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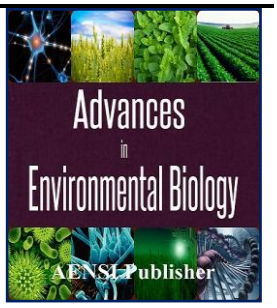

Integration of Sustainable Approaches in the Building Project: A Case Study on a Sustainable Building Project in Malaysia

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ABSTRACT

This paper aims to focus on the sustainability integration approach in the building project and its impact on influencing the project performances. The preliminary study in this research indicated 29 sustainability principles to be considered towards achieving successful performance of a sustainable building project. The study utilised a case study method with interviews, observations and review of the relevant documents to explore the sustainability principles that have been integrated into the project and their impact towards the sustainability performance of the project. This paper looks at a case study project in Malaysia: the Diamond building, which is a successful sustainable building project in Malaysia. The finding reveals the benefits of sustainability integration approach towards achieving successful performance of a building project.

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INTRODUCTION

There are plenty articles discussing barriers of sustainability integration practices in building project. The most commonly cited barriers are related to the 'increment in the project's first cost', 'more time to design', and sustainability requirements that need to be undertaken [28,49]. Thus, this paper attempts to venture the impact of sustainability integration approach in a building project towards successful sustainability performances by the means of a case study. This paper looks at a project that was planned and designed for sustainability, and achieved the sustainability target up to some extent, to identify what is the 'secret'. Diamond building is a successful sustainable building project in Malaysia. The project has received no less than five sustainability related awards from several prestigious bodies. The building is also the first outside of Singapore to obtain the Green Mark platinum rating [31]. It was designed to achieve the results of Energy Index of 55 kWh/m^2/year, which is the way forward for energy efficiency in buildings. Equally important is to integrate the essence of Malaysian culture, urban character in its surroundings, and celebrate them through designs and ideas of sustainability in order to attain the delicate balance of modern comfort with environmental responsibilities. Most interesting is that the project was also completed on time, within the budget, achieved high level of stakeholders' satisfaction, and sustainable building target.

In Malaysia, the focus on sustainable development, especially in devising policies, has been spelled out in government policies at national, state and local level [11]. Most researchers consider that the concept of sustainability in building costs lower than the conventional method and saves energy through efficient resources use, higher productivity and reduced risk [34]. However, some suggested that sustainable buildings cost more to construct than conventional buildings. The range is 5% to 7.5% of construction cost to be recovered in five to eight years [8]. Thus, even if it is widely held that the longer term cost savings in the operation and maintenance of the building enables a recovery of the initial cost, unfortunately, the benefits of operational savings are no longer important, especially to speculative developers who have no long term interest in operating or leasing a building [48]. Sustainability in building will contribute positively to a better quality of life, work efficiency and healthy work environment [8]. This approach enables the construction players to be more responsible to the environmental protection needs without neglecting the social and economic needs in striving for better living.

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This paper identifies sustainability principles of building and its impact towards successful sustainability performance of the project by means of a case study method with interviews, observations and review of relevant documents. Due to some limitation, sustainability integration was only measured throughout the planning and design process of the project and their impact was examined towards sustainability performance achieved by the project.

2.0 Sustainable Building Principles:

Sustainable building is considered as an approach for the building industry to move towards sustainable development by taking into account environmental, social and economic issues [1]. The practice refers to the creation and operation of a healthy built environment based on resource efficiency and ecological design with an emphasis on seven core principles across the building life cycle includes; reducing resource consumption, reusing resources, using recyclable resources, protecting nature, eliminating toxics and estimating life cycle costing [51]. A sustainable building project requires additional considerations on many aspects more than the conventional project. It works best when the expanded group of stakeholders work together to concentrate the majority of their creative efforts very early in the planning process [10]. Sustainable building project involves a complex planning, design and development process includes the need to integrate sustainability principles into the whole life of the building, to reduce energy, water and resources used, reduce its impact on the environment and improve the health of its occupant [28,44]. Overcoming design complexities of the buildings, meeting the requirements of building assessment systems and keeping the project costs at the levels comparable to conventional buildings are only possible through sustainability integration approach into the planning process of the project [50].

Through a thorough literature reviews process, a list of 29 sustainability principles of building are revealed as significant to be integrated into a building project as portrayed in Table 1. The principles are: 1) optimize materials and resources used, 2) sustainable materials and resources, 3) energy efficient, 4) efficient water consumption, 5) noise control, 6) urban design, visual impact and aesthetic, 7) site planning and management, 8) transport management, 9) concern on quality of land, river and sea, 10) air and emissions quality, 11) heritage conservation, 12) efficient environmental management, 13) sustainable method, 14) economic benefit to the stakeholders, 15) improve local market presence, 16) whole life cost efficiency, 17) indirect economic impact, 18) employment benefits, 19) labor/management relations, 20) occupational health and safety, 21) training, education and awareness, 22) fairness, 23) human right performance, 24) society performance, 25) product responsibility, 26) stakeholders participation, 27) macro social performance, 28) sustainable design, 29) sustainable innovation.

The principle of 'optimize materials and resources used' contributes to the global resource conservation to reduce the material intensity and increase the efficiency of the economy [22,45,7]. It is about achieving more with less [1]. Since the building industry is a major consumer of natural resources, many initiatives pursued in order to create environmental sustaining buildings that focused on increasing the efficiency of resources use. Reused and recycled materials and products are suggested in every single life cycle of building [23,22,36]. It should be considered since the planning process of a building project in order to reduce demand for virgin materials and reduce creation of waste.

