time in preparing the cost plan. Green building evaluation systems in Malaysia engages the GBI rating system. This system offers three levels of certification, namely Certified, Silver, Gold, and Platinum for both new and existing construction. Different levels of certification need to fulfil different green point requirements. Therefore, during the planning stage, the organisation needs more time to evaluate green technologies to ensure that the technology they engage use meet the targeted green score. Besides, green technology is still new in the industry. Therefore, the effectiveness is still uncertain with no proven record of accomplishment (Elforgani & Ismail, 2010). Thus, the process will be lengthy because cost-benefit analysis, life-cycle study, and GBI assessment need to be conducted.

Moreover, the lengthy approval leads to other challenges. The finding shows that quantity surveyors also need longer time in preparing cost plans. Cost plan is an instrument for cost monitoring. It will be prepared based on the designed building and within client’s budget. However, due to the uncertainty of green materials, technology, and design components, the preparation of the cost plan will be delayed.
Furthermore, most quantity surveyors express that they are facing difficulties in providing professional advice regarding the pros and cons of different decisions. This problem is caused by shortage of information among quantity surveyors. The research found that the problem of providing professional advice results from uncertainty in the green technology information and leads to delays in preparing the cost plan. In summary, the research highlighted the problem of information management as the main problem in planning suffered by quantity surveyors in Malaysia.

**Project related challenges**

Construction projects are heterogeneous in nature, where no two constructions are alike. This differentiation makes construction a unique industry. Furthermore, the wave of sustainable construction has enhanced the quality of practice within the industry in terms of environmental protection. Thus, the difference between normal and green construction is greater. In order to react to the increasing need of green concepts, quantity surveyors are facing challenges related to green project. The major challenges are longer time required during the selection process and audit and more time required during assessment due to the green certification process.

The process of tender evaluation is to select the most capable contractor to bear the responsibility to construct the building. Different types of projects may require different sets of criteria to be evaluated. However, Malaysian contractors are still fresh in this industry. Hence, the evaluation process needs to be carried out thoroughly to ensure that the most suitable tenderer is awarded. Tendering process is one of the critical stages to ensure the success of the construction phase. It will also determine the implementation of planning on the site.

Next, quantity surveyors face the problem during assessment on green mark certification. Since the objective of green projects is to get the green certification under the GBI rating system, they have to ensure that the implementation of green components meets the targeted green points. If the construction technologies do not fit the score, some parts of construction need to be altered requiring longer time. Therefore, the green mark assessment process may be extended until the targeted score is achieved. The delay in green assessment may delay the duration of the planned construction. In summary, the roles of construction players, especially the design team during the planning stage is the most critical to ensure the success of the construction phase.

**Client related challenges**

The client is one of the most important stakeholders in construction projects. The effectiveness of client decision-making highly influences the efficient communication in green buildings (Yang & Zou, 2014). The research finding indicates that quantity surveyors face problems because the client takes a lot of time in making a decision. The investigation of the importance of the client’s role in green development has been addressed in researches by Elle, Dammann, Lentsch, and Hansen (2010) and Valdes-Vasquez and Klotz, (2013). According to van Bueren and Priemus (2002), the client always delays in making a decision because of the institutional barriers. The term institutional barrier refers to the managerial habit and tradition within the client’s organisation which delay the process of decision-making.

However, according to Bowen, Pear, and Edwards (1999), construction professionals, including quantity surveyors must conduct effective client briefing process to ensure that the client knows their important role in contributing to the success of construction with respect to time, cost, and quality of the construction
project. The client must confirm their essential role not during the briefing process and growing during the design, and construction phase. They must give an immediate decision when required. Moreover, as a professional advisor, quantity surveyors must intelligently tackle the issue by providing excellent professional advice, inform of the pros and cons of every decision making and facilitate the client during the process. Therefore, knowledge management among quantity surveyors is essential to ensure a strong foundation of opinion.

**Material, equipment and labour related challenges**

The cost of construction works is mainly comprised of material, equipment, and labour. The management of these three factors has extensive influence on construction cost and duration (Kaming, Olomolaiye, Holt, & Harris, 1997). Nevertheless, quantity surveyors express several challenges in the management of these factors in green projects. The major threats relate to material, equipment and labour are the high cost of green material and equipment and difficulty in getting information of green technologies. The literature has shown that green projects always lead to higher construction costs compared to conventional projects. This is due to the cost of planning to integrate green, practice on sites and high design complexity (Zhang, Shen, & Wu, 2011). Based on research conducted by Tagaza and Wilson (2004), the capital cost of green projects might increase by 25% higher than normal projects (cited in Hwang & Ng, 2013). The increased cost is estimated because of the high cost of green materials and application of green construction technologies (Hwang & Tan, 2010). The increasing cost of materials, equipment and labour in green projects is a direct threat to quantity surveyors’ works because they are responsible to manage the cost aspect of the project to be delivered within budget.

Furthermore, quantity surveyors are having difficulty in gathering the required information on green technologies. This finding proves that information and knowledge management is critical in the management of green project. This issue has been addressed several times in literatures. Carlisle, Brown, Foster, Bennett, and Sendler (2004), Lee and Egbu (2006) and Shafii (2005) mentioned in their researches that the major barrier among project teams is the lack of green education. Therefore, the selection of the project team for green projects is highly crucial to ensure that the members are full equipped with green knowledge (Graham P., 2000).

**Project team related challenges**

According to Cornick and Mather (1999), the effectiveness of the project team is crucial to ensure the profitability of construction projects. Nevertheless, the research found that quantity surveyors are facing problems in relation to the project teams. They are always having conflict with the architect over the type of material to be used with most of them expressing the challenge is due to a lack of commitment from other project team members.

During the development process, there are many separate organisations closely working together within a long course of a project. These organisations have their own interest to ensure that the project is delivered within budget, on time and meet the minimum quality requirements. These interests always tend to be conflicted among the project team members. Quantity surveyors, being the primary cost advisors in any project, are always concerned with on aspect of cost. This interest always conflicts with the designers, especially architects. Thus, the term ‘lack of commitment from other project team members’ may be translated in the perspective of cost.
The complexity of construction work needs to bring a diversity of individuals together into a team. During the timing, the exchanges of a vast number of information may take place. Thus, the adversarial nature between the construction team may lead to lack of consideration and understanding of others’ interests. Fellows, Liu and Fong (2003) exerted that the power of the project manager is the most essential factor to influence the behaviour of team members. Therefore, as a part of the team, quantity surveyors should ensure that they have to take care of the team’s interests as a whole during the delivery of professional service to ensure an effective team.

External related challenges

The process of construction procurement takes place in a complex and dynamic environment (Abdul Rashid, 2002). There are various external factors the influence the whole process. As far as green construction is considered, the external challenges may come in many forms (Hwang & Tan, 2010). Research findings highlight most quantity surveyors are expressing threats because of the unforeseen circumstance in green projects. Since the green construction in Malaysia is still new, construction players lack experience of incoming risk compared to normal works. They might not be adequately acquainted with the management of unexpected circumstances. Besides, quantity surveyors also face challenges caused by specific performance requirements of green building projects. Quantity surveyors still lack the skills in the management and assessment of green plants to meet green certification requirements. Most quantity surveyors argue that there are limited policies and standards to guide quantity surveyors practitioners in green construction projects.

Challenges based on the stage of construction

The second category of challenges is based on the stage of construction which is divided into four stages, namely (i) Feasibility stage, (ii) Design stage, (iii) Tendering stage and (iv) the Construction stage. Results shows that the design stage is the most critical stage for quantity surveyors. This finding is in line with previous research by Coady and Zimmerman (1998). They argued that the planning during the design stage is the major indication of environmental impact.

In green building projects, the green concept is developed during the design stage (Aniza Abdul Aziz, 2008). Therefore, the design team, including quantity surveyors must have green knowledge in order to properly translate the client’s needs into conceptual form. Previous research by Elforgani and Ismail (2010) found that the attributes of the design team are essential. The satisfactory performance of green building can be assured by the right choice of design team members (Kirmani & Baum, 1992).

Conclusion

Quantity surveyors have high environmental awareness and green consciousness, but limited knowledge and understanding of the concept and implementation of green practices. The findings highlighted that quantity surveyor’s knowledge is influenced by external factors such as efforts and initiatives from others. It also proves that the involvement of quantity surveyors in green projects can enhance their awareness and green knowledge.

In addition, quantity surveyors face many challenges regarding green materials, equipment, and labour, especially due to a lack of information on cost data and lack of knowledge on green technologies. Quantity surveyors face the most critical challenges
during the design stage because too much time is required for approval, making decisions, gathering information and preparation of the cost plan. Some of the challenges are caused by client and other design teams. The findings suggest that the strategies to overcome the challenges are not a one-side effort. It requires a cooperative responsibility of all stakeholders within the industry since most of the challenges are interrelated with various factors and forces.

In summary, the outcome of this research offers insights for quantity surveyors on overcoming challenges of green construction. They can prepare themselves with adequate green knowledge and management skill by involving in various certified programs, workshops, training or seminars and courses. This is necessary to ensure the sustainability and relevancy of the profession to fulfil market needs and public interests by providing efficient services. The outcome of this research may influence the responsible entities/ organisation such as government and profession-related body to provide initiatives and approaches to groom the most proficient quantity-surveying professionals in the Malaysian construction industry. It may also influence academic institutions at to restructure and update the educational program and embrace green elements in the syllabus.

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SUSTAINABILITY REPORTING IN THE CONSTRUCTION INDUSTRY: 
LESSONS FROM THE UNITED KINGDOM AND BRAZIL FOR THE 
MALAYSIAN CONSTRUCTION INDUSTRY

H.C. Bispo Junior¹, E.C.W. Lou² and S.M. Syed Khuzzan³

¹Technology Centre, Federal University of Alagoas, Brazil humbertocavallcente@gmail.com
²School of Mechanical, Aerospace and Civil Engineering, University of Manchester, UK e.c.w.lou@manchester.ac.uk
³Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia smazlina@iium.edu.my

Organisational success is no longer assessed through commercial achievements – but now judged on their social and environmental performance – more than their triple bottom line. They expected to contribute towards the betterment of their customers and stakeholders, sustainability practices (upstream and downstream) and social responsibilities. The Global Reporting Initiative (GRI) is the de-facto non-financial reporting standard on sustainability indicators of social, environmental and human rights impact; diversity; and anti-corruption policies. The European Parliament passed a Law making sustainability reporting mandatory to major businesses by 2017. This is historic considering fewer than 10% of the largest EU organisations disclose sustainability information regularly. The construction industry (CI) is not exempted. This paper researched sustainability reports of the Top 50 construction businesses in the UK and Brazil, and compared them to the logistics/transportation businesses; and their potential impact for the Malaysian CI. Findings indicated low uptake and poor report quality between the UK and Brazilian CI. Lessons learnt could help the Malaysian CI to accelerate sustainability practices, increase reporting uptake and produce better quality reports.

Keywords: Construction, GRI, Logistics, Sustainability, Brazil, Malaysia, UK.

Introduction

Global sustainability relies on the development, inclusion and responsibility of all countries, which is impacted on how organisations are ran. Organisations today, big or small, have a role to play in making the world a better place. They are no longer judged through financial or economical indicators, but also impact towards their staff, the community they work in and environmental impacts of the business. The scrutiny of organisations was the result of realisation that they hold the main impact for countries to engage and deliver in social, economic and environmental development (Hector et al., 2014). The use of sustainability evolved through the years since its first definition
and principles. Theoretical definitions of sustainability have been widely accepted globally with commitments from world bodies (eg. UN, EU, World Bank, etc.), governments and organisations (Sessa and Ricci, 2014). However, it is a complicated issue when it comes to action and implementation of these aspirations (Drexhage and Murphy, 2010).

The sustainability scene is undergoing a major transition – national governments are not only signing-up and committing to global sustainability goals, they are now mandating organisations to disclose their sustainability credentials. The various government-led non-financial reporting initiative is shown in Table 1.

<table>
<thead>
<tr>
<th>Country</th>
<th>Initiative</th>
<th>Year</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>Financial Statements Act</td>
<td>2008</td>
<td>Compulsory for large businesses, listed companies and state-owned companies</td>
</tr>
<tr>
<td>France</td>
<td>Article L225-102-1</td>
<td>2010</td>
<td>Compulsory for listed companies and selected companies</td>
</tr>
<tr>
<td>Ireland</td>
<td>Credit Institutions Act</td>
<td>2008</td>
<td>Compulsory for financial institutions supported by the government guarantee scheme</td>
</tr>
<tr>
<td>Sweden</td>
<td>Guidelines for external reporting by state-owned companies</td>
<td>2009</td>
<td>Compulsory for state-own companies (whole or partial)</td>
</tr>
<tr>
<td>Spain</td>
<td>Sustainable Economy Law</td>
<td>2011</td>
<td>Compulsory for government-sponsored commercial companies and state-owned business enterprises</td>
</tr>
<tr>
<td>UK</td>
<td>Companies Act 2006 Climate Change Act 2008</td>
<td>2006 2008</td>
<td>Compulsory for listed companies</td>
</tr>
<tr>
<td>Brazil</td>
<td>Despacho 3034/2006 The ANEEL Requirements for Annual SR</td>
<td>2006</td>
<td>Compulsory for energy utility companies</td>
</tr>
</tbody>
</table>

**UK and Brazil Context**

Both the UK and Brazil governments have intervened and formed national legislation to make sustainability reporting compulsory for selected organisations. The UK also introduced The Companies Act 2006 that requires listed organisations to deliver a ‘strategic report’ on employees, environmental matters, social and
community issues and their supply chains. These changes also affect the content of annual Directors’ report to include annual carbon dioxide emissions resulting from their activities and from the ‘purchases of electricity, heat, steam or cooling’. The 2013 amendment to this Act (Companies Act 2006 (Strategic Report and Directors’ Report) Regulations 2013) saw the inclusion of carbon reporting for listed organisations: this reports the greenhouse gas (GHG) emissions for which the organisation is responsible. The Brazilian Federal Senate is currently studying a proposal (PS 289/2012) to make sustainability reporting mandatory for all Anonymous Societies (listed organisations) regardless of the number of employees. This draft law has been circulating for two years, calls for transparency in Brazilian organisations and is still open for public consultation.

Mandatory disclosure by legislation has brought benefits of increased social responsibility and a decrease in bribery and corruption to the economies of 58 countries (Glass, 2012). Within the organisational level, positive impact is reported on a range of socially responsible managerial practices (Ioannou and Serafeim, 2012).

