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Sustainable Residential Landscape and Practices in Klang Valley

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ABSTRACT

The concept of sustainable development is now being used as a paradigm in the housing development all over the world. In the case of the Klang Valley (encompassing Kuala Lumpur and its conurbations), one of the area in Malaysia that has a high economic growth and social development, led to increase population and large-scale residential development. Thus, the residential landscape is the main concern because it can create a comfortable residential environment and improve the quality of life to the residents. The developers are willing to invest large amounts of money in residential landscape development. The aim of this paper is to investigating sustainable landscape practices applied for residential estates in the Klang Valley in an effort to creating sustainable residential landscape. The study is divided into two parts. The first part is to identify the principles of sustainable residential landscapes based on literature review on aspects of sustainable human settlements and sustainable landscape in ecological dimension. The second part is to evaluation and comparison of sustainability for two cases of residential estates which has claimed itself as practice of sustainable landscape in the housing markets. Studies revealed that only residential area of outstanding achieved sustainable landscape and exhibited many positive approaches are used in creating a good ecological environment. Therefore, these findings suggest for creating and enhancing a sustainable residential landscape or more ecological environment while improve a high quality of life for the residents, it requires compliance all of sustainable landscape practices which is start during design phase to acceptance phase.

Keywords: *Sustainability, sustainable residential landscape practices, evaluation and comparison*

INTRODUCTION

'Sustainable' is a term widely used starting in 1987 after the Brundtland report published (United Nations 1993). In short, it is an approach to produce a development action that may be taken at the global and local level on aspects of preservation and conservation of natural resources for present and future generations. In the context of landscape architecture, the term 'sustainable' has actually been so long used since the 1960's. This is evident from the book "Design with Nature" (1969) by landscape architects, Ian L. McHarg. He wrote that the different scale greenery system may bring a comfortable living environment and healthy micro-climate to the whole world. His writings have been an important source of reference material by the landscape architects and other professional fields such as engineering, architecture, geology, and planners in their efforts to implement the concept of sustainability development especially in within human settlement (Carew-Reid et al. 2013).

LITERATURE REVIEW

Generally, sustainability can be divided into two concepts: technological sustainability and ecological sustainability (Orr 1992). In the context of human settlement habitat, the application of ecological sustainability is very important because this concept is perpetually maintaining the carrying capacity of surrounding ecosystem (Thayer 1994). If development activities exceed this capacity, it

will cause the negative impacts on environment such as an increase of urban heat island (Adeb Qaid et al. 2016; Connor et al. 2013; Herzele & Wiedemann, 2013), pollution of water, air, and noise (Hammer et al. 2014; Moughtin & Shirley, 2005; Jiangou 2006), an increase in surface runoff due to *the addition of paved surface* (Li et al. 2013) and the loss of biodiversity (Sushinsky 2013; Pickett et al. 2001; Li et al. 2013). The net effect is to deterioration of the quality of life of human communities especially in urban community areas (Grahn & Stigsdotter 2011; Jansson et al., 2013). Today the building consumes up to 1/3 of the world's resources, emit 40% of the global greenhouse gasses, use up 12% of its freshwater, and generate 40% of its solid waste (greenpages 2011). However, people have realized this matter and aspect of preservation and conservation on environmental particularly in the human settlement is very important. They start desire for finding residential areas which would provide a high coverage of green spaces and attractive landscape as an act of 'back to nature'. This environment can affect many aspects of the quality of life such as well-being and comfort. Effect of this trend, developers seem to 'competing' each other to attract more buyers to purchase their residential projects with to claim itself based on the concept of sustainable residential landscape. This marketing strategy is a good effort because it can restore the natural landscape to the residential community.

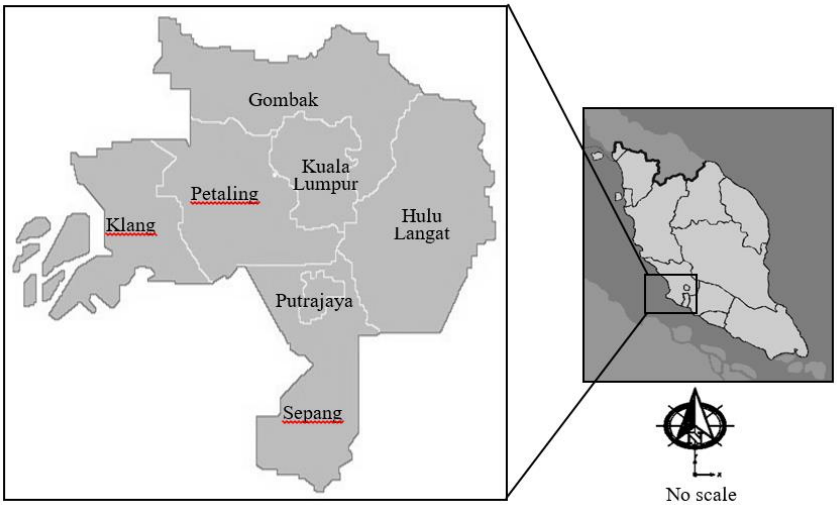
However, in the context of current landscape architecture in the residential area, landscape practice is contrary to the practice of sustainable landscape architecture. The practice is dominated by man-made landscape than a natural landscape. The man-made landscape does not have the natural cycle, maximum use of exotic species, requires the use of large amounts of water, increase cost including maintenance, pesticides, chemical fertilizers and labour (Hough 1984). Without realizing human has changed the structure and function of landscape as a significant source in their lives to the liability burden that requires a lot of financial allocations (Lyle 1999). The lawn area for example is one of the man-made landscape that requires a lot of expense liabilities. Lawn mowing in half an hour per gas power is equal to the amount of pollution generated from the car driven as far as 265 kilometres (Brandum 1994). The type of this landscape not only involves high energy consumption but has little value ecosystems and no function to humans or the environment (Wilson 2010). This occurred because there is a lack of detailed instructions particularly for residential landscape works of large residential estates. It requires understanding and formulates several principles of sustainability that can be identified from the literature review on aspects of sustainable human settlements and sustainable landscaping.

PROBLEMS FROM PRACTICE IN KLANG VALLEY

Klang Valley which is located on the central west coast of Peninsular Malaysia officially has no clear boundary region. However, this area is considered to include the Federal Territory of Kuala Lumpur, Federal Territory of Putra Jaya and its neighbourhood regions are mainly located in the Petaling Selangor (Shah Alam, Petaling Jaya and Subang Jaya), Klang, Gombak (Selayang), Hulu Langat (Ampang Jaya and Kajang) and parts of Sepang (Figure 1) (Majlis Bandaraya Shah Alam 2007). From the 1970's to the 1988's, the total coverage area of natural landscape in the Klang Valley is wide of 23 787.8314 ha because of urbanization under the control. However, in the period between 1988 and 1998, the Klang Valley had begun to decline an eco-urban environment by experiencing the loss of green space of 79 574.2313 ha (BKWPPLK 2001). The areas of forest and other natural vegetation were to be converted into residential development, industry, recreation zones, institution and commercial. The increase in population density from 3983.8 million in 2000 to 5627.4 million for the year 2010 is seen as the main factors that influence these changes in land use (Katiman Rostam et al. 2010). At the same time, because of the high population density, traffic jams and poor air quality in the urban residential, an urban community began to realize the importance of landscape preservation and restoration of the environment, thus causing on trends of settlement planning in the Klang Valley has changed.

Now, the community has shifted their preference residential areas to one that promotes quality of life, comfort and welfare. Therefore, to meet the needs of this trend, the developer has changed from that of conventional design to the concept of sustainable residential environment (the era of the

mid 1990's to the 2000's and beyond) (Ahmad Sanusi 2005). This includes the exploiting innovative landscape design (preservation of natural topography, sustainable open space network and optimum the layout) and changing lifestyle choices (open space network neighbourhood living and 'cul-de-sac' versus grid-iron-road pattern). The property sector is no longer seen as providing shelter to the urban population but has evolved into a highly profitable economic sector for the developer. More particularly luxury residential developed in various places based on the concept of sustainability practices. Generally, sustainable residential development will continue to be emphasis between policy makers and pioneers built the environment of the 21st century and beyond (Liu 2001; Jiu 2001).



Source: MBSA, 2007

Figure 1: Location of Klang Valley and its neighbourhood region

Even with the concept of sustainable landscape with emphasis on large green spaces, most residential landscape suffers in a low biodiversity. This is because focused on the aesthetic aspects that promote non-indigenous plants and a high coverage of turf areas. The concept of "how it looks" rather than "how it functions" has dominated the current residential planning and design (Mustafa Kamal & Shamsul 2006). In addition, it also experiencing the high of runoff, the use of porous material, high energy and high resource consumption including labour input, watering, pruning, fertilizing and pest control. These problems are becoming more and more exacerbated by the development process involves a site is reclaimed land, cutting hills and deforestation as well as not consider continuity with the nearest land use. Indirectly, it shows that the current philosophy of landscape design is contrary to the practice of sustainable landscape architecture.

This situation occurs because Malaysia does not have a specific landscape framework to guide related to the application of sustainable landscape architecture into the planning and design of the residential environment. Although at present, there is a number of the framework have been developed from other countries such as the Sustainable Site Initiatives (SITES) and Canada Mortgage and Housing Corporation for assessing landscape sustainability in residential areas but it cannot be directly used due to the factors of differences in climate, geography and sustainability agenda. Until now, the instruments used in relating with planning and designing residential landscapes are only in the form of guidelines such as National Landscape Guidelines and Planning Guidelines for Housing. Both these guidelines focus on policies and standards in general and not specific to creating sustainable landscapes. Eventually this creates a problem which saw more developers will continue to apply the concept in the development of urban residential landscape for attracting consumers. As a result, the concept of sustainable landscape planning and design carried out in the urban residence landscape is not in the sense based on the principles of the sustainable landscape.

METHODOLOGY

Data set

The selection of two case study* sites was based on the following criteria, namely, the housing projects which is adapting sustainable landscape practices in landscape planning and design developed starting in the mid-1990s and has won several awards for their efforts and commitment to providing quality landscaping to inhabitants. Both the locations of case study are in the Klang Valley, which case study 1 in Kajang district and Shah Alam district is for case study 2.

Data evaluation and comparison

In this study, a comparison of two housing projects is not intended to look for deficiencies or weaknesses in their planning and design instead of to identify approaches to priority and is often practiced producing an integrated landscape design with nature (landscape sustainability) in context of the urban landscape. Hence, this could be a reference or a guide towards the practice of sustainable residential landscape, particularly in the Klang Valley. This two-case study site is to evaluate and compare of their sustainability for which has claimed itself as the practice of sustainable landscape in the housing markets using thirteen principles (parameter) of the sustainable residential landscape. These principles of sustainable residential landscapes based on the empirical study which is from literature review on aspects of sustainable human settlements in urban areas by focusing on ecology dimensions (e.g. green spaces, plants, air and water quality, habitats, etc.). This includes the theory of sustainable urban development and communities, sustainable development, sustainable neighbourhoods, sustainable planning, and building sites and sustainable landscape. The findings related to sustainability theoretical research, there are thirteen principles (parameters) of sustainable residential landscape identified are:

1. Consideration of the ecological environment

Consider the design stage of ecological development which to avoid any development on the biogenic environment such as habitat area, watershed, agricultural or forest reserve. Thus, it will be able to maintain and enhance a healthy settlement which is filled with natural resources. This parameter should be a condition of 'prerequisite' for the applicability as it can create the level of impact and implementation of high sustainable residential landscape in the future.

2. Creating or continuity of green space

This including parks, pocket parks, privacy courtyard, landscape reserves, water bodies and urban forest. In the residential estate in surrounded by rapid urbanization, apart for the 'environmental services', the planning and design of a patch of green space that connects between interior or exterior sites by corridors or green belt are also important in improving health and enhancing well-being residents and their interaction with the environment.

3. Protection or increasing of biodiversity

Protection or increasing of biodiversity and creating of aquatic or terrestrial biotope in the micro eco-environment (urban residential) can be implemented without disrupting the habitat patches of vegetation and wildlife communities. Patches of habitat in the composition, large size and ensure the continuity between the internal filling the community with a patch near the corridors of habitat will be able to produce harmony, and the parameters of healthy life in urban areas.

4. The relationship between landscape and building

This relationship includes building layout, the location and orientation according to the wind, the sun, hydrology, soils, topography, water bodies and vegetation patches need to be implemented during the early stages of planning and design of residential gardens. As well as the parameters that consider to the ecological environment aspect, it not only helps creating a healthy settlement space, harmony and not conflict with the natural environment but also significantly protect natural assets.

5. Applying indigenous plants

The use of local or indigenous plants, adapt to local climate or 'drought-resistant plants' and controlling or removing exotic plants not only sustain the virgin environment, natural setting and offers good bio-diversity models to learn from it but effectively with need no maintenance costs, fertilizing, use labour, money save and increase soil fertility.

6. Preservation trees

Preservation and conservation of trees species by selecting from shading species, shady canopy and dense texture can lower the ambient temperature by several degrees and lead to comfort and cheerful to the residents. In addition, tree placement also creates a positive influence on personality which connects residents and expressed their responsibilities towards the environment.

7. Use of Hedges

The use of hedges not only function to control the wind, noise, and filter suspended particles, but it could be a boundary marker and as ecological corridors in maintaining continuity of habitat networks for wildlife such as birds, butterflies, insects and so on. Use widely of this parameter in residential environment can create equilibrium with the environment and avoid the visual environment dominated by manmade.

8. Landscape water efficiency

Landscape water efficiency can be applied through rainwater collection systems that used for landscape irrigation, recycled water through the rooting system of aquatic plants and 'xeriscape' approach. Residential estates in urban areas especially in the Klang Valley which is experiencing rapid population and indirectly water use is non-efficiency, thus, this parameters practice is very significant in an effort toward water savings.

9. Landscape energy efficiency

Landscape energy efficiency can be applied using the species of shade trees, placed large trees in strategic places close to the house to shade the west facing room from the late afternoon sun but in such a way that natural lights is not kept out the house, the use of elements of trellis, pergola, and green wall, and the water body areas, green roofs and courtyard. Use of this widely approach in the urban residential, which are regularly exposed to the effects of the urban heat island not only can reduce the energy costs in the long term but at the same time create a healthy residential environment.

10. Storm water management design

This design uses bio-retention plants, bio-swale plants or bio-infiltration. It is an approach of managing the runoff of water treatment, filtration and infiltration of water into the soil naturally. Although this approach has not been widely used in Malaysia because of limited information about its effectiveness, but it should be introduced and encouraged its use especially in the urban residential. Stormwater management design has diverse functions such as able to limit runoff, prevent erosion, flooding, water pollution, prevent damage habitat aquatic and can also reduce the cost of infrastructure installation.

11. Green innovation

Characteristics of green innovation and green technologies is method to reduce heat with using solar photovoltaic panels, the materials 'zero' ozone (ODP) or porous materials with natural colours such as concrete pavements, asphalt, biobrick and so on. However, this parameter is more suitable for the type of low-rise housing such as detached, semi-detached, terrace or apartment (not more than five or six floors). This parameter is very potential to be expanded and promoted its use in the creating of environmentally sustainable residential.

12. Applying of 3'R' practices

Applying of three 'R practices' of the landscape on site amenity structures during site clearing activities, use composting and use of local natural materials is an efficient way to reduce the environmental impact resulting from the manufacture and disposal of materials. It is also popular used

practice in the construction of residential projects in Malaysia at present because it able to reduce the cost of construction and landscape maintenance.