Sustainable materials and resources is concerned with the prudent use of materials to reduce the negative impact to the environment and protect the users in terms of health and long term basis [53]. It must be taken into account throughout the project development, where selection of materials are based on the consideration of the environmental impacts generated from the use of the materials, reducing the use of non-renewable materials and the use of non or less toxic materials [1,23]. Energy efficient in building is concerned with renewable energy, reducing carbon dioxide (CO^2) emission and optimizing the use of day lighting in buildings.

Besides, depletion of water resources is becoming an environmental issue of the highest concern worldwide [1]. Building construction and its operations draw heavily on water from the environment. Water is also consumed in the extraction, manufacturing and delivering of materials and products to site. As far as use of water within building industry is concerned, the first step is to reduce demand by using of water saving device in sanitary systems followed by to consider the reuse of grey water. There are several steps of water efficiency in building suggested including to enhance the building rainwater harvesting systems, reduction of potable water consumption, waste water recycling, reducing potable water consumption for landscape irrigation and encourage water efficient fittings [23].

Excessive noise can cause discomfort, annoying and disruptive to occupants and communities. Therefore, noise control method during the whole building process should be considered throughout the planning and development of a building project in order to achieve sustainability. Design flexibility of building towards noise reduction possible to be introduced to avoid discomfort [46]. Acoustic comfort is achieved by controlling sources of noise from mechanical and electrical equipment and from sources exterior to the building [1]. Some of the solutions to ensure acceptable noise level are maintained include such as employ acoustical ceiling, using furniture with sound absorbing surfaces on both sides, acoustic zoning such as locate photocopiers, locate fax

machines away from the main office areas in a separate area, locate mechanical equipment room away from office and conference rooms.

Urban design, aesthetic and visual impact protection are considered as one of the sustainability requirements in building [46]. SBTool2012 listed six requirements to be fulfilled under this category: maximizing efficiency of land use through development density, reducing need for commuting transport through provision of mixed uses, impact of orientation on the passive solar potential of building, building morphology and aggregate measure, impact of site and building orientation on natural ventilation of building during warm season and impact of site and building orientation on natural ventilation of building during cold season. Visual and aesthetic aspects are includes; pleasing architecture, visual interest, art on the walls or natural elements such as plants, fountain or an aquarium, visual quality and others.

Location of a building is a major consideration in the site planning and management aspect. The erection of a building will have a direct impact to the location surroundings, and will bring about change to the land itself and in turn may have an impact on economic. Thus, during the planning and design stages, the building has to be ensured having a wider positive influence on the surrounding area rather than serving itself. For buildings, the location is more likely to be a combination of commercial and business decisions balanced by the benefits to the users such as proximity to public transports, schools, retail facilities, infrastructure development and many others [45,53]. Besides, suitable access to a building is essential whether it be for occupants, workers or for delivery goods. Decisions about occupation and ownership will be influenced by the quality of transport and transport access to the site by public or private means [44]. Malaysia Green Building Confederation (MGBC) encourages locating projects within certain distances of existing or planned and funded public transports. Provision of bus and taxi stop and the use of green vehicles are also encouraged.

Pollution has an adverse impact on the quality of land, water and air. A sustainable project should optimizes and conserves the quantity and quality of land, river and sea by reducing acidification potential and human toxicity potential as well as eco-toxicity potential [32]. Air pollution can be generated by building use, emission process and traffic emissions. Greenhouse gas emissions whether direct or indirect emissions are the main cause of climate change. Tracking and reducing greenhouse gas emission can improve the overall life cycle performance of building and enhance the building's reputation in combating climate change. Air and emissions quality in construction project should be concerned with the regional quality which is the impact on human health, buildings and crops. It includes ensuring clean air, reduce acidification potential, photochemical ozone creation potential and human toxicity potential. Effective environmental planning, management and control are vital to identify the environmental risk and to formulate and implement preventive actions to reduce adverse environmental impacts such as water, land and air pollution. MGBC highlighted the important of efficient environmental management such as in conserving existing natural area and restore damaged area to provide habitat and promote biodiversity and maximize open space by providing a high ratio of open space to development footprint to promote biodiversity.

All materials wear out in time and need replacement, at which point it is necessary to consider whether replacement/repair, complete demolition or the replacement of major elements only is the most sustainable method [44]. Conserving heritage buildings reduces energy usage associated with demolition, waste disposal and new construction, and promotes sustainable development by conserving the embodied energy in the existing buildings. Life-cycle analyses of building fabric: structure, envelope, interior elements and systems and ongoing management and use need to be considered as part of the conservation process to achieve optimum energy efficiency outcomes [42]. In other cases a comparison may be needed between the demolition of an existing structure and its replacement with a new building rather than its retention and revitalization.

Construction is essentially an intensive transformation process that often involves assembling and transforming resources into physical artifacts. Building construction method should be harmonized with the surrounding and minimize depletion of limited resources [12]. It should be planned by considering each of the previous environmental sustainability principles that have been discussed. There are several sustainable methods to achieve sustainability in buildings includes; choosing materials with low embodied energy, insulating the building enveloped, designing the building for energy efficient deconstruction and recycling of materials, design for low energy intensive transportation, developing energy efficient technological processes for construction, fitout and maintenance, use of passive energy design, design for waste management, utilizing durable materials, design for pollution prevention, utilizing non-toxic or less toxic materials, design for dual plumbing to used recycled water for toilet flushing or grey water system for site irrigation, collecting rainwater and grey water, water pressure reduction, adaptive reuse of existing building, locate construction project close to existing infrastructure [1]. Reusability of moulds and formwork, use of prefabricated material and ease of quality control are among the points to be considered for sustainable method. An effective waste management plan should be adopted for sustainable building project to control and minimize its impact to the environment including transportation of hazardous waste, spills and disposal method. Storage and collection of recyclables materials also included in the plan during construction, occupancy and disposal in order to reduce waste generated that is disposed in the landfills [44,23].

