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Sustaining the Integration of User's Aspiration into Passive Building Design and Construction for Smart City proposition

by
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Abstract

The smart cities of the future aim to be innovating in the delivery of social policies that will aid user's aspiration and thus reduce carbon footprints**.** Recent developments to the field of climate change and sustainability have led to an intensive interest to environmental design approaches for the smart cities proposition. Passive design which is one of the environmental design approaches is distinguished from other design system by relying on its natural sources such as solar and wind patterns without the need for mechanical systems. Integrating user's needs into passive building design is emerging as an important issue in the design of responsive buildings. Integration promotes performance of buildings and satisfies user's psychological and physical needs. Traditional passive design methods are mainly aimed at addressing the ecological aspects of a design rather than integrating user's needs into operational aspect of the building. Thus, there is an urgent need for a new design approach that integrates end user's needs with passive design strategies. The paper aims to evolve a methodology for promoting a sustainable design strategy that incorporate user's centered design attributes. This will help the designer to fulfill user needs at the design stage and prevent an uncondusive environment for the user's in smart cities proposition.

Keywords: Methodology, Smart city, strategies, user's centered passive design,

1 Introduction

Most of the Smart cities organizes their innovation effort to focus on priorities and not to look for new solutions in order to create a sustainable environment for the comfort of the user's. This involves environmental design approaches that are to promote the well-being , active ageing, intergenerational solidarity and exploiting the potential ethnic diversity or attract talent and grow their economies. Passive design (PD) is considered to be one of those environmental design approaches which has evolved in recent times in the field of climate change and sustainability. Alzeed and Bonssabaine (2012) posits that Passive Design (PD) is a concept in building design that uses the building architecture to minimize energy consumption and improve thermal comfort thereby eliminating fully requirements for active mechanical systems. PD rely on the use of natural sources such as solar and wind patterns without the need for mechanical systems. Therefore, in the design of resilient building assets,

the issue of user's and occupants of building is a major factor which will include post occupancy evolution and ergonomics theories. Many researchers have concluded that users needs are important in passive design in building but none of them discussed a systematic approach that can help designers in capturing users aspiration through various design constructs at the design stages.

The research is aimed at amplifying the understanding of how end-users needs can be fully integrated into PD for construction and implementation of Smart city proposition concept. Different existing theories will be reviewed in the study regarding the users aspiration and then analyse user-centered design (UCD) theory and its application by a description of proposed methodology which could help designers to meet users needs in the proposal of smart city.

Integrating Users needs into Passive design process.

Coins and Moezzi (2012) concluded that Designing without considering users needs in a systematic way may lead to various complaints at the post design stages. Thus the current trend of design process relies mainly on the benefits from natural resources to operate. Buildings as the existing passive building design processes are limited in meeting users aspirations. Several authors have pointed out that there is mismatch between end users needs and existing PBD theories.

The design team should involve future users and facilities management staff in the design process and develop a building user's guide to inform occupants of the building's design intent. This allows the incorporation of the user needs into the design process as it is of paramount importance before construction and operation of building assets. However, with the view of incorporating the user's needs, the area human factors, post occupancy evaluation and the recycling of building products during the PD process is still vague. Therefore there is need to consider human factors throughout the design process which will lead to the provision of comfort for the end user. Goezi and Moezzi (2012), Alzeed and bouzzabaine (2012) ascertained that, when there is mismatch between assumed and actual user needs, complaints can arise and these can be viewed as part of information gap between the incorrect or incomplete assumptions made during design and actual end-users needs requirements. Although any dissatisfaction from the users always caused a dysfunctional integration of user aspiration in post design and construction . This issue can however be solved through creating a system that can help designers elicits the user's needs and integrate them into design solutions. Thus, Levin (2003) has claimed that by integrating the analysis of the interactions between buildings, occupants and the larger environment, researchers and designers will model successfully the fundamental relationships that should drive designers and its process.

Theories for user's centered design (UCD)

Many researchers have discussed various approach in addressing the comfort satisfaction of various building occupants in the building industry. These include, post-occupancy evaluation, ergonomics, usability measurements for building, building accessibility, building use in design management perspective, buildability attributes for comfort and design. Some of these are briefly reviewed in the study.