13. Landscape maintenance efficiency

Landscape maintenance efficiency through mulching or composting, biological control, IPM, drip irrigation, micro-jet sprinkler and rain censor or the infrared sensor are combination of pest management techniques and conservation of water resources more effective, economical and more environmentally friendly. Although this parameter is still not widely used in residential of Klang Valley but it should be encouraged to enable help to create a healthy environment to the residents.

RESULTS AND DISCUSSIONS

Consideration of the ecological environment

Case study 1

The site of case study 1 has been developed from a former rubber plantation area of Kelton Estate which covered with a rich variety of flora and fauna resources. During the development process, it is not practice of conventional construction, otherwise focuses on the preservation and conservation of the natural landscape of the site which nearly 70% are retained including the existing species habitat, terrains, trees and wetlands. Besides fulfilling recreational needs, the wetlands also provide a diversity of habitats for frogs, toads, iguanas and tortoises. Thus the residential has shown a high level of performance in ensuring continued to growth of ecological in human settlement.

Case study 2

This residential shows excellent effort in attempt to apply sustainable practices by not choosing a site that has a high landscape of natural habitat areas and natural resources instead to take the site 'brown field' and has existing infrastructure. However, the residential is still not showing sufficient natural landscaping because the site factors and limitations of the design concept. Use of forest trees, natural landscape design may help improve the landscape in this area.

Creating or continuity of green space

Case study 1

Case study 1 has 25% green space which is exceeded the requirement of 10% by the national greenery-rate standard. Although the residential development has a high coverage of green space around the edge of the site, but its border separated with outer areas by 3 m high brick-faced perimeter wall intended to protect the security and privacy. This leads to prevents from spreading and the transition ecotone. However, the residential is committed to planning and designing this space to ensure it is integrated and coherent with the natural landscape. Linkages' in the development are provided by roads, avenues, pedestrian walkways and trails. Conservation of biogenic components include patches of natural landscape, the diversity of native plant, a combination of trees and shrubs, topography and the water bodies as well as a comfortable outdoor space is a major focus in the design of it green space. This ensures that the structure of green space not only to the importance of decoration, but can function in providing ecosystem services to residents

Case study 2

As case study 1, case 2 has no green space design continuity with the external space due to barrier enclosures and lack nearest green land availability. In total, the provision of 9% green spaces is slightly short of the requirement of 10 % of the total acreage. Not only is the actual provision less than 10% requirement, the concept of residential landscape more towards the 'artificial' from the create of the natural landscape. Overall residential landscape design that dominated by turf grass, lack the composition of variety plant, mostly decorative features and not focus to creating of space (structure) and function of the landscape has led to suffer of low ecological communities living.

Protection or increasing of biodiversity

Case study 1

Case study 1 has a patch of primer high biotope which combined with the composition of the existing layers of plants and they are left to expanding. The use of local water bodies with aquatic plants in Clubhouse Area is to create more ecological environment and thus can enhance biodiversity

Case study 2

Meanwhile case study 2 is more emphasis on the visual landscape design and there are no efforts to maintain or improve the existence of biological diversity in this residential.

Figure 2: A patch of primer high biotope which combined with the composition of the existing layers of shrub plants in case study 1 (left) and in case study 2 (right) more emphasis on the visual landscape design which use a combination of exotic shrubs.

The relationship between landscape and building

Case study 1

This case still uses the practice of land levelling but it as possible to maximised the conservation of the sanctuary with minimum change to the undulating land, conservation of water bodies, enhance indigenous vegetation communities and fauna habitat. The building structures have been architecturally planned and designed according to environmental characteristics that follow the direction of the wind, facing north-south, cluster layout and the barrier height of the building not more than three levels to ensure that the visual direction of the natural landscape setting is not block.

Case study 2

Even though the site of case study 2 is from quarry sites with scarce natural vegetation but it is reclaimed to create pretty landscape with the natural topography of undulating and sloping flat, soil recovery and consider the site surrounding landscape. However, restructuring the landscaping is not based on the selection of the native plants species in which the use of more exotic species.

Applying indigenous plants

Case study 1

The approach of case 1 that conserve and enhance of native trees and shrubs species, not only to save on maintenance costs (including energy, materials and labour), but significantly help improve the reliability of biodiversity and resilience of life and thus create in diversity of wildlife for the benefit of the functions of residents and the environment.

Case study 2

Even though at case 2 has the implementation effort of planting tree species but it is more focused on exotic species. Similarly, the lack of composition of planting shrubs and use more exotic species. This parameter is among the most important in the create effort of landscaping that has structure and function to humans, the environment and it able to show the unique character of a residential park.

Preservation trees

Case study 1

Preservation of trees in case study 1 is high due to the advantages of the original site covered by trees or mature forest. The residential site is from a former rubber plantation where a total of 3000 species of rubber trees (*Hevea braisiliensis*) is retained. Apart from the rubber tree, the residential is also maintained and replanted about 70% other species of forest trees and palms such as Trumpet Tree (*Tabebuia pallida*), Fistail Palm (*Caryota mitis*), Pokok Cucur Atap (*Baeckia fructocosa*), Fern Tree (*Cyathea latebrosa*) and Crinum spp.

Case study 2

Case study 2 also committed to preserve and improve of trees even though it implementation effort at moderate level. This may be due to significant public awareness about the value of trees that can provide various functions. More over in any development project, the developer must comply with under the Town and Country Planning Act 1978 which requires the maintenance of all trees over 80 cm in diameter.

Figure 3: Preserving of mature trees in residential areas in case study 1 (left) and using a combination of native plant species diversity in case study 2 (right).

Use of Hedges

Case study 1

The use of hedges at case study 1 not only acts as enclosures but at the same time are used for wildlife movement from one patch to another patch, and thus enhance their colony dispersion. Furthermore, the use of this approach can create a more harmonious living environment and integrated with the environment. The residential also use mature trees planted along the road and within dense planting to create an external space ambient moisture, help to absorb the amount of suspended particles in the air and produce oxygen.

Case study 2

As in case 1, the majority of enclosures in case study 2 also use the hedges that can not only create a greener home environment and avoid the domination of man-made elements but to facilitate the movement of wildlife habitat.

Figure 4: The mature trees planted along the road in cases study 1 (left) and in case study 2 uses exotic plants as hedges (right).

Landscape water efficiency

Case study 1

Do not use it

Case study 2

Do not use it

Landscape energy efficiency

Case study 1

Case study 1 practice the use of water elements through the construction of two ponds in which one of them built in the middle of the site (use as recreational centre for residents). Impact of diversity of planting trees and dense forest canopy with combined in clusters planting near the building structures were increase cold ambient environment in this residential area.

Case study 2

Case study 2 should be able to reduce the hot micro-climates environment because it has a lake in the middle of the residential sites. But due to the selection of tree species that are not give shading and lack of planting shrubs in clusters near the home structure cause the environment is still hot. Obviously the residential landscape dominated for please residents on visual level, symbols and decorations.

Storm water management design

Case study 1

Not applicable

Case study 2

Not applicable

Green innovation

Case study 1

Using a combination of porous materials from concrete pavement-related ('permeable interlocking concrete pavement") in almost all pedestrian circulation areas and grass-crete in courtyard could indirectly reduce the heat of the environment temperature.

Case study 2

Using a combination of porous materials from concrete pavement-related ('permeable interlocking Concrete Pavement "), limestone tiles, and 'grass-crete' in almost all pedestrian circulation areas and pocket sites to reduce the heat of the environment temperature.

Applying of 3'R' practices

Case study 1

The use of local natural materials is also practiced in case study 1. Most of the landscape amenities such as gazebo, benches, bridges and trellis dominated by non-stained timbers were not treated with anti-fungal solution. It aims to protect the environment. However, efforts to use natural materials to the landscape elements in the green spaces or courtyard are only for a part of the area.

Case study 2

Approach 3'R' at a high level. In case study 2, it can accumulate a total of seven million tons of granite rocks in which development activities were partially sold and partially re-used. Rocks are then used to stabilize slopes waterways, drainage channels, high walls and build the soil various landscape amenities.

Landscape maintenance efficiency

Case study 1

To help control moisture loss through evaporation from soil surface and to increase the organic content of the soil, they used coconut peat, and shredded bark as organic mulching and dry grass. However, the application of this method is not whole and only a number of areas.

Case study 2

Do not practice it

CONCLUSIONS

From evaluation and comparison of two case studies in the Klang Valley residential area, the study found some of the principles of sustainable landscape that has been practiced in order to create a more sustainable residential area. This includes consideration of ecological environment, a high coverage of green spaces, relationship between landscape and building and maximizing the use of the trees species. However, there are principles of sustainable landscape as practiced at a low level or simply not practiced such as the use of indigenous plant species, increase biodiversity, landscape energy efficiency, landscape water efficiency, low maintenance, recycling material, green innovations and storm water management. The concept of sustainable landscaping as claimed by the developer to attract buyers, in fact, use only partially principles of sustainable landscaping in residential areas. They are more focused on the provision of a huge green area, while other principles of sustainable landscape are negligible. Therefore, the level of implementation sustainable residential landscape principles in two case studies in the Klang Valley has achieved medium progress. In order to achieve greater success in the future residential landscape development, there are three things to note. Firstly, consider aspects about the energy input, labour input and waste output. The second is to protect and enhance indigenous or local plant species because the species is not only able to save costs but increase the biodiversity and lead to a natural eco-model of residential environment. Thirdly is ensure that planning and design landscape in natural setting because through this way, they can bring people to near the environment and thus strengthen the interaction between people and landscape. Toward a more sustainable residential environment, sustainable landscape concept should be studied and applied thoroughly from the design phase to acceptance phase.

**The name of case study sites may not be published because the author is committed to keep all project-related information (client name, project name, etc.) as confidential.*

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A Review on the Effectiveness of Urban Solid Waste Management in Subang Jaya Municipal Council (MPSJ)

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ABSTRACT

The Malaysian Solid Waste and Public Cleansing Management Act of 2007 (Act 672) was introduced in order to provide a comprehensive, integrated, cost-effective and sustainable system of solid waste management. This Act granted the Federal Government through the Federal Government Corporation known as the Solid Waste Management and Public Cleansing Corporation (SWCorp Malaysia) an executive power over managing urban solid waste and public cleanliness throughout Peninsular Malaysia. Should the Act be implemented at the state and local government level, solid waste and public cleanliness are managed by concessionaires chosen by the SWCorp Malaysia. Even though the Act had been gazetted by the Parliament, the State Government of Selangor had decided against its implementation. As consequence, on October 16, 2011, the state government terminated Alam Flora Sdn. Bhd (AFSB) as their waste management contractor. This means that local authority (LA) would resume their traditional duty as waste manager with state government as monitoring agency. There are positive and negative impacts resulted from this change in management of solid waste for the LA's. The positive impacts can be seen in terms of budget allocation and LA's level of involvement in the context of local scenario's. Regardless of this issue, LA's to rearrange their environmental management programs as the Federal Government power had been restricted. Termination of the Federal Government concessionaire's contractor (AFSB) caused LA's workload to increase drastically. Hiring new contractor for waste management service provider was time consuming and caused a delay in the management as the new contractor needed time be familiar with the system. Based on the analysis and findings from this research, MPSJ had proven that LAs that had vast resources were capable in managing their own solid waste issues. This obviously came from the initiatives and programmes that had been put together by the management, although there were still rooms for improvements in the future.

Keywords: *Urban Solid Waste Management; Effectiveness*

INTRODUCTION

Solid waste management in Malaysia has been facing many changes since a few decades ago. Prior to privatization, solid waste management and public cleansing were the LA's responsibilities, where smaller waste management services provider acted normally as the subcontractor. However, with the increasing costs of management, the situation resulted with the subcontractors not being paid promptly, leading to a drastically reduced efficiency of the management (Periathamby et al. 2009). Therefore, in September 1995, the Federal Government decided to privatize the management of solid waste and as an initial step, the privatization was being carried out on an interim basis. On January 1, 1997, solid waste collection and transportation all over Malaysia had been taken over by Southern Waste Sdn. Bhd. and AFSB (Yahya and Larsen, 2008). Then, in 2007, the Cabinet decided for full privatization at the Southern and Central Zone to take place as soon as the Act 672 came into force, which added Environment Idaman Sdn. Bhd (E-Idaman) as another concessionaire (Yahya and Larsen, 2008). The authority governing solid waste and public cleansing was shifted from state government and LA to the Federal Government Corporation (SWCorp Malaysia). Furthermore, the management cost will be shared between these two parties. LA will channel funds to a Federal Corporation that directly managed solid wastes and public cleansing. As an implication, this process had caused many reactions, especially in Selangor. It led to several management issues and disputes in the state of Selangor and other concerned parties. As Selangor is generating the highest amount of solid waste in

Malaysia, the solid waste management is very crucial and becomes a serious issue to all parties, including the public in general.

PROBLEM STATEMENT, AIM AND OBJECTIVE

Selangor had generated approximately 1.13 million tons of solid and household wastes in 2009 (Alam Flora, 2009) and it had spent around RM330 millions per month for all activities related to collection, transportation and disposal of household solid wastes. Before the privatization, solid wastes in Selangor were administrated by the LA with a joint management from the private concessionaire (AFSB). This is in accordance with the Concurrent List (List 3) of the Ninth Schedule of the Federal and State Constitution, which stated that both state and federal have jurisdiction over solid waste administration.

As the state government of Selangor decided not to implement this Act 672, AFSB contract as the waste management service provider has been terminated. This consequently had shifted the responsibility of managing the solid waste in the whole state of Selangor under the respective LA and state government as the monitoring body. This transition has positive and negative impacts toward LAs. Termination of AFSB as the waste contractor would reduce monetary expenses, but in return, increase the workload for the LA.

The dwindling trust in the efficiency of the Federal Government underlies the disagreements between key stakeholders. The LAs stated disagreement issues with the Federal Government and are unconvinced at the accountability and transparency of the Federal Government Corporation in providing better and more efficient waste disposal services. Thus, empowering LAs in managing waste disposal is more effective compared to the previous practice. Therefore, this paper sought to find out a clearer picture of the management of solid waste after the implementation of the new system conducted by the LA. It also compared the effectiveness of the new implementation system, advantages and the disadvantages of it compared to the previous one.

METHODOLOGY

This study adopted three methods of data collection and analysis. This analysis will lead the researcher on the study's findings as a basis for the formation of the recommendations. The survey conducted also aimed to assess the input of knowledge, experience and opinions on the urban solid waste management regarding the previous management and also with the current set of the management team. Through the analysis, various aspects of solid waste management were observed, mainly in the management of the solid waste and solid waste minimization programmes.

Each analysis was also supported with observations by the researcher on the study area. Through this approach, the issues and problems of the research can be understood. In ensuring and determining the aspects that hinder the effectiveness of urban solid waste management by MPSJ, the researcher also conducted two survey techniques which are expert interviews and document review which included information from secondary sources and LA's views.

Data Collection

The qualitative method was done by interviewing the responsible respondents based on the study's scope. Based on the interview method, relevant information associated with the study can be collected. In this study, the Environmental Officer from MPSJ Environmental Management Department and stakeholders such as the community organisation (Jawatan Kuasa Penduduk (JKP) Zon 7, Putra Height) had been interviewed in order to collect the suitable and relevant data for the study.

Analysis

Analysis on the findings was divided into two main aspects, the first one being the analysis on the managerial aspect of waste management. This would determine the effectiveness and efficiency of the management between the previous and current one. In this aspect, the study focused on the element of budget allocated by the local authority who was the employer towards the employee which was the contractor that managed solid waste. The complaint received regarding the domestic waste management from the public was another element included in this managerial aspect. The number of complaints would determine the satisfactions level of services provided by the previous and current management. Notice to Correct (NTC) was also included under this managerial aspect. The NTC was the supervision and monitoring measure used by the MPSJ in ensuring the best possible services provided by the contractor to the public. Through this approach, if the number of NTC issued was as much as the complaint made by the public, it signalled that the appointed contractor was not up to the standards required. The standards are; Collection Schedule and Public Cleanliness.