Besides of the environmental principles, sustainable building project should also consider the economic and social principles of sustainability. The economic sustainability is concerned with the micro and macroeconomic benefit. Microeconomic focuses on the factors or activities which could lead to monetary gains from the construction project while macroeconomic relates to the advantages gained by the public and government from the project success [52]. It also concerned with the project impacts on the economic conditions of its stakeholders and on the economic systems at local, national and global levels. Meanwhile, social sustainability is concerned with the benefits of the workers, stakeholders and future users. It is related to human feeling: security, satisfaction, safety and comfort and human contributions: skills, health, knowledge and motivation. There are seven social sustainability principles are suggested to be the significant assessment tool for social sustainability of building. includes; adaptability, cultural importance, lovability and likeability, planning and building regulations, occupation legislation, and locality and working environment quality [44]. Meanwhile, Labuschagne *et al* [32] summarized social sustainability for sustainable project should include internal human resources aspect, external population, stakeholders' participation and macro social performance aspect [32]. However, for the purpose of this study, the social dimension of sustainability is referred to the impacts a project has on the social systems within which it operates surrounding the aspects of 1) employment, 2) labor/management relations, 3) occupational health and safety, 4) training and education, 5) fairness, 6) human right performance, 7) society, 8) product responsibility, 9) stakeholders participation and 10) macro social performance.

Overall, among the environmental aspect of sustainability, the principles of 'optimize materials and resources used' and 'energy efficient' in building development are the most common in the available knowledge followed by 'sustainable materials and resources used' and 'efficient water consumption'. Besides, the principles of 'concerning on quality of land, river and sea' and 'sustainable design' are also regularly cited in the literatures. Most social sustainability principles including 'conserving heritage', 'labor and management relations', 'human right performance', 'society performance' and 'macro social performance' are listed to be the least popular topic relating to sustainability in building projects.

3.0 Project Success and Sustainability:

There is no specific success criteria model and framework is currently available for the needs of the sustainability in building projects. Moreover, those available frameworks have shortcomings of taking into full account all of the project's life cycle and rarely align the sustainability concept with both short and long term goals of project. Even Project Management Body of Knowledge (PMBOK), the most popular model of project management was also claimed to be predominantly towards managing the execution function [35]. The concept of project success is developed to set criteria and standards by which projects can be completed with the most favorable outcomes [18]. According to PMBOK, in order for a project to be successful, the project team should select appropriate processes required to meet the project objectives, use defined approach that can be adopted to meet requirements, comply with requirements to meet stakeholder needs and expectations and balance the competing demands of scope, time, cost, quality, resources and risk to produce the specified product, service or result. Some other factors that are known to contribute to project success include; defining clear goals and objectives, maintaining a focus on business value, implementing a proper governance structure, ensuring senior management commitment and providing timely and clear communication [2]. Achieving the set goals for building projects within realistic financial and time constraints, superior planning, design, and construction processes as well as having all the stakeholders' satisfaction are acutely needed for project success.

Project success means different things to different people. In the early 1990s, project success was considered to be tied to performance measures, which in turn were tied to project objectives. At the project level, success was measured by the project duration, monetary cost and project performance. Time, cost and quality are the basic criteria to project success and they are identified and discussed in almost every article on project success. Similarly, Lim and Mohamed [33] emphasized that each industry will have their own unique set of criteria and factors, however they agreed with the standard measures of time, cost and quality. Moreover, they expanded on their definition of success, stating that a project must achieve the project's objective such as performance and safety for a construction industry. In addition to these basic criteria, Pinto and Pinto [37] advocated that measures for project success should also include project psychosocial outcomes, which refer to the satisfaction of interpersonal relations with project team members. Meanwhile, Chan and Chan identified nine key performance criteria for measuring project success - time, cost, value and profit, health and safety, environmental performance, quality, functionality, user expectation and satisfaction and participants' satisfaction. Sadeh *et al* [43] divided project success into four dimensions. The first dimension is meeting design goals, which applies to contract that is signed by the customers. The second dimension is the benefit to the end user, which refers to the benefit to the customers from the end products. The third dimension is benefit to the developing organization, which refers to the benefit gained by the developing organization as a result of executing the project [43]. The last dimension is the benefit to the technological infrastructure of the country and of firms involved in the development process. The combinations of all these dimensions give the overall

assessment of project success. Currently, a study by Al-Tmeemy *et al* in line with previous findings showed that project success is a multidimensional concept. Specifically, for a building project, At-Tmeemy *et al*, [4] concluded that the project is most successful when it is capable in integrating three success dimensions; project management success (achieving cost, time and quality target), product or building targets (functionality, technical requirements and customer satisfaction) and market success (company's competitive advantages, company's reputation, increasing market share and reaching specified revenue and profits).

It was common in published works highlighted that sustainability in construction project would improve the project performance [26]. Thus, it will be incompetent to judge a sustainable project's success only according to the criteria of cost, time, quality and stakeholders' satisfaction. Thus, besides of those four criteria of a successful project performance, sustainability in building project should also accomplish the criteria of meeting sustainability project goal and objectives. The authors concluded that a building project is more successful when it is capable in integrating three success dimensions; project management success, building targets and market success as highlighted by At-Tmeemy *et al* [4]. However, to deliver a successful sustainable project, sustainability principles integration into the whole life cycle of the project and product should also been taken into consideration. Sustainability principles and the criteria of successful project performance are related and parallel (illustrated in Figure 1). The author expects that a successful sustainable building project can be achieved by accomplishment of the sustainability principles requirements of the project since the planning process of the project. Even though the term of 'sustainable' or 'sustainability' is not included clearly in the mentioned criteria of a successful project, however, the sustainability principles are actually there.

