The Influence of Project Characteristics on Green Design Performance of Building Projects

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Abstract

The building projects are differentiated, each building project is unique in terms of size, the level of complexity, procurement systems required. The characteristics of building projects could have major influence on overall project performance. Building projects that incorporate green designs, which are complicated to understand or manage adequately and are more complex compared with typical building projects. Therefore, To achieve high- green design performance, understand crucial characteristics of building projects that may have affect performance level of green design is required. The propose of this study to identify key project characteristics of building projects influencing green design performance. To achieve mentioned aim a questionnaire survey was conducted to collect dada required. A sample of 274 respondents has been covered under the study, including architects and engineers practicing design and consultancy building sectors. Prior to analysis of data WINSTEPS software were used to determine validity and reliability of date. Descriptive analysis data includes quantitative and qualitative. The results revealed that the Project Size can influence the Green Design Performance. The type of Building and size of the project are the key factors influencing Green Design Performance. The Availability of Design Information was moderate. The Reused and Recycled Materials were hard to find, while Regional Materials were available in the market.

1. Introduction

Many researchers have identified a variety of characteristics influencing building project performance. Ling [2] and Choo et al.[3] put forward the idea building projects affect project performance. Building projects are differentiated in terms of size, the level of complexity, procurement systems. However, research on of project characteristics has long been ignored, even though they have been considered as the main factors that influence the performance of construction projects [4]. For the purpose of this research, seven most frequent project variables mentioned in literature review were chosen to be investigated. They are project size, engineering service, procurement system, design time frame, reasonability of design fees, availability of design information and availability of materials.

2. The key project characteristics

2.1 Project size

Project size usually influences the complexity of the project. Harold [5] mentioned that complex and large building projects might have a different set of regulations and guidelines from those of simpler and smaller building projects. Weingart [6] found as the project size increases, the complexities of management and coordination of the project also increase. In this context, Pheng and Chuan [1] stated that large and complex building projects usually require multiple contracts, contractors, suppliers, complicated management systems and procedures. Consequently, project performance would be affected.

2.2 Engineering services

Building projects that incorporate green designs involve technologies, which are complicated to understand or manage adequately and are more complex compared with typical building projects. This has led to more effort in managing the installation of the technologies and managing the facilities [7]. Similarly, Mohan and Anvuur [8] also believe that green building projects have great complexity and uncertainty and require more collaboration and technological management innovations. Wong et al. [9] and Al-Najjar [10] stated that the complexity derived from engineering services and technology required of design is one of the factors that influences project performance.

2.3 Type of procurement

The types of project procurement system play a major role in how building projects would be managed. Wardani [11] and Rashid et al. [12] found that project procurement system affect project performance. The type of procurement system selected also has a critical influence on the design process [13].

There are a range of procurement systems available in the construction industry providing a greater option to the clients. Egbu et al.[14] stated that clients and their consultants should select a procurement system carefully while considering project nature, risk, resource availability and characteristics of the individuals participating in the project. Similarly, Abdul-Rahman et al. [15] and Abedi et al. [16] indicated that the criteria used for selection of procurement systems vary among clients, depending on the objectives of the projects.

Ali and Rahmat [17] and Ahmad [23] found that there are five procurement systems commonly used for construction projects in Malaysia. The procurement systems are the traditional, design and build, construction management, and design, build, operate and transfer. However, Ali and Rahmat [17] and Ahmed [23] found that the most popular procurement systems are traditional and design and build methods.

The traditional procurement system requires the design to be completed before construction starts. The possibility of variation order is high. Incomplete documentation and any items added during the construction stage makes it difficult for construction projects using the traditional procurement system to complete on time and within budget [18].

The main criticism of the traditional procurement system is that the process is fragmented, with design process being separated from construction process. Rahamt and Ali [17] argued that having an integrated process can improve project performance. However, The implementation of the integrated process by the construction industry remains inadequate [19].

The design and build procurement system is a system that integrates design and construction stages. Mitropoulos [20] stated that the design and build procurement system is an effective device to facilitate the integration of the design process and construction covering the entire approaches of managing design and construction in a single accountable organization. The main feature of this procurement system is a single point responsibility, whereby, the contractor is the sole party responsible for the project to be complete on the time and within budget. Alexander [21] mentioned that the popularity of the design and build procurement system is increasing. Due to this, the design and build procurement system is the second most popular procurement system used for building projects in Malaysia [17].