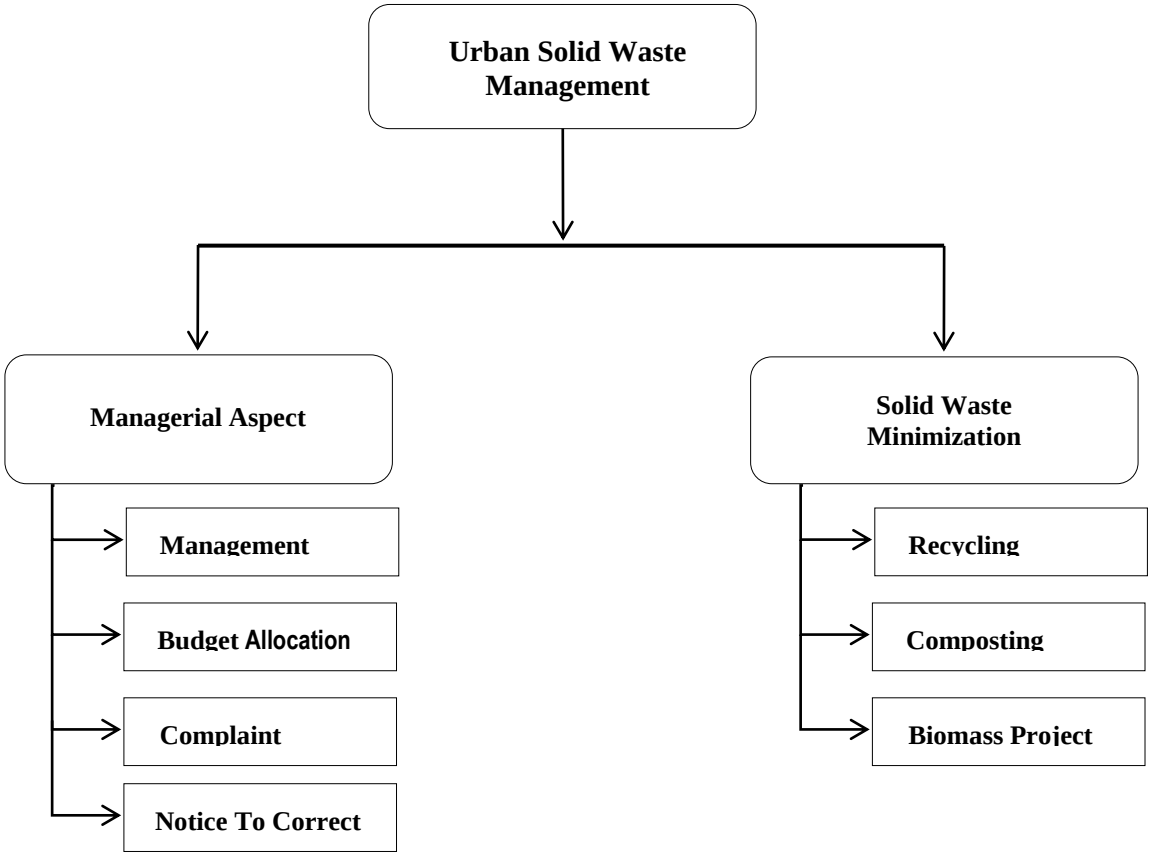

Figure 1.1: The Urban Solid Waste Management

Apart from the above elements, the services delivery in terms of domestic waste and recycling waste collections were the elements also being analysed and included in the managerial aspect. This analysis focused on the collection schedule exercised by the AFSB and also the MPSJ. The approach taken by both sets of management would determine how effective and systematic the waste management was practiced. Moreover, this managerial aspect also considered the management framework of the previous and current management team. This element focused on the management framework of solid waste management where there were issues that arose regarding the transition in management of solid waste in the state of Selangor. By having this, it would determine which management framework was the most suitable in dealing with urban solid waste in the state of Selangor.

The second aspect involved in this analysis would be the solid waste minimization programmes. In this aspect of solid waste minimization, there are numbers of initiatives that had been implemented by the MPSJ. These waste minimizations programmes actually held their own significance to the urban solid waste management. The reason was that; waste minimization would assist the local authority to reduce their budget for solid waste management. The over provision of budget can be used for the benefit of the public in the MPSJ area. The initiatives involved in this solid waste minimization programmes by MPSJ were recycling and composting programs and also the biomass project.

RESULTS

Based on the analysis that had been outlined in the above section for this research, it can be summarized that urban solid waste management was best managed by the local authority itself if there were vast resources and proper planning as shown by the MPSJ. In comparison to the previous management which was by AFSB, LAs such as MPSJ had a better managerial and waste minimization aspect. The findings based on these two aspects are as follows:

Managerial and Administration Elements

a. Management framework

Based on the analysis, the comparison on the management frameworks between the previous and current management was that it involved the issues of the chain of command or bureaucracy. According to the MPSJ officer, the current management by the MPSJ created less bureaucratic issues in dealing with public complaints, especially in terms of time to respond towards complaints. When there were less bureaucratic or red tape issues, the service delivery would reach the targeted group much easier. If there was a complaint made by the public, the LA can respond directly to the issues without the need to consult with the main contractor like in the previous management procedure. The LA would treat the issues from the beginning until the problem was solved and any improvements in the solid waste management programmes can be implemented easily.

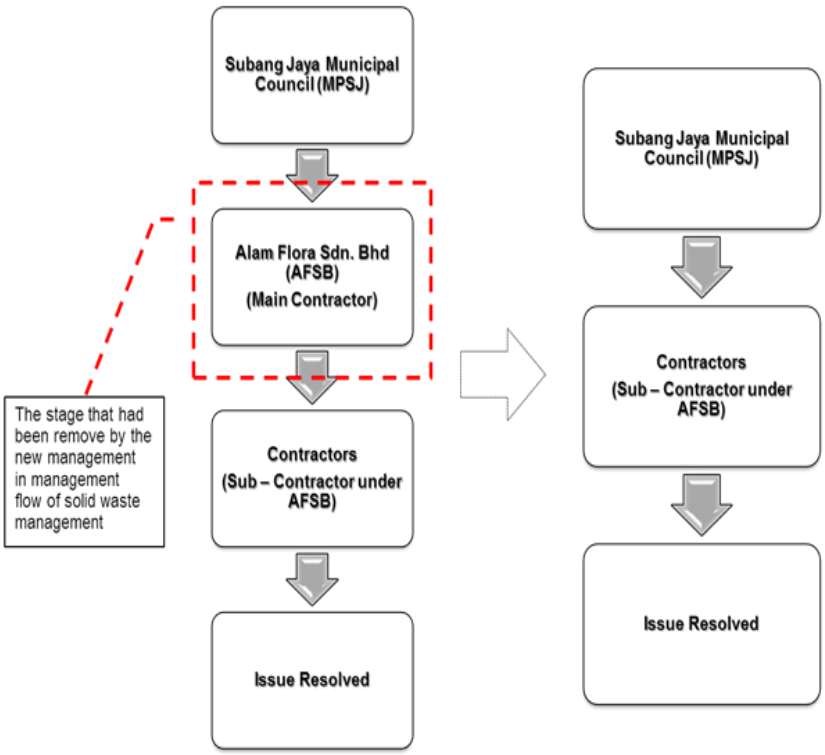

Figure 1.2: The differences of the management flow between AFSB and (MPSJ) in 2012

b. Budget allocation

In this element of analysis, the previous management which was run by the concessionaire, it required huge financial resources in managing the urban solid wastes. Although equipped with vast financial resources, the services provided by the concessionaire in Subang Jaya area were not worth the money spent. This condition was totally differed compared to the management by the LA itself. MPSJ had gradually managed to reduce their waste management cost since the take-over from the concessionaire. This actually helped the enormous programmes conducted by the MPSJ in dealing with waste which eventually gave satisfied services to the public.

Table 1.1: MPSJ Budget Allocation for Solid Waste Management and Public Cleansing Services 2007-2013

Breakdown of Expenses on Solid Waste Management and Public Cleansing	**Year (RM Millions)**						
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Garbage Collection	-	-	-	-	28.4	19.5	19.4
Cleansing	-	-	-	-	38.2	33.7	33.8
Disposal	-	-	-	-	6.1	12.1	12.3
Total	**65**	**70**	**76**	**70**	**72.7**	**65.3**	**65.5**

Source: Adapted from Laporan Tahunan Bahagian Perkhidmatan Bandar MPSJ, 2010, 2011, 2012 and Draf Laporan Jabatan Pengurusan Alam Sekitar, 2013

Through an analysis of this initiative, the current management had proven that they were capable in providing better services to the users. The services provided had accomplished the standard requirements and the scope of work outlined by the LA compared to the previous management. This might be influenced by the relentless effort by the LA in monitoring the performance of hired contractors. Table 1.2 below shows the number of NTCs that had been issued by MPSJ toward the contractors who did not comply with the standard, specification and scope of work that they were tied to. This table consists of the NTC data from year 2010 until the latest year of 2013.

Table 1.2: Number of NTCs Issued By MPSJ towards Contractors (Domestic Waste)

	2010	**2011**	**2012**	**2013**	**Overall Total**
NTC Issued	224	454	147	68	**893**
Percentages (%)	25.08	50.84	16.46	7.62	**100.0**

Sources: Adapted from Laporan Tahunan Bahagian Perkhidmatan Bandar MPSJ, 2010, 2011, 2012 and Draf Laporan Jabatan Pengurusan Alam Sekitar, MPSJ, 2013

c. Complaints

The complaints were another element that supported the statement that urban solid waste management was best managed by the LA itself compared to the previous management by the concession company. Based on the analysis conducted, the number of complaints received during the previous management was much higher than the current management. This showed that although the previous management was an established waste management organisation, lack in quality control can contribute to a low standard of quality service delivery. Table 1.3 below shows the number of complaints received by MPSJ regarding domestic waste.

Table 1.3: Complaints Received by MPSJ Regarding Domestic Waste

	2010	2011	2012	2013	Overall Total	Percentages (%)
Domestic Waste Complaints Received	701	776	1, 911	749	4, 137	**100.0**
False Allegations	477	322	1, 764	681	3, 244	**78.41**
Percentages on False Allegations (%)	**68.04**	**41.5**	**92.31**	**90.93**	**78.41**	

Sources: Adapted from Laporan Tahunan Bahagian Perkhidmatan Bandar MPSJ, 2010, 2011, 2012 and Draf Laporan Jabatan Pengurusan Alam Sekitar, MPSJ, 2013

Based on Table 1.3, the data had clearly shown that there were decreasing patterns in terms of complaints made to MPSJ regarding the domestic waste. However, during the previous management in the year of 2010 and 2011, the data showed that the complaints received and were proven to be true allegations were much higher.

d. Relationship between Complaints and Notice to Correct (NTC)

The services provided were consistent and for that reason, the number of NTC issues was less compared to the number of complaints received by the MPSJ. This also showed that the current set of management had followed the standard and scope of work that had been set up by the LAs. This was different compared to the previous management of solid waste, where the complaints and the number of NTCs issued were higher.

Table 1.4: Complaints and Notice to Correct (NTC)

	2010	2011	2012	2013	Overall Total	Percentages (%)
Domestic Waste Complaint Received	701	776	1,911	749	4,137	**100.0**
NTC Issued	224	454	147	68	893	**21.59**
Percentages of NTC Issued (%)	**31.95**	**58.5**	**7.69**	**9.07**	**21.58**	**100.0**
False Allegations	477	322	1,764	681	3,244	**78.41**
Percentages of False Allegations (%)	**68.04**	**41.5**	**92.31**	**90.93**	**78.41**	

Source: A Review on Effectiveness of Urban Solid Waste Management in Selangor, A Case Study of Subang Jaya Municipal Council (MPSJ), 2014.

In regard to the current management of solid waste by the MPSJ that started their services in the full scale in 2012, the services provided were better compared to the previous management, although Table 1.4 above showed that the number of complaints received was the highest among all. The NTC was issued when the complaint was proven true but in this case, the NTCs issued by MPSJ were recorded differently. This can be concluded that the complaints made by the public might be true but the public might see the problem as a one-day situation and not on the daily basis collection schedule. Collection schedule was also another important element in reviewing the effectiveness of urban solid waste management between the current management (MPSJ) and the previous management (AFSB). Based on Table 1.5 and the analysis that had been carried out, the MPSJ had taken more proactive and more systematic measures in addressing the issues of high generation of waste in their jurisdiction area.

Table 1.5: Collection Schedule of Domestic and Recycling Waste by AFSB and MPSJ

Types of Waste	Collection Schedule (Day/Week)	
	MPSJ	**AFSB**
Domestic	3	2
Recycle	2	1

Sources: Jabatan Pengurusan Alam Sekitar, MPSJ and AFSB, 2014

Through this systematic and more comprehensive approach, it clearly showed that the current management was far more effective than the previous one. This statement was proven through Table 1.5. Although the waste generated kept increasing, the previous management did not take the appropriate measures to counter those problems.

Waste Minimization

a. Recycling program

Recycling programs that had been implemented by the MPSJ had achieved their target in minimizing the wastes generated. This achievement supported by the continuous effort from MPSJ in educating and informing the public about the benefits of this program. Public participation was the key element in ensuring that the waste minimization had an impact towards the generation of waste. The collaboration between the LA and public can help in reducing the management cost, especially in the LA area where effective measure such as this program can create a batter waste management system.

b. Composting program

MPSJ as a responsible LA had tried their best in reducing waste generation in their administrated area. This waste minimization programmes actually aimed in reducing the management cost that kept increasing yearly and the LAs were burdened with this. Based on the analysis, the composting program was not only reduced the management cost, but it also created new marketable products that became new sources of income to the LA.

c. Smart partnership project

This smart partnership project that involved public university, related ministry, local R&D institution, the foreign government and the Federal Government had managed to come out with solution to achieve a more sustainable environment. This eventually had put MPSJ as the frontrunner in becoming an effective, innovative and sustainable LA in Malaysia. Through this, MPSJ had emerged as a good example to the other LAs throughout the country on how to effectively reduce the budget allocated for waste management.

d. Integrated biomass project

The implementation of this Integrated Biomass Project had proven that there was a number of programs and projects that can be planned and implemented by the LA in managing their solid wastes in a more effective way. This also proved that LAs that had their own ideas and initiatives such as MPSJ were more than capable of managing their solid wastes. This however was helped by the fact that MPSJ was more resourceful and wealthier compared to the other LAs.

CONCLUSION

Generally, this study was undertaken to assess the effectiveness of solid waste management by the LA which was exampled by MPSJ. The Federal Government had actually striven towards a more

effective solid waste management by establishing a proper solid waste management legislation and system. The Malaysian Solid Waste and Public Cleansing Management Act of 2007 (Act 672) was introduced in order to provide a comprehensive, integrated, cost-effective and sustainable system of solid waste management.

Based on the analysis that had been carried out, there were many benefits that can be highlighted from the management transition on the Selangor solid waste management. One of the benefits that can be concluded from the analysis was that, the contract termination of AFSB as their waste management contractor can save lot of money as proven by MPSJ. With the increase in solid waste generation in Selangor, where Subang Jaya ranked as the top two waste generator in Selangor (Selangor Times, 2012), it was necessary for the LAs to come out with best possible solution without causing them with unnecessary costs. In MPSJ, the average cost for managing solid waste ranged from 65 to 76 million yearly. By reducing that cost for the third party, this budget can be used for other developmental programmes.