The UK recorded over 4.88 million medium or small enterprises (SMEs) in the UK in 2013, which represents 99.9% of all enterprises in the country (Ward and Rhodes, 2014). SMEs also make 59.3% of the private sector business and SMEs consist of 84.8% of the CI (BIS, 2013). The Brazilian Service for Micro and Small Enterprises (SEBRAE) reported 6.3 million Micro and Small Enterprises (MSE) employing over 16.2 million people in 2012. Small enterprises have fewer than 100 employees and micro enterprises employ less than 20 people. Construction MSE increased 5.1% by 2012, accounted as the fourth largest sector in Brazil (SEBRAE, 2013). The growth of SMEs/MSEs in UK and Brazil are projecting a positive outlook – the UK and European economies are emerging economic slowdown; and Brazil has the Olympics (after the World Cup) to look forward for. Sustainability practices among SME/MSE are also largely debated and unreported. However, it is widely acknowledged that SME/MSE have limited resources to report their sustainability actions, processes and strategies; the myriad of reporting standards also added to reporting confusion (Lou et al., 2011).

**Sustainability Reporting**

The disjunction concepts of sustainability reporting produced a myriad of reporting guidelines or standards available to organisations to follow – the ISO26000 (ISO, 2010), AA1000 (AccountAbility, 2008), GRI4.0 (GRI, 2013), GRI3.1 (GRI, 2010), SA8000 (SAI, 2008) and many others. For example, the ISO 26000 provide guidance into organisational governance, human rights, labour practice, the environment, fair operating practice, consumer issues and community involvement and
development, but this standard is only a guide and cannot be certified. The SA8000 provides a standard based on international human rights norms and national labour laws that will protect and empower all personnel within an organisation’s scope of control and influence.

Literature review from both academic and industrial courses regard the Global Reporting Initiative (GRI) as the de-facto standard for sustainability reporting worldwide. This is supported by Hess (2014), KPMG (2013), Grant Thornton (2014), and others. However, Milne and Gray (2012) argued otherwise. We agree that GRI is not the perfect reporting platform, but is currently the industry ‘standard’ in sustainability reporting. GRI encourages organisation to be more sustainable and contributes towards sustainable development through the use of sustainability reporting. The GRI3.1 framework was introduced in 2011 and the new GRI4.0 in 2013. Most organisational report still uses the GRI3.1; the GRI4.0 is fairly new and is expected to be widely adopted in reports after December 2015. Disclosures in the GRI3.1 include organisational strategy and profile and six performance indicators: Economic (EC); Environmental (EN); Labour Practices and Decent Work (LA); Human Rights (HR); Society (SO); Product Responsibility (PR). Reports are graded by through application levels, which can be C, B or A. This reflects the extend of coverage or detail of the report; if the reports is assured by external sources the grade gets a “+”. GRI requires additional reporting information for airport operations, food processing, construction and real estate, media, electric utilities, mining and metals, event organisers, NGOs, financial services and oil and gas sectors.

Methodology

This research selected the Top 50 contractors in the UK and Brazil, as the case sample size. The UK contractors represents the cohort from a matured developed country and the Brazilian contractors representing an emerging economy - and both SME/MSE organisations make up more than 90% of the industry. Construction organisations are compared with the transportation/ logistics organisations (no passenger traffic is considered). Logistics organisations were selected as they represent the vast portion of carbon emissions for the construction industry, and have hefty influence in the CI supply chain. The UK Top 50 contractors by turnover were selected from The Construction Index (2014) and Building (2014) and the Brazilian contractors were selected by gross revenue from O Empreiteiro (2012); the Top 50 logistics by turnover organisations were selected from the UK MotorTransport (2012) and Brazilian Guia do Transportador (2010) by net operating revenue. Organisations listed in the London Stock Exchange FTSE100 were also identified, as they will need to demonstrate their non-financial reports.
All 200 organisations were checked for their sustainability reports, or similar; and scrutinised for GRI standards, if any. GRI reporting is now in its transition stage between GRI3.1 and GRI4.0, and the non-congruent nature of both reporting formats does not help. Reports with GRI Index were checked for the level to which indicators were reported (fully, partially, none, non-applicable). The organisational performance indicator categories of economic, environment and social (labour, human rights, society and product responsibility) were analysed in each report. For this reporting transition period, this research will only analysed in detail GRI3.1 and GRI3.0 reports.

Data analysis

200 organisations were analysed in this research – 50 top construction organisation in UK and Brazil and 50 top logistics organisations in UK and Brazil. Of which, 73% were held under private ownership. There is a contrast of ownership between the countries, where private ownership in UK construction accounts for 48%, while 84% in Brazil. There are 26 publically owned UK construction organisations, with 2 in the FTSE100 and 8 in the FTSE250. The 2 organisations in the FTSE100 produced sustainability reports but not in GRI standards.

The data collected show only 7.5% top construction and logistics in the UK and Brazil produced GRI based sustainability reports; only 17 reports were produced inline with GRI guidelines – one each from UK and Brazilian logistics organisations; 6 UK and 9 Brazilian construction organisations; only 2 organisation undertook the GRI4.0 guidelines, 5 GRI3.1 and 10 GRI3.0 formats, as seen in Table 2. It is also clear that only 2 logistics organisations (one each from UK and Brazil) among the Top 50 organisations in each respective country disclosed their GRI profile. The analysed construction organisations have diverse specialities and embraced several different sectors, as shown in Table 2. Most of the Brazilian and UK organisations undertook activities within the similar sectors of heavy construction; only one from each country was involved in residential and commercial buildings. Interestingly, majority of the Brazilian construction organisation headquarters were located in the southeast of the country (Minas Gerais and Sao Paulo), while UK HQs were more widespread.

On the whole, 54 of the 200 organisations that represent the top 50 construction organisations in UK and Brazil provided reports; 15% generated GRI reports, 11% provided sustainability report. Only 8 of the Top 50 logistics organisations in UK and Brazil provided reports; only 2% generated GRI reports and 6% provided sustainability reports. Data also show that majority of organisational reports were compliant with GRI3.0 by Brazilian construction organisations. Only 2 organisations (12%) used GRI4.0, 5 organisations used GRI3.1 (29%) and the remainder used GRI3.0. More than half (53%) of the organisations reported to grade ‘C’ or ‘C+’, 33%
reported ‘B’ or ‘B+’ and the rest in ‘A’ or ‘A+’. The data also showed that 40% of the reports were assured but only 2 organisations achieved the highest level of disclosure of ‘A’ or ‘A+’. It is a contrast where all but 1 UK organisations opt to assure their reports, while only 1 Brazilian organisation opt to assure its report. The overall grade of the Brazilian reports is also much lower than the UK reports: 67% of Brazilian reports were graded as ‘C’, 33% graded as ‘B’ or ‘B+’ and there were no ‘A’ reports. The UK organisations counted for 2 ‘A+’, 2 ‘B+’ and 2 ‘C’ ‘C+’ reports.

Table 2–UK, Brazil and Malaysia organisations with GRI reporting.

<table>
<thead>
<tr>
<th>Company</th>
<th>Activities</th>
<th>Location</th>
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A-Highways & Roads; B-Hydroelectric/Hydropower; C-Tunnels; D-Seaports; E-Railways; F-Civil Nuclear Power; G-Offshore Platforms; H-Petroleum & Petrochemical; J-Residential & Housing; K-Office Buildings; M-Shopping & Retail; N-Hotels & Tourism; P-Logistics.

Due to the small sample, data will be analysed by percentage (%) as it is not possible to carry out statistical analysis in a meaningful way; and only GRI3.1 and
GRI3.0 reports were analysed. Figure 1 presents the performance indicators of each category of economic (EC), environment (EN), labour (LA), human rights (HR), society (SO) and product responsibility (PR). Each reporting indicator split into the level of detail of fully reported, partially reported, not reported or non-applicable.

The largest percentage of fully reported indicator is the labour (LA) element, followed by economic (EC) and society (SO). Reporting rates in both countries are almost similar. The highest fully reported element by UK based organisations was the economic element (56%), while the highest scoring element for Brazilian organisations were the labour element (57%). The social element was also highly reported by UK organisations at 53%. The lowest fully reported element was PR at (20%) by Brazilian organisations and 27% by UK organisations in the human rights element. The most contrasting element is society, where 53% of UK organisations fully reported SO compared to only 22% in Brazil. The product responsibility element also showed a 10% difference between UK and Brazilian organisation in fully reporting the PR element. Another concerning element is energy, where 45% of UK and 50% of Brazilian did not provide any report on this element; and the human rights element showed non-reporting of 55% among UK and 66% among Brazilian organisations.

**Lessons for Malaysia**

The Malaysian CI has much to learn in sustainability reporting. Initial research of construction and engineering organisations listed in the Kuala Lumpur Stock Exchange (KLSE) indicated only 3 organisations produced reports within the GRI guidelines; and
only 1 logistics organisation, see Table 2. We also found one report by a privately owned construction organisation. This is an extremely worrying situation. From this limited data, there is a contrast of reporting standards – organisations either choose to report on a high standard or the very minimum. Reporting assurance is also gaining popularity among organisations.

The sustainability theme has only started to gain attention in the past 5-10 years in Malaysia. Leading construction and logistics organisations in Malaysian have indicated their sustainability agenda and credentials - but evidences in world class standard will be essential to demonstrate their work on a similar global platform. The larger organisations were perceived to be the leader in bracing sustainability, but it is the smaller organisations that make up majority of the CI. Most importantly, sustainability must be seen as everyday best practice - not a hindrance to the organisation and not to be used as a PR stunt for publicity.

Moving forward, there is a lack of research conducted in sustainability reporting in Malaysia. There is no clear indication on the poor uptake on non-financial reporting or GRI reporting, and more work will need to be carried out in other industries and understand how they are successful in sustainability reporting. Organisation should be shown the value of truly practicing sustainability and non-financial reporting. This value can be demonstrated in monetary terms or through life cycle costing mechanisms; and in time will improve the organisation internally. Stubbs et al. (2013) analysed 23 Australian companies that did not produced sustainability reports as there is lack of stakeholder pressure; no perceived benefits; internal structure and/or culture does not encourage reporting; a ‘nice to have’; and is not a compulsory report. Another alternative is for the Government, through institution such as the JKR, KKR or CIDB to push for legislation to make sustainability reporting as compulsory. Again, organisations should be shown the benefits in producing these reports and that it will bring benefits and as a next step in achieving their aims.

**Conclusion**

Organisations today, big or small, have a role to play in making the world a better place. They are no longer judged through financial or economical indicators, but also impact towards their staff, the community they work in and environmental impacts of the business. Business leaders not only have internal pressures from the Board, but external push from legislations and lobby groups. Organisational non-financial reporting on sustainability practices, targets and future undertakings are here to stay. From a continental perspective: Europe, through the European Commission enforced mandatory non-financial reporting for large organisations from 2017. Individual countries have started to enforce national legislation for non-financial reporting for the
public and private sector. Like it or not, these changes are coming.

Lessons from the UK and Brazilian construction and logistics industry offer a window of opportunity to embrace change now and pick up best practices. The Malaysian CI can push forward its sustainability credentials within the ASEAN and Asian regions. Perhaps the most important lessons to take on board is that non-financial reporting is here to stay, and is quickly becoming mandatory for organisations. Governments in the UK and Brazil have intervened and placed legislation to ensure organisations report their sustainability credentials. Much can be argued about large multinationals or listed organisations taking the lead - but the industry is made up of 99% SMEs.

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Sustainable construction management bid a supreme scope of opportunities to contribute economic development, environmental stewardship, quality of life and social equality. Sustainability is the critical issue in global urbanization which has a huge impact on the environment. Effective of construction management is becoming increasingly achievement for sustainability in the housing project. During construction period, productivity and efficiency become a key factor in the success of construction project. The most important of these are practices relating to scope management, such as controlling the construction work. This study investigated the sustainability in construction management for housing project. This study is important because it related to the sustainability of construction management that affects the project success.

Keywords: sustainability; global urbanization; environment

Introduction

Construction management is a method to design production system to minimize waste of materials, time and effort in order to generate the maximum possible amount of value. It is to reduce waste and increase the productivity and effectiveness in construction work. The most important determinants of construction are supposed to be workflow reliability and labour flow. Site staff are often faced with problems, such as extensive rework, waiting for materials and tools, constantly moving from one work area to another, confusing work, lack of identify with the project, and lack of recognition for performance (Lu and Yuan, 2011).

It should be noted that Green Supply Chain Management (GSCM) method of construction could achieve successful environmental sustainability (Wan Mahmood et al., 2012). Green Supply Chain Management (GSCM), as well as other related principles, has become an important strategy for companies to achieve profit and
market advantages by reducing the environmental risks and improving efficiency (Tsai and Hung., 2009; Sarkis., 2012). Construction activities are not environmentally friendly due to the diverse adverse impacts such as resource depletion, noise, dust, air pollution and discharge of toxic waste (Sarkis and Lai., 2011). Nowadays, all these impacts are forcing the construction industry to develop toward the mission of sustainability. It to develop and apply green practices in the construction sector, mainly including green building, sustainable construction, sustainable design, construction waste management and low-carbon building. As a result, many countries are setting efforts into the application of sustainable construction practices (Yuan et al., 2012).

Construction Waste Management

Among the culprits contributing to the adverse impacts of construction activities, a noteworthy one is the construction waste caused by various building, renovating and demolishing activities. It is showed that every year an overwhelming amount of construction waste is generated worldwide, resulting in many economic, environmental and social problems, although varying from country to country. In Hong Kong, the construction waste generated annually more than doubled between 1993 and 2004 (Poon, 2007). Furthermore, in 2008, China produced 29% of the world’s MSW, of which construction activities contributed nearly 40% (Wang et al., 2008).

The problems resulted from construction waste are particularly serious in developing countries partially because that on one hand, large-scale construction activities are occurring in these countries due to requirements of urbanization and infrastructure development, and thus resulting in huge amounts of construction waste. On the other hand, project decision makers more concern on cost, duration, quality, and safety, rather than environment (Shen et al., 2006). Construction waste will either positively or negatively influence the economic, environmental and social performance of projects. However, a few research showed that the efforts have been focused on the economic and environmental impact associated with construction waste (Duran et al., 2006). Therefore, they fail to cover the social impact resulted from construction waste. As insisted by Yao (2009), sustainable construction in the long-run should embrace collective development of three major dimensions, namely, economic, environmental, and social aspects.

The research weakness of existing lacks in investigating the social impact with respect to construction management waste. It includes the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions and any social change processes
appeals by those interventions. Its main purpose is to show more sustainable and equitable biophysical and human environment (Chukwunonye and Clive, 2012).

