The Criteria For Decision Making In Adaptive Reuse Towards Sustainable Development

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Abstract. Adaptive reuse is an important strategy for achieving sustainability as it ensures a continuous building life cycle and prevents building destruction. Adaptive reuse has the greatest potential to lower the environmental load of the built environment significantly within the next 20 to 30 years. But, the owners and practitioners still lack of point of references to justify and evaluate their decision making with regard to the adaptation practice. The aim of this paper is to explore the unique criteria of decision making among practitioners in the application of adaptive reuse of existing buildings. The descriptive study has identified five main criteria influenced in decision making in adaptive reuse that effected to the sustainable development; economic, environment, social, legislative and architecture. We designed a questionnaire to determine the most significant criteria in decision making for adaptive reuse towards sustainable development among practitioners. The paper describes the process in identifying the unique criteria and the proposed methodology for the study.

1 Introduction

The climate change has led to significant carbon emission reduction strategy and low carbon urban planning. With the construction of the new building will use a large amount of raw materials and energy, and generates high carbon emissions (Langston, 2011; Gorgolewski, 2008). According to Zuo and Zhao (2014), buildings are responsible for 40% of total energy consumption and produce greenhouse gas emission which is responsible for global warming issues during their life cycle. In terms of waste per year, building construction produce for about 136 million tons of waste, almost half of it from demolition and this also lead to the use of large amounts of raw materials and a huge environmental damage (Gorgolewski, 2008; Rashid et al. 2015). Given these figures, the construction sector has critical to reduce carbon emissions significantly.

Malaysia intends to be a developed country by 2020 and the criteria that need to be achieved are to have the construction of low-carbon emission, sustainable and inclusive, and efficient use of resources. Thus, the new buildings with green requirement are growing rapidly. However, the sustainability cannot be achieved unless the existing building stock is being addressed carefully. This because, even every new building was a 'green building' but their impact on sustainability as a whole will be minimal for some while (Adeyemi *et al.,* 2014).

Therefore, it is important to consider the existing building stock in a sustainable development. As a developing country, Malaysia has a large stock of existing buildings and most of these buildings were not conserved well and most of them were in poor conditions and invaluable (Ahmad, 2009). To address the problem, adaptive reuse of existing buildings is seen as an important strategy for achieving sustainability. This is because, adaptive reuse can extend the life of buildings and avoid demolition wastes, promote reuse of contained energy and also provide environmental, social and economic benefits to the community (Yung and Chan, 2012). While the benefit of adaptive reuse widely espoused, however, it would appear that owners and practitioners still lack a point of reference to justify and evaluate their decision making with regard to the adaptation of adaptive reuse of existing buildings (Bullen and Love, 2011b). Douglas (2006) ague that decision making is complex in the adaptive reuse building because there are many parties involved in the adaptation and each party presents a different perspective. According to Yau (2010) most existing buildings in Malaysia were not categorized into the green responsive building. This is shown by low numbers (10 out of 21) of an adaptive

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reuse project that had been certified by Green Building Index (GBI) (see Table 1). Therefore, the role of industrial players is important to improve the number of adaptive reuse projects to increase the foregoing numbers. Thus, there is an urgent need to understand how practitioner or industry players make decision to adapt the green concept into adaptive reuse of existing building.

This study is still in progress. This paper described the literature review and the development of questionnaires for data collection. The data collection process is in between December 2015 and January 2016.

Table 1. Number of GBI Certified Projects by Category

Update on GBI	Total as of 15 Dec 2015	NRNC Non Residential New Construction	RNC Residential New Construction	INC Industrial New Construction	NREB Non Residential Existing Building	IEB Industrial Existing Building	T Township
Applied	707	369	276	20	21	4	17
Registered	664	341	264	19	21	3	17
Total Certified	335 (100%)	168 (50%)	138 (41%)	9 (3%)	10 (3%)	3 (1%)	7 (2%)
Received with Provisional Certification after DA	283	143	121	5	6	1	7
Received Final Certification after CVA	51	24	17	4	4	2	-
Received Renewal Certification after RVA	1	1	-	-	-	-	-

Source: *Green Building Index (GBI), 2015*

2 Adaptive Reuse Terminologies

Adaptive reuse usually refers to the reuse of the site or building for the purposes other than those originally intended or designed for. According to Enache (2014), adaptive reuse of buildings is one of the most important practices in order to maintain existing buildings, by changing its purpose, after the structure has reached its level of maturity within the life cycle. These new users can offer economic, social and cultural benefits to their environment. In additional, the adaptive reuse is one approach to sustainability where it kept the durability of the original building materials and reduced its carbon footprints. Adaptive reuse addresses issues of conservation and preservation of the built heritage, as well as strategies and policies. Once the old structures become inadequate to their functional and programmatic needs, adaptive reuse becomes a sustainable option for reclamation of sites.