Other than that, by managing the solid waste collection themselves, the LAs in Selangor were directly involved with the process, thus understood the situation even better. LAs' communication with the public will be closer and every problem in the community would be detected and solved quickly. The problem of bureaucracy between the government and the public would be reduced through this approach. In addition, this would create more creative, active and progressive LAs in conducting environmental programs on their own and not only depending on the Federal Government's initiatives alone.

Although the management transition gave lots of benefits to the LAs in Selangor, there were certain concerns that had arisen. The first concern would be on the legislation's point of view. In this situation, the Federal Government has no authority of managing the solid waste in Selangor (Berita Harian, 2011). Therefore, LAs in Selangor needed to solve and implement solid waste management programs at their own initiatives. The worst situation that might happen to those less fortunate LA's was that they might be facing the funding problem for their waste management services. The state of Selangor's LA's was restricted from any assistance by the Federal Government (Hock, 2011). This was one of the risks for LAs in Selangor where the LAs needed to come out with their own management plans if there were financial problems. Programmes such as recycling, composting and many other initiatives of solid waste minimization were the examples of how the LAs can reduce their budget for the solid waste management programmes.

Besides that, there would be no uniformity between each of the LA in Selangor for managing its solid waste. As the state government was responsible in the monitoring aspect, each LA needed to figure out the suitable management plan for solid waste in their jurisdiction area. Therefore, it was difficult to compare or monitor the LAs' progress and outcomes in managing their solid waste. This would lead to some differences in action between LAs where some might focus on the technical aspect while others might focus on public initiatives. Contract termination of AFSB which was the main contractor had increased the workload for the LA. LAs needed to manage their own solid waste collection and disposal alone; hence, they needed to hire new contractors that might burden them with technical, environmental, economic and socio-political issues. The LAs were also facing shortages of human resources in terms of expertise and man power since previously, the AFSB managed the whole processes. Established LAs such as Shah Alam City Council (MBSA), Petaling Jaya City Council (MBPJ) and Subang Jaya Municipal Council (MPSJ) might not encounter any financial problems with this on-going transition, but small and medium sized LAs could face all these problems. These LAs still require continuous assistance from state government on a monthly basis to manage their services. The termination also led to time consuming and delays in the action of services as the new contractors needed to adapt to the previous routine which involved rules and procedures.

Based on the analysis and the findings from this research, MPSJ as LA had proven their capabilities in managing their own solid waste issues with various initiatives and programmes. Although there were advantages and disadvantages associated with solid wastes being managed by the

LA, it somehow showed that with proper management and planning, the LAs were capable in managing their own waste management system.

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The Status of Integration of BIM into the Curricula of Construction Education in Nigeria

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ABSTRACT

This research appraises the status of BIM integration in the Curricula employed for training construction professionals in the Nigerian Construction industry. Using qualitative research approach, semi-structured interviews were conducted to the sample of nine (9) Construction Engineering and Management (CEM) programs offered in four tertiary institutions in Kaduna State. The heads of department of Architecture, Building and Quantity Surveying in these institutions were invited to participate in the survey. Data collected through the interviews were subsequently analysed using content analysis. The study found that although BIM is yet to be fully integrated into the curricula of the CEM programs of the surveyed institutions, the institutions have a fair awareness of the concept of Building Information Modeling and the potential benefits of its implementation in the industry. Also, several barriers such as; lack of room in the existing curriculum for additional classes; lack of staff with the knowledge of BIM; high cost of training; lack of accreditation standards and requirements to guide the integration of BIM within a curriculum were identified to be the major obstacles hindering successful integration among others. The study concludes that the status of integration of BIM into construction education in CEM programs is unsatisfactory and requires tremendous improvement. To ensure wide and improved BIM integration in the curricula of CEM programs, it's recommended that the regulatory and professional bodies of the various disciplines in the built environment should mandate the inclusion BIM in the curricula of all CEM programs offered in the country.

Keywords: *Building Information Modelling (BIM), Construction Engineering and Management (CEM), Curricula, Construction education.*

INTRODUCTION

The rate at which the Architecture, Engineering and Construction (AEC) industry is embracing Building information modelling (BIM) in the delivery of its services is continuing to grow. Various sectors of the industry such as the construction professionals, public, and private construction clients in many parts of the world have established formal requirements for implementing BIM in their projects (Khemlani, 2012). McGraw-Hill Construction (2014) summarised the status of BIM adoption over the last three to five years around the globe and identified Canada, France, Germany, the UK and the USA as mature markets for BIM technology with new under explored market in countries such as; Australia, Brazil, Japan, New Zealand, South Korea, China and India. On a general note, the report depicts the rapid and robust BIM uptake globally, especially in the US and the Scandinavian regions where BIM acceptance and adoption is growing exponentially. Furthermore, significant successes have also been reported in the UK, Australia, Singapore and other maturing countries in the Middle East (McGraw-Hill Construction, 2014).

Despite the numerous potentials and benefits associated to the application of BIM tools in AEC's delivery process, low rate of BIM implementation has been widely reported in many parts of the world (Isa, 2015; Jung & Joo, 2011; McGraw-Hill Construction, 2014). However, 'lack of personnel with competent BIM skills' has been reported to be a major factor responsible for the low rate of implementation (Abubakar, Ibrahim, & Bala, 2013; Ashcroft & Shelden, 2008; Barison & Santos, 2010; Isa, 2015). To address this challenge, CEM programs in higher institutions of learning

play a pivotal role in that in addition to producing BIM competent professionals to the industry, the burden of training professionals already in the industry is drastically reduced(Ann, Cho, & Lee, 2013). Therefore, several researchers have highlighted the importance of BIM in CEM programs. For example, Peterson et al (2011) and Sacks and Barak (2010) demonstrated the application of BIM in project management and civil engineering programs respectively.

To achieve continuous improvement and the knowledge management necessary for realising the values of BIM projected by researchers in the AEC industry(Eastman, Teicholz, & Sacks, 2011), professional education, training and development of professionals in the industry becomes imperative (Sacks & Barak, 2010). Consequently, universities around the world are developing BIM-integrated curriculums for students of construction engineering and management (CEM) programs. These curricula are based on BIM education frameworks that facilitate the establishment of comprehensive breakdown of knowledge and competency needs of the industry (Sacks & Pikas, 2013). Sacks and Pikas (2013) developed and tested a BIM framework for BIM education of graduate engineers and BIM-competent construction managers.

In Nigeria, although some level of readiness for BIM implementation has been established (Abubakar et al., 2013; Abubakar, Ibrahim, Bala, & Kado, 2014; Usman, 2015) the industry is reported to be at level 1 maturity stage(Isa, 2015). This low level of implementation has been attributed to several factors (Abubakar et al., 2013; Abubakar et al., 2014; Usman, 2015) among which includes 'lack of trained and competent BIM experts. However, despite the pivotal role and potentials of tertiary institutions to increase the rate of BIM implementation in the construction industry, the status of integration of BIM into the curricula of Nigerian Construction Professional in Nigeria is not known. Therefore, this paper examines the status of BIM integration into the curricula of CEM programs offerred in Nigerian tertiary institutions.

LITERATURE REVIEW

Definition and Application of BIM

The Acronym 'BIM' has many interpretations depending on the context in which it is used: It could be 'Building Information Modelling'; 'Building Information Model'; or 'Building Information Management'. The term BIM is considered to be ambiguous and has no universally accepted definition (Aranda-Mena et al., 2008). According to RICS (2014b), the concept of BIM has no accepted definition due to its ever-evolving nature where new areas and frontiers are creeping into the boundaries of what it could be defined as. There are definitions that present BIM as a 'Process', a 'Product', a 'technology', an 'innovation', or a 'Strategy'. However, simpler definitions consider BIM as a digital representation of the physical and functional characteristics of a facility. Whatever definition is given to BIM, the major function and goal of BIM involves the detailed and complete replication of a building in a digital environment with the sole goal of providing a collaborative platform for managing Building information throughout the lifecycle of a facility (Aouad et al., 2014). The terms '*Building Information Model'* and '*Building Information Modelling'* are often used interchangeably, basically referring to a way of creating, using, and sharing building lifecycle data.

The National Building Information Model Standard; NBIMS (2007) defines BIM as a shared informational resource, which digitally represents the physical and functional characteristics of a building and allows for reliable decision-making though out the building's life cycle (NIBS 2007). Eastman, Teicholz, and Sacks (2011) described BIM as a modelling technology and associated set of processes to produce, communicate, and analyse building models.

Several benefits have been attributed to BIM, the followings are some the benefits of BIM at the various stages of the lifecycle of a facility (Eastman et al., 2011; Pittard & Sell, 2016):

Concept, feasibility, and design benefits

Owners/clients of facilities are always interested in determining whether a building of a given size, quality level, and desired program requirements can be built within a given cost and time budget. BIM model built into and linked to a cost database can provide owners with accurate and reliable information that guides decision on whether to proceed with a project or not.

Increased building performance and quality

Schematic models developed prior to constructing detailed building model allow for a more careful evaluation of the proposed scheme to determine whether it meets the building's functional and sustainable requirements. Early evaluation of design alternatives using BIM analysis/simulation tools improves the general quality of the building.

Improved collaboration using integrated project delivery

Where Integrated Project Delivery (IPD) is the adopted project procurement approach, BIM can be used by the project team from the commencement of the design to improve their understanding of project requirements and to extract cost estimates as the design is developed (Eastman et al., 2011). This allows design and cost to be better understood and also helps in avoiding the use of paper exchange and its associated delays and other complications.

Earlier and more accurate visualisations of a design

3D models can be used to visualize the design at any stage of the process with the expectation that it will be dimensionally consistent in every view.

Automatic low-level corrections when changes are made to designs

The parametric nature of BIM makes objects used in the design to be controlled by parametric rules that ensure proper alignment, hence making the 3D model free of geometry, alignment, and spatial coordination errors which ensures automatic adjustments to changes made at later stages.

Generation of Accurate and consistent 2D drawings at any stage of the design:

Through a BIM model, 2D designs can be extracted for any set of objects or specified view of the project. This significantly reduces the amount of time and number of errors associated with generating construction drawings for all design disciplines.

Earlier collaboration of multiple design discipline:

BIM technology facilitates simultaneous work by multiple design disciplines which consequently shortens the design time; significantly reduces design errors and omissions, and ultimately gives earlier insight into design problems and presents opportunities for a design to be continuously improved

Use of design model as basis for fabricated components

BIM models are used in steel, sheet metal work, precast components, fenestration, and glass fabrication. These offsite fabrications help in drastically reducing cost and construction time. BIM also allows larger components of the design to be accurately fabricated offsite than would be done using 2D designs.

Quick reaction to design changes

Changes introduced during design can be automatically evaluated and updates made automatically based on the established parametric rules. Design changes can be resolved more quickly in a BIM system because modifications can be shared, visualized, estimated, and resolved without the use of time-consuming paper transactions. Updating in this manner is extremely error-prone in paper-based systems.

Discovery of design errors and omissions before construction

Because the virtual 3D building model is the source for all 2D and 3D drawings, design errors caused by inconsistent 2D drawings are eliminated. In addition, because models from all disciplines can be brought together and compared, multisystem interfaces are easily checked both systematically (for clash detection) and visually (for other kinds of errors).

Improved commissioning and handover of facility information

During the construction process the general contractor and MEP contractors collect information about installed materials and maintenance information for the systems in the building. This information can be linked to the object in the building model and thus be available for handover to the owner for use in their facility management systems. It also can be used to check that all the systems are working as designed before the building is accepted by the owner.

Better management and operation of facilities

BIM provides a source of information (graphics and specifications) for all systems used in a building. Previous analyses used to determine mechanical equipment, control systems, and other purchases can be provided to the owner, as a means for verifying the design decisions once the building is in use. This information can be used to check that all systems work properly after the building is completed.

Integration with Facility Operation and Management Systems

A building model that has been updated with all changes made during construction provides an accurate source of information about the as-built spaces and systems. This provides a useful starting point for managing and operating the building. A building Information Model supports monitoring of real-time control systems, provides a natural interface for sensors, and remote operating management of facilities. Many of these capabilities have not yet been developed, but BIM provides an ideal platform for their deployment.

BIM Education in Construction Engineering and Management Courses

The state-of-the-art in university-level BIM education for the broad architecture, engineering, and construction (AEC) sector, report positively, inspite of the hitches faced by institutions in terms of understanding ‘what to teach’ and ‘how to teach’ BIM components they integrate into their CEM related program(Sacks & Pikas, 2013). Studies report that BIM is being adopted gradually, and that implementation by majority of existing course is done at basic level by teaching a specific tool (Barison & Santos, 2010). For example, results of the survey of 488 U.S. CEM accredited programs show that 60% of construction management programs have some BIM component in their curriculum in only one or two courses which mostly are electives (Becerik-Gerber, D.J. Gerber, & Ku, 2011). The various components of BIM courses according to Becerik-Gerber et al. (2011) include introduction to BIM concepts (40%); BIM assignments merged into the project work in classes (67%); standalone BIM courses (67%); BIM immersed into existing courses and design projects (60%); and BIM merged into research projects (28%).

Many institutions apply BIM in the teaching of construction methods and that has fundamentally improved the understanding of the students(Kymmell, 2008). Facilities are virtually built and all necessary tasks involved in the construction process such as estimating, scheduling, constructability analysis, clash detections and several others which before are taught theoretically are now demonstrated and undertaken in BIM environment, and that to some large extent eases and fast track students understanding(Sacks & Barak, 2010; Sacks & Pikas, 2013).

To effectively produce BIM competent construction professionals, institutions of learning must align their curriculum with the current industry needs in addition to other relevant BIM skills. This is quite necessary because different maturity levels are achieved at different times by various

industry sectors, and thus, training should be directed towards meeting up with the various needs at all times(Ahmad, Demian, & Price, 2012). Lee and Hollar (2013) identified and rated BIM competency areas, most of which concern BIM functionality such as clash detection, 4D modeling, etc, and concluded that effective BIM education should be adopted broadly across multiple courses, to satisfy the growing need for BIM-competent professionals. Therefore, several frameworks for BIM education have been proposed by researchers (Molavi & Shapoorian, 2012; Pikas, Sacks, & Hazzan, 2013; Solnosky, Parfitt, & Holland, 2013). These frameworks were designed to bridge the gap between industry needs and university education and emphasized that curricula development should also consider innovations such as green building and integrated project delivery(Molavi & Shapoorian, 2012).

RESEARCH METHOD

In order to ascertain the status of integration of BIM education into the curriculum of Nigerian tertiary institutions offering CEM programs, an extensive literature review was first conducted, purposely to articulate issues regarding the concept of Building Information Modelling (BIM) and BIM in Construction Education. Based on the information gathered from the review, a semi-structured interview guide was developed and administered to the heads of department of CEM programs offered in tertiary institutions in Kaduna state, Nigeria. The interview involved only tertiary institutions offering CEM courses; Architecture, Building Quantity Surveying, Civil engineering, Estate Management and Urban and Regional planning. A total number of nineteen (19) CEM programs were identified to be offered in four (4) tertiary institutions resident in Kaduna state. These institutions are; Ahmadu Bello University (5); Kaduna State University (3); Nuhu Bamalli Polytechnic (6); and Kaduna Polytechnic (6). Table 1 shows the distributions of the CEM programmes offered in all the institutions.