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Ergonomic design and building Sustainability theory

Ergonomic design is a part of the environment that should accommodate the end-users comfort, health and productivity (Hedge 2008). Alzeed and Bonizzaboine (2012) submitted and define ergonomics as the science of human engineering which combines the study of human body mechanics and physical limitations with industrial psychological. In this regard, physical and psychological aspects of users are considered in achieving users comfort. Hedge 2008, summarized the function and activities of building in a way that enhances ergonomics and concludes that user's preferences should be considered in design process and also amplifies the participation of users in design process. Furthermore, the design features such as equipment, tools, work aids, furnishings and accessories to reduce risk and be accepted by the end-users to take advantage of ergonomic features in the design process.

Alzeed and Bonizzaboine (2012) concludes that meeting user needs in the early stages of design is not considered in this theory and the theory does not provide a systematic approach for capturing and using user's aspirations in the design process.

Theory of Usability measurement for building

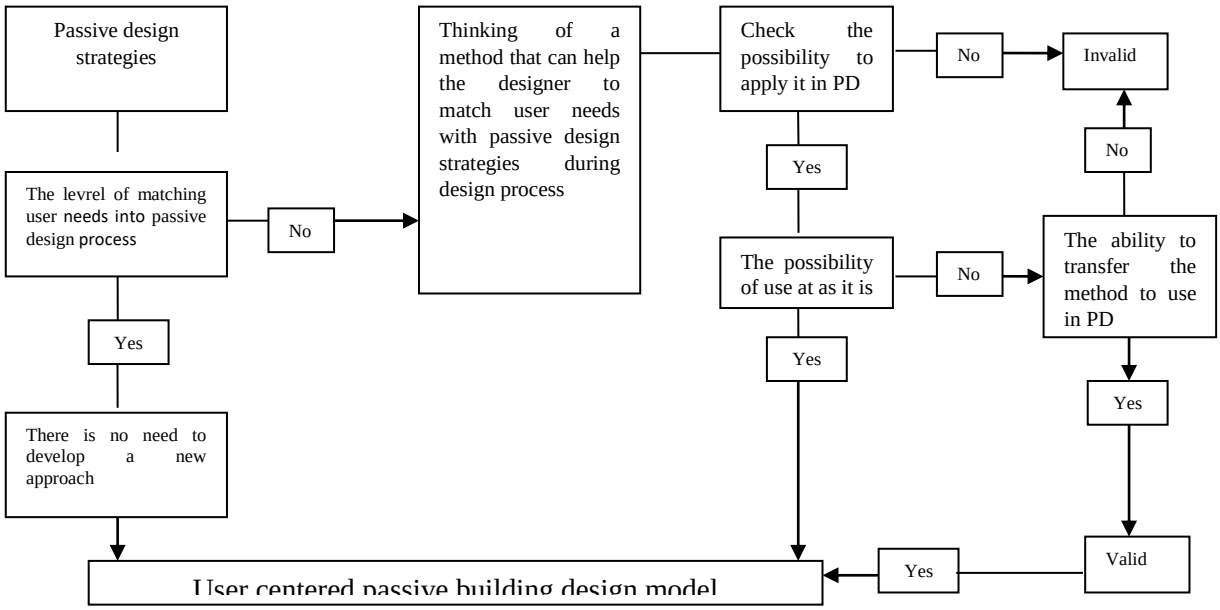
The human factor theory of usability measurement in building design supports the user' activities and its physical surroundings. Usability is measured through efficiency, satisfaction and effectiveness attributes. Thus, from human purpose point of view, usability could be looked on as a social construction process, activities and social practices of end users.

However, Blakstaad (2010) posits that theory is premised on usability in building designwhich analyse the dimention and relationship between building and the end user efficiency of facilities and value creation.The theory only capture some of user's needs to some extent but lack systematic processes, lack translation of users, design constructs into design solution. Therefore there is need to investigate the development of a new approach that can help designers meets users' needs through integration of various attributes of PD into a design.