The performance of projects using design and build procurement system are always better in achieving quality standards in both normal and complex or innovative projects[22]. Rahmat [23] also found that construction projects using design and build procurement system performed better that those using traditional procurement system. On the other hand, Ibbs et al.[24] found that the performance of design and build projects was greatly worse in the American United States compared to the performance of traditional projects. These findings were supported by Ann et al. [25] who also found that the performance of some D&B projects is low because the aim of the design team was to reduce the total cost of construction and to utilize low-cost and quick term solutions to solve design problems.

Literature review revealed that no research had been carried out to measure the effect of the procurement system on the green design performance of building projects. This research is to fill this gap. Gaia [26].

2.4 Design Information Availability

Wang et al.[27] mentioned that design information is one of the most critical factors in determining the performance of design phase. Karl [28] believes that the lack of adequate resources is critical to team effectiveness and frequently a major reason of poor team performance.

Abdullah [29] mentioned that one of the main problems of building professionals in responding to green development is a lack of information. These findings were supported by Green Purchasing Network [30] who found that most of low performance design and construction firms in implementing green design issues was due to a lack of allocated resources and organizational commitment to green buildings. Ofori [31] concluded that one of the key barriers of implementing green issues in Singapore was the lack of resources.

Pheng and Chuan [1] defined availability of information as the information from clients, contractors and other design team professionals required to perform the assigned task. The quality of Information plays a major role in achieving high performance in building projects. Ali [32] quoted Mackinder and Marvin (1982) stating that the quality of information provided at the early design stage would assist the design team greatly to accurately complete designs as needed. A strong relationship was found between sufficient drawings and the performance of engineers [33]. These findings were supported by Choo et al. [3] who also found that the

performance of design depends on the quality of available design information. Hes [34] concluded that the lack of information available is one of the key barriers of integrating green innovation into the building industry.

Information availability has a major influence on the quality of decisions made during design the stage [35]. Any decisions made at the early design stage can influence the overall performance of the project. Pheng and Chuan [1] maintained that the decision on the quality of design team leaders is highly affected by the availability of design information. This view is echoed by Steemers [36] who stated that although there is extensive availability of information on energy efficiency and renewable relating to the design of green buildings, there is a lack at the management level of how building design can adapt to climate change. There is also a lack of particular decisions to enhance the performance of green buildings.

2.5 Green Materials Availability

Various raw materials are currently being consumed which are from non-renewable sources or their rate of utilization is much faster than their rate of renewal [37, 38]. Shafii et.al [39] highlighted that about 50 percent building materials and products are damaging the environment because they are obtained from the crust of the earth. Furthermore, Kichuk [40] discovered building materials contribute between 20-30 percent to the overall cost of building cost, therefore a major component of building project. Therefore, using green building materials would contribute substantially to greening the building project. This suggests that it is vital for the design team to select appropriate building materials. Ljungberg [41] recommends more efficient use of materials through additional material substitution, material efficient design, use of composite materials and future recycling.

At the current rate, material utilization is not efficient because it generates a lot of wastage. Ceridon [38] believes that efficient material utilization and the adoption of clear approaches to reduce raw material consumption and waste generation are essential ways to reach green material levels. Whereas, Knesl et al. [42] suggested that the hierarchy of 'reduce, reuse, recycle' can provide a guideline for decisions associated with efficient building materials utilization. Therefore, it is crucial to consider in product development the selection of renewable materials like woods and plastics, which in a short time can be replenished [41].

The main aim of green building is to minimize the negative impact of buildings on the environment. Lam et al. [43] suggested that including green objectives in the specifications for building materials and practices would contribute the greenness in the construction industry. Over and above the green building can be more easily achieved by including green considerations into building specifications and construction.

The application of green materials in the construction industry is still insufficient. Sands [44] found that the most important barriers to high performance green building is the lack of availability of accurate data of green materials. These findings were supported by Shafii and Othman [45] who also found that manufacturers of building materials and products should take life-cycle into consideration and move toward making green materials available. Building manufacturers should also ensure that green building materials are more durable as compared to those utilized in conventional systems.

2.6 Design Time frame

Pheng and Chuan [1] defined the time availability of a project as the availability of time required to do an assigned task. He considered time as an intangible resource that is unique because it is absolutely finite. Peshos and Hall [46] mentioned that the design process is an intuitive and innovative assignment, normally constrained by time limits. Tilley [47] found that with the increasing complexity of construction projects, the key factor contributing to poor performance of design is time reduction being made to win the design task.