Table 1: Study Sample Frame: CEM Programs

Program	Frequency	Percentage
Architecture	4	21%
Building	4	21%
Quantity Surveying	4	21%
Urban and Regional Planning	2	11%
Estate management	2	11%
Civil Engineering	3	16%
Total	**19**	**100%**

As shown in Table 2, nine (9) Heads of Department from the four (4) Institutions offering CEM programmes which represent 47% of the study sample frame were selected for the interview. Each head of department was invited to participate in the study and was issued interview guide to prepare for the discussions. The sample was considered to be adequate and representative in that most of the programs operate similar curriculum as provided by the minimum bench mark by either the Nigerian Universities commission (NUC) or National Business and Technical Education Board (NABTEB) as the case may be. The interviews conducted were audiotaped, transcribed, coded and analysed using content analysis. The interview focused on four (4) major themes; background of the respondents; BIM awareness of the respective departments involved; status of BIM integration in the institution's curriculum and finally the challenges and barriers hindering the full implementation and integration of BIM into CEM programs in these institutions.

Table 2: Respondents' Profile

Variables Discipline	Categories	Frequency	Percent
	Architecture	4	44%
	Quantity Surveying	2	22%
	Building Services	3	33%
Experience & Qualification	**Respondents**	**Qualification**	**Years of experience**
	INTVW 1	BSc. Qs, MSc. PhD, MNIQS,RQS	8 years
	INTVW 2	BSc. Qs, MSc.,PhD, MNIQS	10 years
	INTVW 3	BTech. Qs	5 years
	INTVW 4	BSc., MSc., MNIQS,RQS	18 years
	INTVW 5	BSc., Msc, MSc.	8 years
	INTVW 6	BSc., MSc.	9 years
	INTVW 7	BSc., MNIQS	10 years
	INTVW 8	BSc., MSc.	11 years
	INTVW 9	BSc., MSc.	12 years

* INTVW: Interviewee

RESULTS AND DISCUSSION

Respondents' Background, BIM awareness and Knowledge

To ensure the reliability of the data collected from the respondents, only heads of department were involved in the survey. This is based on the assumption that the heads have acquired reasonable understanding and knowledge of the entire workings of the department and have adequate and sound technical competence in their respective disciplines. As shown in Table 2, all the respondents were registered members of their respective professional bodies and have at least Bachelors and Master of Science degrees in their academic profiles which clearly suggest the reliability of information they provide.

Furthermore, the respondents BIM awareness and knowledge was also considered to be a crucial measure of the reliability of data obtained from the survey and therefore, it was explored to further ascertain the reliability of information collected. All the nine (9) respondents demonstrated satisfactory level of BIM awareness, as most of them have heard and read about the concept. Similarly, while 55.56% (5) of the respondents have knowledge and skill of BIM, 44.45% (4) are not knowledgeable in BIM. This logically confirms the low status of adoption reported locally(Abubakar et al., 2014) and globally(McGraw-Hill Construction, 2014).

The extent of BIM Integration into the Curricula of the surveyed CEM programs

With regards to the integration of BIM into the curriculum of the CEM programs surveyed, only three (3) out of the Nine (9) departments were found have incorporated some aspects BIM education into their curriculum. BIM is integrated as a Core course delivered weekly for a period of 2-hours and is taught to students in their fourth year (400 Level) when they have covered most of the technical components of the curricula. According to the interviewees, BIM is taught at lecture, practical and Computer Aided Design (CAD) sessions. This clearly corroborates the findings of Woo (2006) who reported similar results. While Building departments have integrated BIM as an independent course in their curriculum, the Quantity Surveying departments did not integrate BIM as a course but rather as a module or sub-component of other courses, e.g computer application courses. The BIM modules in their curricula are delivered in the students' third year and covered within the

period of three to four consecutive weeks. The modules capture BIM concept and its application in the areas of model visualisations, quantity take-off and estimating. Design, modeling, visualisation, scheduling, simulation were the major areas captured in the curricula of the Architecture and Building departments surveyed. Emphasis is generally made on the specific skills of modeling and basic analysis in both QS and building departments. The major BIM-based applications used in demonstrating BIM concepts in these programs are Revit Autodesk QTO, and Google. These results support the findings of Woo (2006) that there is no commonly accepted approach to teaching BIM in AEC programs . Furthermore, BIM integration and implementation in these programs is done at basic level, focusing on specific tools just as the case was reported by Barison and Santos (2010) that integration is limited to a single discipline in 90% of CEM programs and that majority of the programs implement BIM at a basic level, teaching a specific tool and limiting their perspective on BIM to viewing it simply as a productivity enhancing tool for producing drawings.

Challenges facing the integration of BIM into the Curricula of the Surveyed Institutions

The interviewees identified several barriers hindering the integration of BIM in the curriculum of their programs. The barriers highlighted by the respondents are:

- Lack of room in the existing curriculum for additional classes
- Lack of staff with the knowledge of BIM
- High cost of training
- Lack of accreditation standards and requirements to guide the integration of BIM within a curriculum
- Difficulty in learning and using software
- Poor staffing capability
- Lack of BIM-specific materials and textbooks as well as other educational resources for students
- Lack of staff with the knowledge of BIM
- Training staff is expensive
- Availability of electricity supply
- Scepticism in introducing BIM
- Industry is not serious about BIM
- Lack of client readiness and demand
- Lack of government support.

Most of the challenges identified by the interviewees were similar to the challenges reported by previous researches investigating BIM integration in CEM programs in other parts of the world(Barison & Santos, 2010; Kymmell, 2008; Pikas et al., 2013; Sacks & Barak, 2010; Sacks & Pikas, 2013; Woo, 2006). For example Kymmell (2008) listed difficulty in learning and using BIM software; misunderstanding of the BIM processes; and issues related to the circumstances of the academic environment as the major issues stumbling BIM education.

CONCLUSION

This study has appraised the status of BIM integration into the curriculum of tertiary institutions in Nigeria. The study found that although BIM is yet to be fully integrated into the curricula of the CEM programs of the surveyed institutions, all the institutions are aware of BIM. Also, BIM integration was found be done differently. While some of the programs teach BIM as a course of its own others capture BIM as sub-component of other courses. Several barriers such as; lack of room in the existing curriculum for additional classes; lack of staff with the knowledge of BIM; high cost of training; lack of accreditation standards and requirements to guide the integration of BIM within a curriculum were identified to be the major obstacles hindering successful integration among others. The study concludes that the status of integration of BIM in construction education is unsatisfactory and requires serious improvement.

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Assessment of Private Sector Spending in Construction Sector in South Africa: An Auto-Regression Distributed Lags Approach

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This paper investigates the influence of macro-economic variables on the contribution of the private sector spending in construction sector to the South African economy. The methodology adopted for the study was an ex-post facto survey research because it was based on existing data. Annual data of the construction contributions, GDP, inflation rate and interest rate were collected between 1984 and 2011. The data were extracted from the published sources of the South African National Reserved Bank (SARB); Statistics South Africa (Stats. SA) and Quantec, South Africa. The study makes use of autoregressive distributed lags (*ARDL*) to prove that there is a long run causal relationship between private sector spending in construction and macroeconomic variables, namely, GDP, Real Exchange Rates, GDP in construction sector, interest rates and inflation rate in South Africa.

Keywords: *ARDL, Construction, Macroeconomic variables, Private sector, South Africa*

INTRODUCTION

South Africa economy has been struggling for decades due to the political and economic reasons. In the 1970s to early 1990s, there was economy sanction imposed by the Western economies on the government of South Africa because of the prolonged rule of the apartheid regime, and there were also internal crises due political reason (Dollery, 2003). Gordhan (2014) states that between 1985 and 1986, large number of skilled workers migrated out of South Africa and this incident had a great impact on the economy.

However, 1994 marked the beginning of a democratically elected government in South Africa. According to Harmse (2006) there was an improvement in the macro-economic environment in South Africa when the first democratically elected government resumed power in 1994. This last statement was supported by Ntsama (2010) and Lysenko and Barnard (2011) and that after a prolonged period of declined in the socio-economic growth in South Africa, there was an improvement from mid-1990s, with the introduction of some economic policies by the government.

Meanwhile, to develop South Africa economy and to make it sustainable, sectoral stimulation have to be initiated by government through adequate and sound policies. Keynesian asserts that increasing spending in construction industry can stimulate economic growth. This is because construction sector through its engagement in the provision of capital infrastructure development can enhance growth and sustainable development (Dlamini, 2011).

LITERATURE REVIEW

Macro-economic policies and the construction sector's contributions in South Africa

South Africa is a rapidly changing environment, because of various political, economic and global influences (Mbachu and Nkado, 2007). According to Harmse (2006), in the 1980s and the

1990s, the South African economy was faced with external pressures in the form of economic sanctions by the Western economies, and the ongoing internal structural inadequacies. The era of sanctions led to import substitution and self-sufficient policies on strategic products by the State; and this caused huge government investment in oil from coal, and in the weapons industries. This period of economic recession saw about 420 000 workers lose their jobs (Harmse, 2006).

The unstable macro-economic environment of South Africa, during the sanctions era, improved when the first democratically elected government came into power in 1994 (Harmse, 2006: 21). According to the analysis of the macro-economic environment, as carried out by Frankel, Smit and Sturzenegger (2006), the income per capita increased rapidly during the 1960-1980 period; but thereafter the economy experienced a downward trend that lasted for 15 years. And, it was only from mid-1994, that the economy began its upward trend. Ntsama (2010) and Lysenko and Barnard (2011) state that after a prolonged period of declining economy growth, South Africa has had an improved macro-economic management since the mid-1990s; and this can be attributed to the introduction of inflation targeting by the South African Reserve Bank (SARB), as well as the introduction of the Growth Employment and Redistribution (GEAR) programme in 1996.

However, the improved economic growth in South Africa is very slow; and the impact has not been felt by all the people, because the rates of poverty and unemployment were still very high (Moller, 2007). Cassim (2006) reviewed the economic reform in South Africa within the period between 1994 and 2004, and came to the conclusion that the macro-economic policies in South Africa concentrated more on issues to address macro-economic instability, external pressure, balance of payments crises, and exchange rate volatility, instead of on long-run structural problems, like the problems of employment generation, unequal income distribution, poverty and crimes.

Meanwhile, the unstable macro-economic environment prevailing in South Africa has contributed immensely to the cyclical trends in the output of the construction industry. According to a study carried out by Windapo and Cattell (2013), the key challenges perceived by stakeholders causing the fluctuations and poor performance of the construction industry in South Africa are: The increasing costs of building material; access to mortgage and credits; high interest rates; and the high rate of failure of contracting enterprises. The Construction Industry Development Board (CIDB) (2013) reveals the following on the key challenges faced by sub-contractors as follows: "*The lack of security of payment; bid price pressure from the main contractors; weak management practices; poor attitudes within sub-contracting organizations; and general industry-wide factors, including the lack of working capital, high levels of competition, and skills shortages.*"

These above challenges testify to the fluctuations and the poor performance of the emerging contractors. These individuals have all faced some challenges in their bid to deliver infrastructural projects effectively – because of the sharp decline in employment, a decline in NGCF, and the slow execution of construction projects owing to poor capacity, low productivity, poor-quality workmanship, and low profit margins for contractors (Perkins, Fedderke and Luiz, 2005). Dlungwana, Nxumalo, Huysteen, Rwelamila and Noyana (2002) attribute some of the challenges confronting the construction industry to the rapid globalization of the South African economy, whereby large contracting firms are increasing their offshore markets, in order to grow their revenue, and to survive the current economic recession. They went further, by maintaining that, in an attempt of the government to improve the present situation of the industry, the National Department of Public Works (NDPW) was tasked to develop a remedial strategy, which was done. And this then led to the formation of the CIDB, which is now in charge of construction industry development.

Private sector and the economic development in South Africa

Private sector in any economy is regarded as the engine of the economic development and it includes wide variety of actors, such as large private enterprises whose aim is to maximize profits for shareholders, to millions of individuals who are in business activities to support themselves and their family (Reality of Aid Network International Co-ordination Committee, 2012).

International Finance Corporation (IFC) (2011: 3) describes the private sector as a critical stakeholder and partner in economic development of any nation because of the role it plays in provision of income, jobs and good services to enhance the standard of living of the people and to reduce the level of poverty. IFC (2011: 3) continues by elaborating on the challenges confronting the developing nations of Africa such as promotion of growth, creation of jobs, poverty reduction, improved health and education, all these can only be adequately tackled by incorporation of vibrant private sector in government system.

The role of the private sector in the economic development of any nation cannot be under-estimated. According to the African Development Bank Group (AfDB) (2013) the future of millions of people in any economy depends on the private sector; therefore, the public sector must create conducive environment in which it can operate effectively. The problems of the private sector in Africa varies from inadequate government regulations, restrictive policies, poor infrastructure, severe skill shortages, trade restrictions, tariff and non-tariff barriers to export, difficulties in obtaining medium and long-term finance on affordable terms, and a large number of informal operators (AfDB, 2013).

RESEARCH METHODOLOGY

The study assesses the contribution of the South African private section in construction to the economy. The research design adopted in the study is “ex-post facto” type, otherwise known as “causal comparison”. According to Bernard (2006), ex-post facto is a non-experimental research design that is used to explore possible causal relationships among variables that cannot be controlled by the researcher.

The study uses secondary data sources of information because of the nature of the data that were involved and because of the well-developed knowledge in the field of economics; the economic data can easily be sourced from national statistical sources. The sampling design adopted in this study is a non-probabilistic sampling method, this is to avoid the accidental inclusion of deviant cases which is highly possible with these data characteristics. The choice of variables was purposive; since the study is particularly about those variables that impact on the other; and the choice of the variables would need to be a function of the performance of the choice test statistics. The subject of the sampling for the collection of the macro-economic variables is made simpler by the fact that sources are mostly limited to government approved sources.

The data used in the study were extracted from the published sources of the South African National Statistics, such as South African Reserve Bank (SARB); South African Statistics (STATSSA); and Quantec South Africa (QuantecSA). The data were extracted on quarterly basis via an instrument designed for the purpose. The administration of the data collection instrument did not pose any problem since the extraction could be done either at the information unit of the SARB or research unit of the STATSSA.

The variables used in the study were defined as follows: Private Sector Spending in Construction (Private_SP), this is the total cost of completed projects by private sector in South Africa between the period of the study 1984 and 2011 and is measured in million rand; Real Interest Rate (INT_RATE), the real interest rate is the nominal interest rate adjusted for expected inflation rate and is measured as the difference in the nominal interest rate and the expected inflation rate in the economy, is measured in percentage; Real Exchange Rate (RER), the real exchange rate is defined as the nominal exchange rate that takes into account the inflation difference among nations, it is the rate at which a country currency is compared with the currencies of other countries; Gross Domestic Products (GDP), GDP is used to assess level of performance of a country economy with another country, South Africa GDP is measured in billion rand; Gross Domestic Product in Construction Sector (GDP_CONSTR), the output total of the construction over a period of time, it is measured in million rand; Inflation_Rate (INF_RATE), inflation rate is based on the consumer price index, it is a percentage change in the price of goods and services in the economy within a given period of time.

All the data for the study were subjected to estimation as follows: The study employed Auto-Regression Distributed Lag (ARDL) model, developed by Peasaran, Shin and Smit (2001). This approach can be used to test both long-run and short-run dynamics in variables in a study. Meanwhile, this approach is simple to use as compared to other integration techniques for the following reasons: Firstly, the ARDL bound test does not require variables to be integrated of the same order, that is, they can be either I (0) or I (1); Secondly, the test solve the serial correlation and endogeneity problems by specifying appropriate lags, the long-run and the short-run parameters can be estimated simultaneously. Thirdly, the ARDL bound test has superior small sample properties (Pesaran & Shin, 1997; Pesaran, et al. 2001).

