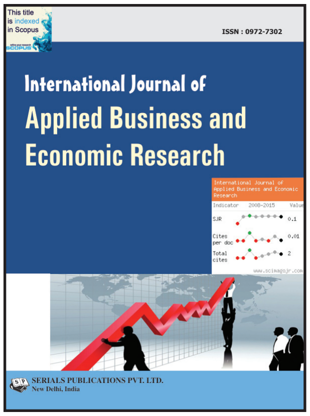

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An Evaluation on the Effectiveness of Green Buildings in Malaysia

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ABSTRACT

This study aims to investigate the prima facie conjecture that there are problems to an evaluation on development of green building in Malaysia with regard to the effectiveness of green building index (GBI). This is due to the lack of information on its effectiveness. These problems may explain why the main players are less responsive to the implementation and practice of the GBI. It is essential that an appropriate model of GBI be used by the administrators and professionals. This proposed model is based on the dependent variable, green building performance and the independent variables namely, awareness of environment, technology, social element and legislation. Three prominent factors are identified: firstly, awareness on the environment and the practice of the GBI among practitioners in green building implementation is lacking, secondly, the effects of technology and social aspects are not properly addressed and thirdly, insufficient rules and regulations on green building development that affects the implementation of the GBI. The data were collected via a questionnaire survey and analysed with the help of SPSS. The major research findings indicate that there was a concordance of opinions among the respondents on the three main factors. Four hypotheses were accepted based on the analyses. This study recommends the need for all parties involved to develop plans, regulations, procedures, specific guidelines and inputs to pertinent academic programmes if the green concept and GBI elements were to be effectively practised in property development in this country as a whole. A quantitative survey was done on GBI professional members through random sampling on 266 people, In conclusion, it can be inferred that the GBI is still at its infancy stage and as such serious attention is needed among the players in the development of green building in Malaysia.

Keywords: Building Industry, Green Building Performance, GBI Tools, Green Indicators.

1. INTRODUCTION

Most of the constructed buildings in Malaysia are not categorized in green responsive building. From energy views, current life styles demand for lots of energy to support a comfortable environment to run our daily life such as: air-conditioning to counter Malaysian hot weather, light in indoors even during daytime, filtered water for drinking and daily use and more, Ninety-five percent of energy in Malaysia is generated by non-renewable natural resources such as oil, coal and natural gas (Oh, 2010). It is harmful to our living environment and brews an insecure environment for our next generation. From construction view, the buildings which are not sustainable or uses green material as a construction material and the construction method are considered improper managerial of waste and land usage. Malaysian communities need more awareness and education with the responsibility towards environment and knowledge about sustainable, green and ecology technology (Mat Said et. al, 2003). However, there are many emerging ways to define a green design. In Malaysia, rating system for green design called GBI has existed. Green Building Index (GBI) was developed by the Malaysian Architect Associate (PAM) and provides a checklist to achieve sustainable building design. Features in the checklist in clued a range of construction aspects from site selection, to energy sources, to materials of construction. Energy-efficient appliances, alternative heating/ cooling source, solar energy and water conservation all contribute to what is widely considered to be green (Gan and Li, 2008).

The Malaysian construction industry is generally separated into two areas. One area is general construction, which comprises residential construction, non-residential construction and civil engineering construction. The second area is special trade works, which comprise activities of metal works, electrical works, plumbing, sewerage and sanitary works, refrigeration and air-conditioning works, painting works, carpentry, tiling and flooring works and glass works (Salim and Yadav, 2012). This research will be investigating the constituent determinants of GBI in the Malaysian building industry and how these have affected green building performance, Awareness of Environment, Technology, social element and Legislation as the key factors. Much of the research that exists provides conflicting or ambiguous empirical findings.

2. THE LITERATURE REVIEW FOR RESEARCH

2.1. Sustainable Construction in Malaysia

In Malaysia, there is an increasing public awareness and interest in how buildings affect the environment, worker productivity and public health. The participation of the local government, local authorities, professional bodies and private companies plays an important role for a country to develop sustainably. In 2009 at the United Nation Climate Change Conference in Copenhagen, our prime Minister promised to reduce our carbon emissions by fourty percent by the year 2020 as compared to the level in 2005. Following that, in the 2010 budget (GBI,2010), under the Heading 'Developing Green Technology, Item fifty six on GBI', our Prime Minister announced that the government will establish a fund amounting to RM1.5 billion to promote green technology. GBI is a green rating index on environmentally friendly buildings. Green buildings save utility costs and preserve the quality of the environment.