Process of Integrating User's needs into PD Strategies

This involves identification of user's needs in totality and identifying the functional strategy to be used in designing for the needs. This process can be premised on the concept model developed by Alzeed and Bonzzabaine (2012) which indicates that the process of integration consists of several interactive steps. The process of PD strategies are reviewed to ensure the functionality is designed based on end-user needs. Thus, UCD theory which is used in the IT industry is found to be similar to Building design process which can be harmonize with PD attributes and contents (see figure 1).

Figure 1:Process of integrating User's needs into PD Strategies



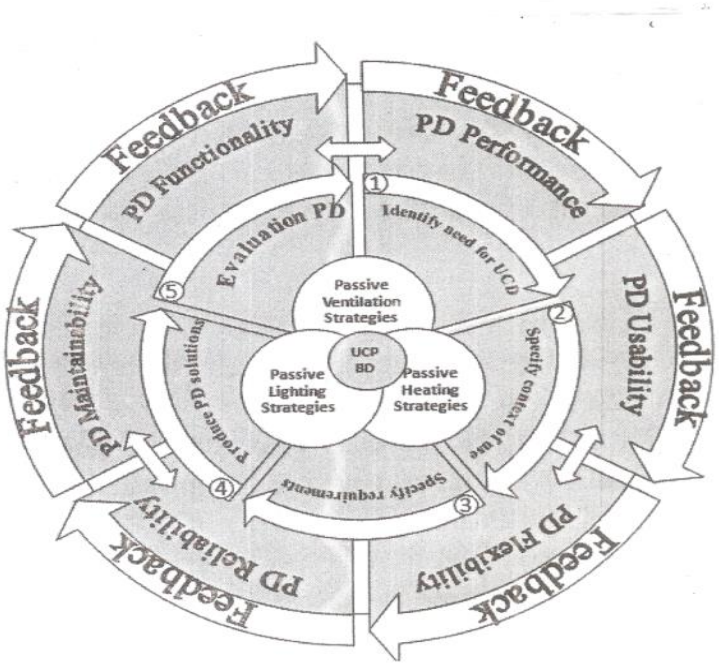
Source: Alzeed and Bonzzabaine (2012)

User Centered Passive Building design concept.
The concept of passive building design contain three main stages which are:

i. Determination of Passive design dimensions.
ii. Design processes needed to implement the proposed approach.
iii. Selective integrating of proper attributes to meet the user's needs.

All these aforementioned stages forms the user centered passive building design conceptual model (figure 2).

Figure 2: User Centered Building Passive Model.



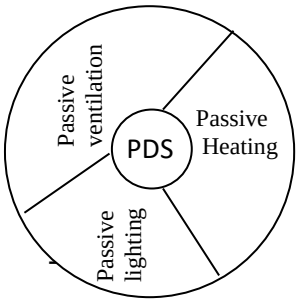
Source: Adopted from Alzeed and Bonzzabaine (2012)

Passive design is one of the approaches proposed to reduce negative environmental impacts in the model. The PD Strategies are classified into three main dimensions (figure 3);

- Passive design ventilation.
- Passive design lighting.
- Passive design heating.

All these forms the core of the conceptual model. Therefore with the knowledge of these core dimensions, it will make the designer to develop design solutions that fulfill user needs.