Coles [48] emphasized the significance of having adequate design time to complete a high quality building design. Time is vital to design teams, particularly for gathering all required information from various sources. If the timeframe given by the client is inadequate, the design teams would only utilize the available data and have to make many assumptions when making design decisions. Unrealistic design duration would result in many design changes, which may result in a further loss of time.

Odeh and Battaineh [49] observed that unrealistic time imposed by clients is a major cause of building projects' delay. In addition, Ali and Rahmat [50] mentioned that insufficient time given for design might negatively affect the morale of the design team, relationship with others and communication efficiency, resulting in a reduction of productivity and attention to design related details. Similarly, Andi and Minato [51] found that a limitation of design time is one of key factors influencing the documentation output quality of a design. Pertaining to this issue, Abedi et al.[16] maintained that insufficient time allocated to design might interrupt the design teams' chance to develop drawing details and perform coordination on the various features of the design. These findings were supported by Tilley [47] who discovered that with more

time allowed for the design process and documentation, the design quality improves significantly.

However, Wan and Kumaraswamy [52] argued that even though time may be limited, too much time is wasted during the design process. He suggested that improving design management practices during design might help to reduce that waste.

It could be argued that applying green aspects in design will add time to each stage of a project. Sandra [53] argued that incorporating green building features adds to the timeline of the project, therefore, design teams of projects with time constraints will avoid implementing green aspects. Danielle [54] mentioned that to apply green design aspects, design teams require more time to justify budget allocations for green initiatives and to discuss the expectations of the client for the building. Furthermore, additional time might be required to facilitate an integrated green design process and the construction plan may require additional time to establish green management practices (i.e. waste recycling, water harvesting and environmental system management).

Throughout the design stage, the main objectives of traditional client goals are cost and quality. Graham [55] mentioned that the design process is often a time-limited process. Therefore, the design team faces difficulties in their practices to tackle the complicated issues of green performance of buildings, particularly, when it is not stated clearly in the client brief. Hoffman and Henn [56] argued that clients should allow additional time for implementing green features because when the design team is involved in green design they expand the scope of design problem investigation. Green performance assessments might increase the design time required and may require additional environmental consultants during the conceptual design stage.

2.7 Reasonability of design fees

The funding of a building project must be adequate and sufficient for a project to run smoothly. A sufficient budget allocated for a project is the most critical factor contributing to design outcomes [57]. According to findings of research made by Tilley [47] concerning the association of fees structure and design deficiency demonstrated that when design fees are reduced below the design team's optimal level, design deficiency increases sharply. Likewise, Love et al.[58], also found that insufficient funding of a project was a main contributing factor to a rework in design. These findings were supported by Andi and Minato [51], Darwish [59] and Sahil [60] who also confirmed that there was a strong relationship between a total reduction in design fees and the quality of outcomes in design, documentation and construction process efficiency.

Abedi et al.[16]discovered that budget constraints might occur if the client has inadequate financial management and control. Delay of payment to the design teams could contribute to project delays. These findings were supported by Tilley [47] who also found that overall project quality is determined by the level of design team services provided and that the quality of these services is usually influenced by how the fees of these services are negotiated. When a design team is selected based on minimal design fees, the quality level of the service and proficiency provided is expected to be insufficient and generally interprets into extra project costs to the owner. From a management prospective,

The design process of green building requires more time and effort. Kohler and Moffatt [61] believe that the fees of a green building design team are allocated more for the design stage but less or the same for the construction stage. Additional design fees could be covered with lower construction costs. Yudelson [62] mentioned that the design of green buildings is more complex and requires the application of special architectural and engineering aspects, which lead to the involvement of specialized consultants, consequently the design fees tends to increase.

Certainly, owners and developers of buildings dislike paying more design fees simply to include green features in the building design. Yudelson [62] suggested that to ensure the successful design of a green building, the owners should be willing to pay additional design fees while taking the selection of the best green design practitioners into consideration. This view is supported by Lamborn et al. [63] who mentioned that one of the key barriers to implementing green design issues during the design stage in commercial building is fee constraints. Ofori [31] confirmed that although design fees are the major determinant in selecting design teams, the significance of fees must not be overstated, since value adding by a design team is much more significant.