As a developing country, Malaysia realizes that the construction industry is regarded as an essential and highly visible contributor to the process of growth of the country. Over the last two decades, the construction industry had been consistently contributing between three percent to five percent of the national gross domestic product (CIDB, 2009). The CIDB is a corporate body and established with the main functions of developing, improving and expanding the Malaysian construction industry. Besides that, they also placed environmental and other sustainability related issues as top priorities in their agenda to promote in the construction industry.

At present, there are several sustainable projects that are being or have been constructed in Malaysia. Several examples include the Bangunan Suruhanjaya Tenaga which achieved platinum GBI rating, Ken Bangsar with gold GBI rating, 1 First Avenue with gold GBI rating and several hundred buildings that are currently being processed by the GBI. This goes to indicate that the construction of sustainable projects in Malaysia with the concept of sustainable construction is beginning to settle within the industry. However, the development of sustainable buildings in Malaysia at this point in time is still relatively low. Projects on sustainability in Malaysia are mostly at its pioneering stage which indicates that the Malaysian construction industry is still at its infancy level when dealing with sustainable matters (Abidin, 2010).

The growing number of sustainable projects being built in Malaysia is a sign of the moderate assimilation of the sustainability concept among construction practitioners. Much to the detriment of the matter, issues related to sustainability regularly appear in headlines, mainly about the dissatisfaction with the outcome or results of construction and the irresponsible actions by contractors and developers relating to environment protections. These negative remarks about construction show that the contributions and efforts by the government, non-government organisations and educational institutions have not fully penetrated into construction activities. Hence, a lot more effort and work are necessary to enhance and improve the level of environmental awareness and civic consciousness among the people to build sustainably in the future (Zainul, 2009).

2.2. Green Building Development

A Green building focuses on increasing the efficiency of resource use energy, water, and materials while reducing building impact on human health and the environment during the building's life cycle, through better siting, design, construction, operation, maintenance, and removal. Green buildings should be designed and operated to reduce the overall impact of the built environment to its surroundings (Salama, et. al., 2010) (see Table 1).

The benefits to green building are manifold, and may be categorized along three fronts:

1-environmental 2-economic 3-social

Table 1
Benefits to Green Buildings (Salama, et. al., 2010)

Environmental Benefits	*Economic Benefits*	*Social Benefits*
Emissions Reduction	Energy and Water Savings	Improved Health
Water Conservation	Increased Property Values	Improved Schools
Storm Water Management	Decreased Infrastructure Strain	Healthier Lifestyles and Recreation
Temperature Moderation	Improved Employee Attendance	
Waste Reduction	Increased Employee Productivity	
	Sales Improvements	
	Development of Local Talent Pool	

Green buildings are designed to save energy and resources, recycle materials and minimise the emission of toxic substances throughout its life cycle. Green buildings harmonise with the local climate, traditions, culture and the surrounding environment. Green buildings are able to sustain and improve the quality of human life whilst maintaining the capacity of the ecosystem at local and global levels. Green buildings make efficient use of resources; have significant operational savings and increases workplace productivity. Green building sends the right message about a company or organisation that it is well run, responsible, and committed to the future. Humans use the building for a long period of time. There are a lot of buildings that can be categorized as green even before the term green building was introduced. In other words, the green design existed for a long time. When it had been introduced as a new concept, the green building was given serious attention. According to Beatley (2012), a few early records showed that the green design concept started to be used before the arrival of the European people to North America. For example, the Anasazi people had been building their houses facing the plunged cliff. The projecting cliff will prevent the sun light during the summer. Nowadays, this concept is known as passive solar shading design.

