CONCEPTUAL INTELLIGENT BUILDING (IB) DESIGN FRAMEWORK TO IMPROVE THE LEVEL OF USER COMFORT TOWARDS SUSTAINABLE ENERGY EFFICIENT STRATEGIES: PROPOSAL VALIDATION

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Abstract: This study introduces an Intelligent Building (IB) design framework. The IB design framework is considered as a sustainable proposal, based on understandings on "Energy Efficiency (EE) as environmental strategy", "User comfort as social performance", "IB as economic platform of building performance". The framework proposes the stepwise sequence of activities to be taken by design team. This paper is to report the design phase of framework development process.

Keywords: Intelligent Building (IB), Energy Efficient in Building, Building User Comfort, IB Design Framework, Sustainable Thinking

INTRODUCTION

In this study Intelligent Building (IB) is defined as economic platform for building operation. Based on Wong et al [1] there are three main 'team' within the body of knowledge of IB research; Investment evaluation, advanced innovative technology and performance evaluation (Figure1). From the figure1 missing research on IB design framework is obvious. IB design framework is unique in the sense that the designer is introducing new buildings features which may contradict with social need or environmental aspects. On the other hand, there are a number of studies indirectly addressing the specific IB design framework [2]. According to Kua et al. [3] and the author's literature review, no direct explanation on IB design framework was presented.

This study is to present the design phase of the IB design 'framework development process'. In other words, the design framework can be considered as 'System'. There are phases in System Development, in literature the lifecycle/phases can vary from one

author to another. This study follows steps introduced by Arham et al. [5] including requirement study, system design, system implementation, and testing. The proposed framework only addresses the 'requirement study' to propose the conceptual IB design framework.

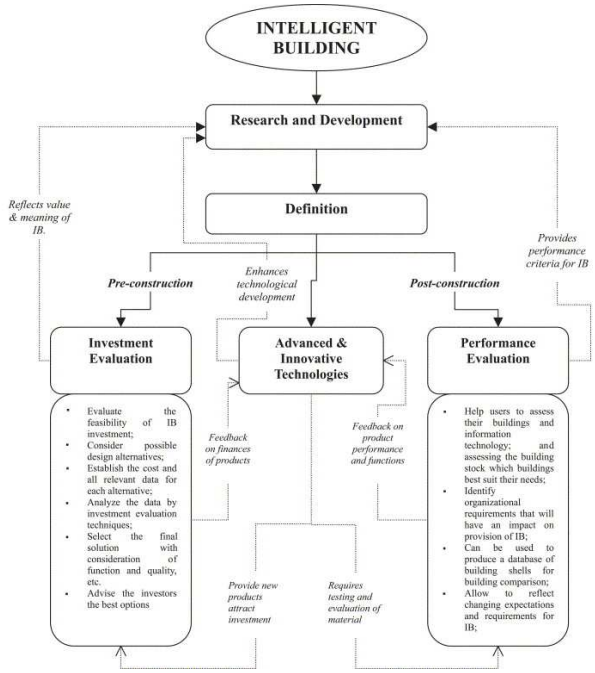

Figure 1. Taxonomy of research in intelligent building (Adopted from Wong et al. 2005)

SUSTAINABLE PROPOSAL

In the case of sustainable proposal for building design, importance should be given to "Energy Efficiency (EE) as environmental strategy", "User comfort as social performance", "IB as economic platform of building performance" [4]. This logic, schematically, is presented in Figure 2.