According to Wang et al., (2008) discussed the major factors influencing construction waste reuse in Brazil. In their study, the social impact was not separately examined but considered along with economic and legal factors. Meanwhile, the social impact associated with construction waste reuse was analyzed from a qualitative point of view. The reasons for scant research into social performance of construction waste management (CWM) are probably attributed to three aspects. Firstly, the social influence of performing CWM is by and large of lower priority while implementing construction projects (Katz and Baum, 2011). Mostly, the major focus is given to objectives such as project cost, time, duration and safety. Secondly, social impact is not always obedient to empirical measurement. Fundamentally, many indicators used for assessing the social impact of CWM are qualitative and thus very difficult to be quantified. Finally, implementation of CWM affects different groups of project participants in different ways (Seadon et al., 2010).

Major participants involved in CWM can be generally divided into two groups: one group includes the authorities, general public and NGOs. The other group comprises project clients, main and subcontractors. It is obvious that the former group more focus on construction waste minimization, aiming at lessening the environmental and social impacts, while the latter concerns more on the economic benefits from managing construction waste (Villoria et al., 2012). Nevertheless, in most practices, particularly those developing economies, it is the latter group that is more powerful in developing and executing CWM plans. Hence, it is not surprising that more concern on assessing and monitoring the economic performance of CWM (Sufian and Bala, 2007). But in line with an increasingly recognized consensus that the three dimensions, namely, the economic, environmental, and social aspects, should be collectively considered for elevating the effectiveness of CWM, it is imperative to evaluate the social performance of CWM (Yuan and Shen, 2011).

Development of sustainable criteria
The selection of criteria for an assessment framework mainly depends on a number of factors. In terms of sustainability, it must focus an integral approach that encompasses suitable measures that reflect economic, environment and social aspects (Teo and Loosemore, 2001). According to Bovea and Wang (2003) established an apparatus for integrating environmental and social elements of sustainable development. In this apparatus, ecosystem and human well-being is evenly required for achieving sustainable development.

Golicic and Smith (2013) established that criteria provide a systematic approach
in order to measure the sustainability of a system in a simple and easy manner. They further argued that the sustainable criteria in construction will focus on land issues beside water, energy and material use. It is valuable in making policy in terms of environment, socio-economic and technological improvements. Their research work further emphasized that indicator of sustainable development should be closely selected, refined in order to maintain its contextual effectiveness. Previous research has emphasized on economic, environment, social and technical measures of sustainable performance (Tang and Zhou., 2012). A number of prior indicators in this area are combined with the concern of sustainability. As an outcome, these criteria are classified under three categories of sustainable development; Socio-economic, and Environment (Hwang and Ng., 2013).

All construction work required different types of equipment and machineries and have their own level of equipment usage. Commercial projects have moderate usage of equipment and machineries. Industrial and heavy construction projects required intense and high utilization of machinery for carrying out mass excavation, stabilizing, compacting, asphalt paving and finishing, pipelines, railroads and many other special activities. The common application of heavy construction equipment includes but is not limited to; earthwork, structural steel works, concreting, building, lifting and positioning of components (Akadiri and Olomolaiye., 2012).

The roles of heavy equipment are very vital for increasing the construction productivity especially for infrastructure works. However, their acquisition is very much capital intensive for construction firms. It is also considered as a major financial burden during the construction period beside other expenditures (Singh., et al., 2007). The previous research shows that the heavy equipment constitutes 36 percent of the total project cost and possesses high risk and uncertainties for the owners. This increased level of awareness and the application of mechanized equipment and machineries are considered as a positive thrust for the advancement of construction industry.

Nevertheless, its adoption has important drawbacks for the environment and the people working in its vicinity. The emerging concept of sustainable or green construction has emphasized the elimination and minimization of harmful impacts to the environment (Yan et al., 2009). Construction organizations are accountable for the impacts of an implemented project on the society, environment and economy long after the project has been completed. Therefore, construction and sustainable development issues are closely related because this sector is a principal contributor to global resource depletion (Rees, 1999).

Sustainable development has now become a significant subject discussed and debated at various levels e.g. national, international, governmental, non-governmental
and as well within the academic circles as an agenda of socio-economic and environmental development. A fair amount of diversity exists among the definitions of sustainability and sustainable development (Kline., 2000). Sustainable construction is a broad term and it includes the whole process from basic and detailed design, engineering, planning and procurement, construction toward the approved deliverable to the client and then the different stages over the product’s lifetime which consisted of operation, maintenance, refurbishment, re-construction, demolition and recycling (Teo and Loosemore, 2001). Among the environmental impacts from construction processes (such as waste generation, energy consumption, resource depletion, etc.), emissions from onsite construction equipments account for the largest share (more than 50%) of the total impacts (Moffatt, 1994). Therefore, during the selection of construction equipment, there is a need for the most rational criteria that have a positive impact on operational efficiency, productivity, cost minimization and as well as environmental and human well being. These criteria make it possible for the contractors to consider the sustainability agenda in the equipment selection procedures (Popp et al., 2001).

**Sustainability of housing construction practices**

The actual construction process may create massive environmental problems, including noise pollution, air and dust, and harmful contamination through toxic waste (Tang and Zhou., 2012). The waste from construction and demolition activities is frequently dumped illegally in dams, river courses and any available hollows (Wang and Yuan, 2009). The extraction of raw materials often happens in rural areas, causing the degradation of land and ecosystems. Deforestation can also be related to the building materials industry, as timber is often obtained unsustainably from indigenous forests, which, given minimal biomass and ecosystem replacement activities afterwards, leads to soil erosion, salinisation of watercourses, reduced precipitation and the related problems (Simon and Stephen., 2005).

Defective and inefficient construction materials and techniques can put at risk both construction workers and the end-use residents (Rocha and Sattler., 2009). Sustainable house-building industry should prevent the use of harmful building materials and finishes of residential buildings, which constitute a large share of the global toxic load (Klang, et al., 2003). Construction practices should also promote sound and safe activities on construction sites, especially with regard to reduction in topsoil and vegetation losses, dust and noise pollution, and safe storage of harmful chemicals. There remains a huge potential for sustainable construction technologies and practices involving ecological, healthy and safe materials and environmentally friendly techniques (Grace., 2008).
Recycling in the construction industry
There is a need in a practice of producing buildings and materials with a longer life span, and which are recyclable and disposable at a minimal environmental cost (Lu, and Yuan., 2010). Recycling provides a number of environmental advantages, especially in terms of a reduced consumption of natural resources and deposition of landfill; saving energy in material production and hence reduced pollution; and the availability of more durable materials (Robichaud and Anantatmula., 2011). Recycling may be possible for wood, metal, glass and limestone (Zhang and Wen., 2008).

Conclusion
Although in the field of using alternative materials in construction a lot of progress has already been made, several areas remain where further research and development is needed. Production methods of construction materials starting from waste materials have their special points of attention and are sometimes quite non-standard compared to regular production routes. Therefore, detailed and realistic investigations should be made to develop new methods or improve existing ones, rather than copy regular production routes. Reporting such case studies could inspire other people to look for other applications.

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References


EVALUATION AND EXPLANATION OF SPATIAL DECISION SUPPORT SYSTEM IN PRE-EARTHQUAKE CRISIS MANAGEMENT (CASE STUDY- ZANJAN/ IRAN)

Elnaz Behzadpoor¹, Mohammadreza Khatibi² and Behnaz Ebadolahzade Maleki³

Elnaz Behzadpoor -M.A Candidate in Regional Planning-Islamic Azad University of Qazvin, Iran. elnaz_behzadpoor@yahoo.com
Mohammadreza Khatibi- Assistant Professor in Faculty of Architecture & Urban Planning-Islamic Azad University of Qazvin, Iran. khatibimohammadreza@gmail.com
Behnaz Ebadolahzade Maleki- M.A Candidate Urban Management- University of Tehran, Iran. Behnaz_march20@yahoo.com

Abstract:
Earthquake is one of the most important natural phenomena which we face it in Iran considering our situation with regard to faults. in crisis situation decision making is highly regarded, therefore in this research with using of spatial decision support system (SDSS), physical vulnerability of Zanjan (which is one of the northern province of Iran) to earthquake for executing crisis management before earthquake has being studied. studies show that Zanjan is one of the regions with high acceleration fields and has located on two dangerous faults, Soltaniye and Tabriz, using unsustainable materials in the most parts of building, lack of public services, open spaces, urban foundation and equipments like fire stations and medical centers in high population regions, cause the necessity of crisis management plan for this city. The research method is analytical-descriptive and the using system components in this research are data base (geographical information system), spatial analysis model (vulnerability model) and decision making quantitative strategic planning matrix (Q.S.P.M). Effective variables in physical vulnerability in the research are vulnerability of availability of open space, building density, the average components area and grading, buildings material, buildings antiquity, physical structure and land using. At the end each of these variables based on their importance factors in GIS will be overlapping and final pathology map will be provided. Results shows regard to pathology over than 55 percent of Zanjan area is highly vulnerable to earthquake and the highest vulnerability relates to mideral fabrics that include district 1 and 2 and part of district 3 and 5 of Zanjan. In the next level for decision making and prioritize strategies, quantitative strategic planning matrix has been used. using SDSS in earthquake crisis management in Zanjan shows that using this system not only cause improving planners performance and efficiency, also cause rapidness in decision making in earthquake crisis and decreasing mistakes in decision makings.

Key words: earthquake, crisis management, spatial decision support system.

1- Introduction
Due to territory extent and vast intense damages they impose, earthquakes are among highly known natural disasters in the world (Maleki, 2007: 114). Although earthquakes are not avoidable, it is possible to mitigate its resulting damages. The major issue is to save human against this natural event. Urban growth brings about many facilities whereas it gives rise to disastrous elements and environmental facilities change into disadvantages (Nakabayashi, 1994: 4).

The necessity to decrease social, physical and economic damages resulted from earthquake is not unknown. Regarding unanticipated nature of earthquakes, the need to make quick proper decisions and perform actions, theoretical and fundamental principles, created a science known as crisis management which ends in a decrease in vulnerability and the impacts of accidents. The issue has unique relation with urban planning, regional planning and geography. Using principles and standards and explicating concepts existing
in the science, it is possible to decrease natural disaster resulting impacts excessively. Depending upon urbanism geographical information systems and spatial decision support local model, urbanism executes management principles required to lessen cities’ vulnerability to these occurrences. Regarding city divisions, city of Zanjan is divided into 6 areas (with residential use dominant) and 1 including gardens and agricultural territories and 24 regions (Naghsh-e-Mohit consulting engineers, 2013: 373). Studies show that Zanjan, as a whole, is regarded as an area with high acceleration fields and a potential of medium to large earthquake occurrences. Zanjan current context natural bed is surrounded by two hazardous faults, Tabriz and Soltaniye, which necessitates detailed zoning studies and a comprehensive crisis management planning in the city (Zanjan preparations, 2010: 4).

Over 400,106 people live in this city (Iran Statistics Center, 2006) and its area is around 646,126,18 square meters which faces extensive loses of life and property during earthquakes. A major part of city constructions in Zanjan, during recent years, have been carried out regardless of buildings stabilization and resistance regulations like 2800 regulation. As is noted in earthquake vulnerability studies report, in case of an earthquake in Zanjan, there will be massive casualties exclusively caused by earthquake, not considering secondary loses. Lack of green and open spaces for settlement and narrow passages undoubtedly obstructed at the time of earthquake are among challenges facing the responsibility of earthquake management. In addition to the issues mentioned, evidencing a necessity of planning for earthquake crisis management in order to avoid or decrease damages and loses in Zanjan (Naghsh-e-Mohit consulting engineers, 2013: 40), in last two decades, several models of urban areas vulnerability measurement were provided to direct societies decisions in order to decrease vulnerability. for instance In 2003, to determine vulnerability resulted from earthquake, Rashed chose some indicators like hospitals, highways, maximum rebuilding cost, etc and modeled them using AHP method and GIS software (Rashed & Weeks, 2003: 547-576). In 2006, Mahdi Abedi carried out a study titled “Evaluation of impacts caused by buildings demolition after an earthquake in city passages- case study: Chizar, Tehran, 1st area” (Abedi, 2006). the results show that the maximum vulnerability belongs to center and southern sections and 60 percents of this region is vulnerable. Dr. Kyumarth Habibi et al made an effort to determine building elements influencing vulnerability of old urban context of Zanjan using GIS and Fuzzy Logic in 2007 (Habibi et al., 2014: 27-36). In present research, it is tried to determine effective indexes in vulnerability for specifying vulnerable areas in urban textures and also suggesting new offers for determine possible damages in urban areas with using modern knowledge (Habibi and partners, 2008: 27-36). Mohammad Azizi –Reza Akbari, urbanity considerations for estimating urban vulnerability caused by earthquake (case study, Farahzad-Tehran), beautiful arts journal, 2008: NO 3. In this paper Farahzad region vulnerability to earthquake has been estimated, the results show with increasing population density, building density, vulnerability will be increased by indexes such as distance from faults, components area and etc decrease vulnerability. In present research, it is tried to resolve shortcomings of last studies and remodel vulnerability based on sections of Zanjan as a whole. The aim of this paper is to measure physical vulnerability of Zanjan, using decision support system, to perform crisis management process before an earthquake happens.
Figure 1: Physical divisions of Zanjan
Source: (Naghse-e-Mohit consulting engineers, 2013: 312)

2- Definition of keywords

**Sustainable Management:** Sustainable management can be considered as the evolution of life and attaining ideal economical, social and cultural condition which is followed by fulfillment of concepts such as justice and social and cultural dynamism (Abedi, 2009).

**Crisis:** Crisis is an accident happening suddenly as a result of human-related or natural functions and occurrences, it imposes hardship, distress and damages to a human society or complex and resolving it requires emergency measures and actions (Hosseini, 2006: 19).

**Earthquake:** Earthquake is a seismic energy transferred from depth to surface resulting some sectional, tensional or pressed (horizontal, vertical and circulatory) fractures in earth crust with a seismic strong pressure. The shakes result in damages of buildings and facilities and ending in injuries and casualties (Habibi, 2009: 50).

**Crisis Management:** Crisis management is an operational science which, as soon as a crisis is observed and analyzed systematically, tries to find a tool to avoid a crisis to happen or in the case of happening, it manages to mitigate the impacts, make necessary preparations, provide quick aids and mend the situation (Nategh Elahi, 2011: 60). Crisis management can also be introduced as planning, organization, leading, coordination, control and support process (Mitchell et al., 1989: 391).

**Decision making:** Selection of a solution or measure among variable practical solutions to solve problems and benefit from opportunities (Timmermans, 2007: 207).