2.3. Green Building in Malaysia

The Standards and Industrial Research Institute of Malaysia (SIRIM) encourages sustainable building practices. In 2009, the Green building Index (GBI for short) was founded in collaboration by Pertubuhan Akitek Malaysia (PAM) and The Association of Consulting Engineers Malaysia (ACEM), propelled by the need to take care of the environment. The GBI is aimed at leading the building industry into becoming more eco-friendly in their practices. It is fortunate that the GBI has the full support of the Malaysian construction industry. One of its main aims is to promote awareness on green building practices to the concerned parties especially the designers, engineers and the decision makers of both the government and the private sector Apart from Singapore's GREENMARK Malaysia's GBI is the only rating tool in tropical Asia. The scoring system has been largely customized in order to best suit the situations in Malaysia. Therefore, highest scores have been allocated to energy and water saving. It is not surprising that the GBI (M) differs from Singapore's GREENMARK since it has been customized to Malaysia's environment, climate and resources available (GBI, 2009).

There are similarities and differences regarding evaluation criteria among countries. Table 2 shows the comparison of assessment methods in selected countries. The evaluation process involved assessment on the early construction stage which led to the temporary GBI rating award. The final award will be given a year after the building has been occupied. The building will be assessed again every three years to maintain the GBI rating, to ensure that the building has been maintained well. These buildings will be awarded with Platinum, Gold or Silver category depending on the score achievement. In Malaysia, the building owners, developer and consultants can apply for GBI assessment to GBI Sdn Bhd (GSB), a company that has been established specifically by PAM and ACEM. The applicants can also appoint GBI as the facilitator to provide professional assessment service. GBI provides an assessment to encourage environmental friendly building construction for the future of Malaysia. This is a rating system that has integrated the best practices in environmental design and performance, which is recognized internationally (Baharuddin, et. al., 2011). Malaysian GBI becomes the only evaluation method for tropical zone, besides GREENMARK in Singapore. GREENMARK was first launched in 2005. In April 2008, the evaluation became mandatory for every building either, new or existing that exceed 2000 square meter to meet the minimum rating of GREENMARK certified in Singapore (Samad, et. al., 2014).

Table 2
The Green Building Assessment Criteria Differences by Country (Ali, et. al., 2009)

Name Country Year	*BREEAM UK 1990*	*LEED USA 1996*	*GREEN STAR Australia 2003*	*GREEN MARK Singapore 2005*	*Green Building Index Malaysia 2009*
Assessment Criteria	1. Management 2. Health & Comfort 3. Energy 4. Transportatn 5. Water Consumption 6. Materials 7. Land Use 8. Ecology 9. Pollution	1. Sustainable Site 2. Water Efficiency 3. Energy & Atmosphere 4. Materials & Resources 5. Indoor Environmental Quality 6. Innovation & Design/Construction Process	1. Management 2. Transport 3. Ecology 4. Emissions 5. Water 6. Energy 7. Materials 8. Indoor Environmental Quality 9. Innovation	1. Energy Efficiency 2. Water Efficiency 3. Environmental Protection 4. Indoor Environmental Quality 5. Other Green Features	1. Energy Efficiency (EE) 2. Indoor Environmental Quality (EQ) 3. Sustainable Site Planning & Management (SM) 4. Materials & Resources (MR) 5. Water Efficiency (WE) 6. Innovation (IN)

2.4. Green Building Index (GBI) Facilitators

Appointment of the GBI facilitator to engage throughout the construction duration from design phase till project completion is to streamline the application and certification process. Up to 2013, there has been 800 qualified GBIF who are available in Malaysia. The professional fees of GBIF are not fixed and it will solely depend on the preference of the GBIF.

Components of Green Building Index (GBI)

2.4.1. Energy Efficiency (EE)

In Malaysia, the government has been playing a role in promoting the importance of EE by implementing various EE initiatives covering incentives, education and subsidiaries over the last three decades. It is noticed that the building professionals do not consider energy efficiency an issue that should be highlighted (Manan, et. al., 2010). The lighting zone is encouraged with the usage of auto-sensor controlled lighting and motion sensor for lighting zoning. Individual switches shall be used for greater flexibility of light switching. Separate sub-metering for energy use ≥100 kVA shall be implemented and by using the Energy Management System to monitor and analyse energy consumption in the building: Sustainable maintenance to ensure the energy system will perform as expected beyond twelve months of defects and liability period has to be achieved by setting up the Energy Monitoring Committee (EMC) and providing a maintenance office and permanent maintenance team one to three months before practical completion (GBI, 2009).