Adaptation is derived from the Latin word 'ad' means (to) while 'Aptar' is (fit). Usually the definition of adaptation refers to a 'change of use', 'retention' of the original structure and fabric of the building and also extends the 'life expectancy' of the property of the person (Douglas, 2006; Bullen, 2007). In the context of building, adaptive reuse is a term that has been interpreted widely and is defined by many researchers (Douglas 2006, Bullen, 2007). There are different interpretations for "adaptive reuse" known as conversion,

retrofitting, adaptation, refurbishment, rehabilitation and etc. (Langston, 2011; Douglas, 2006). According to Bullen (2007), adaptive reuse is a 'rehabilitation, renovation or restoration work that does not necessarily involve a change of use' and it will 'extend the useful life and sustainability in a combination of improvement and conversion'. Wilkinson and Reed (2008) defined adaptive as activity in maintaining as much of the original as possible, improve performance with modern standards and needs changing. They also state that refurbishment is a 'conversion describing a change in use'. Therefore, some the term refurbishment and adaptive reuse could mean the same thing.

3 Decision Making Issues

In previous studies, many researchers argue that the decision making to adaptive reuse of existing buildings is a complex stage (Douglas, 2006; Wilkinson and Reed, 2009; Alauddin, 2014). This is because there are many stakehoders involved in making decisions and each party has a different view. Those involved in the adaptation decision making are the owners, developers, producer, investors, regulators and marketers. They come from a variety of backgrounds and when the building adaptation be considered, it has triggered a range of views and perspectives based on their choice (Wang and Zeng, 2010). For example the building owner that wants to adapt the building will look into the financial resources they have. Investors want to see the future to build and marketers look to the latest market demands. Producer (professional team) will correlate with original architecture, structure, function, space and others when making a decision to reuse the building. In addition, another layer of complexity is when the stakeholders involved in the process of decision making at various levels and each had different degrees of influence (Alauddin and London, 2011). Furthermore the ability of stakeholders to influence the decision can be classified as either directly or indirectly. Thus, when a decision is made at the beginning of the process it will affect continue throughout the project. The desire of an organization that aspires to be the occupier or user of the building is yet another layer of complexity. This is due to the decisions taken will affect the activities or operations in the building. (See Table 2)

Table 2. Decision agent for adaptation of existing buildings (*Adapted Wilkinson and Reed 2009*)

Decision agents	Description & Professional Affiliations	Stage in adaptation where decisions made
Investors	Pension/ super funds, insurance companies, banks, independant investors, professionals who find capital to invest	Beginning/ early

Producers	Professional team- PM, QS, Architects, Engineers, contractors, surveyors, suppliers (RICS, AIAA, AIQS, AIBS, Fire engineers, structural and M&E engineers)	QS/A at feasibility stage Design stage Construction stage
Marketeers	Surveyors, agents, professional who find users for buildings (API, RICS)	During the design (if selling off plan) and/ or Construction stage
Regulators	Local Authorities, Planners, Heritage, Building Surveyors, Fire engineers (PIA)	During the design stage (and possibly during construction if amendments are made)
Policy makers	Federal, State and Local Government departments	Indirect effect on decision making in adaptation at all stages
Developers	Organizations who combine investment, production & marketing in whole or in part. Professionals from above bodies and others	Beginning/ early
Users-Corporate Residential	Large institutional owners and users individuals	

The next aspect is the range of options available to the stakeholders such as to change the use to a minimum because of the involvement of 'flexibility' is in the building as there was the first choice. The second choice has for small changes and adjustments to the third option required a higher level of engagement and are usually referred to as the 'reform' or 'retrofitting'. The fourth option involves the demolition while the fifth is an extension of the facility. Finally, the sixth is the demolition and redevelopment and selected when the economic, environmental and social conditions, physical and regulations are such that the building is said to be at the end of the life cycle and lack of utilities (Wilkinson, 2011).