In project management, sustainability involves both individual and corporate responsibility to ensure the outputs, outcomes and benefits are not only sustainable over their life cycles, but also sustainable during their creation [2]. Using natural and human resources indiscriminately to achieve growth and financial profit, without regard to the environment or social cost is no longer acceptable. Even it was proved that thinking sustainably now is the way to build in lower costs and increase value [13]. Sustainability should be considered in many different core areas of project, programme and portfolio management. Projects should be selected to meet sustainable objectives. Sustainable development is an area in continual flux and is rarely without debate and argument. However, every profession needs to consider it as a core aspect of being a professional and ethical person.

4.0 The Case Study: Diamond Building Project:

Diamond building is a sustainable building project in Malaysia which applied a holistic planning and design approach. An integrated design concept has been implemented, where energy-efficient target and the use of day lighting were decided since the design brief stage of the building project. Sustainable building materials are used for this building. The usages of materials were reduced and priority was given to the materials that have no or less impact to the environment. The materials that were used whenever feasible are non-toxic, recycled and recyclable, renewable, local, standard sizes, and modular, pre-cut to reduce waste, certified wood, durable and long lasting. Prefabricated components were used for this building in order to minimize waste and labour trimming to fit. During the construction stage, wastes were minimized to reduce disposal to landfill. On-site separation of materials and waste material sorting policy were implemented, where containers were clearly labeled and construction personnel were trained in material sorting policies. The building occupants had been prepared with a series of talks for their new experience. They were brought earlier to the building just to have them experience it before they moved to the building in June 2010. Besides, there are regular talks on sustainability by the experts provided for the building occupants as they will become the organisation and the building little ambassadors who share their experiences with others [31]. Two questions are thus raised. First, do the project stakeholders integrate sustainability principles into the Diamond building project, if yes, what are the principles?, and second how the sustainability integration approach influence the sustainability performances of the project?

5.0 Research Methodology:

This paper uses a case study research design to identify and understand the sustainability integration approach in the case project that makes the project successful in delivering sustainability. The 29 sustainability principles as mentioned in the literature review were used for the semi-structured interview. Seven principles have been omitted from the list as they are considered not significant and not in accordance with the current local context by the respondents. The principles are 'conserving heritage', employment benefits', 'labour/management relations', 'fairness', 'human right performance', 'society performance' and 'macro social performance'. The respondents of this research are the project stakeholders, who have been directly involved in the planning and design process of the Diamond building project. The stakeholders of construction and operation and maintenance stage of the project were also interviewed. Inputs from the project planning and design stakeholders are useful to understand the sustainability principles that have been integrated throughout

the planning process of the project and its influence towards sustainability performance of the project. While, inputs from the construction and operation and maintenance stakeholders of the project are significant in order to measure the sustainability performance of the building. Beginning August 2012, email requests and telephone calls for interview appointments were sent to the initial seven main stakeholders of the project including the owner, developer, architect, energy consultant, local authority, contractor and energy/facility manager. However, due to the age and nature of the project, only five groups of project stakeholders were still available to be interviewed consisting of the owner (O1), energy consultant (E1), local authority (L1), contractor (C1) and energy/facility manager (U1), making the total respondents of five. The overall completion of the interview process took about one month of duration from 1st December 2012 to 31st December 2012. Each interview lasted about 90 minutes to 150 minutes depending on the respondents' willingness to spare their time and to provide additional information. Besides interviews with the stakeholders, the data for the research were also obtained through reviews of relevant documents such as drawings, plan, briefing documents, Green Building Index (GBI) submission reports, newspapers, project reports, site observations and photographs, making the research its desired depth. The data from the interviews were analyzed using content analysis which involved the process of 'identifying', 'coding', 'categorizing', 'classifying' and labeling the primary patterns in the data.

Table 1: Sustainability Principles of Building and the Supporters..

Authors/Factors	Optimise materials and resources used	Sustainable materials and resources	Energy efficient	Efficient water consumption	Noise control	Urban design, visual impact and aesthetic	Site Planning and management	Transport management	Concern on quality of land, river and sea	Air and emissions quality	Conserving heritage
BRE, 2013	×	×	×	×	×		×	×	×	×	
USBGC, 2009	×	×	×	×			×	×	×		
iiSBE,2012	×	×	×	×	×	×	×	×	×	×	×
GBCA, 2008	×	×	×	×	×		×	×	×	×	
GSB, 2009	×	×	×	×	×		×	×	×	×	
BCA, 2012	×	×	×	×	×		×	×	×	×	
GRI, 2011	×	×	×	×	×		×	×	×		
DOS, 2007	×		×				×			×	
CIDB, 2007											
Muldavin, 2010			×								
Zainul Abidin, 2010a		×	×	×	×	×	×	×		×	
Yudelson, 2009											
ASHRAE, 2006											
Sayce *et al*, 2004	×	×	×	×			×	×			×
Graham, 2003	×										
Haris and Goodwin, 2001											
Polese and Stren, 2000	×	×									
Edward, 1998			×					×	×	×	
Schumann, 2010	×	×		×			×		×	×	
Reyes *et al*., 2014											
Akadiri *et al*., 2012	×	×	×	×	×	×	×		×	×	
Zainul Abidin, 2009	×	×	×	×	×	×	×		×	×	×
Gething and Bordass, 2006		×	×	×	×			×	×		
Ugwu and Chaupt, 2005	×	×		×	×	×	×	×	×	×	
Labuschgne *et al*, 2005	×		×	×					×	×	
Brent and Labuschagne, 2004	×	×	×	×					×	×	
Edum-Fotwe and Price, 2009											
Zavrl, M. S., *et al*, 2009											
Essa and Fortune, 2008											
Total	17	16	17	16	11	5	14	12	15	14	3