**Spatial Decision Support System (SDSS):** In basic point, there are three main parts including: data base, model and user linker, which collect, process, save and distribute information to support and control decision in an organization (Flacke, 2012: 5). SDSS, actually is a combination of geographical information system and consolidated model beside each other (Sagumaran et al., 2011: 35).

3-Theoretical principles and concepts of research

Natural disasters such as earthquakes are considered as a major obstacle for Sustainable management, occurrence of which barricades economical, social and constructive development. Regarding that, crisis management in countries is entirely dependent on how the Sustainable management is performed there; one can claim that
crisis management is an urban Sustainable management approach (Rezaii Nia et al., 2011: 1) Vulnerability to a natural hazard contains different dimensions, e.g. physical, economical, social, etc dimensions (Birkman, 2005: 3), which, not only, individually influence each other but also they create a system, interacting each other (Chardon, 2006: 198). In this research, earthquake-resulted physical vulnerability is studied. Physical vulnerability means damages happening to residences and dependents. Residences’ vulnerability to natural disaster is partly dependent on buildings and infrastructures features which have variable levels of vulnerability to different hazards such as earthquake (Bull-Kamanga, 2003: 6). When a crisis occurs and disastrous situation dominates, a quick reaction for decision making is very crucial, this is why crisis management must be paid high attention (Yaghinloo et al, 2007: 8).

It is believed, when making a decision, that the essence of crisis management is to take a proper decision so crisis management and decision making are considered as synonyms. One new approach to encounter city-wide crisis in order to make decisions, is spatial decision support system (SDSS) (Halbic et al., 2011: 723). Applying computers and information technology, when making decisions, in evaluations and picking up more appropriate solution among existing techniques resulted in the creation of DSS, but because of their weakness in using time and place-related data, spatial decision support system(SDSS) has been created (Eissa, 2013: 10). Complexity and difficulty of decision making in urban planning is completely evident (Witlox et al., 2009: 877). In order to solve problems, SDSS can help government and society or even support planners when dealing with spatial information related to resource allocation activities and planning (Coutinho- Rodrigues et al., 2011: 2). To define the importance of SDSS for crisis managers during pre-earthquake stage, one should say that all crisis management phases are dependent on data from different organizations and sources. The data must be collected, organized and displayed in order to determine the amount and expanse of emergency service management activities. Since, most of the information related to crisis management activities for earthquake are place-referred (R. Johanso, 2000), SDSS, as an optimal science and technology, capable of collecting, storage, alteration, analysis, modeling and displaying spatial and non-spatial information, can be applied for a quick and comprehensive information analysis and organization and also for taking proper decisions during pre-earthquake crisis management (Chakroun, 2005: 5).

4- Research method

The research method of this study is analytical descriptive, data collection is largely based on field observations including space perception about physical and constructive features of the city, a library survey is provided on the importance of variables effective in physical vulnerability in the area studied using 1:2000 maps, satellite images for map updates and also the existing statistics and information considering research subject. According to figure 2, components of the system used in this research include a local data base of studied area applied by researcher during the research is created and used as an informational subsystem to store and manage applied information. To create a database, first, an informational framework and then informational items are specified and information collection and preparation is carried out. Eventually, considering existing facilities and research requirements, a data base selection and design is felt necessary including informational framework exploitation and data collection and
preparation. During the exploitation of informational framework, first, the data, containing 1:2000 maps, existing in Zanjan were identified. Since the applications identified in crisis management, parcel constructive information are required, 1:2000 map was selected as the optimal scale for geographical information system of earthquake response phase management and through this step, when collecting and preparing data, with a knowledge of local and descriptive information, the data was collected and prepared. According to the data base formed, six parameters influential in physical vulnerability in Zanjan were selected which include: vulnerability resulted from open space access (K1), vulnerability resulted from building density (K2), vulnerability resulted from an average components area and grading (K3), vulnerability resulted from building materials (K4), vulnerability resulted from building life (K5) and vulnerability resulted from physical structure and land use (K6).

Using math definition, the model is as followed:

\[
\text{Vulnerability} = F(K1, K2, \ldots, K6)
\]

K1, K2, K3, …, K6 are the elements influencing vulnerability, i.e. As a result, when analyzing studied region using this model, studied units (separated components), considering limitations and existing variables, are graded 1 to 4 (low, intermediate, considerable and high vulnerability). Due to the fact that each of variables mentioned have special importance, the level of their importance and effectiveness in vulnerability is not the same, as a result, each should receive its specific weight. In order for each variable weight to be specified and estimated, a survey was carried out among certain experts and based on following formula, an average of opinions was considered as a weight for each variable. Actually, based on importance coefficient in GIS, vulnerability maps are accumulated and a final vulnerability map is obtained showing 4 low, intermediate, considerable and high vulnerability levels.

Replacing obtained weights, the model is provided as:

\[
\]

Using this model, an output is obtained for physical vulnerability level of Zanjan and implementing it in maps, areas with low to high vulnerability are specified. To measure \( K_t \) vulnerability level, K1, K2, …, K6 are obtained and placed in the model. Eventually, the system will contain decision model. In this research, as a decision model, quantity strategic planning matrix (QSPM) is used to produce appropriate strategies and select preferable choices to be performed in an area with high vulnerability to earthquake in order to help managers and urban planners. Matrix formation requires 5 steps.
5- SDSS methodology and its usage in studied area

As was mentioned the research methodology, SDSS is used to perform pre-earthquake crisis management process including data base, vulnerability model and decision model. In the following, based on data base created, physical vulnerability and decision models are considered.

5-1- Stage1- Zanjan’s physical vulnerability model against earthquake

In former sections, variables influencing physical vulnerability were specified, the analytical model required for analyzing Zanjan’s vulnerability to earthquake was provided, studied area was introduced and required materials were explained. In the following section, considering variables applied in proposed model and the data provided, Zanjan’s physical vulnerability to earthquake is analyzed.

5-1-1- Variables influencing physical vulnerability

The first step in performing the process of physical vulnerability model is to specify variables influencing vulnerability. In order for this, regarding the data base created, 6 parameters influencing physical vulnerability of Zanjan are selected including: vulnerability resulted from open space access (K1), vulnerability resulted from building density (K2), vulnerability resulted from an average components area and grading (K3), vulnerability resulted from building materials (K4), vulnerability resulted from building life (K5) and vulnerability resulted from physical structure and land use (K6). Vulnerability resulted from each variable shows 4 vulnerability levels (low, intermediate, considerable and high) which are displayed, considering Number of parcels, area and percent, in tables and map.
Vulnerability resulted from open space access

<table>
<thead>
<tr>
<th>Distance from open space</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;x&lt;50</td>
<td>28168</td>
<td>24284348</td>
<td>39.40</td>
<td>Low</td>
</tr>
<tr>
<td>50&lt;x&lt;150</td>
<td>26485</td>
<td>16485757</td>
<td>26.74</td>
<td>Intermediate</td>
</tr>
<tr>
<td>150&lt;x&lt;300</td>
<td>12011</td>
<td>11783049</td>
<td>19.11</td>
<td>Considerable</td>
</tr>
<tr>
<td>x&gt;150</td>
<td>3576</td>
<td>9089464</td>
<td>14.75</td>
<td>high</td>
</tr>
</tbody>
</table>

Vulnerability resulted from building density

<table>
<thead>
<tr>
<th>Constructive density</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; x &lt; 70</td>
<td>29364</td>
<td>24777774</td>
<td>40.19</td>
<td>Low</td>
</tr>
<tr>
<td>70 &lt; x &lt; 120</td>
<td>14366</td>
<td>12536629</td>
<td>20.33</td>
<td>Intermediate</td>
</tr>
<tr>
<td>120 &lt; x&lt;240</td>
<td>21272</td>
<td>19424129</td>
<td>31.51</td>
<td>Considerable</td>
</tr>
<tr>
<td>x&gt;240</td>
<td>5238</td>
<td>4904086</td>
<td>8.00</td>
<td>high</td>
</tr>
</tbody>
</table>

Vulnerability average components area and grading

<table>
<thead>
<tr>
<th>Parcel area classes</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;x&lt;200</td>
<td>4413</td>
<td>7035236</td>
<td>11.41</td>
<td>Low</td>
</tr>
<tr>
<td>200&lt;x&lt;300</td>
<td>5137</td>
<td>8577838</td>
<td>13.91</td>
<td>Intermediate</td>
</tr>
<tr>
<td>300&lt;x&lt;500</td>
<td>12465</td>
<td>12066854</td>
<td>19.47</td>
<td>Considerable</td>
</tr>
<tr>
<td>x&gt;500</td>
<td>48225</td>
<td>34022690</td>
<td>55.19</td>
<td>high</td>
</tr>
</tbody>
</table>

Vulnerability resulted from open building materials

<table>
<thead>
<tr>
<th>Building material classes</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal/concrete frame</td>
<td>1870</td>
<td>5292058</td>
<td>8.58</td>
<td>Low</td>
</tr>
<tr>
<td>Bricks and iron</td>
<td>13850</td>
<td>10647530</td>
<td>17.29</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Mud-brick</td>
<td>17028</td>
<td>16139965</td>
<td>26.47</td>
<td>Considerable</td>
</tr>
<tr>
<td>Ruined or without building</td>
<td>37492</td>
<td>29383065</td>
<td>47.66</td>
<td>high</td>
</tr>
</tbody>
</table>

Vulnerability resulted from physical structure and land use

<table>
<thead>
<tr>
<th>Building life classes</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;x&lt;10</td>
<td>20682</td>
<td>20722390</td>
<td>33.61</td>
<td>Low</td>
</tr>
<tr>
<td>10&lt;x&lt;20</td>
<td>9641</td>
<td>3004197</td>
<td>4.87</td>
<td>Intermediate</td>
</tr>
<tr>
<td>20&lt;x&lt;30</td>
<td>26691</td>
<td>24346030</td>
<td>39.49</td>
<td>Considerable</td>
</tr>
<tr>
<td>x&gt;30</td>
<td>13226</td>
<td>13570001</td>
<td>22.03</td>
<td>high</td>
</tr>
</tbody>
</table>

Vulnerability resulted from building life

<table>
<thead>
<tr>
<th>Function classification</th>
<th>Number of parcels</th>
<th>Area on the basis of square meter</th>
<th>Area percent</th>
<th>Vulnerability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardens &amp; agriculture, barren, park &amp; green space, river &amp; creek</td>
<td>16445</td>
<td>13177873</td>
<td>22.39</td>
<td>Low</td>
</tr>
<tr>
<td>Historic, recreational – touristic, cultural-artistic, religious, medical, athletic</td>
<td>3029</td>
<td>4485049</td>
<td>7.27</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Training &amp; research &amp; technology, educational, business &amp; service, transportation &amp; storage, industrial, military, official, security</td>
<td>19434</td>
<td>17783503</td>
<td>28.84</td>
<td>Considerable</td>
</tr>
<tr>
<td>Residential, urban facilities, urban services</td>
<td>31332</td>
<td>26196193</td>
<td>42.49</td>
<td>high</td>
</tr>
</tbody>
</table>

Figure 3: six-fold variables, their classification and related score measurement
Figure 4: basic maps of vulnerability to earthquake
5-1-2- Vulnerability resulted from compound physical variables

So far, vulnerability caused by each variable was considered individually and compound vulnerability of Zanjan was obtained using the following relation:

$$KT=6.2K1+6.9K2+5.9K3+9.2K4+7.6K5+8.9K6$$

Fig 5 and table 1 display the result of vulnerability analysis considering all variables and their importance coefficient.

<table>
<thead>
<tr>
<th>Vulnerability level</th>
<th>Area percent</th>
<th>Area on the basis of square meter</th>
<th>Number of parcels</th>
<th>KT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>15.55</td>
<td>10661082</td>
<td>11624</td>
<td>0&lt; x &lt;83</td>
</tr>
<tr>
<td>Intermediate</td>
<td>29.11</td>
<td>20747112</td>
<td>22555</td>
<td>83&lt; x &lt;119</td>
</tr>
<tr>
<td>Considerable</td>
<td>42.23</td>
<td>24087583</td>
<td>26151</td>
<td>119&lt; x &lt;155</td>
</tr>
<tr>
<td>High</td>
<td>13.11</td>
<td>9116841</td>
<td>9910</td>
<td>x &gt;155</td>
</tr>
</tbody>
</table>

Figure 5: map of Zanjan’s variable-compound caused physical vulnerability

As is displayed, the largest area of Zanjan is located within considerable vulnerability level which is 42.23% with high level forming the least part which is 13.11% of Zanjan’s area. As is seen in figure 5, the highest amount of vulnerability is related to central parts of the city, neighborhoods such as Islamabad and those located around Motahari Street and Esteghlal square located in second region, are fine-grained and much vulnerable to earthquake. Areas such as Bism, located in 5th region, which are central and historic edges of the city, are highly vulnerable to earthquake and the reasons include: size of parcels, fine-grained context, distance from open space, high density of constructions and etc. Due to physical erosion, neighborhoods in region 1, 3 of Zanjan undergo a high vulnerability, Poonak and Golshahr in area 6, Azadegan-Karmandan Town in area 4, due to new construction, vicinity to open space, durable materials used and etc, have lowest physical vulnerability to earthquake.

5-2- Decision model: priority of strategies using QSPM

In this stage, using QSPM, all strategies are studied and prioritized. Actually, each strategic element is measured by related strategy and it is scored. Total scores i.e. strategy...
priority, are measured in table. As a result, different strategies of Zanjan are determined through a specified numerical, they are prioritized and then compared with each other. According to physical strategic quantitative tables program, formulated based on kinds of strategies (WT, WO, ST, SO), SO2 with maximum score of 10.815 which is organization of functions, structure and operation of hospitals, police, is introduced as best strategy to mitigate physical vulnerability of Zanjan to earthquake and SO1 with the score of 9.592 which is city open space increase and considering urban hierarchy, is provided as second strategy while ST2 with the score of 8.836 which is renovation, merging and construction high in eroded contexts, is the third physical strategy. The following table displays the order of fourfold physical strategy to be imposed in areas with high vulnerability to decrease physical vulnerability of Zanjan to earthquake.