4 Research Questions

Based on the issues raised in the literature review, research questions have been established as part of this research are:
1) What are the criteria of decision making among industrial players in the application of adaptive reuse for existing building?;
2) What are the most significant criteria in decision making for adaptive reuse of existing building?; and
3) What can be done in order to enhance the industrial player's knowledge in adaptive reuse decision making related to green elements?

5 Methodology

The three-stage of methodology was conducted to achieve the research aim, these are:

Stage 1 – Identifying the criteria of decision making and Developed the Instrument

The literature review process started by looking into primary and secondary sources. The primary literature sources included refereed journals, refereed conferences, dissertations/theses, occasional papers and government reports. Secondary sources included text books, trade journals, newspapers and magazines. The five top journals that were reviewed in the search are: i) ScienceDirect; ii) Emerald Group Publishing; iii) Google Scholer; iv) Springer Link; v) Elsevier. These top five journals were selected as they frequently publish scientific scholarly papers in multiple field and they have been ranked highly by several researchers (Maidin, A. B. *et al*, 2014).

Through an extensive literature review, the decision making criteria were identified (see Table 3) and were used to develop the questionnaire. Type of the instrument developed for this research was a closed-ended questionnaire with taking into consideration the aim and objectives of the study.

Table 3. Measures of decision making criteria

No	Measures of decision making criteria	Wilkinson, S. J. (2011)	Bullen & Love, P (2010, 2011 a&b)	Wang, H. & Zeng, Z. (2010)	Barrett, K. (2009)	Yildirim. M. (2012)	Wilson, C. A. (2010)
1.	Target Market/ Profit from market demand	x	x	x	x		x
2.	Sources of finance/Risk	x	x	x	x	x	x
3.	Subsidize/ Financial incentives	x	x	x	x		
4.	Initial investment and necessary investment in future maintenance		x	x			
5.	Benefit of exemption/ Tax concessions	x	x	x			
6.	Building value	x	x	x	x		
7.	Site and situation	x	x	x			x
8.	Land use plan or zoning	x		x			
9.	Potential environmental quality of the surroundings/ Contamination	x	x	x		x	x
10.	Sustainability	x	x	x	x		
11.	Reduce use of Greenfield sites		x				
12.	Reduction of resource consumption		x		x		
13.	Compatibility of newly introduced uses with existing			x			x
14.	Public interest	x	x	x			x
15.	Social and Cultural Value	x	x	x	x	x	
16.	Location (proximity to transport and amenities, cost of land)	x	x	x	x		x
17.	Enhancing the role of communities	x	x	x	x		x
18.	Retaining a sense of place		x		x	x	

19.	Regional development policies		x	x			
20.	Official Plan and Zoning regulations	x	x		x		x
21.	Building Code	x	x	x	x		x
22.	Heritage Designated Buildings	x	x	x		x	x
23.	Development or Government Incentives	x	x				x
24.	Conditions of integrity and authenticity		x	x		x	
25.	Building system/ Technological value	x	x	x			x
26.	Structural Condition	x	x	x	x	x	x
27.	Architectural Condition and Space layout	x	x	x	x		x
28.	Site Layout		x				x
29.	Building Suitability				x		
30.	Client requirement		x		x	x	

In order to develop a more comprehensive decision making criteria, the developed questionnaire was submitted to the professional to be discussed and analyzed. For the discussion and analysis, the criteria are grouped according related, measures and concluded by five condensed criteria of decision making are formed. Table 4 presents the criteria of decision making that will use for the conceptual model of study.

Table 4. Decision making criteria

Main criteria	Sub Criteria
Economic	Target Market/ Profit from market demand
	Sources of finance/Risk
	Subsidize/ Financial incentives
	Initial investment and necessary investment in future maintenance
	Benefit of exemption/ Tax concessions
	Building value
Environment	Site and situation
	Land use plan or zoning
	Potential environmental quality of the surroundings/ Contamination
	Sustainability
	Reduce use of Greenfield sites
	Reduction of resource consumption
Social	Compatibility of newly introduced uses with existing
	Public interest
	Social and Cultural Value
	Location (proximity to transport and amenities, cost of land)
	Enhancing the role of communities
	Retaining a sense of place
Legislative	Regional development policies
	Official Plan and Zoning regulations
	Building Code
	Heritage Designated Buildings
	Development or Government Incentives
	Conditions of integrity and authenticity
Architecture	Building system/ Technological value
	Structural Condition
	Architectural Condition and Space layout
	Site Layout
	Building Suitability
	Client requirement