Figure 3: Passive designer Strategies

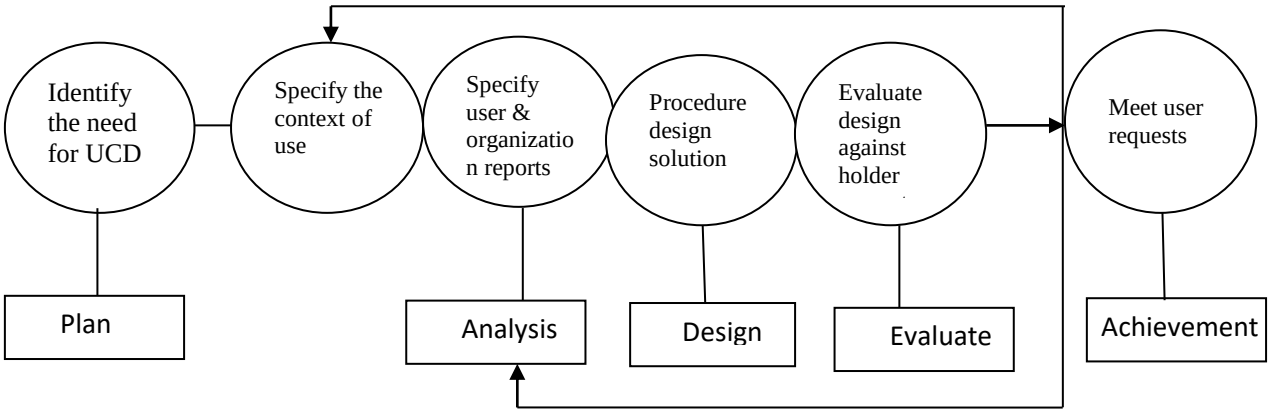


The model has been developed based on the following attributes which are:

- Functionality
- Reliability
- Usability
- Efficiency
  Maintainability and Portability

Thus, the UCPD process helps the designers to integrate user needs throughout the design process as it is divided into several stages. The theory of the process is in relation to ISO13407 (Figure4).

Figure 4: UCD theory in relation to ISO 13407



Source: adapted from Jokela et al. (2003)

- Relating to the process of ISO13407 by Jokela et al. (2003)
- Specify the context of use: This consists of identifying the user, the usage environment and the purpose for using the product.
- Specify user and organizational reports: This is will be achieved through identifying factors that can help users to be able to perform a task without a barrier. This stage aims at determining the design line reports.
- Produce a design solution: This is to create a solution based on usability attributes.
- Evaluate design against requirements: This analyzed the extent to which the end product can be measured against user requirements.

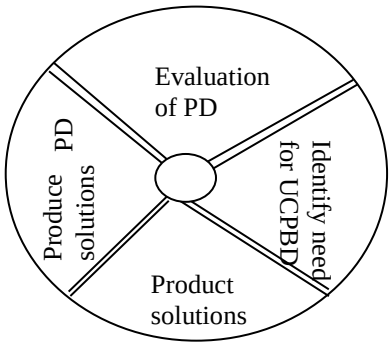
The UCD theory, conclude to assist the designer in managing, planning the design process and defining the context of Building asset use. The second phase of the UCD theory is directly related to extracting or organizing user requirements which will enable the user to derive a possible solution that satisfies the user's needs. Moreover, verification of the

proposed solution by the designer to meet user's needs in the design process is needed to ensure all the needs are captured within the design paradigm.

Design Process

The design process is germane to the concept of smart city proposition. The process stems from the conceptual model for the user's passive building design (UCPBD).

Figure 5: Design process model for UCPBD



The process comprises of following main stages which are:

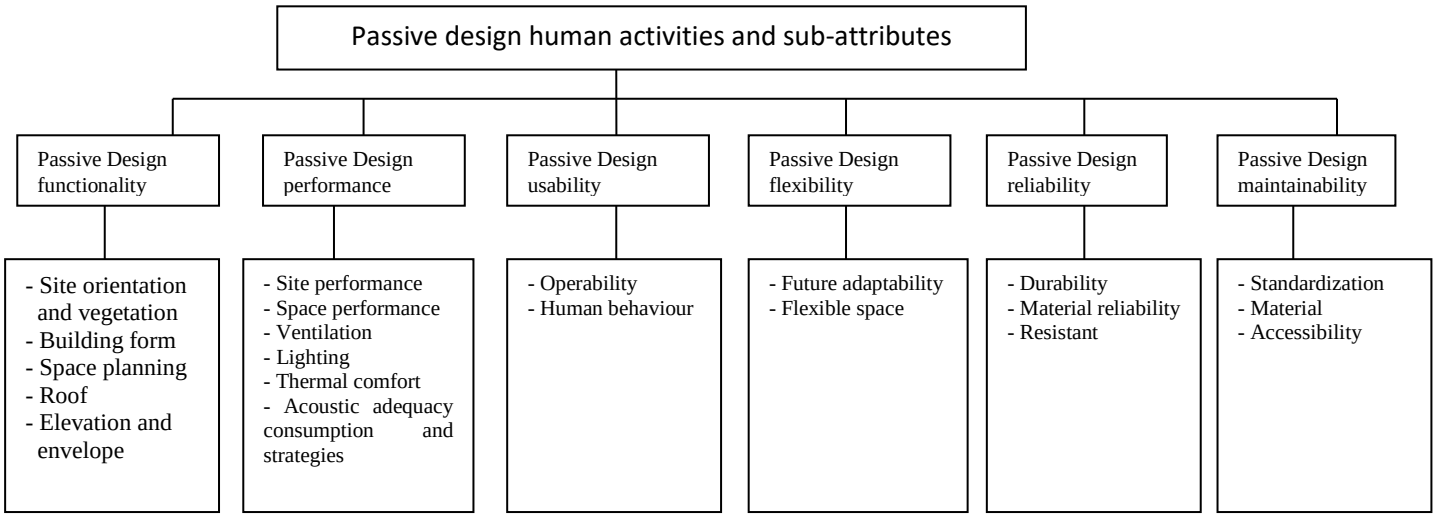
- Identifying user's centered design needs.
- The designer starts to think of the design concept.
  - -Keeping user and reports in mind.
  - -Specify context of use.
- The designer thinks of the problem context.
- Designing bubble diagrams, relationship of space and needs.
- Creating design solutions sketches.
  - -The designer creates solutions that will comply with both user needs and passive design strategy (highlighting ventilations and heating).
  - -Identify the requirements and context of use.
- Assessment of passive design attributes and their relationships, to optimize passive design punctuality.
  - -Selecting the best design solution.
  - -The passive design function should operate to satisfy user needs.
  - -Designer's role in creating the best design solution will be enhanced by identified contextual design attributes.
  - -Evaluation of PO
- This allows the designer to evaluate the proposed solution based on user-needs design constructs.
  - -Evaluation to assess whether the design derived solution successfully capture the user's needs and its functionality.

-If the evaluation failed, then the dysfunctional aspect of the derived solution should be revised.

Passive Design (PD) attributes

This is defined as factors that capture the needs, wants, and invitation of the end user's in relation to functionality, maintainability, performance, reliability, usability and flexibility. These attributes will aid designers in integrating PD issues and human needs into the design process. The attributes formed from several ends-user factor have been assessed to be in line with Architecture practice.

Figure 6: Human attributes in PD Process



Source: Adapted forms Alzeed and Bonzzabaine (2012).

However, UCPBD is an innovative approach and a tool that aid designers integrating user needs during the design process. Thereby making user's needs the bench work arrow which the design solutions are derived. This will help to enhance the indoor environment and well-being of the occupants.

The reasoning of sustainability of UCPD will also help to ensure user comfort and satisfaction and guarantee the interaction between user needs and passive design strategies.

Systematic process of testing the model.

This systematic process summarily comprises of following steps which are:

- Comparison of proposed approach with existing Architecture theories.
- Designing the questionnaire for capturing end-users' aspirations –This should include attributes, sub attributes and end-users' aspiration.
- Validation for both the model and questionnaire – To seek views of Architects for effectiveness of the end user's design constructs and usefulness of the main model components. The feedback will be used to modify the contents of the model,.

Conclusion

The paper demonstrates the knowledge about UCD, and gave an overview of the links and integration of user needs and passive design premised in a conceptual model. This has been developed through various processes and stages. User-centered design is described in the study as an important tool that is able to sustain the satisfaction and comfort level needs of building end users during the design process.
Moreover, the study amplified that by using end user's needs as a benchmark for design assessment, the potential for improving the indoor environment and user well-being in building is enormous. However, the city policies to create a sustainable enablement for the citiy needed to be constructively proposed and enforced. The failure of the policy to integrate user's needs in any of the models will hamper the sustainability of the environment and its innovations.

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