2.4.2. Indoor Environmental Quality (EQ)

An energy efficient strategy can be incorporated into passive design strategy which is mainly involved in the design stage and active design strategy which is mainly involved in the installation of mechanical elements. The equipment and appliance for natural ventilation and air conditioner have incurred a relatively high cost in implementing the green building projects (Zhang, and Shen, 2011). The building is required to meet the minimum requirements of ventilation rate in Indoor Air Quality (IAQ) procedure of ASHRAE 62.1 or local building code. The purpose of the standard of ASHRAE 62.1 is to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects. An attempt such as natural ventilation, exhaust duct location, and ventilation system control are the methods introduced in ASHRAE 62.1 (Wilson and Piepkorn, 2008).

2.4.3. Sustainable Site Planning and Management (SM)

A site planner should consider how to minimize the disturbed area for the project. The key element of minimizing the disturbed area is the degree to which habitat and open space are preserved and created. The selection of site plays a crucial role in this section. The building should be constructed with a minimum density of 20,300 m^2 per hectare net. Also, it would be the best if it is located within 1km of residential zone or at least ten basic services. Redevelopment of existing site can reduce the exploitation of site where the natural environment is preserved (Zhang, and Shen, 2011).

2.4.4. Materials and Resources (MR)

The materials used are very important in reducing the environmental impact caused during the extraction and processing of virgin resources by reuse of the products and pre consumer content or post-consumer recycled content materials (Ismail, et. al., 2012). Construction waste management plays a role in diverting the construction waste or debris from disposal from landfill, redirecting the reusable materials to the relevant site and the recyclable materials to the manufacturing factories respectively. A proper storage area and recycle bin shall be prepared to store the non-hazardous materials for recycling to reduce waste.

2.4.5. Water Efficiency (WE)

The supply of edible water is limited, if the level of consumption of the water remains, the humans will suffer from the water stress soon. The GBI has introduced the rainwater harvesting system to reuse the rainwater and the grey water, i.e all waste produced in the home is greatly encouraged for recycling for building consumption or irrigation (Ismail, et. al., 2012). The type of plant for landscaping could also contribute for the water reduction such as the native and adaptive plant. Another way to reduce the water usage is to use adequate water system such as automatic self-closing equipment's to get rid of further water wastage. Water sub metering and leak detection systems already require to achieve WE that allows monitoring and management of water consumption. The common water meter has low sensitivity towards the small water consumption such as water leakage (Liew, 2012).

2.4.6. Innovation (IN)

To encourage the design integrated with the requirement of GBI and streamline the application and certification process, it is encouraged to have at least one key participant in the project to be the GBI facilitator. In addition, any initiation in adopting a better innovation system other than the requirements in constructing the building will be added with additional points (GBI, 2009).

2.5. Awareness of Environment Influence on Green Building Performance

Nowadays, awareness of environment is very important, especially to students that are involved in technical and building environment courses. Based on the outcomes of the interviews between the researcher and academic experts, they suggested that it was a need to emphasize more on green building aspects in building environment courses in local institutions. The environmental exposure to the students nowadays is still low. Environmental subject should be incorporated in engineering courses at the undergraduate level which include the structure design. Machineries and developments plan preparations and constructions (Todd, et. al., 2001).

Awareness of environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, we can maximize both economic and environmental performance. Green building methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team takes an integrated approach from the earliest stages of a building project (Ding, 2008). Potential benefits of green building can include: Awareness of environment benefits: 1-Enhance and protect biodiversity and ecosystems, 2-Improve air and water quality 3-Reduce waste streams, 4-Conserve and restore natural resources

2.6. Technology Influence on Green Building Performance

Technology allows people to become more efficient and to do things more intelligently that were not possible before. Any technology is not just a set of engineering achievements, but is centrally positioned within profoundly cultural and environmental boundaries. The knowledge for conserving natural environment and resources and to reduce human involvement, green technology is used. It is an alternative to improve the national economy without harming the environment. The government is taking a leading role in promoting energy efficiency, resource conservation and environmental measures through the growth of green building technologies and products industry (Azhar, 2011). The government's strategy on green building Technologies and Products is being developed with the hope that one day, many of these green technologies and products will be mandatory in the construction of new buildings. Part of this strategy is driving the industry towards improving productivity and competitiveness using Building Information Modeling (BIM) technology. Increasing the awareness and implementation of BIM technology in sustainable building design is a key strategic initiative intended to elevate the global competitiveness of the Malaysia building industry (Komnitsas, 2011).