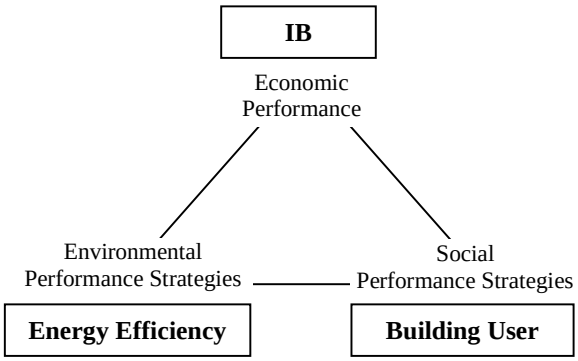

Figure 2: Sustainable Strategic Themes in Enhancement of Building Design

There are numbers of definitions by different authors, organizations, and countries. Mainly they are three perspectives of definitions:

American perspective

more on "Automation in building" (dates to 1980's by (Intelligent Building Institute (IBI) [6]):

"…one which provides a productive and cost-effective environment through optimization of its four basic elements, i.e. structure, systems, services and management and the interrelationships between them."

European perspective

on "Green Building" (dates to 1990's by European Intelligent Building Group (EIBG) [7]) :

"…creates an environment which maximizes the effectiveness of the building's occupants while at the same time enabling efficient management of resources with minimum life-time costs of hardware and facilities"

Asian perspective

which is combination of both US and European definitions (initiated in the last decade by Asian Institute of Intelligent Building (AIIB) [8]):

"…An Intelligent Building is designed and constructed based on an appropriate selection of quality environment modules to meet the user's requirements by mapping with the appropriate building facilities to achieve long-term building value".

Reviewing these three different perspective of IB definition, in this research the common aspect of these three perspectives is considering IB as "economic" platform is given priority.

On the other hand, the increase in human Quality of Life have on higher BTU energy consumption and it has direct relation in increasing carbon footprint. This confirms Malaysia has to optimize its energy consumption and carbon foot print in Sustainable building design framework towards improving quality of life [9]. Figure 3 highlights correlation between HDI and Energy consumption contrast within various countries and shows the critical position of Malaysia.

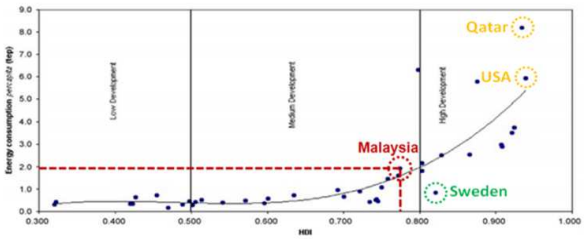

Figure 3: HDI versus Energy consumption within various countries (Adopted from R.A. Dias et al., 2006)

Furthermore, 'Energy Efficiency' plays the main role as an environmental control strategy. It is "The role of existing buildings in the sustainability agenda" [10]. If 'Energy Efficiency' is considered in sustainable approach, the trend can aid reducing material consumption and decreasing air pollution as well. Effects have been made since 1991 to manage energy consumption of building through intelligent approach. This encouraged us to follow this research.

In the triple bottom line of sustainability, the strategy of 'Social performance' is also essentially needed. Referring to literature on social sustainability [11-12], the following five (5) main principles are to be considered for a project to be socially sustainable; 1. Equitable society, 2. Diverse society, 3. Inter-connected society, 4. Democratic society and 5 quality of life-based society. On the other hand, referring to literature there are 15 different building function [13-14-15] which are; Comfort, Health , Safety, Security , Functionality , Efficiency , Social , Psychology , Aesthetics , Operations , Durability , Economics , Flexibility , Accessibility , and Culture. Based on the researcher's preliminary survey, and the analysis of correlation of building performance criteria versus social sustainable aspect it observed that "User comfort" is the first priority for a building user to fulfil the requirements of social sustainability.

PROPOSED CONCEPTUAL FRAMEWORK

Based on the conceptual framework (presented by Zaimi et al. 2012), there must be establishment of proposing IB design criteria, as well as conducting assessment of user comfort criteria, followed by energy efficient priorities (Figure 4). Indeed, design iterations are not modelled, and it needs further study from conceptual framework to details.