Efficient environmental management	Sustainable method	Economic benefit to the stakeholders	Improve local market presence	Whole life cost efficiency	Indirect economic impact	Employment Benefits	Labor/Management Relations	Occupational Health and Safety	Training, Education and Awareness	Fairness	Human right performance	Society Performance	Product responsibility	Stakeholders participation	Macro social performance	Sustainable Design	Sustainable Innovation
×	×			×				×	×				×	×		×	×
×	×		×		×			×					×			×	×
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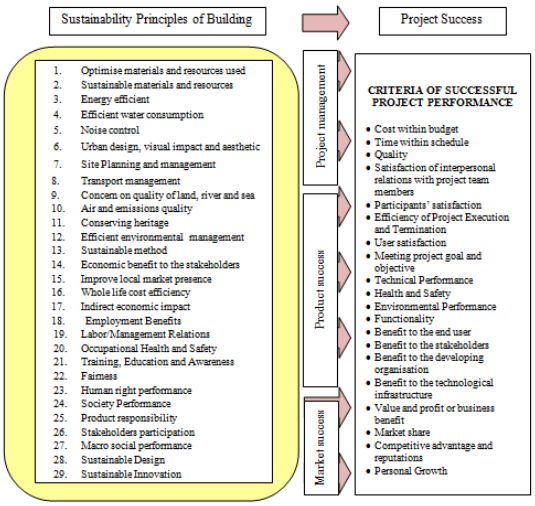

Fig. 1: Sustainability Principles of Building and Successful Project Performance.

6.0 Findings and Discussion:

6.1 Sustainability Integration into the Building Project:

The planning and design stage stakeholders (O1, E1, L1) of Diamond building project were asked to assess the sustainability principles that measured and documented during the planning process of the project. The results are portrayed in Table 2. The project documents that reviewed together to ensure the validity of the answers are including Development Proposal Report for Layout Plan and Building Development Plan, project development brief, design requirements and project specifications. The results show that, 19 out of 22 principles were mentioned clearly in the project documents. The principles were clearly communicated among the owner and designers team and also measured by them during the planning and design process of the project. Other 3 principles which are *'sustainable method', improve local market presence' and 'indirect economic impact'* were also appraised by them during the planning process even though the principles were not mentioned in the project documents. However, only 11 out of 22 principles were included in the project documents that had been submitted to the local authority of Putrajaya. The principles were clearly measured and considered by the local authority as the requirements to be fulfilled by the client and the team members for the project approval. Two principles, which are *'efficient water consumption'* and *'economic benefit to the stakeholders'* were not clearly mentioned in the submission documents, but the principles had been communicated and considered by the local authority and the entire stakeholders during the process. Meanwhile, the rest 9 principles, which are 'sustainable method', *'sustainable materials and resources', 'optimized materials and resources used', 'whole life cost efficiency', 'improve local market presence', 'indirect economic impact', 'product responsibility', 'training and education' and 'stakeholders participation'* were not mentioned in submission documents to the local authority and also not measured by the local authority during the approval process of the project.

Eleven principles had been practiced by all project stakeholders and mentioned clearly in the project documents. The principles are *'efficient environmental management', 'concern on quality of land, river and sea', 'site planning', 'energy efficient', 'air and emissions quality', 'transport management', 'urban design, visual impact and esthetic', 'noise control', 'occupational health and safety', 'sustainable design' and 'innovations'.* There was no one principle not considered by all the stakeholders during the planning and design process of the project. Overall, the sustainability principles mentioned in the project documents and the consideration of the principles during the project planning process was at a high level.

Table 2: Sustainability Principles Integration into the Project Planning Process.

Sustainability Principles	Considered? Documented?				
	Owner	Energy Consultant	Local Authority	Σ Documented	Σ Considered/Integrated
Environmental Sustainability					
Efficient environmental management	●*	●*	●*	3	3
Concern on quality of land, river and sea	●*	●*	●*	3	3
Site planning and management	●*	●*	●*	3	3
Energy efficient	●*	●*	●*	3	3
Air and emissions quality	●*	●*	●*	3	3
Sustainable method	●	●		0	2
Sustainable materials and resources	●*	●*		2	2
Optimize materials and resources used	●*	●*		2	2
Efficient water consumption	●*	●*	●	2	3
Transport management	●*	●*	●*	3	3
Urban design, visual impact and aesthetic	●*	●*	●*	3	3
Noise control	●*	●*	●*	3	3
Economic Sustainability					
Whole life cost efficiency	●*	●*		2	2
Improve local market presence	●	●		0	2
Indirect economic impact	●	●		0	2
Economic benefit to the stakeholders	●*	●*	●	2	3
Social Sustainability					
Occupational health and safety	●*	●*	●*	3	3
Product responsibility	●*	●*		2	2
Training, education and awareness	●*	●*		2	2
Stakeholder participation	●*	●*		2	2
Design and Innovation					
Sustainable Innovation	●*	●*	●*	3	3
Sustainable Design	●*	●*	●*	3	3
Mentioned in the project documents	19 (High)	19 (High)	11 (Low)	49 Average: 16 (High)	57 Average: 19 (High)
Considered by the interviewees	22 (Very High)	22 (Very High)	13 (Medium)		
Total respondents				3	
22-20 Very High	*19- 16 High*	*15-11 Medium*	*10-7 Low*	*6-0 Very Low*	
Note: ● Integrated into the project planning process			**Mentioned in the project documents*		