The Green Building Technologies and Products industry is ripe for expansion due to rising demands for higher standards in building construction and to get insight into the latest green technologies and innovations that are making buildings more green (Zuo, et. al., 2014). Earn valuable continuing education credits and learning more about green-building performance, energy modeling, GBI, green-building materials, and more.

There is a great reliance on Technology influence green building to solve environmental problems around the world today, because of an almost universal reluctance by governments and those who advise them to make the social and political changes that would be necessary to reduce growth in production and consumption. Yet the sorts of technological changes that would be necessary to keep up with and counteract the growing environmental damage caused by increases in production and consumption would have to be fairly dramatic. The technological fixes of the past will not do. Technology influence green building is not independent of society either in its shaping or its effects. At the heart of the debate over the potential effectiveness of sustainable development is the question of whether technological change, even if it can be achieved, can reduce the impact of economic development sufficiently to ensure other types of change will not be necessary (Rahardjati, 2010).

2.7. Social Element Influence on Green Building Performance

The social benefits of green building are related to improvements in the quality of life, health, and well-being. These benefits can be realized at different levels – buildings, the community, and society in general. At a building level, research on the human benefits of green design has centered on three primary topics: health, comfort, and satisfaction. Although these outcomes are clearly interrelated, they have different scholarly roots and employ different methodologies (Ali and Nsairat, 2009). The green building can have both negative and positive impacts on the occupants' quality of life. Negative impacts include illness, absenteeism, fatigue, discomfort, stress, and distractions resulting from poor indoor air quality, thermal conditioning, lighting, and specific aspects of interior space design (e.g., material selections, furnishings, and personnel densities). Reducing these problems through sustainable design often improves health and performance. Improved indoor air quality and increased personal control of temperatures and ventilation have strong positive effects. In addition to reducing risks and discomforts, buildings should also contain features and attributes that create positive psychological and social experiences. Although less research has been done on health-promoting environments, emerging evidence shows that certain green building features, including increased personal control over indoor environmental conditions, access to daylight and views, and connection to nature, are likely to generate positive states of well- being and health (Kibert, 2012).

While it may initially seem like the only benefits of "green building" efforts go to the environment at the cost of human comfort and expense this is not the case. Proponents of eco-friendly architecture take a holistic approach to the concept of environmental health, including human well-being in their calculations. Another emerging social issue affecting buildings is security. The relationships between sustainable design and building security are important topics that need to be discussed for future. At a community or societal level, the social benefits of green design include knowledge transfer, improved environmental quality, neighborhood restoration, and reduced health risks from pollutants associated with building energy use. Although more research has been conducted on the benefits of green design features to building occupants, interest is growing in the community of the benefits of green design (Stenberg, 2006).

2.8. Legislation Influence on Green Building Performance

As a result of the increased interest in green building concepts and practices, a number of organizations have developed standards, codes and rating systems that let government regulators, building professionals and consumers embrace green building with confidence. Green building codes and standards, such as the international council's code draft international green construction code, are sets of rules created by standards development organizations that establish minimum requirements for elements of green building such as materials or heating and cooling (Circo, 2007).

There are many government legislation in place to ensure that Malaysia's green businesses meet the minimum standards required to minimise their impact on the environment. How these regulations will affect you will depend on the size and type of your green business, as well as the sector you operate in and the process you have in place.

A legislation for green building is a written statement outlining an organisation's mission in relation to managing the environmental effects and aspects of its operations. All organisations, to some degree, have an effect on the environment. Having a legislation for green building in place demonstrates your green credentials to your shareholders, clients, customers and employees. Increasingly, customers are demanding that businesses prove their environmental credentials; this is particularly true if you deal with the public sector where there are top-down requirements from government that all their procurement activities meet certain green standards. Legislation for green building is free and can help make sure you not only stay within the law but can also help you to improve your cost controls and conserve raw materials and energy. Having a legislation of green building in place is essential if you want an environmental standard, which is a technical document that describes an agreed and recognised way of doing something (Choi, 2010).