3. Research methodology

The research was performed throughout three main stages, the first stage was a comprehensive literature review validated in a preliminary questionnaire survey. Data collection involving semi-structured interviews was the second stage. The main aim of this stage was to upgrade and refine the research problem and proposed theoretical framework. The last stage involved the final questionnaire survey, in which data was collected for statistical analysis purposes. Prior of this survey

preliminary questionnaire was posted. Four research variables were verified.

To investigate key characteristics of building projects influence green design performance, in final questionnaire survey, the questionnaire was divided into two parts. The first part requires respondents to provide their personal particulars, whereas, the second part focuses on uncovering the key characteristics of building projects. A survey package consisting of the detailed questionnaire was posted to professionals in various architectural consultancy firms as well as engineering consultancy firms, selected by the lists of architects and engineers provided from their organizations. The population for this study became key design team players for architects and engineers. Only architects registered in PAM and Engineers registered in AECM are selected as the research context. The target population includes architects and Engineers working in design consultancy located in Malaysia. A total of 274survey questionnaire were distributed, 102 valid replies were received, which represents a response rate of 37.1%. WINSTEPS software was used for Rasch Modeling of the Principal Performance Measures to examine data validity and reliability was analyzed. SPSS virsion19, software was used to analyses data collected. The technique of descriptive statistics was used to describe and make sense of the data. The descriptive statistics included the frequency and mean for studied variables.

3.1 Validity and reliability

Prior to analysis, functioning of the 5-point Likert scale was examined according to the criteria by Linacre (2006). More than 10 observations are found in each category. Table 1 shows the rating scale category function data for design team attributes suggesting no category disordering. Beside, both the observed average measures and category measure are characterized by criterion of monotonic advance. The Outfit MNSQ values, which are close to infit MNSQ values, for each category are all close to 1.00 and measurement information rather than noise in the data. The threshold estimates increase with the category label, indicating that the response categories were used in expected and intended manner. These evidences suggested that the rating scale categories are effectively satisfactory for effective design team variable

3.2 Reliability and separation index:

As can be seen from Table 2, reliability of all variables item difficulty measure was very high (0.98). This suggested that the ordering of item difficulty was highly replicable with other comparable sample from similar population. The item separation index was very high which are considerably higher than the minimum desired 2.00. The Adj-Sd was at accepted estimate. The item measure RSME measure was 0.11 which considered very well. Taken together, these statistics indicate good separation between items and item measures.

Table 1:Key reliability and validity parameters of project characteristics items

Total variance in observations	Category measures	Threshold estimates
-1.22	-2.92	-
-0.62	-1.19	-1.65
-0.02	-0.02	- .38
.67	1.20	.47
1.03	2.86	1.56
Rasch Principal Components Analysis (RPCA)		
Total variance in observations	55.9%	
variance explained by measures	23.4%	
Unexplained variance in 2ndcontrast	44.1%	
Reliability and Separation index		

	Model RMSE	Mean	Adj-Sd	Separation	Reliability
Behavior measures	0.43	0.06	0.84	6.86	0.98
Item measures	0.11	0.35	0.84	7.35	0.98

3.3 Dimensionality test of variables

For the project characteristics with five-category response model as can be seen in Table 2, all items had acceptable outfit MNSQ statistics between 0.78 and 1.45 the lowest infit was 0.75 whereas the highest was 1.49 suggesting that it was not redundant items with considering high values may represent a lack of homogeneity with other items in the subscale. All items had high to very high PTMEA correlations (0.26 - 0.62) which exceeded 0.20 as critical value for the correlation. Positive sign of correlation values identified that the items are systematically correlated in the same direction, measuring the same latent variable calling "project characteristics", therefore, all items had good discrimination.

Table 2: Item statistics: misfit order and item correlations

Variables	MNSQ				PTMEA	
	outfit		Infit			
Clients' qualities	Lowest	Highest	Lowest	Highest	Lowest	Highest
	0.78	1.45	0.75	1.49	0.26	0.62

4.0 Results and discussion

Various researchers have identified a variety of Project Characteristics that influence the overall project performance. Pheng and Chun (2006) stressed that Project Characteristics are one of the factors that have an influence on the project performance.

This study measures the variables under Project Characteristics which are measured by using five-point scale ranging from (1) very low to(5) very high. General Project Characteristics are discussed below.