<table>
<thead>
<tr>
<th>Final score</th>
<th>Priority</th>
<th>Compound physical strategies to decrease physical vulnerability resulted from earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.81</td>
<td>1</td>
<td>SO2- organization of functions, structure and operation e.g. hospitals, police, rescue centers and …</td>
</tr>
<tr>
<td>9.59</td>
<td>2</td>
<td>SO1- increasing city open space and considering urban hierarchy</td>
</tr>
<tr>
<td>8.83</td>
<td>3</td>
<td>ST2- renovation, merging and high construction in eroded context.</td>
</tr>
<tr>
<td>8.41</td>
<td>4</td>
<td>WT1- considering functions adjacency (compatibility and incompatibility).</td>
</tr>
<tr>
<td>7.29</td>
<td>5</td>
<td>WO2- more lasting buildings using high quality materials.</td>
</tr>
<tr>
<td>7.21</td>
<td>6</td>
<td>WO1- urban hierarchy organizing to decrease vulnerability to earthquake.</td>
</tr>
<tr>
<td>6.513</td>
<td>7</td>
<td>ST1- abandoning construction in naturally hazardous areas.</td>
</tr>
<tr>
<td>6.244</td>
<td>8</td>
<td>WT2- renovation and reinforcement of infrastructure networks.</td>
</tr>
</tbody>
</table>

**6- Conclusion**

Today, an increasing need by planners to collect and classify data to use existing sources and making decisions to meet requirements is observable. In this regard, a system capable of taking the role of a consultant and support in decision making seems to be crucial. In research process, Zanjan, considering its location in areas with many earthquakes happening there and the importance of crisis management in city, was evaluated. The results of physical and social vulnerability of Zanjan show that areas 1, 2 and 3, 5 have highest vulnerability to earthquake. Study the results of this survey indicates that the most important issues in these regions are (physical, social, service and crisis management):

- **Physical**: Unconformity of structures of the area with their high earthquake potential/ Residential constructions on faults/ Narrow passages.
- **Social**: High population density in the regions/ Groups with high vulnerability to earthquake/ Socio- cultural heterogeneity in most regions and following it a decrease in social values of the regions/ High population density in these regions compared to the city.
- **Service**: Insufficiency of open space and extended green spaces/ few fire stations and medical centers and crisis management in the regions.
- **Crisis Management**: lack of monitoring in performing urban plans/ weakness in managerial system for earthquake/lack of experts and science facilities for using in crisis management.
A Spatial decision support system (SDSS) to manage earthquake crisis includes: data base, spatial analysis model and decision making model (possible decisions). Considering the fact that the aim of spatial decision support system (SDSS) is building decisions and through combining geographical and descriptive information systems of Zanjan and the analyses carried out about physical vulnerability to earthquake, a decision model for decision making is obtainable. According to this research, it is concluded that SDSS is a modern tool in urbanism helping planners in different contexts like earthquake crisis management. But, due to new nature of the system, it is widely used by planners.

Planners’ awareness of SDSS advantages and using it in spatial and local problems both improves performance of planners and their efficiency in the city and increases promptness in decision making and minimizes errors and faults in decision makings to a considerable point.

Reference
- Abedi, Gh. (2011). A study on disasters and their role in stable development with a focus on Iran: Sepehr magazine. 7th year, n 28.
Malaysia’s capital city, Kuala Lumpur is one of the cities that have among the highest urban densities in the world as a result of increasing urban population. This circumstance has directly impact the need to conserve land and reduce greenhouse gas emission. Most of urban planners and designers have advocated more compact living to accommodate this situation, which has resulted to more people living in high-rise residential buildings. Residential highrise in Malaysia currently is the highest energy user in terms of residential building per square meter due to the high density of building. This is based on the need of cooling due to the fact that Malaysian climate is very hot and humid. The best known way to cool down fast is by using air conditioning units that is very high in energy consumption. Currently, the cost of energy is rising and the need to reduce energy is a must. If the rise of cost in energy continues, Malaysia will be hard hit because of the need of constant cooling throughout the year. That is why there is a need of natural ventilation and cooling in high-rise buildings particularly in urban settings. This paper focuses on natural ventilation relating to thermal comfort in high-rise residential buildings in urban neighbourhoods in Malaysia. It concentrates on typical high rise residential building designs which are developed solely for the purpose of accommodation and also custom designed high-rises that takes into account of natural ventilation and also thermal comfort achieved through natural sources.

Keywords: Urban living, High-rise residential. High density, thermal comfort, natural ventilation

1.0 Introduction

Living in high rise residential areas suggest that the occupants would have the advantage of better views, privacy and the possibility of getting more wind into the living spaces. In planning a good high-rise residential house it is important to consider features that would impact the overall livability of the resident or occupant. Thermal comfort is one of the aspects that need to taken into consideration in the planning and design stage. Among the criterias include; local climate (wind, sun path and solar angle) and site characteristics such as topography aspect and other natural features. However, there are
several important issues that would reduce the benefits of living in high rise residential. One of the most important aspects is due to the fact that higher residential buildings tend to be located close to each other, hence reduce air flow around the buildings and block views. This would also lead to the heat island effect that has been proven by several previous research. Consequently, the need to consider the local climate issues such as ventilation and day lighting is important in order to ensure the advantage of living in high rise residential building is not compromised. These issues would be the central theme of this paper. The study focuses on typical high rise residential building designs which are developed solely for the purpose of accommodation and also custom designed highrises that takes into account of natural ventilation and also thermal comfort achieved through natural sources.

2.0 Background

High-rise type of residential housing is known to be the most compact housing form which would be associated with high-density. This type of housing has been accepted and referred to as a sustainable housing solution by planners and policy makers due to several characteristics that it hold. Among them are, less land consumption, higher energy efficiency, lower resource consumption, better access to services and facilities and some would have better view quality (Rudlin and Falk, 1999; Jenkins et.al., 2007; Barter, 2000). Due to this, high-rise residential building has been built and continually being built in many cities to accommodate the ever-increasing urban dwellers.

Due to rapid urbanization process in Malaysia has led to the increase in demand for housing and the scarcity of land for development of landed residential properties. This situation can be seen in major urban areas in Malaysia such as Kuala Lumpur, Selangor, Penang and Johor Bahru (Tiun, 2009). This has resulted to the rapid development of high-rise residential schemes in these high-density areas. High-rise living in urban centers is a practical response to the increase in land prices which has been successfully and well implemented in Singapore and Hong Kong.

Natural ventilation in high-rise residential building

The study of natural ventilation in residential buildings is of significance importance as it has direct impact towards human health, comfort and general well being. Priyadarsini and Wong (2004) mentioned that since the energy crisis in the early 70s, the need for energy conservative buildings has become an issue. In a hot humid country like Malaysia, natural ventilation is the most cost effective way to minimize the physiological effect of the
high humidity to achieve acceptable indoor thermal comfort condition. In a typical residential building in a tropical country, which also refers to Malaysia, Priyadarsini and Wong (2004) explained that living rooms are usually well-ventilated during the day since most openings remained open. However, bedrooms are the least ventilated regions, as there is no cross ventilation with single-sided window (Priyadarsini and Wong, 2004).

As Aynsley (2007) explains, there are basically three principal factors affecting natural air movement hence create such natural ventilation for a particular building. These factors are as follows (Aynsley, 2007):

1. *The site and local landscaping features;*  
   It refers to local climatic condition such as wind speed. Other local feature such as hilly site or flat site does impact the natural ventilation as winds can be accelerated by up to 54% on the windward side of a hilly site.

2. *The building form and building envelope design*  
   Orientation of buildings contributes significantly to impact natural ventilation. Naturally ventilated buildings are highly recommended to be positioned accordingly to maximize their exposure to the required wind direction, and designed with a relatively narrow plan form to facilitate the passage of air through the building.

3. *The internal planning and room design*  
   Design of internal spaces is also one of the important aspects in natural ventilation. In order to improve the natural ventilation of rooms, the resistance to airflow through the building has to be minimized. The use of large windows and other openings for the passage of air and reduce the number of rooms which the air has to pass would help to facilitate natural ventilation.

**Thermal Comfort in High-rise Residential Building**

Due to the physical characteristics of high-rise residential building, thermal comfort in high-rise residential buildings is a design issue. The problem arise when architects need to focus on mitigating solar heat gains, particularly on upper floors and solar-facing facades that are not well ventilated by adjacent structures. Hence, to achieve thermal comfort in high-rise buildings is more challenging compared to low-rise buildings especially in tropical climate regions. Furthermore, high-rise buildings are more exposed to climatic elements such as the sun, wind and rain compared to low-rise buildings. On the other hand low-rise buildings are often surrounded by landscape elements such as trees and adjacent structures that help to buffer the building from unfavorable climatic conditions. Chia Sok Ling et al., (2007) noted that the building envelope of high-rise buildings in Malaysia are more exposed to the impact of the outdoor temperature and global solar radiation.
compared to lowrise buildings that are often shaded by the roof. Overall, these factors have resulted to most high-rise residential buildings having low level of thermal comfort if not being properly designed to facilitate natural ventilation or being supported by mechanical ventilation. The basic criteria to facilitate natural ventilation, hence improve thermal comfort in high-rise residential building is the orientation of building towards the passage of wind (Ayata and Yildiz, 2006).

3.0 Summary of Methodology

This study revolves around the concept of natural ventilation and thermal comfort in high rise residential building. Due to the limitation of time and budget, the researcher explores this issue on two case study highrise residential buildings in Malaysia which are completed with architectural drawings. The drawings of these buildings were supplied by the architects involved in the projects. The details of the two case study buildings are provided in table 3.1 and 3.2 accordingly. Comparison of the natural ventilation effects are the main focus of this study with great emphasis on thermal comfort of the internal space.

Table 3.1: Case Study Building 1

<table>
<thead>
<tr>
<th>Name of Project</th>
<th>The Plaza</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>TTDI Holdings</td>
</tr>
<tr>
<td>Architect</td>
<td>TR Hamzah &amp; Yeang</td>
</tr>
<tr>
<td>Use</td>
<td>Residential &amp; Commercial</td>
</tr>
<tr>
<td>No. of floors</td>
<td>3 floors – Commercial</td>
</tr>
<tr>
<td></td>
<td>21 &amp; 26 floors – Residential</td>
</tr>
</tbody>
</table>

Table 3.2: Case Study Building 2

<table>
<thead>
<tr>
<th>Name of Project</th>
<th>Kejora Apartment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>Kejora Indah Sdn. Bhd.</td>
</tr>
<tr>
<td>Architect</td>
<td>Arkitek Ilham Karya</td>
</tr>
<tr>
<td>Use</td>
<td>Residential</td>
</tr>
<tr>
<td>No. of floors</td>
<td>15 floors (including ground floor)</td>
</tr>
</tbody>
</table>

This study focuses on typical high rise residential building designs which are developed solely for the purpose of accommodation and also custom designed highrises that takes into account of natural ventilation and also thermal comfort achieved through natural sources. For the analysis, computational fluid dynamics software was used to analyze the differences in affects of the design and also supported by predicted mean vote.
3.1 Data

Data used in this study is based on two case studies which are The Plaza TTDI and Kejora Apartment. Basically, there are two approaches to achieve the research objectives. Firstly, computational analysis for thermal, wind flow and comfort. Secondly, through the comparison of existing comforts levels in PMV form and CFD modelling. The Plaza residence is a highrise residential building designed by Datuk Dr AR. Kenneth Yeang a renowned architect in Malaysia. The building consists of two residential apartment and retail plaza and podium at ground floor. The building is designed to be a high rise modern service apartment and residence. It is located at the heart of Kuala Lumpur in an elite neighbourhood of Taman Tun Dr Ismail. The Plaza TTDI apartment is a development that is intended to be low energy, optimizing natural sunlight and also wind flow for cooling. The design is well established since initial design stage. In this study, the Plaza TTDI acts as a benchmark. The data that was gained from this building were used as a reference for best conditions and also as a baseline in comparing to other buildings. Data’s generated is compared with other buildings in the basis of the best PMV of existing case studies and also comfort graphs.

The second case study is the Kejora Apartment. Kejora apartment is a typical designed apartment complex built in Setapak, Kuala Lumpur, Malaysia. This apartment complex consist of two apartment blocks and other amenities. The apartment was designed by a local architect firm Arkitek Ilham Karya. This apartment complex is what is to be expected in any high rise development in Malaysia. This apartment is designed to maximize sellable floor area and profit.
4.0 Results and Discussion

Simulation is done to test the wind movement at the side of the building that is the east west axis to find out the flow of wind through the corridors of the building. In this analysis it is found out that the wind flow enters at 0.69 m/s and inside the corridors can accelerate up to 1.89 m/s in an ideal condition and exits at 1.2 m/s. This shows that there is a healthy amount of windflow inside the building that will generate positive air pressure that can initiate wind flow from the insides of the units.

Wind from west east axis at 0.5 m/s

Figure 4.1: Distribution of air velocity in west east axis

Figure 4.1 illustrates the distribution of air velocity in west east axis of The Plaza TTDI. It indicates that outside the building, the wind velocity recorded is up to 1.99 m/s.
from the south north axis. This is because there are turbulence happening at the top of the building. The turbulence on top of the building with that kind of velocity generates positive pressure resulting in wind movement from below to the top. Furthermore the heat from the sun at the top of the building can be used as a thermal stack conductor in order to initiate stack effect to the building. The analysis is generated with reference to the main model where a single unit is chosen representing the whole unit in the building. Referring to figure below, the unit chosen is generated with winds from north south axis at 0.5 m/s. Based on the figure below it is clearly seen that the windflow inside the building is efficient with wind velocity ranging from 0.2 m/s to 0.003 m/s depending on the location of the rooms. The level of wind from ground is 1.2 meter as this is the body. In the figure below, the wind flows through the main balcony into the living area at a velocity of 0.1 m/s until it reaches bedroom 2 and kitchen. In the kitchen area wind velocity accelerated from 0.1 to 0.17 m/s exiting through the drying yard. This shows that there is a healthy movement of air in the units. As for the master bedroom, there is little movement due to small openings recording at least 0.07m/s up to 0.03 m/s of wind flow.