3. RESEARCH METHODOLOGY

In this research, quantitative analysis is used to analyze the data. This study analyzes data which include descriptive statistics, goodness of measures, reliability analysis, validity analysis, hypothesis testing and mediation effects testing. It investigates relationships between Awareness of Environment, Technology, Social Element, Legislation and Green Building Performance.

The data collection resources (tools) are classified into two groups of primary and secondary sources or information. In the case of secondary resources, articles, books, researches, studies and the theses conducted in this field (collected from libraries and internet websites) have been used. Also, the primary information has been collected using the field research method (questionnaire).

A draft of the questionnaire is evaluated by ten academic professors in the areas of GBI and Green Building in Malaysian building Industry. These processes enable a researcher to develop a questionnaire with high content validity. According to our respondents who are a group of experts, where all the ambiguities in the questionnaire were made clear and items have been designed and reviewed

A structured questionnaire is according to a 5-point (Likert-type) scale ranging from 1 to 5 namely Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree and Strongly Agree. Because, the Likert scale makes available more information about the respondents' degree of contribution, it can make available deeper implications of the perception to be surveyed. Table 3 shows the reliability coefficient of the questionnaire. It shows that the Cronbach's alpha of the questionnaire is 0.8235 which means the reliability of the present research questionnaire is acceptable. (Cronbach, 1951).

Table 3
Reliability Statistics

Cronbach's Alpha	*N of Items*
0.8235	39

Sampling technique in this research is stratified sampling, where, the researcher divides the population into separate groups, called strata. Then, a probability sample (often a simple random sample) is drawn from each group. The sample size of research can be determined according to Morgan's Table (Krejcie and Morgan, 1970). In this research population size is N = 800 and According to Morgan's Table the sample size should be $n = 260$ but could were collected 266 (33.25%). The target population of this research consisted of managers and non-managerial staff and professional members of green building index (GBI).

4. ANALYSIS AND INTERPRETATION

This part discusses the objectives of the research, namely the effects of GBI in Malaysian Building Companies. In data analysis part, the collected data and summarized information, are studied, categorized and tested using the descriptive and inferential statistical techniques in order to achieve the research objectives, answer its questions/hypotheses and its problems as well as the detailed process of how it works will be explained.

4.1. Mahalanobis Distance

Mahalanobis distances provide a powerful method of measuring how similar some set of conditions is to an ideal set of conditions, and can be very useful for identifying which regions in a landscape are most similar to some "ideal" landscape. Moreover, Mahalanobis distances are based on both the mean and variance of the predictor variables, plus the covariance matrix of all the variables, and therefore take advantage of the covariance among variables. The region of constant Mahalanobis distance around the mean forms an ellipse in 2D space (i.e. when only 2 variables are measured), or an ellipsoid or hyperellipsoid when more variables are used (refer to Table 4).

Table 4
Residuals Statistics

	Minimum	*Maximum*	*Mean*	*Std. Deviation*	*N*
Predicted Value	4.0000	4.6667	4.4211	.16039	266
Std. Predicted Value	–2.625	1.531	.000	1.000	266
Standard Error of Predicted Value	.000	.000	.000	.000	266
Adjusted Predicted Value	.	.	.	.	0
Residual	.00000	.00000	.00000	.00000	266
Std. Residual	.000	.000	.000	.000	266
Stud. Residual	.	.	.	.	0
Deleted Residual	.	.	.	.	0
Stud. Deleted Residual	.	.	.	.	0
Mahal. Distance	23.095	25.504	24.906	1.043	266
Cook's Distance	.	.	.	.	0
Centered Leverage Value	.087	.096	.094	.004	266

[a]Dependent Variable: dv

The tests results show that minimum is for Mahalanobis distance (23.095) and maximum for Mahalanobis distance is (25.504). It means that, our data value is between min and max range.

4.2. Skewness and Kurtosis Test Results

Skewness and Kurtosis it can be used to test the normality of a given data set. Since the statistics is between (–2, 2) means that the distribution of the sample is normal.