4.1 Project Size

Pheng and Chuan [1] mentioned that as the Project Size increases, the complexities of management and coordination of the project also increase. In the final questionnaire survey, the sizes of the building projects undertaken by the respondents are obtained. The classification of Projects Size followed the classification used by the Public Works Department. Table 3 shows about two-thirds (63.7%) of the contract value of building projects in the study which is more than RM11million. Thus the building projects surveyed in this study tend to be large.

Table 3: Project size and contract value (RM/Million)

Project Size	Contract value (RM/Million)	Frequency	Percent
Small	2 -10	37	36.3
Medium	11 - 50	39	38.2
Large	More than 50	26	25.5
Total		102	100.0

In the semi-structured interviews, all respondents agreed that the size of the project has a major influence on the degree of project complexity. An Architect pointed out that building project requires an effective leadership and management of design teams. This point of view was confirmed by Wang and Mills (2002) who stated that design performance is affected by project size and technologies.

The results indicate that the all of the contract value of selected projects were more than RM2 million that satisfies one of the parameters of this study.

4.2 Engineering services

Wong [9] and Al-Najjar [10] stated that buildability of design is one of the factors that influences project performance. Pheng and Chuan [1] observed that as project size increases, the complexity of the building project also increases. Large and complex building projects usually require complicated management systems; consequently, project performance would be affected. This study measures the complexity of technology and Engineering Services. The result is shown in Table 4. About half (50.9%) of the buildings are complex/very complex. This is expected since the building projects are mostly large.

Table 4: Complexity of technology and engineering services

Level of Complexity	Frequency (N=102)	Percentage
Not Complex	3	2.9
Low Complex	10	9.8
Moderate	37	36.3
High Complex	34	33.3
Very high Complex	18	17.6

In the semi-structured interviews, all Architects pointed out that those large building projects have more complicated Engineering Services that need the involvement of several of professionals.

The result reveals that as the complexity of the Engineering Service and technologies require increased as the contract value (project size) increased. Pheng and Chuan [1] stated that large and complex building projects usually require complicated multiple management systems, consequently, project performance would be affected.

4.2 Procurement Systems

The type of project procurement systems play a major role in how building projects would be managed. Naoum [65] observed that the key factor affecting a project performance was the project procurement system adopted. This view was supported by Walker [66] and Bowen et al. [67] who also believe that the performance of building projects is greatly affected by the use of inappropriate procurement systems selected for the building projects.

Table 5 shows that the traditional procurement system is more popular than Design and Build system, both for public and private building projects. Almost two-thirds (59.9%) of the building projects, use the traditional procurement system.

Table 5: Percentage of procurement systems used via type of client

Type of client	Traditional (N=61)	D&B (N=41)	Total (N=102)
Private	32.4	26.4	58.8
Public	27.5	13.7	41.2
Total	59.9	40.1	100.0

4.3 Design Fees Reasonability

The Design Fees Reasonability is considered as the key factor influencing Design Team Performance [13, 68].The funding of a building project must be adequate and sufficient for a project to run smoothly. A sufficient budget allocated for a building project is the most critical factor contributing to design outcomes [57].

The respondents in this study were asked about the Reasonability of Design Fees for the building projects using five point scales ranging from (1), very unreasonable to (5) very reasonable. The result is shown in Table 6. In about half of the building projects (45.1%), the design fees were found to be reasonable / very reasonable. In fact, twice as many building projects were having reasonable / very reasonable (45.1%) responses design fees compared to the building projects having unreasonable / very unreasonable design fees (20.5%). Hence, it can be concluded that generally the design fees allocated for the building projects in this study is reasonable.

Table 6: Reasonability of design fees

Reasonability of Design Fees	Frequency (N=102)	Percentage
Very Unreasonable	3	2.9
Unreasonable	18	17.6
Neutral	35	34.3
Reasonable	40	39.2
Very reasonable	6	5.9

*Key: 1 - 1.8: very unreasonable; 1.9 - 2.6: unreasonable; 2.7- 3.4: neutral; 3.5 - 4.2: reasonable; 4;2 - 5.0: very reasonable.

4.4 Design Time Frame

Time Availability of design is the availability of time required to do an assigned task [1]. Ali *et al.*[69] mentioned that one of the most significant feature influencing performances of building projects that should be considered by the clients of building projects are budget and time.