DATA ANALYSIS AND DISCUSSION OF FINDINGS

This sector of the study presents the data analysis and discussion of findings. The section begins with the stationary/unit root tests, in order to determine the integration of the variables. Then followed by the determination of the ARDL model.

Stationary/Unit Root Tests

The main objective of the stationary/unit root test is to provide a useful insight into either a deterministic or the stochastic secular component in any time series. To carry out this purpose the following test were performed: Augumented Dickey-Fuller (ADF) test; Phillips-Perron (PP) test; Kwiatkowski-Phillips-Schmidt-Shin (KPSS); and Ng-Perron (NP) test.

However, from all the tests, it was discovered that variables are not consistent to all the tests, especially at all levels. The variables react to all the tests at the first difference and were found to be significant. In conclusion on the stationary/unit root tests, all the variables were regarded to be integrated at the first difference, which is to the order of I (1).

Test for Multi-Collinearity

Test for the multi-collinearity was also carried out because of its importance in model building. Probability value determines the significance of a variable in a model and a variable is said to be significant if it probability value is below 5 percent. Multi-collinearity will cause the probability value to be large in model building. Therefore, test must be carried out to ensure that there is no multi-collinearity among the variables under consideration.

The test carried out discovered there was multi-collinearity and the solution was to remove some of the affected variables such as: Crude oil price; Labour productivity in construction and money supply.

Estimation of Auto Regression Distribution Lag (ARDL) Model

The steps for the estimation of the ARDL model for the study are as follows: To determine whether the variables are stationary and that the variable is not of I (2); Selection of optimal lag; Test for long-run relationship by using Wald test statistics and run ordinary least squares model; Save the residual and copy it as error correction term (ECT) and run ordinary least squares model including ECT as one of the regressors; Ensure ECT is negative and significant. Thereafter, follows the explanation of the results and the diagnostics test.

From the above steps, the stationary/unit root tests for the study revealed that all the variables are of order I (1). The next step is the selection of the optimal lag model. The variable for the ARDL model estimate are: PRIVATE_SP as the dependent variable; other variables are INFL_RATE; INT_RATE; RER; GDP; and GDP_CONSTR as the independent variables.

The model can be expressed as follows:

PRIVATE_SP = F (INFL_RATE; INT_RATE; GDP; RER; GDP_CONSTR)
Where PRIVATE_SP is Private sector spending in construction
INFL_RATE is inflation rate in the economy
INT_RATE is the interest rate in the economy
GDP is the gross domestic products in the economy
GDP_CONSTR is the construction sector contribution to the economy
RER is the real exchange rate in the economy.

For the selection of the optimal lags; the values of Akaike (AIC) and Schwards (SIS) information criteria were considered for various models and the one with the lowest valves of AIC and SIS was taken. The results of the optimal lag selection are summarised in Table 4.1

Table 4.1: Results of optimal lag selection

No of lag	AIC	SIC	Comment
1	-2.14	-1.18	Not the lowest lag
2	-2.09	-1.61	Not the lowest lag
3	-2.17	-1.45	Not the lowest lag
4	-2.56	-1.76	The lowest lag
5	-2.49	-1.52	Not the lowest lag
6	-2.47	-1.33	Not the lowest lag

From the Table 4.1 above, model with four lags is optimal, the best to be used to produce reliable and acceptable model. Thereafter, the model with four lags was tested for serial correlation. The result was that the model has no serial correlation. Also test for stability was carried out and it was discovered that the model with lag four is stable. This is shown in the figure below.

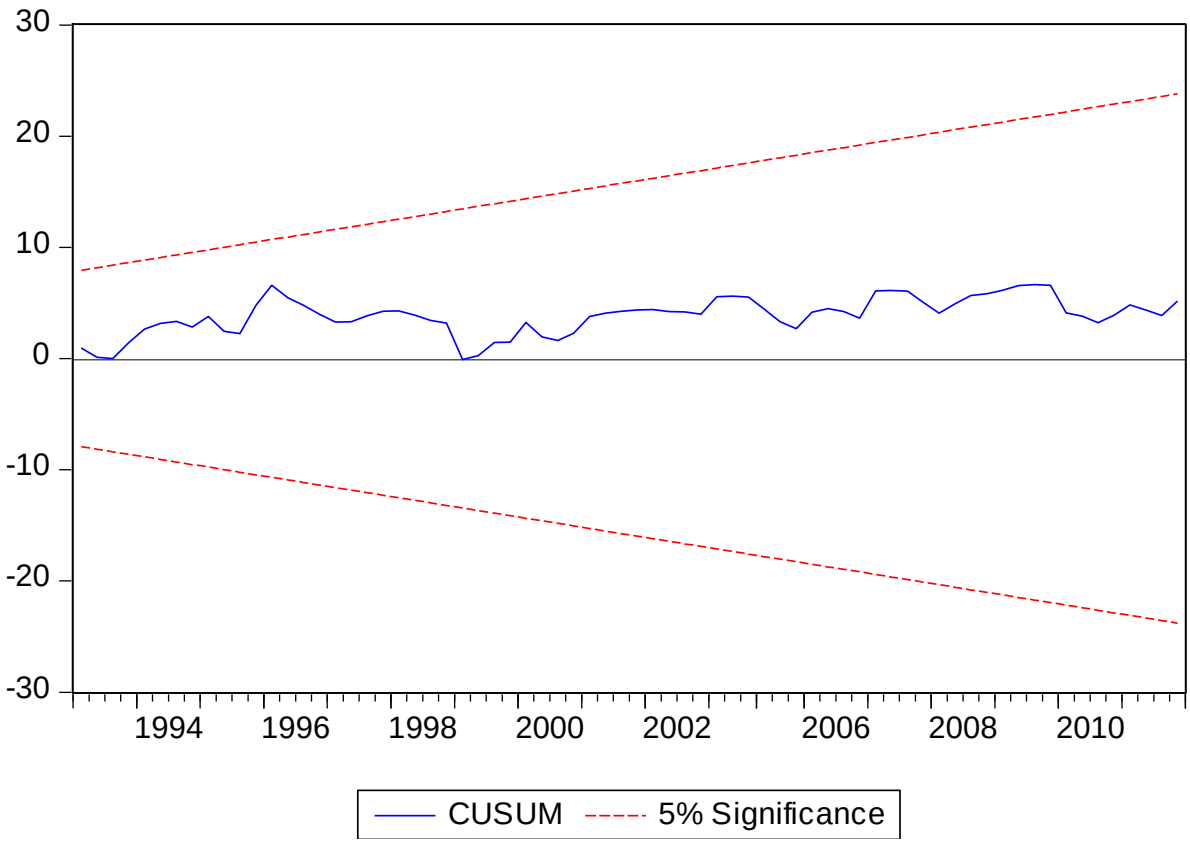

Figure 4.1: Optimal lag four test for stability

The next step is to determine long run model or bound testing using four lags. The results are shown in Table 4.2

Table 4.2: Results of estimated long-run coefficient ARDL model

Variables	Coefficient	T-Statistics	Probability
C1 = Constant	0.570624	1.336896	0.1856
C2 = PRIVATE_SP(-1)	-0.256034	-2534880	0.0135
C3 = PRIVATE_SP(-2)	-0.346896	-3.346441	0..0013
C4 = PRIVATE_SP(-3)	-0.173218	-1.598259	0.1145
C5 = PRIVATE_SP(-4)	0.289232	-2.847396	0.0058
C6 = GDP(-1)	-0.222756	-2521006	0.0140
C7 = GDP(-2)	-0.179141	-2.120194	0.0375
C8 = GDP(-3)	-9.47E-07	-2.735433	0.0097
C9 = GDP(-4)	-7.47E-07	-2.219657	0.1685
C10 = RER(-1)	0.179019	1.391373	0.1685
C11 = RER(-2)	0.273465	1.937374	0.0567
C12 = RER(-3)	-0.052627	-0.407012	0.6852
C13 = RER(-4)	0.008184	0.060844	0.9517
C14 = GDP_CONSTR(-1)	0.480119	0.67148	0.0094
C15 = GDP_CONSTR(-2)	0.462215	2.652248	0.0099
C16 = GDP_CONSTR(-3)	0.421222	2.532573	0.0136
C17 = GDP_CONSTR(-4)	0.547076	3.260778	0.0017
C18 = INT_RATE(-1)	0.089040	4.207859	0.0001
C19 = INT_RATE(-2)	0.011237	0.565730	0.5734
C20 = INT_RATE(-3)	0.014259	0.859781	0.3928
C21 = INT_RATE(-4)	-0.025210	-1.804191	0.0755
C22 = INFL_RATE(-1)	0.129525	1.333104	0.1868
C23 = INFL_RATE(-2)	0.006521	0.065839	0.9477
C24 = INFL_RATE(-3)	0.274534	2.632363	0.0104
C25 = INFL_RATE(-4)	0.085057	0.775772	0.4405
C26 = PRIVATE_SP(-1)	0.038469	-1.900337	0.0615
C27 = GDP(-1)	0.078584	3.874000	0.0002
C28 = RER(-1)	-0.022709	-0.324357	0.7466
C29 = GDP_CONSTR(-1)	-0.188714	-3.691176	0.0004
C30 = INT_RATE(-1)	-0.028188	-1.391719	0.1684
C31 = INFL_RATE(-1)	-0.132496	-3.089133	0.0029

Table 4.2 presents the results of the Wald test for long-run relationship between the dependent variable and the independent variables in the model under consideration that contains four lags.

Meanwhile, after the model estimation then follows the testing long-run relationship using the Wald test and the hypotheses are stated below:

Null hypothesis is that C(26) = C(27) = C(28) = C(29) = C(30) = C(31) = 0
Alternative hypothesis is that C(26) = C(27) = C(28) = C(29) = C(30) = C(31) $\neq$ 0

Table 4.3: Results of the Wald test for the long-run relationship

Test Statistic	Value	df	Probability
F-statistic	5.126701	(6.70)	0.0002
Chi-square	30.76020	6	0.0000

From the result, the F-statistics is 5.126701 and the probability is 0.0002; while the Chi-square value is 30.76020 with probability value 0.0000.

However, to know whether the variables have long-run association or not, the F-statistic 5.126701 is compared with the Pesaran critical value at 5 percent level. The model is unrestricted

intercept and no trend. From the Pesaran table, the lower bound value is 3.79; and the upper bound value is 4.85.

The guide line principle for acceptability in the Pesaran table is that if the F-statistic is more than upper bound level value we reject null hypothesis and then accept alternative hypothesis.

Therefore, from our Wald test F-statistic is 5.126701 greater than the Pesaran upper bound value of 4.85. That is 5.12> 4.85. From the Wald test the six variables in the model: PRIVATE_SP; GDP; RER: INT_RATE; INFL_RATE and GDP_CONSTR have long-run relationship and can move together in the long-run. Next is to develop model of short-run with error correction term as one of the regressors.

Development of short-run and error correction term (ECT).

Table 4.4 presents the results of the short-run and error correction term (ECT). ECT (-1) is incorporated into the above model to form long-run component. ECT (-1) is the speed up adjustment towards long-run and it must be negative, at the same time be significant.

From the Table 4.4 the following observations were taken on the short-run association between the dependent variables and the independent variables: firstly, only INT_RATE (-1), (-2), (-3) and (-4) can jointly cause short-run causality with PRIVATE_SP. The other variables such as GDP; RER; GDP_CONSTR; and INFL_RATE did not have short-run association with PRIVATE_SP.

Table 4.4: Results of short-run and ECT

Variable	Coefficient	T-Statistic	Probability
C1= Constant	0.003575	0.391716	0.6964
C2= PRIVATE_SP(-1)	0.250492	1.856706	0.0674
C3= PRIVATE_SP(-2)	-0.092698	-0.969825	0.3353
C4= PRIVATE_SP(-3)	0.1103317	1.053663	0.2955
C5= PRIVATE_SP(-4)	0.573009	5.160574	0.0000
C6= GDP(-1)	0.035467	0.517007	0.6067
C7= GDP(-2)	0.041208	0.593963	0.5544
C8= GDP(-3)	-0.038230	-0.519078	0.6053
C9= GDP(-4)	1.03E-07	0.353810	0.7243
C10= RER(-1)	0.116388	0.870204	0.3870
C11= RER(-2)	0.231701	1.627113	0.1080
C12= RER(-3)	-0.196558	-1.440137	0.1541
C13= RER(-4)	0.051169	0.367542	0.7143
C14= GDP_CONSTR(-1)	-0.015909	-0.113630	0.9098
C15= GDP_CONSTR(-2)	-0.010843	-0.074700	0.9407
C16= GDP_CONSTR(-3)	-0.017197	-0.118700	0.9058
C17= GDP_CONSTR(-4)	0.068569	0.482203	0.6311
C18= INT_RATE(-1)	0.053898	3.390943	0.0011
C19= INT_RATE(-2)	-0.042741	-2.402194	0.0188
C20= INT_RATE(-3)	-0.011129	-0.716076	0.4762
C21= INT_RATE(-4)	-0.038681	-2.7021569	0.0086
C22= INFL_RATE(-1)	0.099285	0.669986	0.5050
C23= INFL_RATE(-2)	-0.121388	-1.106820	0.2720
C24= INFL_RATE(-3)	0.229467	2.053836	0.0436
C25= INFL_RATE(-4)	-0.125003	-1.067612	0.2892
C26= ECT(-1)	-0.538070	-2.850634	0.0057

Discussion of Findings

The private sector in construction is found to be an important sector of the economy and the macroeconomic variables such as inflation rate, interest rate, economic growth and the exchange rate have great role to play in the contribution of the private sector in construction to the South African economy. From the Wald test, it was discovered that the macroeconomic variables: GDP, RER, INT_RATE, INFL_RATE and GDP_CONSTR can jointly influence the contribution of the private sector in construction at the long-run.

From the above findings, inflation in the economy would influence the performance of the private sector in construction at the long-run. If at the long-run there is high inflation, this means an increase in the price of construction materials thereby affecting the contribution of the private sector in construction to the economy. This follows the economic theory such as the theory of price which stipulated that when the price of the good rises above its equilibrium level, it demand would be greater than its supply and this happens when there is inflation in the economy. Equally, when the price of a good is above the equilibrium price, supply would be greater than the demand, this incident happens when there is low inflation in an economy.

Interest rate is another variable that influence the contribution of the private sector in construction in the long-run. This follows that high rate of interest rate will reduce development by the private sector in construction thereby affecting their contribution to the economy. This follows the theory of loanable funds, all things being equal a low interest rate would increase investment but when the interest rate is high, investment will be low. The investment would come down when there is high rate of interest rate because the cost of capital has gone up. Also according to the theory of loanable fund, savings is related to interest rate and the volume of savings in an economy will determine the level of investment. When the interest rate is high, the level of savings will be low and when the interest rate is low the level of savings will be high. High savings will affect the contribution of the private sector in construction to the economy.

Economic growth is another important variable affecting the contribution of the private sector in construction to the South African economy in the long-run. This finding was in agreement with past studies by Aiyetan (2010) and Dlamine (2011) that there is a close relationship between the construction industry and the economy of any nation. The private sector in construction in South Africa will contribute more to the economy when there is boom in the economy. Following the Keynesian theory which says that increase in spending in construction industry can stimulate economic growth due to the fact that construction sector engages in infrastructure development.

CONCLUSIONS AND RECOMMENDATIONS

The private sector in the construction industry has been found to be of great importance in the development and sustainable growth of any country; however, the unstable macro-economic environment in South Africa is depriving it of this great benefit.