The amount of skewness for all variables respectively is –0.590, –0.391, –0.277, –0.592 and –1.365. Its shows these variables were normal and symmetric distribution.

The amount of kurtosis for all variables respectively are −0.040, −0.657, −0.644, −0.467 and 1.872. Its shows that variables distribution is normal (refer to Table 5).

Table 5
Descriptive Statistics to Skewness and Kurtosis

	N	*Skewness*		*Kurtosis*	
	Statistic	*Statistic*	*Std. Error*	*Statistic*	*Std. Error*
DV	266	-.590	.149	-.040	.298
IV1	266	-.391	.149	-.657	.298
IV2	266	-.277	.149	-.644	.298
IV3	266	-.592	.149	-.467	.298
IV4	266	-1.365	.149	1.872	.298
Valid N (listwise)	266				

4.3. The Regression Test among Independent Variables (Awareness of Environment, Technology, Social Element, Legislation) and Dependent Variable (Green Building Performance)

Multiple linear regression (MLR) is a method used to model the linear relationship between a dependent variable and one or more independent variables. The dependent variable is sometimes also called the predictand, and the independent variables the predictors. MRA to identify the significant factors that affect of green building performance on Malaysian green building. Analysis of Variance (ANOVA) shows that factors identified by this analysis together significantly related to the dependent variable. This means that the factors identified in this analysis are significantly related to the green building performance (refer to Table 6). If there is a change in the factors, there will be change in the green building performance.

Below Table shows the individual factors relationship with the dependent variable of the regression model. It shows that all impact factors such as, awareness of environment (2.035); technology (2.744), social element (2.774) and legislation (5.599) are significantly related to the green building performance.

Table 6
The Regression Test among IVs and DV

IV	*DV (Green Building Performance)*								
	Coefficients[a]				*Annova*[b]		*Model Summary*		
	B	*Beta*	*t*	*Sig*	*F*	*Sig*	*R*	*R^2*	*Durbin Watson*
Constant	3.697	–	6.336	0.000	11.236	0.000[a]	0.383[a]	0.147	2.285
Awareness of Environment	0.181	0.124	2.035	0.043					
Technology	0.310	0.171	2.774	0.006					
Social Element	0.223	0.161	2.744	0.005					
Legislation	0.469	0.350	5.599	0.000					

[a]Predictors: (Constant), legislation, social building, awareness of environment, technology
[b]Dependent Variable : D

As observed in the above table, since the obtained sig in ANOVA table is smaller than 0.05 (0.00 < 0.05), the whole regression has the required statistical validity. In the next stage, the effects of independent variable on the dependent variable are assessed. The Beta coefficient and significance value (sig) of the variables imply that all of the independent variables have statistical validity, because the significance value of these variables are smaller than the significant level 0.05.

♦ – Unstandardized Model

$$Y = 3.698 + (0.181\,x_1) + (0.310\,x_2) + (0.223x_3) + (0.469\,x_4)$$

♦ – Standardized Model

$$Y = (0.124\,x_1) + (0.171\,x_2) + (0.161\,x_3) + (0.350\,x_4)$$

Y = Dependent Variable (green building performance)

x_1 = Independent Variable 1

x_2 = Independent Variable 2

x_3 = Independent Variable 3

x_4 = Independent Variable 4

4.4. Pearson's Correlation Coefficient

The Pearson Product-Moment Correlation Coefficient is a measure of the linear correlation (dependence) between two variables X and Y, giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation. It is widely used in the sciences as a measure of the degree of linear dependence between two variables. It was developed by Karl Pearson from a related idea introduced by Francis Galton in the 1880s. Early work on the distribution of the sample correlation coefficient was carried out by Anil Kumar Gain and R. A. Fisher from the University of Cambridge. Pearson's correlation coefficient is defined between two random variables equal to their variance divided by the standard deviation (refer to Table 7).

Table 7
Correlation Pearson Coefficient Test between Variables (c1, c2, c3, c4 and c5).

Independent Variables (IV)	*Dependent Variable (DV) (Green Building Performance)*	
Awareness of Environment	Pearson Correlation	0.227 **
	Sig. (2-tailed)	0.000
Technology	Pearson Correlation	0.137*
	Sig. (2-tailed)	0.03
Social Element	Pearson Correlation	0.271**
	Sig. (2-tailed)	0.000
Legislation	Pearson Correlation	0.399
	Sig. (2-tailed)	0.000

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Statistical Hypotheses:

Null Hypothesis (H0): There is no significant positive relationship between c1 and c2, c3, c4 and c5.