Time is vital to design teams, particularly for gathering all required information from various sources. As Table 7 shows where the 40.2 percent of projects had less than 5 percent of time variance, 23.5 percent of projects were not having time variance. Only 13.7 percent of projects had time variance between 10 – 15 percent.

Table 7: Time variance of designed building projects

Time Variance	Frequency (N=102)	Percentage
Completed on time	24	23.5
Less than 5%	41	40.2
5%- 10%	18	17.6
10% - 15%	5	4.9
More than15%	14	13.7

The result indicates that the majority of projects were designed with only 23.5 percent completed on or before the planed time. Five percent only of time variation for both traditional and D&B procurement systems.

4.5 Design Information Availability

Lack of adequate resources influences project performance. Abdullah [29] was of the view that one of the main problems of building professionals in responding to green development is a lack of resources. These findings were supported by Zulina *et al.*[70] who found that most of low performance design and construction firms in implementing green design issues was due to a lack of allocated resources and organizational commitment to green buildings.

Availability and Quality of Information play a major role in achieving high performance in building projects. The respondents were asked about the degree of green Design Information Availability using multiple choice answers from a very low extent to a very high extent. The result of the survey as shown in Table 8 about two-thirds of respondents found that the information of green design was moderately available. About a fifth (18.6%) of respondents agreed that the extent of Design Information Availability is high / very high. The majority of the building projects had only a moderate level of Design Information Availability.

Table 8: Availability of Green Design Information

Design Information Availability	Frequency (N=102)	Percentage
Very low	4	3.9
Low	15	14.7
Moderate	64	62.7
High	16	15.7
Very high	3	2.9

In semi-structured interviews, all architect interviewees agreed that the main source of required information for design conceptualization is the client brief. The other project participants such as M&E engineers, contractors and suppliers are the second most important source of functional information. An M&E mentioned that good leadership and effective communication could facilitate information exchange among design team members.

The result indicates that Availability of Design Information have a major influence on design performance of green buildings. Green design information is moderately available and requires an effective communication and coordination among design team members.

4.6 Green Materials Availability

Integrating green elements into the buildings designs aims to minimize the influence of building on the environment. The Availability of Green Materials plays a major role in achieving green building. The respondents were asked about the degree of Availability of Green Materials using multiple choice questions and give answers from very low extent to a very high extent. The results of the survey are shown in Table 9. Almost all the respondents found that the materials of green design availability were high / very high.

Table 9: Availability of green materials

Green Materials Availability	Frequency (N=102)	Percentage
Very low	1	1
Low	14	13.7
Moderate	36	35.3
High	42	41.2
Very high	9	8.8

In the semi-structured interviews, all interviewees agreed that the majority green materials are not available locally, particularly reused and recycled construction materials and their price was not reasonable. The Architects believe that the green materials could be obtained if related specifications were available.

The result indicates that the Availability of Green Materials have important influence on Green Design Performance of buildings. Design team through integrating green materials face key barriers such as availability of reused and recycled materials, cost competitiveness and client commitment.

5. CONCLUSION

It can be concluded that the availability of green materials have a great influence on the green design performance of green building projects. The key

features of green materials that could be used in buildings are that they can be reused, recycled and reduce waste. There is a need for more emphasis on the implementation of effective green selection techniques such as specifications and life-cycle assessment during the design stage.

The buildings that incorporate green design require more time for the design process compared to buildings that are not. The green design process is more complex than ordinary projects and requires that additional time be given to the design team.

The project funds in general and design funds in particular have major influences on the green design performance of a building project. Insufficient design fees could affect design quality, increase design errors and influence the design teams' coordination level. Green design is more complex in nature, therefore, it requires more time and fees, which should be allocated by the client to achieve high-performance design.

To achieve appropriate green building performance, more consideration is needed in selecting the appropriate procurement system. Joyce and Tim [71] believe that green procurement should be encouraged through polices, information availability and the dismantling of barriers with more emphasis on green procurement implementation within government procurement.

In conclusion, the results revealed that Project Size can influence the Green Design Performance. The extent of Engineering Service is required. The type of Building and size of the project are the key factors influencing Green Design Performance. Sixty percent of building projects implemented traditional procurement system and 40 percent used D&B system.

Design time variances of studied projects were ranged 5 to 10 percent. The Availability of Design Information was moderate. The Reused and Recycled Materials were hard to find, while Regional Materials were available in the market.

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