The questionnaire was designed into two sections. The first section needs feedback about respondents' background as well as their experience. It was followed by the research content which is divided into five categories. First category will be touched on Economic Category, followed by Environmental Category and Social Category before ended with Legislative and Architectural Category. The respondents were asked to evaluate the listed criteria based on a 5 Likert Scale with 1 = Strongly Disagree to 5 = Strongly Agree. This method will easily compare the respondents' opinion either in positive or negative response according to respective criteria by neutral category included as applied by Addae-dapaah et al. (2009).

The basic questionnaire survey is divided into five major criteria to enhance stakeholders understanding to avoid duplication and redundancy of criteria overlapping each other. However, to achieve the research objectives and to answer research questions, all sections as well as categories (economic, environmental, social, legislative and architecture) will be combined into a single cluster.

Stage 2 – Distribute of Questionnaire

In order to achieve the objectives of the study, the researcher has identified the stakeholder and sources of information that involved in the adaptive reuse field as a target group. However, there are limitation to get the real numbers for the stakeholders that involve in adaptive reuse. Therefore, the stakeholders from the state under the world heritage is the target respondent. The data collected includes the lists of following stakeholders from different sources such as:

- Lists of Registered Architect (involved in adaptive reuse or equivalent) from Board of Persatuan Arkitek Malaysia (PAM).
- Lists of Registered Valuers from Board of Valuers, Appraisers and Estate Agents Malaysia (BOVAEA) in Penang and Melacca, Malaysia.
- Local authorities (involved in adaptive reuse or equivalent) in Penang and Melacca, Malaysia.
- List of Government Departments (involved in adaptive reuse or equivalent) in Penang and Melacca, Malaysia.
- List of Town Planners (involved in adaptive reuse or equivalent) in Penang and Melacca, Malaysia.
- Lists of Building Owners (involved in adaptive reuse or equivalent) in Penang and Melacca, Malaysia.

From the lists obtained, the researcher will develop a database known as Adaptive Reuse Stakeholders Database which will consist of potential respondents in regards to meet the objectives of the research. This stage is significant to ensure the reliability and the quality of data gathered will meet objectives requirement without prejudice the research analysis and findings.

A total of 65 survey forms that consist of 31 questions regarding decision making criteria complete with 'cover note' started to be distributed at early of December 2015 until end of January 2016. Bullen (2007) points out that the small size of the sample could be considered can reduce the global significance of feedback received with the balancing the value of obtaining opinions from a group of professionals with specialized and specific knowledge of sustainability principles. The collection of data also involved with reminders based on ad-hoc basis to increase the response rate of the research. This form had been sent according to Adaptive Reuse Stakeholders

Database developed at an earlier stage of the research activities.

A various medium of survey form distribution have been used where majority of them involving online medium through web-based hyperlink known as www.surveymonkey.com. The email address of the sample, where available have been sent through while in the absence of email address and immediate data collection, the researcher has decided to execute by-post and by-hand approach.

Stage 3 - Analysis of Quantitative Data

Data collected from the questionnaire form will be analyzed using quantitative techniques. Data from the questionnaire survey will be analyzed quantitatively through SPSS software involving the descriptive statistical method. Factor Analysis (FA) technique will be executed to achieve objectives of the study while Reliability Analysis (RA) will be performed accordingly to test the significant findings. The data collected will be formulated and designed in chart, table and other tools.

6 Conclusions and Further Steps

This paper has explained the complexity of decision making with regards to adaptive reuse of buildings and the criteria for decision making has been identified by thorough review of literature. This paper also presented the flow of the research activity to be conducted and administered to ensure the objectives of the research can be accomplished. It justifies the application of questionnaire, respondents and in-depth approach of analyzing the data collected to enhance the findings reliability. Thus, it is important for the researcher to ensure the process of research methodology being followed and perform accordingly. Until the end of January 2016, data that has been collected is 95% and now in the process of analyzing the data collected. This research will be complete within April 2016 for the purpose of obtaining a master's in Green Architecture and the final result of the analysis shall be published in the journal.

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