The aim of this study is to assess the private sector spending in construction sector in South Africa using ARDL approach. ARDL was used because the influence of the independent variable is always felt over time, rather than all at once. It was discovered from the ARDL model that there is a long-run causal relationship between the private sector spending in construction and the macro-economic variables namely: GDP; RER; GDP_CONSTR; INT_RATE; and INFL_RATE in South Africa. On the short-run association, only the INT_RATE (-1), (-2), (-3), and (-4) that can jointly cause short-run causality with the PRIVATE_SP. The remaining independent variables such as GDP; RER; GDP_CONSTR and INFL_RATE did not have short-run association with the PRIVATE_SP.

The recommendations of this study are as follows: firstly, the monetary policy on inflation targeting in South Africa must be properly anchored to withstand any external shocks; secondly,

efforts of the monetary authorities must be geared towards a stable macro-economic environment via policies that would bring about price stability, low interest rate, and a stable exchange rate of Rand to the Dollar; thirdly, the inflation rate in South Africa that is fluctuating and unstable must be addressed by appropriate policy because of its impact on the construction prices.

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LIST OF ABBREVIATIONS

ADF	Augumented Dickey-Fuller
AIC	Akaike Information Criteria
AfDB	African Development Bank Group
ARDL	Auto- Regressive Distributed Lag
CIDB	Construction Industry Development Board
C1……Cn	Variables
GEAR	Growth Employment and Redistribution
GDP	Gross Domestic Product
GDP_CONSTR	Gross Domestic Product in Construction Sector
IFC	International Finance Corporation
INF_RATE	Inflation Rate
INT_RATE	Interest Rate
KSPSS	Kwiatkowski_Phillips- Schmidt-Shin
NDPW	National Development of Public Works
NP	Ng-Perron
PP	Phillips-Perron
Private_SP	Private Sector Spending in Construction
RER	Exchange Rate
SARB	South African Reserved Bank
SIS	Schwards Information Criteria
Stats.SA	Statistics South Africa

Influence of Accommodation on the Academic Performance of Architecture Students

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ABSTRACT

Academic performance of students in Higher Education is an issue of concern following rising global unemployment rates and funding problems because of its link to social and economic progress for many countries. This study investigates the influence of accommodation as a subset of school factors on academic performance of HE students employing students from Ahmadu Bello University (ABU) Zaria, the oldest school of Architecture in Nigeria. Questionnaires from 96 respondents were analyzed for Relative Influence Index, differences in ratings of 24 variables via Mann Whitney U test and Kendall Tau test for possible relationships of academic performance with room size. Results reveal living conditions notably cleanliness, electricity and water supply, overpopulation and territoriality most influence academic performance. Students living on campus also perform better academically and room size significantly influenced academic performance. The study recommends, amongst others, that policy makers and facility managers prioritize current management practices to improve living conditions in existing accommodation facilities on campus while planning for adequate infrastructure to cater for student accommodation needs in future.

Keywords: *ABU, Accommodation, Academic performance, Architecture students, Higher Education*

INTRODUCTION

The overarching goal of every student is to graduate, preferably with the highest possible grades. With rising global Higher Education (HE) enrolment, many universities, employers of labour and HE funding organizations are increasingly becoming concerned with creating and maintaining environments, which foster better learning conditions and achievements (Masrek & Zainol, 2015). This is important because students are the most essential asset of any educational institution and their performance is directly linked to the social and economic development of any country (Mustaq & Khan, 2012).

Consequently, factors affecting the academic performance of students have received considerable research attention in recent years. These are broadly categorized under family, student and school/university characteristics (Baharin, Othman, Azizan, & Isa, 2015; Dey, Choudhury, Mollah, & Kim, 2015). Several studies establish parents' educational level, occupation and income as family characteristics that influence academic performance of students (Tesfay & Zekiros, 2015). Student characteristics such as gender, well-being, motivation, health status, involvement in scholastic and co-circular activities have also been found to determine the academic performance of students (Mersha, Bishaw, & Tegegne, 2013; Tiruneh & Petros, 2014). School and university factors, which affect student performance, include teacher qualifications, competencies, teaching quality and methods (Muzenda, 2013; Baharin et al, 2015; Nyadanu, Garglo, Adampah, & Garglo, 2015; Costa, Cardoso, Lima, Ferreira, & Abrantes, 2015). School and university factors are argueably an area where public policies and funds are visibly targeted at for improvong HE in many contexts unlike family and student characteristics which go beyond public domain and influence. Few studies focus on the influence and effect of the built environment on the academic performance of students, especially accommodation as an aspect of school characteristics. This is important because huge funds are

expended in developing the physical built environment in a bid to improve HE experiences of students in many developing countries.

The research therefore seeks to establish features of student accommodation that most influence academic performance of architecture students using undergraduate final year and Masters students at the Department of Architecture, Ahmadu Bello University (ABU), Zaria-Nigeria. Architects are primarily concerned with the conceptualization and design of the physical built environment and are thus more knowledgeable and sensitive about matters relating to buildings. They are also major players in the construction industry. The department of Architecture at ABU was chosen because it is the oldest School of Architecture in Nigeria. Influences on the academic performance of architecture students are also rare in empirical research (Adewale & Adhuze, 2013).

Specifically, the study seeks to address the following research questions:

i) Which features of student accommodation influence academic performance of the respondents?
ii) Is there a difference in the perception of influence of accommodation features between students living on or off campus?
iii) Is there a difference in overall academic performance between students living on and off campus?
iv) Is there a relationship between academic performance and the size of rooms, which is a basic spatial design consideration in student accommodation?

REVIEW OF RELATED LITERATURE

Academic performance

Academic performance is the measure to which students excel in their subject, course, discipline or registered program. Sometimes expressed as academic achievement, ‘it represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments’ (Steinmayr, Meibner, Weidinger & Wirthwein, 2015). The cumulative grade point average (CGPA) at the end of a semester or entire program is often employed to measure academic success and achievement in HE (Muslim, Karim, & Abdullah, 2012; Baharin et al., 2015; Ranjandran, Hee, Kanawarthy, Soon, Kamaludin, & Khezrimotlagh, 2015).

Many studies have attempted to predict and determine factors that affect academic performance across a wide range of locations and contexts. Academic performance is a function of many factors and dependent on the study sample as well as study context. Consequently, results vary. Baharin et al. (2015) established a significant relationship between family characteristics and academic performance in Johor, Malaysia. This supports findings in a study of undergraduate students in Ethiopia which established level of parental education as an influence on female students’ academic performance (Tiruneh & Petros, 2014).

Findings on student characteristics are overall often contradictory. This in part is because of the difficulty to control all factors that affect university attainment and academic performance (Thiele, Singleton, Pope, & Stanistreet, 2016). Whist Mersha et al. (2013) and Tiruneh & Petros (2014) established the negative effect of school environments notably teacher roles and off campus facilities on female undergraduate student perfomance in Ethiopia, Ranjandran et al. (2015) note that gender is not an important factor for determining first year students’ academic performance in Malaysia. The study found that entry qualifications, a student characteristic, was ‘the strongest variable that determines the CGPA of first year students’ (ibid, p. 58). Similarly, Fields (1991) established previous academic performance as the most influencial variable on student academic performance. These findings collaborate a recent study of British graduates where males enter university with lower grades than females and ‘were also less likely to achieve either a first or an overall good degree’ (Thiele et al., 2016, p. 1432). Females also performed better than their male counterparts for a core architectural course in an study of academic performance (Opoko, Alagbe, Aderonmu, Ezema, & Oluwatayo, 2014). In contrast, Adewale & Adhuze (2013) establsihed a low correlation between entry

qualifications (in Mathematics and Physics) and academic performance of architecture students in Nigeria. Enthusiasm and pre-knowledge of famous architects and their works were found to influence the design performance of first year undergraduate students in Turkey (Kirci & Yildirim, 2013). Other related student characteristics found to affect academic performance are emotions/self-perception, self-regulated learning and motivation (Tiruneh & Petros, 2014; Mega, Ronconi, & De Beni, 2014). Teaching methods were also inferred to maintain the academic perfomance of architecture students in core architecture courses (Afolami, Olotuah, Fakere & Omale, 2013).

Findings on the relationship between academic performance and university features such as accommodation and faculty characteristics also vary depending on location and sample. Baharin et al. (2015) established a significant relationship betweeen academic performance and university feautures largely due to the proximity, accessibility and quality of physical facilities notably the library and classrooms as well as IT services provided by UiTM, Malaysia. Mersha et al. (2013) however note that 'the school environment in the higher education institutions is a system of stratification that embodies differences of prestige and status among sexes' (p. 144). Nchungo (2013) identified inadequate student accommodation as a factor affecting 82.5% of the surveyed undergraduate students at the University of Zambia.

Student accommodation

Studies on student accommodation either assess the direct effect of student housing conditions on academic performance or address satisfaction, attitude, perception and quality of student housing as part of modalities towards the general improvement of student experience and by implication, student achievement. The latter form the vast majority of the literature reviewed. Analyses were often conducted with gender and nature of accommodation in terms of living on or off campus as dependent variables. Araujo and Murray (2010a) in a study of students in the United States established that living on campus increases GPA by between 0.19-0.97. The degree of improvement to student performance caused by living on campus ranges between one-fifth and one full-letter grade (Araujo and Murray, 2010a, p. 1). Owolabi (2015) establsihed a similar trend at the University of Ibadan. In contrast, Omar, Abdullah, Yusof, Hamdan, Nasrudin & Abdullah (2011) note that the academic performance of off-campus students are not influenced by the environment in Malaysia 'although living off campus is said to be more challenging than staying on campus' (p. 1225). Other studies either report significant improvement of academic performance largely owing to living on-campus or the inverse where living off-campus was found to negatively impact academic performance (Yusuff, 2011; Modebelu & Agommuoh, 2014; Ekejiuba, 2015).

Depending on quality of facilities and services provided, students' satisfaction with their accommodation varies across the different contexts reported in literature. Features generally rated less satisfactory include overall student accommodation quality (Nimako & Bondinuba, 2013), fees (Khozaei, Ayub, Hassan, & Khozaei, 2010; Matthew, 2014), room size, service spaces notably bathrooms, kitchens and laundries as well as auxiliary facilities such as the internet, security, electricity and water supply (ibid; Neema, 2003; Yusuff, 2011; Najib, Yusof & Osman, 2011; Igbinedion, 2012; Oladiran, 2013; Ekejiuba, 2015). Conditions associated with student housing which record negative satisfaction ratings include overcrowding and issues of territoriality (Amole, 2011; Modebelu & Agommuoh, 2014; Ekejiuba, 2015), cleanliness (Nchungo, 2013), distance from academic facilities (Araujo & Murray, 2010a, 2010b), thermal comfort and noise levels (Yusuff, 2011).

METHODOLOGY

Study Area

Ahmadu Bello University (ABU), founded in 1962 is one of the first generation universities in Nigeria and the largest university in Sub-Saharan Africa with twelve faculties, 84 departments as well as a Postgraduate School (ABU , 2011). The University has sixteen halls of residence accommodating about 40% of its student population (ibid). Half of the hostels are situated on the main campus. These are Amina, Alex and Ribadu Halls (accommodating female students) while Danfodio, ICSA, Ramat and Suleiman accommodate male students. Amina, Suleiman, Ribadu and Alexander halls are multi-storey hostels going up to third floors.

The remaining hostels are all on ground floors. The Department of Architecture is situated on the main campus. Subsequently, undergraduate and few postgraduate architecture students who reside on campus are accommodated across the aforementioned hostels. Postgraduate students are accommodated in Yar'adua, Sassakawa and Akenzua hostels also on the main campus. Hostels in ABU comprise rooms, bathrooms, toilets, laundry as well as dining facilities run by reputable private caterers. Hall administrators oversee the daily running, cleaning and maintenance of the hostels. The institution's security personnel man entrances to hostels as ABU observes strict regulations about male entrance into female hostels (ibid).

Methods and instruments

In line with findings from literature, the study adopted a framework focusing on the effect of living conditions and building/architectural features on academic performance (Figure 1).

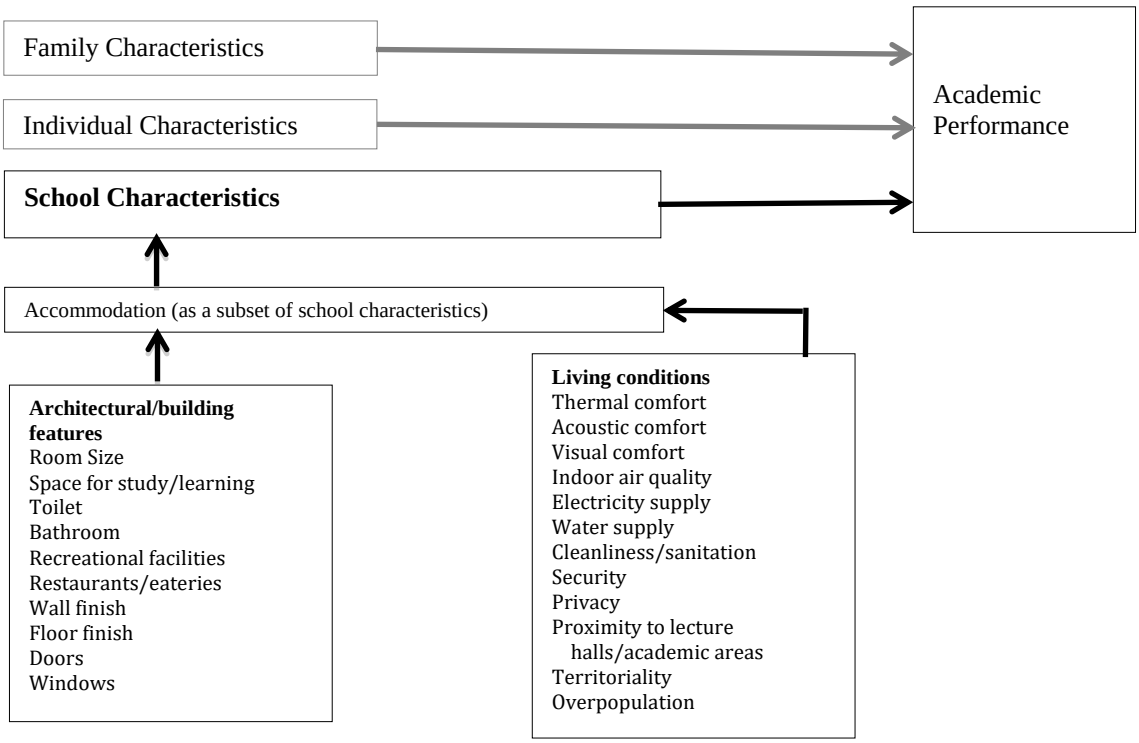

Figure 1: Conceptual and theoretical framework for the study

The target population was final year students at both BSc and MSc levels because these students have the longest experience on campus at undergraduate and postgraduate levels respectively. The population size for final undergraduate students for the 2015/2016 session was 96 while the MSc II class was 74 (NIA/ARCON Revalidation Exercise Document, 2016). The sample size was calculated using Yomens (2000) formula $SS = N/1 + (e)^2$ where *SS* is sample size, *N* is population size and *e* is the tolerable error in estimating the population. This was taken as 0.05. Sample size was therefore calculated at 120. The same number of questionnaires was distributed, with 96 (80%) retrieved and employed for analysis. This response rate is slightly higher than reported in recent studies for a similar population (Samaila, 2016; Maina, 2015).