6.2 Sustainability Performances:

The stakeholders were asked to assess the performance level of sustainability principles delivered by the project. The owner, energy consultant and local authority (O1, E1, L1) of the project were asked to assess the project's sustainability performances delivered at the conceptual and design stage, contractor (C1) was asked to evaluate the performances of the construction stage and energy manager (U1) was asked to judge the sustainability performances of the operation and maintenance stage of the building. The summary of the results are illustrated in Table 3. The findings show that the shape of the Diamond building was an optimum passive design approach to achieve energy efficiency. The tilting façade allows self-shading for the lower floors, protection from direct sun rays into the building and a smaller footprint, resulting in a larger area for landscaping. The sunken garden located at the basement serves as a void space which provides natural ventilation to the parking area at the basement level. The building is oriented in accordance with the solar path, minimizing the areas impacted by direct sunlight. The building was installed with active features such as photovoltaic (PV), day lighting systems natural and artificial and insulated concrete roof for energy efficiency. In general, the expected electricity generated is 102,000 kWh per year which is equivalent to RM40k cost savings annually or an avoidance of 63,000kg annual carbon dioxide (CO_2) emission. The Diamond was designed to obtain 50% of its day lighting needs from natural lighting. Insulated concrete roof was installed to reduce heat absorption in the building; the roof top area was insulated using boards with a thickness of 100mm. It was tightly insulated both horizontally and vertically (E1).

In term of water efficiency, the owner (O1) highlighted that rainwater harvested is used for toilet flushing and combined with efficient water fittings such as dual flush toilets, waterless urinals and water taps equipped with aerators reduces potable water usage by more than 65%. To further optimize the water efficiency of the building, grey water collected from the wash basins is also recycled to irrigate the wetland at the ground floor. The diamond is the form adopted in relation to the main concept and design philosophy which is a distinctive design for being on tourist map and city landmark objective. Utilizing fresh cues of modern building forms, distinctive materials and colours, the buildings relates to not only to the technical requirements but also to the surrounding architecture creating a unique blend (O1).

Sustainable building materials were used for this building, where the usages of materials are reduced and priority is given to the materials that has no or less impact to the environment. Materials and resources use was optimized and reduced such as via doing away with suspended ceilings, except for small areas to conceal the ducts. Sustainable materials were used such as green labeled plasterboards which have low volatile organic compound (VOC) emission and has 30% recycled content for the ceiling and the internal partitions. The floor carpeting is also green labeled for low VOC emission and has at least 10% recycled content. The interior paint used in the building is also of low VOC content. The workstations contain material that protects against UV rays

(O1). The contractor (C1) confirming the argument as he said: *'Materials selection was very important. It was the GreenMark and GBI requirements as well, we used recycled content materials, we also gave priority on meeting the requirement of low VOC materials and we used as much as possible the local product'.* The materials that were used whenever feasible are non-toxic, recycled and recyclable, renewable, local, standard sizes, and modular, pre-cut to reduce waste, certified wood, durable and long lasting. Recycled aluminum was used for the suspended ceiling in this building. Prefabricated components were used for this building in order to minimize waste and labour trimming to fit. During the construction stage, wastes are minimized to reduce disposal to landfill. On-site separation of materials and waste material sorting policy were implemented, where containers were clearly labeled and construction personnel were trained in material sorting policies. However, as highlighted by the energy consultant (E1), it was quite difficult to get sustainable materials in Malaysia and as a result; it was imported from abroad. Indoor and outdoor environmental quality of the building is at an 'excellent' level. Extensive landscaping and sunken outdoor garden ensure not only connection to greenery but also provide a cool and shaded ambient environment for the occupants. A green roof help to further reduce urban heat and effect whereby the hardscape areas are reduced and replaced with soft green landscape as the energy manager (E1) mentioned: *'The indoor and outdoor environmental quality are excellent, the air is very fresh and we also control the CO_2. Cooling is provided via radiant cooling slabs that have chilled water pipes embedded in the concrete slab itself. This is complimented with the conventional cold air supply system. The noise from the ducts is also reduced significantly to improve the acoustic comfort'.* Considering all cycles of the project that has been discussed, the stakeholders assessed the project sustainability performances of Diamond building during conceptual and design stages, construction stage and operation and maintenance stages to be at an 'excellent' level.

Table 3: Responses on the Level of Sustainability Performances of Diamond Project.

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
Environmental Sustainability						
Efficient environmental management	4	4	3	4	4	4
Concern on quality of land, river and sea	3	3	2	4	4	3
Site planning and management	4	3	3	4	4	4
Energy efficient	4	4	3	4	4	4
Air and emissions quality	3	3	3	4	4	3
Sustainable method	2	2	2	3	4	3
Sustainable materials and resources	3	3	2	3	3	3
Optimized materials and resources used	4	3	2	4	3	3
Efficient water consumption	4	4	2	4	4	4
Transport management	3	3	1	4	2	3
Urban design, visual impact and aesthetic	4	4	3	4	4	4
Noise control	4	3	3	4	3	3
Economic Sustainability						
Whole life cost efficiency	4	4	3	4	4	4
Improve local market presence	4	4	2	4	3	3
Indirect economic impact	3	3	2	4	3	3
Economic benefit to the stakeholders	3	4	3	4	4	4
Social Sustainability						
Occupational health and safety	4	3	3	4	4	4
Product responsibility	3	3	2	3	4	3
Training, education and awareness	4	4	2	4	4	4
Stakeholders participation	4	4	2	4	4	4
Design and Innovation						
Sustainable innovation	4	4	3	4	4	4
Sustainable design	4	4	4	4	4	4
TOTAL SCORE	79	76	55	85	81	78
Average Rating	4	4	3	4	4	4
Level of Performance	Excellent		Good	Excellent		Excellent
Note: 1 = Poor	*2 = Fair*		*3 = Good*	*4 = Excellent*		