![Figure 4.2: Main entrance open space, balcony](image-url)

Referring to the external CFD results, the wind flow is only at 0.5 m/s and flow through the building at up to 0.85 m/s in velocity. This is due to the open corridor area and wide corridors that allows better wind flow. Figure 4.3 shows the external view of the wind flowing through the building at north south axis where the entrance point at the corridor recorded a drop of velocity from 0.55 m/s to 0.32 m/s and accelerates in the middle of the corridor for up to 0.85 m/s. This is due to channelling effect where the wind drops in velocity in the entrance due to the small entrance and accelerates once entering the internal corridor of the building.
The following illustrates the internal CFD for Kejora apartment. The spaces involved in this analysis are master bedroom, kitchen, bedroom, main open area, main balcony and open space. For the internal CFD of Kejora apartment, due to the restrictive nature of the design, the internal CFD records small changes in wind flow. In figure 4.19, the wind indicates very low velocity of wind entering the building even though there is a big opening in the living/open area of the unit. The unit only recorded wind flow of 0 m/s to 0.1 m/s. In figure 4.19 the wind flow pattern in floor plan indicates that there is an effort of wind to enter the units but due to the positive pressure build up in the units resulting to low air velocity. The openings area recorded 0.15 m/s to 0.28 m/s entering the unit but only low velocity of air at 0 m/s to 0.03 m/s of air pass through the internal spaces. Based on the internal wind flow result can be seen reflected in the PMV and PPD graph. In the graphs it is clearly shown that at all times and at the 3 most major spaces that is usually used by the occupants during the day (living room, master bedroom, kitchen) shows 100% dissatisfaction in terms of thermal comfort and noting a level of 3 in the ASHRAE PMV scale indicating hot. CFD is taken at body level that is 1.2m above the floor level.
**COMFORT = PMV, ADAPTIVE ALGORITHM**

**The Plaza TTDI PMV**

The Plaza TTDI PMV recorded variable readings during the day at all spaces that are analysed. This is due to the high solar intensity during the day and also based on the material. In figure 4.23 shows that the PMV and PPD levels are at acceptable level even though it is hot. The variation of level ranges from 2.8 to 3 for PMV and 98.2% to 100% in ppd. The lowest PMV and PPD level is recorded during early in the morning at 9pm and gradually rises to peak at 12 pm. The temperature recorded at 9am is at 37 degrees Celsius and jumps to 39 degrees Celsius at 12pm.

**Kejora Apartment PMV**

PMV and PPD levels in Kejora apartments recorded constant levels of 3 for PMV and 100% for PPD in all rooms at all times of the day. This shows that the comfort levels in the room are very low and PMV levels indicate that the comfort level is constantly hot and
predicted dissatisfaction shows that 100% dissatisfaction in all room conditions. For the internal temperature in the room recorded variable levels across all rooms at all times. In the master bedroom, the lowest recorded internal temperature is at 38 degrees Celsius land 40 degrees at peak. The lowest temperature happens at 10 am and highest is at 6 pm in the afternoon. This is due to direct solar radiation in the room and as the location of the bedroom is furthest and most exposed to solar radiation makes the condition worst, lack of air flow makes the internal comfort level is at its most uncomfortable state.

Figure 4.6: Living room PMV and PPD   Living room internal temperature

Figure 4.6 indicates constant level of PMV and PPD where at all times PMV recorded as 3 – hot in the Ashrae table and 100% dissatisfaction for PPD in the living room. The internal temperature ranges between 39.0 and 39.5 throughout the day where the lowest temperature is at 11am and highest is at 6pm. This is due to the lack of wind flow and also solar shading making the internal spaces to be hot and uncomfortable. This is also due to placement of the space where it is placed on the outer most part of the unit and exposed directly to the sun and the orientation of the building exposes all main space to direct solar path.

**Comparison of PMV, PPD results between both buildings**

Comparison of the PMV and PPD of both building clearly indicates high level of difference in the results in terms of comfort. In the Plaza TTDI building, the PMV and PPD recorded variable results during various time of the day. Results of the PMD and PMV and internal air temperature and moisture content of the living room it varies during the day. In the morning from 12am shows a decrease on predicted dissatisfaction of 98% and PMV indicates levels as low as 2.8 and as high as 100% predicted discomfort and 3 in Predicted mean vote from 12pm until 10pm at night. This shows that the comfort condition varies during the day as per sun condition in the unit. Internal temperature of the unit ranges from 38 degrees Celsius to 39 degrees Celsius indicating change of temperature according to time of the day. During the day sun penetration in Malaysia is at the strongest starting at 11am until 4 pm in the afternoon. At this time of the day temperature is at the
highest and comfort level is usually low. In the case of the the Plaza TTDI the variation of the comfort level based in the PMV, PPD survey shows that there are still room of improvement in order to upgrade the thermal comfort in the building. Furthermore, the materials of the building also play a significant role in achieving thermal comfort. In order to achieve thermal comfort in the building, an introduction to mechanical cooling system such as a ceiling fan would result in better thermal comfort. Mechanical generates better wind flow in the building thus dispersing all the hot air in the building without the need of air conditioning.

5. Summary and Conclusion

This study has come into a few conclusion related to the research question. Design problems faced in designing natural ventilated highrise in Malaysia seems to relate to the Malaysian low wind velocity. In Malaysia, the basic wind velocity is 0.5 m/s and this is deemed to be very low to generate enough wind to cool the building. Other problems related to this is the materials that is used in constructing the building itself. Mostly buildings in Malaysia are constructed using the most resourceful material in the region that is concrete and bricks. As we know concrete and bricks is a very good thermal storage material. Concrete and bricks can hold up heat for up to 8 hours daily depending on mass and u value. As all the buildings here are using that material, thermal mass in the materials will disrupt the temperature inside the building during night time. The best solution in counterung this problem is by providing mechanical ventilation system such as ceiling fans. This is because for building that is already designed for natural ventilation, what it lacks is only wind velocity that can be improved through design of the building orientation (Ayata Yildiz). By adding more wind velocity the space can be much cooler and comfortable. The reliance of air conditioning system can be lowered and resulting to energy saving hence contribute to better comfort in highrise residential living among urban dwellers. To conclude, strategies in designing a naturally ventilated highrise residential building need to consider building design, site orientation, environmental parameters, facade treatment, floor plan and passive and active features as explained by Allard (1998) to ensure it fulfills the comfort parameters. Finally, it is hoped that the findings can contribute to better understanding in natural ventilated highrise residential building in Malaysia and would provide a suitable mean of references particularly in Malaysia or any hot and humid region.

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COMPARATIVE REVIEW OF GBI AND GREEN MARK - UNDERSTANDING THE STANCE OF GREEN RATING SYSTEMS

Shraddha Pandey1, Eka Sediadi2, Lim Yaik Wah2

1International Scholar, MIT-UTM Malaysia Sustainable Cities Program (2014-2015)
E-mail: ar.shraddhapandey@gmail.com
2Faculty of Built Environment, UTM, Johor Bahru
E-mail: ekasediadi@utm.my, limyaikwah@gmail.com

Buildings are the dominant energy consumers in the world. Thus it makes it very important to keenly understand and progressively improvise on the tools that have been created to make our buildings energy efficient around the world. The green building rating systems are the tools that have set off to influence the design and construction of green buildings on a large scale. The paper compares GBI, Malaysia and Green Mark, Singapore on the EE criterion. A comparative review of both rating systems was made based on various factors viz. Thermal Performance, Lighting Zoning/Artificial Lighting, Renewable Energy, Advanced Energy Performance, Thermal Comfort Parameters, Ventilation and Air Changes, Daylighting and Glare control and Energy efficient practices & Innovation. Green Mark awards points considering a more progressive approach, which promotes good design and encourages the designer to try and push through the limits little by little. GBI does it in a more defined manner, by clear cut values and numbers, increasing the ease of use and applicability of GBI. Green Mark focuses on and defines basic techniques and expected results, and thus is a good guide for those want to go into the details of designing sustainable buildings. GBI is a more result oriented system.

Keywords: green buildings, rating systems, GBI, Green Mark, energy efficiency

Introduction

In today’s world of increased awareness and efforts towards developing and implementing environment friendly methods, processes and systems in every field possible, we as architects/construction managers/builders have the onus upon us to take care of the environment that we create. Buildings today are actually creating an environment that people would be living in for the rest of their lives. And buildings are an indispensible part of today’s society as they cater to all domestic and commercial needs. We have realized that new infrastructure is important to growth and development
of our society. Naturally, buildings are the dominant energy consumers in the world. Around 40% of the total energy demand comes from the construction and operation of the buildings all around the world.

Buildings though static and fixed, are a process in themselves for the whole span of their life. This process as it interacts with the raw environment cannot be a controlled one. And buildings change their behavior hourly and seasonally, which again varies from place to place. This makes it very important to keenly understand and progressively improvise on the tools that have been created to make our buildings energy efficient around the world.

The tools that affect the commercial architecture and construction are the green building rating systems. This paper is an attempt to understand their stance and effect of the sustainability of green buildings. The paper encompasses Green Building Index (GBI), Malaysia and Green Mark, Singapore.

**Green Building Index (GBI), Malaysia**

The Green Building Index, Malaysia is a building rating system developed by PAM (Pertubuhan Arkitek Malaysia/ Malaysian Institute of Architects) and ACEM (the Association of Consulting Engineers Malaysia). The Green Building Index is a comprehensive rating system for evaluating the environment design and performance of buildings based on the six (6) main criterion viz. energy efficiency, Indoor environment quality, sustainable site planning & management, materials and resources, water efficiency, and innovation. It is a fairly new concept for Malaysia, launched in 2009.

**Green Mark, Singapore**

The building and Construction Authority Green Mark Scheme, which was launched in Singapore in 2005 is an effort to move the construction industry in Singapore towards more energy efficient buildings. It also aims at promoting sustainability in the built environment and increase awareness about rising environmental issues among the builders, developers, architects and designers, to create larger impact starting right from the conceptualization of the building. Green Mark evaluates the buildings based on the
several criterion viz. Energy Efficiency, Environment Protection, Indoor environment Quality, other green features and requirements.

**Table 1: Evaluation criterion**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>GBI, Malaysia (evaluation criterion)</th>
<th>Points</th>
<th>Green Mark (evaluation criterion)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy Efficiency</td>
<td>35</td>
<td>Energy Efficiency (Part 1)</td>
<td>116 (min 20)</td>
</tr>
<tr>
<td>2</td>
<td>Indoor Environment Quality</td>
<td>21</td>
<td>Indoor Environment Quality</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Sustainable Site Planning and Management</td>
<td>16</td>
<td>Other Green Requirements</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Material and Resources</td>
<td>11</td>
<td>Environment Protection</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>Water Efficiency</td>
<td>10</td>
<td>Other Green Features</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Innovation</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>100</td>
<td>TOTAL (Part 2)</td>
<td>190 (min 30)</td>
</tr>
</tbody>
</table>

The paper shall review and compare the two rating systems on the energy efficiency criteria. Following are the sub criterion included in the EE (energy efficiency) criterion of both the rating systems in consideration. Some related points that have been covered under different heads in GBI have also been included.

**Table 2: Criterion compared**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>GBI</th>
<th>Green Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum EE Performance</td>
<td>Thermal Performance of Building Envelope – ETTV</td>
</tr>
<tr>
<td>2</td>
<td>Lighting Zoning</td>
<td>Air-Conditioning System</td>
</tr>
<tr>
<td>3</td>
<td>Electrical Sub-metering</td>
<td>Building Envelope – Design/Thermal Parameter</td>
</tr>
<tr>
<td>4</td>
<td>Renewable Energy</td>
<td>Natural Ventilation /Mechanical Ventilation</td>
</tr>
<tr>
<td>5</td>
<td>Advanced EE Performance</td>
<td>Daylighting</td>
</tr>
<tr>
<td>6</td>
<td>Enhanced Commissioning</td>
<td>Artificial Lighting</td>
</tr>
<tr>
<td>7</td>
<td>Post Occupancy Commissioning</td>
<td>Ventilation in Carparks</td>
</tr>
<tr>
<td>8</td>
<td>Verification</td>
<td>Ventilation in Common Areas</td>
</tr>
<tr>
<td>9</td>
<td>Sustainable Maintenance</td>
<td>Lift and Escalators</td>
</tr>
<tr>
<td>11</td>
<td>Air Change Effectiveness</td>
<td>Renewable Energy</td>
</tr>
<tr>
<td>12</td>
<td>Daylighting</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Daylight Glare Control</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Innovation</td>
<td></td>
</tr>
</tbody>
</table>

**Thermal Performance**

*GBI* - Fixed OTTV (Overall Thermal Transfer Value) and RTTV (Roof Thermal Transfer Value) baseline values (50W/sq.mt) combined with provision of Energy Management Control systems for air-conditioned spaces.

*Greenmark* – Fixed ETTV value and lower pre requisite ETTV (Envelope Thermal Transfer Value) for Gold (42W/sq.mt) and Platinum (40W/sq.mt) rated buildings.

**Lighting Zoning/Artificial Lighting**

*GBI* – Encourages the use of Specific type of switches and sensors to increase efficiency, while maintaining the specified luminance level.

*Greenmark* – Encourages the use of energy efficient lighting systems/installations, while fixing the maximum level of power consumption and comfortable illumination levels.

**Electrical Sub-metering**

*GBI* – Encourages the monitoring of energy consumption through sub-metering.

**Renewable Energy**

*GBI* – Encourages the use of renewable sources of energy production from 0.5% to 2% of the total estimated energy consumption of the building.

*Greenmark* – Encourages the use of renewable sources of energy production from 1% to 7% of the total estimated energy consumption, setting the standard higher and limits the points to the same certification category.

**Advanced Energy Performance**

*GBI* – Awards points to achieve higher building energy intensity i.e. energy consumption in the building. 150kWh/mt.sq yr being the highest limit, points are awarded stepwise to bring it down to 90kWh/mt.sqyr.

*Greenmark* – Encourages reduction in ETTV of the building.
Thermal Comfort Parameters

**GBI** – FA mention of designing as per ASHRAE and MS:1525 has been made. No standards or scale has been set as per the thermal comfort parameters.

**Greenmark** – Scales for orientation, window sizes, sun-shading devices and thermal transmittance (U-value) for façade and roof have been set and points are awarded accordingly.

Ventilation and Air Changes

**GBI** – Ventilation systems need to be designed as per ASHRAE and an ACE (Air change effectiveness) of minimum 0.95 has to be achieved.

**Greenmark** – Encourages building design that ensures natural ventilation with proper building layout that captures prevailing wind and promotes cross ventilation. Modeling softwares shall be used to ensure that. Points are awarded based on window openings in the north and south directions and the ability of the design to achieve required airflow through natural ventilation. Higher pre-requisites for Platinum rated buildings. It encourages efficient mechanical ventilation systems to minimize air conditioned spaces (as per the code SS553).

Daylighting and Glare Control

**GBI** – Awards points for having more than 30% or 50% of NLA to have a standard daylight factor. Specifies in detail about the measures to be taken for glare control by both active and manual modes.

**Greenmark** – Requires at least 75% of the units with Daylighting option to provide minimum illuminance level with acceptable glare. Points are awarded based on the distance from the façade. It promotes the use of glare simulation analysis to verify ambient levels of lighting. It awards points for 80% coverage of services/common/utility areas, by daylighting. It also specifies the use of automated lighting systems in all day lighted areas.
Energy Efficient Practices and Innovation

GBI – Provides an extensive list of the techniques active/passive, if applied, shall earn points for the building.

Greenmark – Promotes energy consumption calculation in the form of Energy Efficiency Index (EEI), vertical greenery system and its orientation, approved equipments/products, and use of other energy efficient active/passive features.