To establish which accommodation features influence academic performance of architecture students (Research Question 1), a survey questionnaire was developed in two sections. Section one elicits demographic information relating to gender, age, marital status, type of accommodation (whether on or off campus), number of occupants in the room, room size as well as cumulative grade point average (CGPA). Section two required respondents to rank the degree to which, architectural features and living conditions common in the study area influence academic performance on a scale of 1-5, 1 being un-influential to 5, very influential.

Responses were analysed in SPSS v.21 for descriptive statistics and Relative Influence Index (RII). Descriptive statistics were employed to obtain the profile of respondents while RII was employed in establishing the features that most influence academic performance of the respondents. RII is calculated as the ratio between total actual scores per question from all respondents (TAS) and maximum possible score for that question (MPS). MPS for each question in this sample is a product of the total number of respondents by the maximum Likert scale response possible, which is 5 points. Cronbach's alpha was employed to test the reliability of the two scales (architectural features and living conditions). These produced scores of 0.852 and 0.916 respectively for both scales containing 12 items each. The questionnaire was adjudged reliable for the purposes of the study as these figures are higher than the recommended range of 0.7-0.8 (Field, 2013).

To test whether differences exist between these two scales based on nature of accommodation (on or off-campus) in order to address research question 2 as well as differences in academic performance of architecture students living on and off-campus (research question 3), independent samples Mann-Whitney U tests were conducted, as the distributions of scores from both scales as well as CGPA were found to be significantly different from normal distributions. To address research question 4 investigating the possibility of a relationship between academic performance of architecture students and the basic spatial variable of room size, Kendall-Tau correlation coefficient (τ) was employed. Results from these analyses are presented in the next section.

FINDINGS AND DISCUSSION

Findings

The average respondent from the sample is a single undergraduate male student residing on campus (Table 1). This fits the profile from recent studies of architecture students in the study area (Abdulkarim, 2011; Maina, 2015).

Table 1: Demographic profile of respondents

Variable	Category	N	%
Gender	Male	71	74
	Female	25	26
Age	16-20 years	9	9.4
	21-25	47	49
	26-30	23	24
	31 and above	17	17.7
Marital status	Single	85	88.5
	Married	10	10.4
	Divorced	1	1
Level	400L (Undergraduates)	68	71
	MSc II (Postgraduates)	26	27.1
	Missing	2	1.9
Location	On Campus	61	64
	Off Campus	33	30.1
	Missing	2	1.9
Mode of acquiring accommodation (on campus)	Reserved from School	42	43.8
	Agent	30	31.3
	Swapping	4	4.2
	Bought from a student	13	13.5
	Bought from Staff	2	2.1
	Family and friends	5	5.2

In response to research question one, living conditions and amenities most influence academic performance of architecture students (Table 2). Specifically, cleanliness/sanitation, electricity, portable water, overpopulation and territoriality were ranked the highest most influential variables. These are closely followed by thermal comfort, privacy, indoor air quality, security and visual comfort. Architectural or physical building features were generally less influential on academic performance, with size of room and spaces for learning both ranked 11th.

Table 2: Features influencing academic performance

Variable	N	M	SD	TAS	RII	Rank	Category
Cleanliness/ sanitation	96	4.03	1.071	387	0.81	1	Living Condition/ Amenity
Electricity	96	4.01	1.310	385	0.80	2	Living Condition/Amenity
Portable water	96	3.98	1.231	382	0.80	2	Living Condition/Amenity
Overpopulation	96	3.97	1.432	381	0.79	4	Living Condition/Amenity
Territoriality	96	3.94	1.280	378	0.79	4	Living Condition/Amenity
Thermal comfort	96	3.86	1.193	371	0.77	6	Living Condition/Amenity
Privacy	96	3.86	1.092	371	0.77	6	Living Condition/Amenity
Indoor air quality	96	3.80	1.166	365	0.76	8	Living Condition/Amenity
Security	96	3.80	1.175	365	0.76	8	Living Condition/Amenity
Visual comfort	96	3.68	1.192	353	0.74	10	Living Condition/Amenity
Size of room	96	3.64	1.087	349	0.73	11	Arch/Bldg feature
Space for learning	96	3.63	1.250	348	0.73	11	Arch/Bldg feature
Proximity to lecture hall	95	3.61	1.416	343	0.72	13	Living Condition/Amenity
Acoustic comfort	96	3.39	1.309	325	0.68	14	Living Condition/Amenity
Rest area	96	3.31	1.268	318	0.66	15	Arch/Bldg feature
Window	96	3.21	1.132	308	0.64	16	Arch/Bldg feature
Restaurants/ eateries	96	3.05	1.234	293	0.61	17	Arch/Bldg feature
Door	96	3.02	1.222	290	0.60	18	Arch/Bldg feature
Floor finish	96	3.01	1.227	289	0.60	18	Arch/Bldg feature
Space of toilet	96	3.00	1.306	288	0.60	18	Arch/Bldg feature
Space of bathroom	96	2.75	1.298	264	0.55	21	Arch/Bldg feature
Wall finish	95	2.72	1.226	258	0.54	22	Arch/Bldg feature
Recreational facilities	95	2.71	1.211	257	0.54	23	Arch/Bldg feature
Ceiling finish	94	2.66	1.196	250	0.53	24	Arch/Bldg feature

In response to research question two, distributions of ratings from three variables were found to significantly differ for students living on and off-campus (Table 3). These are proximity to lecture halls, portable water and size of room. It is pertinent to note that the first two are living conditions/amenities while the third is a design feature of the physical built environment. Mean scores of all three variables on influence on academic performance are significantly higher for students living on-campus than off-campus. This implies that the academic performance of architecture students living on-campus is influenced more by proximity to lecture halls, portable water and size of room than for their counterparts living off-campus. The differences in rating for electricity, while not significant, are ranked fourth. Floor finish, space for learning and overpopulation are ranked fifth, sixth and seventh respectively.

Table 3: Differences between ratings for features influencing academic performance

S/No	Variable	Overall Mean	Mean On campus	Mean off campus	Test stat (*U*)	*p* value
1	Proximity to lecture halls	3.61	3.98	2.94	652	0.002**
2	Portable water	3.98	4.19	3.59	779	0.024**
3	Size of room	3.64	3.82	3.29	927	0.027**
4	Electricity	4.01	4.21	3.65	847.5	0.084
5	Floor finish	3.01	3.15	2.76	850	0.108
6	Space for learning	3.63	3.74	3.41	896	0.158
7	Overpopulation	3.97	4.21	3.53	887	0.16
8	Rest area	3.31	3.42	3.12	886	0.187
9	Restaurant/ eateries	3.05	2.95	3.24	1217	0.198
10	Window	3.21	3.31	3.03	909.5	0.253
11	Cleanliness/ sanitation	4.03	4.16	3.79	920.5	0.278
12	Indoor air quality	3.8	3.89	3.65	943.5	0.378
13	Recreational facilities	2.71	2.77	2.58	927	0.438
14	Wall finish	2.72	2.77	2.62	955	0.516
15	Bathroom	2.75	2.69	2.85	1127	0.567
16	Visual comfort	3.68	3.63	3.76	1125	0.573
17	Door	3.02	3.06	2.94	988	0.604
18	Toilet	3	2.95	3.09	1115	0.629
19	Security	3.8	3.85	3.71	999.5	0.663
20	Privacy	3.86	3.9	3.79	1002.5	0.68
21	Ceiling finish	2.66	2.69	2.61	957	0.69
22	Thermal comfort	3.68	3.87	3.85	1019	0.778
23	Acoustic comfort	3.39	3.42	3.32	1027.5	0.834
24	Territoriality	3.91	3.95	3.91	1060.5	0.953

**Significant at 0.05

In response to research question 3, academic performance of students living on campus is significantly higher than for those residing off-campus. Averagely, a student living on-campus within student halls of accommodation would graduate with a second class lower degree in architecture while his/her counterpart living off-campus would graduate with a third class degree. Academic performance was also inversely proportional to density or number of occupants per square meter. In other words, the higher the density, the lower the academic performance of respondents measured by the CGPA (Table 4). While the average density of on campus accommodation from the sample meets the minimum standard requirement for hostels per person (Neufert & Neufert, 1990, p. 470), density computed for off-campus accommodation from the sample is higher than the stipulated figure of 3.1m^2 per occupant. Room sizes were on average smaller off-campus than on-campus. This may account for the relatively high ranking of overpopulation and territoriality as influential to academic performance (Table 2). A significant but weak relationship was however recorded between size of room and academic performance from the sample (τ=0.2, p=0.003) in response to research question four.

Table 4: Differences in academic performance of students living on and off campus

S/No	Location	Mean CGPA	Test stat *U*	*p* value	Av. Room Size (m^2)	Av. Density (m^2/pers.)
1	On campus	2.47	701.5	0.002**	11.34	3.1
2	Off campus	2.03			8.82	4.6

**Significant at 0.05

Discussion

Managerial related variables most influence academic performance

Results established cleanliness/sanitation, electricity, portable water supply and overpopulation as the most influential aspects of accommodation on academic performance. This result supports findings in literature that amenities and living conditions influence enrolment and retention rates at HEIs as well as academic achievement (Neema, 2003; Yusuff, 2011; Najib, Yusof & Osman, 2011; Igbinedion, 2012; Oladiran, 2013; Ekejiuba, 2015; Baharin et al. 2015). The variables constitute aspects of living conditions as amenities of the physical built environment, which should ideally be maintained and enhanced by effective management practices unlike the construction of architectural and building features which are arguably more capital intensive.

Cleanliness/sanitation directly affect the health and well being of an individual. This variable is more crucial for students living on campus than for those staying off-campus on their own in part because cleanliness and sanitation on-campus is handled by the school management on the larger scale and by students within the individual rooms. This is unlike obtains for students living off-campus who are solely responsible for maintaining a clean environment. Findings from other studies note toilets, kitchenettes and laundry areas as particulary prone to low rankings for cleanliness and poor sanitation. There is a need for future studies to investigate such variables as problem areas.

The issue of epileptic electricity supply has been the bane of many sectors of the Nigerian economy in recent times, academia not exempt. While government and management of Higher Education Institutions (HEIs) in the country are making efforts to improve this vital area, it is imperative that a holistic approach be employed to address the problem as it is crippling the future of the next generation in many ways including their education. This is also true for the adequate provision of portable water. Water is life. It is therefore critical for the smooth running of day to day activities in the academic context. While management and government have been criticised for the inadequate supply of both amenities, the behavior patterns of residents from the consumption end also demands a rethink in future studies if the problem is to be tackled holistically.

Hostel overpopulation in Nigerian HEIs is an endemic and chronic issue. Many hostels in the study area were designed for a maximum of two occupants. It is not uncommon however to find double or triple that number in a room largely due to an explosion of population and increase in infrastructure provision in HEIs (Matthew, 2014; Ekejiuba, 2015). Squatting is an established practice by many students in response to lack of accommodation in schools (Alaka, Pat-Mbano, & Ewulum, 2012). This unfortunate trend is not restricted to the study area alone but to virtually all public tertiary institutions in the country.

Academic performance of students living on-campus is higher than for their counterparts living off-campus

This result supports findings from studies such as Araujo & Murray (2010a) and Owolabi (2015) underscoring the vital role accommodation plays on academic performance of students (Nimako & Bondinuba, 2013; Modebelu & Agommuoh, 2014; Ekejiuba, 2015). Students generally prefer to live within close proximity to facilities of learning. Architecture students are particularly vulnerable in this regard as they spend late hours in studio. Living far from school often poses challenges not encountered by their counterparts staying in hostels. Generally, parents and guardians of students in HEIs prefer campus accommodation because it is believed that being on-campus affords a holistically better student experience than living off-campus (Araujo & Murray, 2010a). Studies confirm that proximity to lecture halls and adequate provision of ameniities is a significant variable influencing academic performance (ibid). In recent times however, the preference to live off-campus has permeated student thinking in part arising from the deplorable conditions of student hostels on Nigerian campuses. It has even become a form of status symbol especially among the affluent for

students to rent out rooms and apartments off-campus in the name of a better study environment. While significant differences were established between variables relating to living conditions from this study, results confirm that for architecture students, it is academically advantageous to reside on-campus. This maybe linked to the fact that architecture is a studio based discipline and collaborations in school foster better academic performance in contrast to secluded environments represented by off-campus living. Interestingly, the perceived poor conditions of student hostels often serve as motivation to perform well and secure a better future after leaving school.

Size of room as a design feature matters when it comes to academic performance

Results from the study suggest that the size of a room has a significant influence on overall academic performance. This is closely related to overcrowding, density and issues related to territoriality which respondents rated high for influencing academic performance. As revealed by the study results, off-campus accommodations are on average smaller than what obtains on-campus. This implies that students living off-campus may in reality be faced with deplorable living conditions in terms of available space. This is largely due to the fact that off-campus accommodation is usually a profit-making venture, with landlords going for maximum profit at the expense of adhering to basic spatial standards for student accommodation (Yusuff, 2011). This has adverse effects on the health, wellbeing and ultimately academic performance of students.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In conclusion, this study set out to investigate the influence of accommodation as a school characteristic on academic performance of HE students. Results from the study revealed that living conditions notably cleanliness/sanitation, electricity and water supply, overpopulation and territoriality were ranked as highly influences on academic performance of architecture students. These are closely followed by thermal comfort (possibly resulting from overpopulation), privacy, indoor air quality, security and visual comfort. Findings also revealed significant differences in ratings based on location for proximity to lecture halls, portable water and size of rooms. Overall, academic performance was higher for students living on-campus than for those living off-campus. Size of room also had a significant but weak relationship with academic performance.

Recommendations

Based on these findings, the study proffers the following recommendations targetting policy makers in government, infrastructure and maintenance officials in ABU and other institutions, parents and guardians of architecture in HEIs as well as researchers embarking on similar studies in future.

First, government policy makers and managers of institutional facilities need to priotize maintenance of available infrastructure while planning for future expansion of for HEIs. Living conditions are often initiated at the design stage prior to construction. Many of such amenities are however implemented and maintained after construction by proper management. While research has repeatedly and rightfully called for better provision of additional buildings and infrastructure by government as a panacea to improving student experience and performance in HEIs, it is vitally important to ensure that adequate managerial practices for living conditions are put in place for existing facilities and sustained to support HE learning. These are arguably less expensive and often well within the control of institutions. It is also vital to adequately maintain facilities and buildings already in use to the benefit of users. Very few facilities demand this level of urgent attention than student accommodation in ABU and by implication other Nigerian campuses.

Secondly, parents and guardians of HE students in general and architecture in particular need to carefully consider the accommodation arrangement of their children and wards. Indeed, the perceived comfort level desired for students living off-campus may not always translate to a better school experience or grades. As results from this study have revealed, living off campus is on average not advantageous. Institutions and government also need to put modalities to ensure building regulatios such as basic room sizes adhere to stipulated standards by landlords and organizations catering to accommodating students off-campus.

Thirdly, future studies need to employ a larger sample size and student population to ascertain features of accommodation which influence overall student academic performance. This study employed a single discipline within one school. These limit genaralization of findings even in the study area. Additionally, variables such as cost of living, fees, transportation, internet and other contemporary facilities were not included in this study. These may ultimately influence the overall academic performance of HE students.

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NOTES FOR CONTRIBUTORS

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Baig, M. H. A., Zhang, L., Shuai, T., & Tong, Q. (2014). Derivation of a tasselled cap transformation based on Landsat 8 at-satellite reflectance. *Remote Sensing Letters*, *5*(5), 423-431.

<u>*Book*</u>

Malcolm Taylor (2000) *Avoiding Claims in Building Design: Risk Management in Practice*, Blackwell Science Ltd, London

<u>*Conference Proceeding*</u>

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