Hypothesis A: There is significant positive relationship between c1 and c2, c3, c4 and c5.

Test results: Considering that the significance levels are smaller than 0.05, the null hypothesis is rejected and therefore hypothesis A is accepted. There is significant positive relationship between Dependent Variable and Independent Variables.

4.5. Variance Influence Factor (VIF)

We can use the/statistics = defaults tol to request the display of "tolerance" and "VIF" values for each predictor as a check for multicollinearity. The "tolerance" is an indication of the percent of variance in the predictor that cannot be accounted for by the other predictors, hence very small values indicate that a predictor is redundant, and values that are less than .10 may merit further investigation. The VIF, which stands for variance inflation factor, is (1/tolerance) and as a rule of thumb, a variable whose VIF values is greater than 10 may merit further investigation. As you can see, the "tolerance" and "VIF" values are all quite acceptable. Please refer to Table 8.

The test results show that VIF values for C2 (1.133), C3 (1.019), C4 (1.135) and C5 (1.007) is below 10. It means that, VIF value is acceptable.

Table 8
The Test Results for VIF Values

Model	*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*	*Correlations*			*Collinearity Statistics*	
	B	*Std. Error*	*Beta*			*Zero-order*	*Partial*	*Part*	*Tolerance*	*VIF*
1 (Constant)	3.697	.584	–	6.336	.000	–	–	–	–	–
c2	.181	.089	.124	2.035	.043	.227	.166	.158	.883	1.133
c3	.310	.113	.171	2.744	.006	.137	.130	.123	.982	1.019
c4	.223	.080	.161	2.774	.006	.271	.201	.193	.881	1.135
c5	.469	.084	.350	5.599	.000	.099	.097	.091	.993	1.007

[a]Dependent Variable: c1

This research study has successfully achieved four objectives as stated on the analysis, namely: refer to Table 9.

Table 9
Relationship between Research Objectives and Research Questions and Research Hypothesis

Research Objectives	*Research Questions*	*Research Proposition (Hypotheses)*	*Test Result*
1. To evaluate the effects of awareness of environment on green building performance	1. Does awareness of environment influence the implementation of green building performance?	1. There is a significant relationship between awareness of environment and green building performance.	Accepted
2. To investigate the effects of technology on green building performance	2. Does technology affect the implementation of green building performance?	2. There is a significant relationship between technology and green building performance.	Accepted

Research Objectives	*Research Questions*	*Research Proposition (Hypotheses)*	*Test Result*
3. To assess the social element on green building performance	3. Does social element affect the implementation of green building performance?	3. There is a significant relationship between social element and green building performance.	Accepted
4. To determine the effects of legislation on green building performance	4. Does legislation affect the implementation of green building performance?	4. There is a significant relationship between legislation and green building performance.	Accepted

5. CONCLUSION

This research study has explored the concept of the effects of GBI on the Malaysian building industry. It has demonstrated that the integration of GBI tools in the construction industry offers considerable potential for enhancing construction collaboration and ensuring that each sector of the Malaysian building industry is provided with access to green-specific data, information and services, hence improving the green construction project. However, to realise the concept of GBI in the construction industry is a great challenge because, on top of the complexness of construction processes and fragmented nature of construction organisations, the construction industry is still very conservative and not ready to adopt new technology. There are numerous potential benefits in providing a GBI support infrastructure for green building and the construction industry needs to take advantage of the sophistication of the digital and new green technologies and make the necessary investments to realise these. The writer is confident that this research is important to find methods to make future Malaysian building developers more aware of this issue. However, there is ample scope to conduct a future study by taking more samples with the inclusion of government building sectors. It is hoped that this research will pave the way for writers and those interested in conducting deeper research with more respondents who represent the whole population of the country. This will require ample financial resources and a longer period. In conclusion, the author hopes that the information in this research can assist future researchers to embark on further researches pertaining to the field of green buildings and use any suggestion contained herein as rough guidelines for the direction of the next research.

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