Discussion

- Thermal Performance – The fact that higher rated buildings being more energy efficient is ensured by Green Mark. As thermal performance control in a building would present longevity in its green character
- Lighting Zoning/Artificial Lighting – GBI criterion ensures that energy saving happens during the operational phase and in the scope of operational dynamics of the lighting use.
- Renewable Energy – Green Mark promotes the use of renewable sources of energy more as a requirement rather than a unique character and sets the standards higher for the rated buildings.
- Thermal Comfort Parameters – GBI is only suggestive about creating thermal comfort. Whereas, Green Mark gives directives so as to take into account each and every parameter and design it. A stepwise procedure is followed to award points, which pushes the designer to think sensitively about the comfort conditions for the occupants.
- Ventilation – Natural Ventilation is promoted by Green Mark, which creates a place for passive techniques and encouragement is given for the use of local conditions to maximum effect. Points are awarded based on the basic concepts of climate responsive ventilation techniques i.e. the orientation of windows. Both GBI and Green Mark involve the use of air exchange design for mechanical ventilation. Where GBI aims at comfort conditions in air conditioned rooms, Green Mark also looks into reduction in air conditioned areas in the building.
- Daylighting – Green Mark expects a much more detailed documentation of the process of how daylit areas achieve the minimum prescribed level of illumination.
Indirectly, forces the designer to use passive measures and be sensitive towards the environment and its positive and negative impacts on the building as a whole and each room as well.

- **Energy efficient practices and innovation** – Both the rating systems more or less place the onus on the designer to come up with and use innovative climate responsive designs.

  Green Mark awards points considering a more progressive approach, which promotes good design and encourages the designer to try and push through the limits little by little. Whereas, GBI does it in a more defined manner, measured by clear cut values and numbers, singular in character, which increases the ease of use and applicability of GBI.

  Green Mark focuses on and defines basic techniques and expected results, and thus is a good guide for those want to go into the details of designing sustainable buildings. Whereas, GBI is a more result oriented system.

  GBI is a first generation rating system for Malaysia and still waiting to receive a market response about its success. There are fewer examples of GBI rated buildings and it is supposed to be a continuous process of review and update. Green Mark is a mature concept and collectively creates awareness and encourages good building design growing through the conceptual level.

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GBI Assessment Criteria For Non-Residential New Construction (Nnrc).

CHARACTERISTICS OF ROAD CRASHES IN KOGI STATE, NIGERIA

Adetunji Musilimu Adeyinka

Department of Geography, Faculty of Arts & Social Sciences, Federal University Lokoja, Kogi State, Nigeria
Email: maadetunji@yahoo.com

The menace of traffic accidents in developing countries most especially in Nigeria is highly devastating as many people have lost their lives on a daily basis on the nation's road networks. Thus, this study examined the trends, patterns and characteristics of traffic accidents in Kogi state, Nigeria. Both primary and secondary data were used in the study. Due to lack of mechanical method of data collection on route characteristics in the State, data on route characteristics were collected manually over a period of one month in the study area. Data on road crashes between 2006 and 2012 were obtained from the seven unit command of the Federal Roads Safety Corps in Lokoja. The findings reveal that commercial vehicles are mostly involved in road traffic crashes in the state because of attitudinal behavior of motorists to traffic regulations. Further analysis also shows that road crashes frequently occur at certain periods of the years. The fatality rate varied significantly across the seven accidents prone areas in the state. The study concludes that there is need for public enlightenment on traffic regulations for motorists in order to reduce the occurrence of road crashes in Kogi State and in Nigeria in general.

Keywords: crashes; death; injuries; roads; policy

Introduction

Road traffic crashes in African countries now constitute a major concern as thousands of people die while many other sustain injuries on a daily basis. The psychological trauma of seeing ghastly road accidents on African highways is fast belonging unbearable. In a report by World Health Organization (WHO) in 2010, road traffic injuries accounted for an approximately 1.24 million deaths worldwide, 59% of this death is pedestrians, cyclists, and persons with working class group, while men constitute approximately 75% of deaths caused by road traffic crashes. A most road crashes occur in the developing countries especially in South-East Asia and African countries (Global status report on road safety, 2013; WHO, 2009).

Many studies have shown that several factors are responsible for traffic crashes in African countries. These include mechanical problems, poor transport infrastructure, motorists disregard for traffic rules and regulations such as road signs (Ipingbemi, 2007; Odero, 1995). Despite numerous researches with good policy recommendations, traffic crashes continue to occur every day with increasing social and economic consequences. A situation whereby road accidents leading to death and surpassing deaths caused by malaria and other diseases, this implies that much research is still required in order to reduce the carnage on the nation’s highway. More importantly, studies on road traffic crashes in the middle belt of Nigeria particularly in Kogi state is scanty and unwarranted given the location importance of the region between the south and Northern parts of Nigeria. The mass movements of people into different parts of Kogi State in the recent times had led to a complex traffic and
high rate of traffic accidents in the state. This study is therefore designed to examine
the trends and characteristics of road traffic crashes in Kogi state with a view to
initiating appropriate regional transport policy to curb road traffic crashes in the state.

**Literature Review**

A review of literature on traffic accidents at the global level, point to the
numerous factors responsible for road traffic accidents, namely, driving behavior of
motorists, vehicle condition, roads condition and other environmental issues. In a
survey of road traffic accident in Kaduna State between 1975 and 1976, Mukoro
(1986) argued that 80% of road crashes in the state were caused by human error. In a
similar study conducted by Ogunjumo (1995) noted that excessive speed and
recklessness driving accounted for a lion share of the factors responsible for road
traffic crash in the same state. In 2002 study of road traffic crash on federal highway,
Oyeyemi (2002) reported that over speeding accounted for 47% of traffic accidents,
dangerous driving was responsible for 37%, while tire burst, brake failure and route
obstruction shared the remaining 16%. In nutshell, human error is responsible for the
greatest percentage of road crashes in Nigeria. Elsewhere in the continent, Odero
(1995) in a study on road crashes in Kenya reported that 60% of the RTAs occurred
on rural roads with a higher fatality rate of 16% compared to those occurring in urban
areas (11%). According to Odero (1995) human factors were responsible for 85% of
all causes of road crashes in Kenya. Vehicle-pedestrian collisions related accidents
were most severe and had the highest CFR of 24%, while only 12% of injuries
resulting from vehicle accidents were fatal. Utility vehicles, the 'matatus' and buses
were involved in 62% of the injury producing accidents. Of all traffic fatalities
reported, 42%, 38%, 12% and 8% on Kenya roads involved pedestrians, passengers,
drivers and cyclists respectively.

In some of the developed countries of the world as well most especially in Italy,
human behaviour has been identified as the principal factor responsible for traffic
accidents. For instance, Giuseppe La Torre and others (2007) studied the determinants
of within- country variation in traffic accident mortality in Italy. They found that
socio economic characteristics of the Italian population (employment status) have
direct and positive relationship with traffic mortality rate. Moreover, it was also
reported that traffic mortality rate at national level shows a positive correlation with
alcohol intake ($\beta = 0.601; p = 0.005$). This again shows human factor is the dominant
factor of high traffic accidents in Italy. A critical assessment of some of these findings
shows that the conditions of the vehicles involved in road traffic accidents, season and
or time of the crash, road characteristics, gender and other environmental factors were
not critically considered in some of these previous studies on road traffic accidents.
Whereas these other factors contributed in no small measure to the causes of road
traffic crashes in other parts of the world especially where road conditions are bad and
technologies are not only importaed but often faked or of low quality. In Nigeria,
most vehicles spare parts on sale are imported used parts commonly referred to as
“Tokunbo”. More striking is the fact that nearly all daily national newspapers are
awash with heart breaking news on road traffic crashes in different parts of Nigeria in
which many people are usually reported dead or injured. This is usually in addition to lost of property and thousands of naíra. For instance, in some of the headlines in national daily newspapers on road read like these below:

*Nigeria Auto Accident Claimed 70 Passengers
at Igbogui market along the Ore-Benin highway.*
*By Sahara Reporters, New York April 5, 2013*
*Kogi State people asked to donate blood to save accident
Victims along Abuja- Lokoja road, which is the road
with high prevalence of accident in the country*
*http://fmi.gov.ng/latest/19312/*

Road traffic crashes in Kogi state have assumed an alarming proportion. In a state whose economy is basically agriculture, continuous loss of thousands of people lives through traffic accidents is bound to have serious negative impact on the socio-economic development of the state.

**Study Area**

Kogi State is one of the North Central states of Nigeria. It is often referred to as confluence State because Lokoja, the state capital is located at the confluence of both rivers Niger and Benue. The state was carved out from Kwara and Benue states in 1991. The State is located on latitude 7° 30’N and 8° 10’N and longitude 6° 01’E and 7° 50’ E (See Figure 1). The total land mass of the State is 29,883km². Kogi State has a total population of 2, 147,756 in 1991 (NPC, 1991). And with a projected total population of 3, 595,789 and 4,332,981 in 2005 and 2012 respectively.

Given its geographical location, Kogi State is a transition zone between the Southwestern, Southeast and Abuja, the Federal capital territory of Nigeria. Since its creation in 1991, the state has witnessed large volume of movement of vehicles not only within the state capital or between the state capital and other parts of the state. As an agricultural state, there is also an increasing movement of vehicular traffic within the state and other parts of Nigeria. The increase in the number of vehicular traffic within the state and between the state and elsewhere in recent years has led to increase in the number of road traffic crashes. This is particularly so when the increase in vehicular traffic is faster than the development of transport infrastructure which is generally poorly developed. Many roads in developing worlds are un tarred. Those that are usually fall into state of disrepair since after their construction due to lack of proper maintenances. Thus, most road crashes occur in these poorly maintained roads.
Methodology

The data used for the study were collected from primary and secondary sources. The former were collected manually in the absence of the mechanical method of data collection especially on route characteristics in the state. This was done over a period of one month from April 3, 2013 to May 4, 2013 with the assistance of four other field assistants to obtain information on road characteristics. Data on road traffic crashes between 2006 and 2012 were obtained from the seven units commands under the FRSC, Kogi Sector Command RS 8.3. Both descriptive as well as inferential statistics were employed to analyze the collected data. Furthermore, tables of percentages and graphs were used to depict the road traffic crashes and their trend in the period under study. ANOVA was used to examine the variation in casualty of road traffic crashes across the state.

Results and Discussion of Findings

Road traffic crash is a global phenomenon. The situation in the developing countries is getting worse by the day in Nigeria. The fear to travel on its roads is the beginning of wisdom. Table 1 below reveals that one hundred and eighteen (118) road traffic crashes occurred in Kogi state in 2006. The figure increased by (55.7%) or to two hundred and twelve (212) in 2009. The number of vehicular road traffic crashes became worse in 2011 with seven hundred and nine (709) cases reported in the state. Shortly, the number of reported cases in the state went down to 635 in 2012 as a result of a massive campaign undertaken by the Federal Road Safety Corps in the state. This number is still very high for any country willing to achieve sustainable economic development for her citizenry.
Patterns of Road Traffic Crashes in the State

The frequency of road traffic crash varies over time in the state. For instance, Figure 2 shows a high rate of road traffic crashes occurring in the month of December when not only frog formation impedes traffic but also period of Christmas and New Year festival when the volume of traffic passing through Kogi state or within the state is very high. One the other hand, the months of April and September also shows a drastic increase in the rate of traffic crashes in the state. For instance, Figure 2 reveals that the number of road traffic crashes reported increase from 49 in March to 59 in the month of April in 2012. The month of July recorded the highest number (81) of road traffic crashes in the state. This month of July experienced heavy down pour of rainfall in the state which affects motorists driving behaviors and which invariable resulted in high rate of road traffic crash in the state.

Table 1: Number of Road Traffic Crashes in Kogi State Between 2006 -2012

<table>
<thead>
<tr>
<th>MONTH</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>JANUARY</td>
<td>15</td>
<td>19</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>80</td>
<td>47</td>
<td>205</td>
</tr>
<tr>
<td>FEBRUARY</td>
<td>5</td>
<td>10</td>
<td>17</td>
<td>20</td>
<td>49</td>
<td>46</td>
<td>41</td>
<td>188</td>
</tr>
<tr>
<td>MARCH</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td>25</td>
<td>49</td>
<td>49</td>
<td>51</td>
<td>200</td>
</tr>
<tr>
<td>APRIL</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>25</td>
<td>65</td>
<td>51</td>
<td>59</td>
<td>231</td>
</tr>
<tr>
<td>MAY</td>
<td>6</td>
<td>16</td>
<td>8</td>
<td>18</td>
<td>43</td>
<td>69</td>
<td>41</td>
<td>201</td>
</tr>
<tr>
<td>JUNE</td>
<td>7</td>
<td>15</td>
<td>7</td>
<td>14</td>
<td>79</td>
<td>59</td>
<td>44</td>
<td>225</td>
</tr>
<tr>
<td>JULY</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>4</td>
<td>57</td>
<td>58</td>
<td>81</td>
<td>231</td>
</tr>
<tr>
<td>AUGUST</td>
<td>17</td>
<td>10</td>
<td>10</td>
<td>13</td>
<td>62</td>
<td>64</td>
<td>65</td>
<td>241</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>13</td>
<td>18</td>
<td>17</td>
<td>31</td>
<td>69</td>
<td>43</td>
<td>41</td>
<td>232</td>
</tr>
<tr>
<td>OCTOBER</td>
<td>7</td>
<td>17</td>
<td>8</td>
<td>9</td>
<td>53</td>
<td>58</td>
<td>42</td>
<td>194</td>
</tr>
<tr>
<td>NOVEMBER</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>19</td>
<td>53</td>
<td>62</td>
<td>51</td>
<td>211</td>
</tr>
<tr>
<td>DECEMBER</td>
<td>13</td>
<td>36</td>
<td>24</td>
<td>18</td>
<td>65</td>
<td>70</td>
<td>72</td>
<td>298</td>
</tr>
<tr>
<td>TOTAL</td>
<td>118</td>
<td>186</td>
<td>147</td>
<td>212</td>
<td>660</td>
<td>709</td>
<td>635</td>
<td>2667</td>
</tr>
</tbody>
</table>


Figure 2: Trends of Road Traffic Crashes in Kogi State in year 2011 - 2012
Death and Injuries Sustained on Road Traffic Crashes in the Study Area.

Out of 118 road traffic crashes reported in 2006 by the Federal Road Safety Corps in the state, 117 people were killed, while 631 sustained different degrees of injuries. The death rate resulting from road traffic crashes increased astronomically to 396, while 2923 sustained injuries in 2011 (See Figure 3).