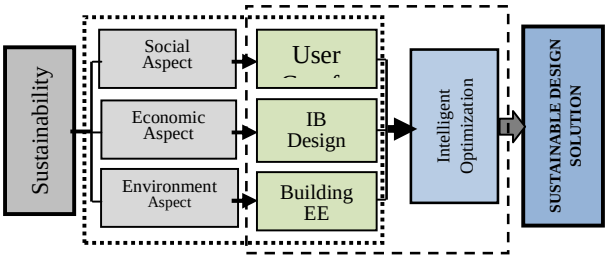

Figure 4: Conceptual Framework of Sustainable Design Solution; Covering User Comfort Criteria, IB Design Criteria, and Energy Efficient Criteria (adopted from Zaimi et al. 2012)

To introduce the stepwise presentation of the mentioned IB design framework the following framework is developed. The framework is proposing the stepwise sequence of activities to be taken by design team in the number of steps (Figure 5). First Step is Fundamental finding of IB conceptual design and EE analysis. In the second step design team is to measure and Dis-satisfaction Satisfaction coefficient of user interaction futures and finally design team will conduct a Life Cycle Cost Analysis (LCCA). This model is proposed as Decision making tool to enhance the decision design process of IB design.

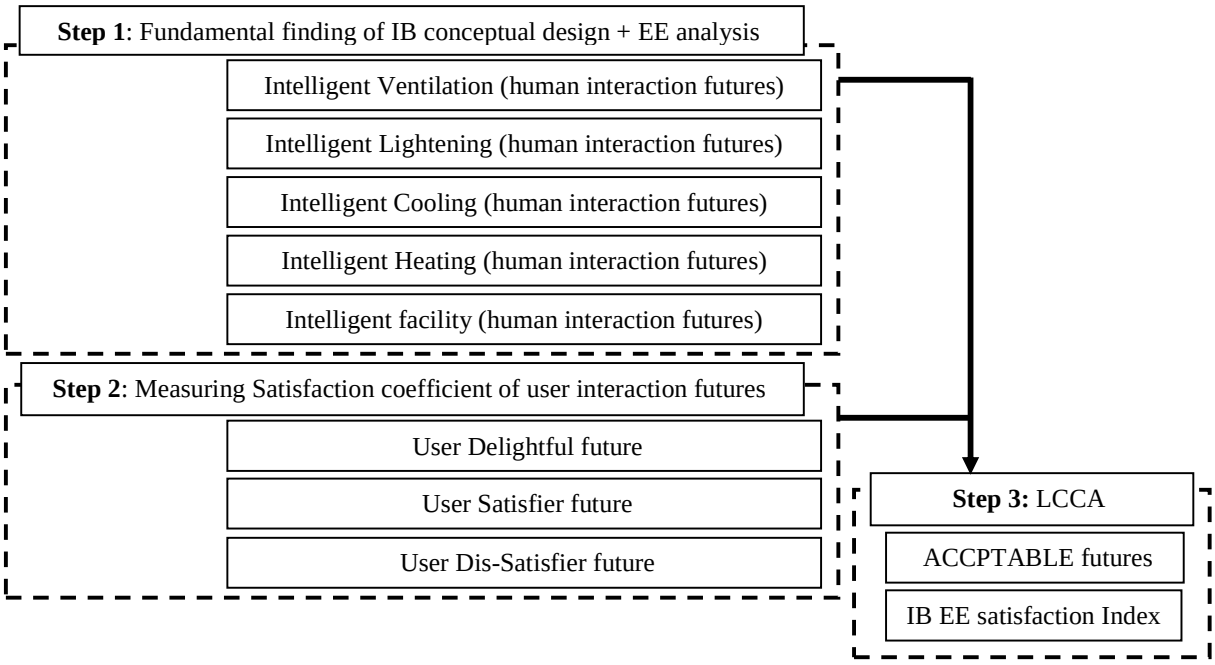

Figure 5: Stepwise sequence of activities to be taken by design team

CONCLUSION

In this study IB design framework was developed based on triangular of sustainability (Economic, Environment and Social performances). The design phase of the framework development is presented in this paper.

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