Although Diamond building incorporates combination of new concepts and ideas for a sustainable building, the occupants' comfort and satisfaction was placed at the highest priority. The building has been awarded with Platinum Certificate for meeting the standard of the Malaysia GBI and the Singapore GreenMark in 2011. Diamond building has gained international recognition as it was named the most energy efficient building at the ASEAN Energy Awards 2012 held in Phnom Penh, Cambodia in September 2012. Subsequently, in the month of October 2012 the building won the second place in the Commercial Building-New Category in the prestigious ASHRAE Technology Award 2013 by American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) (O1,U1,E1). The building also championed the New Commercial Buildings category in the Emerson Cup 2012 for India and Southeast Asia by the Emerson Climate Technologies. There was only minor complaint about the building performances have been received by the owner, energy consultant, contractor and the energy manager (O1,E1,C1,U1). Meanwhile, the local authority has never been received any complaint or negative feedback about the building performances (L1). In conclusion, while the Diamond project might be an exclusive project in Malaysia, it is not contrast with the theories discussed in the literature review. To the contrary, it supports many of the ideas about sustainability principles of building, the integration approach into the planning process and its impact towards successful sustainability performances of the project.

The case shows some clear opportunities for integrating sustainability principles into a building project and at the same time achieving the project success.

Conclusions:

This paper presents an outlook of sustainable building project stakeholders in the assessment of sustainability integration in a sustainable building development and its impact towards sustainability performance of the project. In this paper the authors have revealed that sustainability integration approach in a building project has a positive impact towards the project success. The fact was revealed by the case study project that was selected for this research; the Diamond building which has achieved at an excellent level of sustainability performance. It is clear that the building have impressed people as it has been recognized by several prestigious sustainability related awards. The findings are very useful to be an example of a successful building project in Malaysia through sustainability integration approach.

REFERENCES

[1] Akadiri, P.O., E.A. Chinyio, P.O. Olomolaiye, 2012. Design of a Sustainable Building: A Conceptual Framework for Implemanting Sustainability in the Building Sector. *Buildings, 2:* 126-152.
[2] APM, 2012. *APM Body of Knowledge: Sixth edn.* Buckinghamshire: Association for Project Management.
[3] ASHRAE, 2006. *ASHRAE GreenGuide: The Design, Construction and Operation of Sustainable Buildings (2nd edn)*. Atlanta: American Society of Heating Refrigerating and Air Conditioning Engineers. Inc.
[4] At-Tmeemy, S.M.H.M., H. Abdul Rahman, Z. Harun, 2011. Future Criteria for Success of Building Projects in Malaysia. *International Journal of Project Management, 29:* 337-348.
[5] BCA, 2012. BCA Green Mark: Certification Standard for New Buildings (GM Version 4.1). Retrieved 18th July 2013, from http://www.bca.gov.sg/EnvSusLegislation/others/GM_Certification_Std2012.pdf
[6] BRE, 2013. BREEAM International New Construction Technical Manual. Retrieved 15th July, 2013, from http://www.breeam.org/BREEAMInt2013SchemeDocument/
[7] Brent, A.C., C. Labuschange, 2004. *Sustainable Life Cycle Management: Indicators to assess the sustainability of engineering projects and technologies.* Paper presented at the Engineering Management Conference.
[8] CBRE, (CB Richard Ellis), 2009. Who Pays for Green? The Economics of Sustainable Buildings. EMEA Research. CB Richard Ellis
[9] Chan, A.P.C., A.P.L. Chan, 2004. Key Performance Indicators for Measuring Construction Success. Benchmarking. *International Journal of Project Management, 11*(2): 203-221.
[10] Choi, C., 2009. Removing Market Barriers to Green Development: Principles and Action Projects to Promote Widespread Adoption of Green Development Practices. *JOSRE, 1*(1): 107-138.
[11] Choo, F., 1999. *Malaysian Economic Development Perspective.* Paper presented at the Seminar Perancangan Agenda 21, Shah Alam Malaysia.
[12] CIDB, 2007. Construction Industry Master Plan Malaysia 2006-2015, Malaysia: CIDB.
[13] CIOB, 2010. *Code of Practice for Project Management for Construction and Development.* 4th Edn, United Kingdom: Wiley-Blackwell.
[14] DOS, 2007. The Planning Guidelines for Environmental Noise Limits and Control (2nd ed.) Putrajaya, Department of Environment Malaysia
[15] Edum-Fotwe, F.T., A.D.F. Price, 2009. A Social Ontology for Appraising Sustainability of Construction Projects and Development. *International Journal of Project Management, 27*(4): 313-322.
[16] Edward, B., 1998. *Green Buildings Pay*. Oxford: Alden Press.
[17] Essa, R., C. Fortune, 2008. Pre-construction Evaluation Practices of Sustainable Housing Projects in the UK. *Engineering Construction and Architectural Management, 16*(6): 514-526.
[18] Freeman, M., P. Beale, 1992. Measuring project success. *Project Management Journal, 23*(1), 8-17.
[19] GBCA, 2008. Green Star - Office v3 Technical Manual. Retrieved 17th July, 2013, from http://www.gbca.org.au/green-star/rating-tools/green-star-office-v3/1710.htm
[20] Gething, B., B. Bordass, 2006. Rapid Asessment Checklist for Sustainable Buildings. *Building Research and Information, 34*(4): 416-426
[21] Graham, P., 2003. *Building Ecology-First Principles for a Sustainable Built Environment* Oxford, UK: Blackwell Publishing.
[22] GRI, 2011. Sustainability Reporting Guidelines (G3.1 Guidelines 2000-2011). Retrieved 3rd February, 2012, from https://www.globalreporting.org/reporting/G3andG3-1/Pages/default.aspx
[23] GSB, 2009. GBI Assessment Criteria for Non-Residential New Construction (NRNC) Retrieved 19th July, 2011, from http://www.greenbuildingindex.org/Resources/GBI%20Tools/GBI%20NRNC%20Non-Residential%20Tool%20V1.0.pdf.