![Figure 3: Death and Injuries Sustained on Road Traffic Crashes in the Study Area](image)

Fatality Rate

The fatality rate is the ratio of people killed in road traffic crashes to 100,000 persons per year. On average, the fatal index for the state between 2006 and 2012 is 6.0 deaths per 100,000 persons. This is considered high compared to the fatality index of 5.6 in Ekiti state in southwestern Nigeria (Ipingbemi, 2007). Figure 4 shows that the highest fatality index was recorded for the state in 2010 with 9.4 per 100,000 persons. This is closely followed by 2011 with fatality index of 9.39. This implies a negative externality effect of road traffic crashes on human population in particular and on the socio-economic development of the nation in general.

![Figure 4: Trend of Fatality Index Between 2006 – 2012 in Kogi State](image)
Types of Vehicles Involved in road traffic crashes in Kogi State

Besides taxis, buses and motorcycles that ply different categories of roads in the state, freight vehicles also play a significant role in transporting goods either within or outside the state. However, the level of involvement of each type of vehicle in road traffic crashes in the state shows an interesting pattern. For instance, Table 2 reveals that approximately 37.9% of private vehicles were involved in road traffic crashes in the state with the highest occurrence (50%) along Kabba-Okene route. Further analysis reveals that commercial transport of different categories accounted for 40.5% of road traffic crashes in the state within the period under study. The incidence of road traffic crashes by commercial motorcycles is highest along Isanlu–Kabba routes. The establishment of the cement industry at Obajana, a distance of less than 15kms from Lokoja and the Iron Steel rolling Mills at Itakpe along Okene-Lokoja route were largely responsible for high volume of traffic of heavy duty trucks which may have increase traffic crashes in the state. Table 2 reveals that 21.6% of freight vehicles were involved in road traffic crashes along different routes in the State. The Zariagi and Okene road recorded the highest volume of road traffic crashes involving by heavy duty vehicles. The traffic crashes in this road accounted for approximately 26.8% of total road crashes in the state.

Table 2: Types of Vehicles Involved in Road Traffic Crash in 2012 (in %)

<table>
<thead>
<tr>
<th>Route</th>
<th>Private</th>
<th>Public transport</th>
<th>Freight vehicle</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lokoja-Obajana Junction</td>
<td>32.4</td>
<td>42.6</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>Ankpa- Ajaokuta-Okene</td>
<td>32.4</td>
<td>50</td>
<td>17.6</td>
<td>100</td>
</tr>
<tr>
<td>Kabba-Okenke</td>
<td>50</td>
<td>44.6</td>
<td>5.4</td>
<td>100</td>
</tr>
<tr>
<td>Koton Karfe-Abaji</td>
<td>39.7</td>
<td>39.4</td>
<td>20.9</td>
<td>100</td>
</tr>
<tr>
<td>Zariagi-Okenke</td>
<td>36.8</td>
<td>36.4</td>
<td>26.8</td>
<td>100</td>
</tr>
<tr>
<td>Isanlu-Kabba</td>
<td>37.5</td>
<td>62.5</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Ogori-Obehira Junction</td>
<td>42.4</td>
<td>40.0</td>
<td>17.6</td>
<td>100</td>
</tr>
<tr>
<td>Total average</td>
<td>37.91</td>
<td>40.52</td>
<td>21.56</td>
<td>100</td>
</tr>
</tbody>
</table>


Characteristic of Households Involved in Road Casualty 2012 in the State

Studies of household travel behaviour in many parts of the world show that men tend to travel long distances and rely mostly on automobile more than women (Adetunji, 2013; Oyesiku 2002; Peter 2000). Men are therefore more prone to road traffic crashes than women. Table 3 shows that 75.4% of men were involved in road casualty in the state. On the Isanlu and Kabba road 92.6% of men were involved in traffic crashes. This is followed by 85.4% on kabba – Okene road. The results of this analysis confirmed the findings of Ipingbemi (2007) and Hodero (2005) in similar studies undertaken elsewhere. According to them, more than 70% of people involved in road traffic crashes were men. Similarly, the percentage of women involved on road crashes in the state varies from 35.7% to 25% on Ankpa – Ajaokuta-Okene and Kotonkarfi – Abaji roads respectively. 3.6% of person involved in traffic crashes were children of school age.
Table 3: Household Characteristics involved in roads Casualty in 2012

<table>
<thead>
<tr>
<th>Road</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Children (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lokoja- Obajana Juntion</td>
<td>76.5</td>
<td>20.5</td>
<td>2.9</td>
<td>100</td>
</tr>
<tr>
<td>Ankpa- Ajaokuta- Okene</td>
<td>61.5</td>
<td>35.7</td>
<td>2.8</td>
<td>100</td>
</tr>
<tr>
<td>Kabba – Okene</td>
<td>85.4</td>
<td>13.4</td>
<td>1.2</td>
<td>100</td>
</tr>
<tr>
<td>Koton Karfe – Abaji</td>
<td>71.3</td>
<td>25</td>
<td>3.7</td>
<td>100</td>
</tr>
<tr>
<td>Zariaji – Okene</td>
<td>79.8</td>
<td>15.6</td>
<td>4.6</td>
<td>100</td>
</tr>
<tr>
<td>Isanlu - Kabba</td>
<td>92.6</td>
<td>7.4</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Ogori - Obehira Junction</td>
<td>78.2</td>
<td>18.1</td>
<td>3.6</td>
<td>100</td>
</tr>
<tr>
<td>Total Average</td>
<td>75.4</td>
<td>21</td>
<td>3.6</td>
<td>100</td>
</tr>
</tbody>
</table>


Time of Road Traffic Crashes in 2012 in the Study Area

Many commuters prefer to travel early in the morning in the state. For instance, Table 4 shows that 39.7% of road traffic crashes in 2012 occurred between 6am – 11.59am. Another 35.5% of the road traffic crashes occurred between 12noon – 5.59pm. It is pertinent to note that despite the massive campaign against the night journey by the Federal Road Safety Corps and all other stakeholders in the country, an average of 14.2% of the road traffic crashes recorded in the state occurred during the night most especially between 12.00am – 5.59am. Further analysis shows that 9.7% of traffic crashes occurred in the state between 6.00pm -11.59pm.

Table 4: Period of Road Traffic Crashes in the year 2012 in Kogi State

<table>
<thead>
<tr>
<th>Time</th>
<th>Number of case reported</th>
<th>percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midnight- Morning (12.00am- 5.59am)</td>
<td>61</td>
<td>14.2</td>
</tr>
<tr>
<td>Moring – Afternoon (6.00am -11.59am)</td>
<td>171</td>
<td>39.7</td>
</tr>
<tr>
<td>Afternoon- Evening (12.00pm -5.59pm)</td>
<td>153</td>
<td>35.5</td>
</tr>
<tr>
<td>Evening- Mid-night (6.00pm-11.59pm)</td>
<td>42</td>
<td>9.7</td>
</tr>
<tr>
<td>Unclassified</td>
<td>4</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>431</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Causes of Road Traffic Crashes in Kogi State

Human factors have been identified as the major causes of road traffic crashes in the state. This accounted for 82.8%. When human factors are disaggregated, loss of control by drivers accounted for 23.6%, while 14% occurred as a result of dangerous driving (As shown in Table 5). Many road accident victims interview on their sick beds attested to the fact that many drivers are impatient. 18.7% of the crashes were due to wrongful overtaken. Mechanical faults accounted for 15.1%. Only 2.1% of road traffic crashes in the state were attributed to road poor quality.
Table 5: Causes of Road Traffic Crashes in Kogi State

<table>
<thead>
<tr>
<th>Causes</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstruction</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Route violation</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Dangerous driving</td>
<td>54</td>
<td>14.0</td>
</tr>
<tr>
<td>Loss of control</td>
<td>91</td>
<td>23.6</td>
</tr>
<tr>
<td>Wrongful overtaken</td>
<td>90</td>
<td>23.4</td>
</tr>
<tr>
<td>Over speeding</td>
<td>55</td>
<td>14.3</td>
</tr>
<tr>
<td>Brake failure</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Speed limit violation</td>
<td>22</td>
<td>5.7</td>
</tr>
<tr>
<td>Tyre burst</td>
<td>40</td>
<td>10.2</td>
</tr>
<tr>
<td>Bad road</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>Mechanically defective vehicle</td>
<td>19</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>385</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Accident prone routes in the state

The volume of the vehicles plying different categories of routes is a significant factor in road traffic crash in the state. For instance, the volume of vehicles plying routes in the northern parts of the state, particularly the Abuja - Abaji – Lokoja routes is very high. The volume of vehicle decreases on the route as it enters Lokoja following the route diversions going to Okene and Ajaokuta axis. Similarly the volume of the vehicles also tend to decrease further when it reaches Okene as many diversion occur to Kabba, Ilorin, Ekiti, Auchi – Onitsha road and Lagos routes. A detail analysis of the accident prone route reveals that Koton karifi route recorded the highest rate (31.8%) of road traffic crash because this route is narrow with several bend, obstacles and pot holes, which inhibit the free flow of vehicular traffic. Also, Table 6 reveals that the route that connects Zariagi - Okene is ranked to be the second accident prone area in the state and this accounted for approximately (25.2%). This route is characterized with many pot holes with deep trenches in some of their length. During the rainy season, the pot holes store water which level with road surface, many motorists ran into pot holes and loss their control. Further analysis reveals that Isanlu- Kabba route recorded the least number of road traffic crash in the State. The volume of vehicular traffic on this route is low and the route surface is fairly compared to others.

Table 6: Characteristics of Accident Prone Routes 2012 in Kogi State

<table>
<thead>
<tr>
<th>Routes</th>
<th>No</th>
<th>%</th>
<th>Ranking</th>
<th>Routes Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lokoja-Obajana Junction</td>
<td>204</td>
<td>22.2</td>
<td>3</td>
<td>Uncompleted dual carriage way, undulating, well tarred with heavy traffic</td>
</tr>
<tr>
<td>Ankpa- Ajaokuta - Okene</td>
<td>34</td>
<td>3.7</td>
<td>6</td>
<td>Fairly smooth, minor pot holes, heavy traffic south eastern part of Nigeria</td>
</tr>
<tr>
<td>Kabba – Okene</td>
<td>56</td>
<td>6.1</td>
<td>5</td>
<td>Well tarred road, smooth surface with minor potholes, low vehicular traffic</td>
</tr>
<tr>
<td>Koton Karfe– Abaji</td>
<td>292</td>
<td>31.8</td>
<td>1</td>
<td>Sharp bends, numerous pot hole, with heavy vehicular traffic</td>
</tr>
</tbody>
</table>
Zariaji – Okene                  231   25.2   2 Rough surface route, numerous pothole, sharp bend and very heavy traffic
Isanlu - Kabba                   16    1.7    7 Rough route, numerous pot holes, few sharp bends and low vehicular traffic
Ogori - Obahira Junction        85    9.3    4 Hills / mountain, sharp bends, very deep pot holes, non pedestrian walkway

Total Average                   918   100.0


Analysis of Variance

The result of the Analysis of variance in Table 7 shows that the causes of road traffic crashes varies with (Death F= 27.92, p< .00, Injured F = 2.92 p< .00, Route Characteristics F = 2.05 p< .01; Time F = 1.23, P< .25).

Table 7: Result of Analysis of Variance on the causes of road traffic crashes in Kogi State

<table>
<thead>
<tr>
<th></th>
<th>Sum of squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of dead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>948.007</td>
<td>14</td>
<td>67.715</td>
<td>27.920</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>894.951</td>
<td>369</td>
<td>2.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1842.958</td>
<td>383</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of Injured</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>867.914</td>
<td>14</td>
<td>61.994</td>
<td>2.917</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>7863.083</td>
<td>370</td>
<td>21.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8730.997</td>
<td>384</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rout</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>847.436</td>
<td>14</td>
<td>60.531</td>
<td>2.049</td>
<td>.014</td>
</tr>
<tr>
<td>Within Groups</td>
<td>10899.478</td>
<td>369</td>
<td>29.538</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11746.914</td>
<td>383</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>5502111237</td>
<td>14</td>
<td>393007945.5</td>
<td>1.230</td>
<td>.251</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.169E+11</td>
<td>366</td>
<td>319469932.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.224E+11</td>
<td>380</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>5.189E+15</td>
<td>14</td>
<td>3.707E+14</td>
<td>.810</td>
<td>.659</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.694E+17</td>
<td>370</td>
<td>4.579E+14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.746E+17</td>
<td>384</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>5.608</td>
<td>14</td>
<td>.401</td>
<td>.749</td>
<td>.725</td>
</tr>
<tr>
<td>Within Groups</td>
<td>197.950</td>
<td>370</td>
<td>.535</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
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<td>384</td>
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<td>Seriousness</td>
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<td>Between Groups</td>
<td>3.349</td>
<td>14</td>
<td>.239</td>
<td>.568</td>
<td>.889</td>
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<tr>
<td>Within Groups</td>
<td>155.705</td>
<td>370</td>
<td>.421</td>
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<tr>
<td>Total</td>
<td>159.055</td>
<td>384</td>
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Source: Author’s Computation, 2013
Conclusion, Recommendations and Planning Implications.

This paper has examined in the main trends and characteristics of road traffic crashes in Kogi state of Nigeria. The findings reveal that the fatality index is very high compared to other parts of the country with fatality index of 6.0 deaths per 100,000 person compared to Ekiti state with fatality index of 5.6 as reported by Ipingbemi in 2007. The study also shows that commercial vehicles were more involved in road traffic crashes in the state. The results of analysis of variance also reveal that the causes of road traffic crashes in the study area vary significantly with death, injuries sustained and the time of the occurrence of road traffic crashes in the state. Further analysis shows that human error takes the lion share of the major causes of road traffic crashes in Kogi State. The study recommends that there is need to improve on transport infrastructure in Nigeria and other African countries in general. There is need to complete the ongoing dual carriage way from the Nigeria capital territory, Abuja to Kogis State so as to ease the free flow of vehicles to different parts of the country because of the strategic location of the state in the country. The paper concludes that the Federal Road Safety Corps and other stake holders’ need to be alive to their responsibilities in monitoring the flow of vehicular traffic and enforcing the traffic rules and regulations on highways as this will reduce the rate of road traffic crash in the state in particular and the country in general.

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THANK YOU

SUDLiC 2014 Organizing Committee
Universiti Teknologi Malaysia Kuala Lumpur
Jalan Semarak, 54100 Kuala Lumpur
MALAYSIA
Phone: +603-2180 5138; Fax : +603-2180 5380
E-mail: sudlic2014@gmail.com