[24] GSB, 2012. What is a Green Building. Retrieved 4th November, 2012, from http://www.greenbuildingindex.org/why-green-buildings.html
[25] Harris, J.M., N.R. Goodwin, 2001. Volume Introduction. In J. M. Harris, T. A. Wise, K. P. Gallagher & N. R. Goodwin (Eds.), *A Survey of Sustainable Development: Social and Economic Dimensions* Washington DC: Island Press.
[26] Hayles, C., 2004. The Role of Value Management in the Construction of Sustainable Communities. *The Value Manager, 10*(1).
[27] SBE, 2012. SBTool Retrieved 17th July, 2013, from http://www.iisbe.org/sbtool-2012
[28] Isa, N.K.M., A. Alias, Z.A. Samad, 2014a. Towards Developing a Sustainability Integration Framework for Building Project, Journal of Building Performance, 5(1): 22-33.
[29] Isa, N.K.M., Z.A. Samad, A. Alias, 2014b. A Review on Sustainability Principles of Building: Formulation of a Theoretical Framework, *Journal of Surveying, Construction and Property*, 5 (1), 1-16.
[30] Kibert, C.J., 2008. *Sustainable construction: Green building design and delivery*. 2nd ed. US: John Wiley & Sons.
[31] Koay, A., 2011. Diamond Building: A Shining Example of Energy Efficiency. *The Star Online*, from http://www.thestar.com.my/Story.aspx/?file=%2F2011%2F7%2F5%2Flifefocus%2F8925744
[32] Labuschagne, C., A. Brent, S.J. Claasen, 2005. Environmental and Social Impact Considerations for Sustainable Project Life Cycle Management in the Process Industry. *Corporate Social Responsibility and Environmental Management, 12*, 38-54.
[33] Lim, C., M. Mohamed, 1999. Criteria for Project Success: An Exploratory Re-examination. *International Journal of Project Management, 17*(4): 243-238.
[34] Mochal, T., A. Krasnoff, 2010. Green Project Management: Supporting ISO 14000 Standard Through Project Management Process. Retrieved 14th October 2011, from http://greeneconomypost.com/green-project-management-greenpm-iso-14000-11040.htm
[35] Morris, P.W.G., 2011. Managing the Front-End: Back to the Beginning. *Project Perspectives, 33*, 4-8.
[36] Muldavin, S.R., 2010. *Value Beyond Cost Savings, How to Underwrite Sustainable Properties*. USA: Muldavin Company Inc.
[37] Pinto, M., J. Pinto, 1991. Determinants of Cross-functional Coorperation in Project Implementation Process. *Project Management Journal, 22*(2): 243-248.
[38] PMI, 2008. *A Guide to the Project Management Body of Knowledge (PMBOK)* (Fourth ed.). United States: Project Management Institute Inc
[39] Polese, M., R. Stren, 2000. *The Social Sustainability of Cities: Diversity and the Management of Change*. Toronto: University of Toronto Press.
[40] Putra Perdana Berhad, 2011. Awards. Retrieved 1st December, 2011, from http://www.p-perdana.com/
[41] Reyes, J.P., J.T. San-Jose, J. Cuadrado, R. Sancibrian, 2014. Health and safety criteria for determining the sustainable value of construction projects *Safety Science, 62:* 221-232
[42] Rowe, D., 2009. Heritage Buildings and Sustainability. Retrieved 25th July, 2013, from http://www.dpcd.vic.gov.au/__data/assets/pdf_file/0003/44859/Sustainability_Heritage_tech_-leaflet.pdf
[43] Sadeh, A., D. Dvir, A. Shenhar, 2000. The Role of Contract Type in the Success of R&D Defence Projects under Increasing Uncertainty *Project Management Journal, 31*(3): 14-21.
[44] Sayce, S., A. Walker, A. McIntosh, 2004. *Building Sustainability in the Balance: Promoting Stakeholder Dialogue*. London: Estate Gazette.
[45] Schumann, B., 2010. *Impact of Sustainability on Property Value.* Unpublished Master's Thesis, University of Regenburg, Regenburg.
[46] Ugwu, O.O., T. Chaupt, 2005. Key Performance Indicators for Infrastructure Sustainability – A Comparative Study between Hong Kong and South Africa. *Journal of Engineering, Design and Technology, 3*(1), 30-43.
[47] USGBC, 2006. Building a greener future. Special advertising section in partnership with Fortune. *Fortune, March 20, S2-S14*. Retrieved 1st August 2010, from http://www.usgbc.org
[48] USGBC, 2009. LEED for New Construction and Major Renovations. Retrieved 16 July 2013, from http://www.usgbc.org/sites/default/files/LEED%202009%20RS_NC_04.01.13_current.pdf
[49] Wu, P., S.P. Low, 2010. Project Management and Green Buildings: Lesson from the Rating Systems. *Journal of Professional Issues in Engineering Education and Practice, 136*(2), 64-67.
[50] Yudelson, J., 2009. *Green Building through Integrated Design*. United States: Mc Graw Hill Companies.
[51] Zainul Abidin, N., 2009. Sustainable Construction in Malaysia - Developers' Awareness. *World Academy of Science, Engineering and Technology, 53:* 807-814.
[52] Zainul Abidin, N., 2010a. *Environmental Concerns in Malaysian Construction Industry*. Pulau Pinang, Malaysia: Universiti Sains Malaysia.
[53] Zainul Abidin, N., 2010b. Investigating the Awareness and Application of Sustainable Construction Concept by Malaysian Developers. *Habitat International, 34:* 421-426.

[54] Zavrl, M.S., R. Zarnic, J. Selih, 2009. Multicriteria Sustainability Assessment of Residential Buildings. *Technological and Economic Development of Economic*, *15*(4): 612-630.