PREPAREDNESS AMONG TECHNICAL PROFESSIONALS FOR GREEN BUILDING IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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Preparedness among Technical Professionals for Green Building in the Malaysian Construction Industry

by

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CERTIFICATION OF APPROVAL

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Approved by,

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

MOHAMAD KHAIRILFAREEZ BIN ZAINUDIN

ABSTRACT

This project is entitled 'Preparedness among Technical Professionals for Green Building in the Malaysian Construction Industry'. The aim for this project is to propose on how to promote Green Building and Green Building Rating System and also to recommend possible implementation strategy in Malaysia's Building and Construction Industry.

This project is a quantitative survey based project that focuses on the awareness, understanding, preparedness and perceptions of the people in the industry, especially Technical Professionals from various fields including; Construction and Structure, Mechanical and Electrical, Architect, Quantity Surveyor, Contract Manager and etc, regarding Green Building concept and its' rating system.

In conducting the survey, the questionnaire forms have been distributed through mail to various related companies. Furthermore, feedbacks and responses of the research were also collected by attending Malaysian Property Expo (MAPEX) and face to face interview with the respective personnel from the industry. Thorough literature review is done in order to have better explanations and evaluation of the findings.

At the end of the report the author has concluded that the current condition of Malaysian Construction Industry in term of the awareness on global environment issues is still moderate and the understanding of the Green building concept, practices and techniques is relatively low. Thus, it reflects the preparedness of the industry on Green Building Rating System and the Green Building Index Malaysia to be in the same level as well.

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I would like to express the deepest appreciation to my Supervisor, Dr. Mohd. Faris Khamidi, who has the attitude and the substance of a genius; he continually and convincingly conveyed a spirit of adventure and an excitement in regard to research. Without his guidance and persistent help this dissertation would not have been possible.

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1.1 BACKGROUND STUDY

1.1.1 Environmental Issues

The growing concern on the current situation of the environment has creates such havoc in the global community. The Global Warming issues, Climate Change crisis and the increasing accumulation of Green House Gases in the atmosphere are the most relevant topic of discussion throughout the entire global. Referring to the information available on the website http://www.climatecrisis.net/ which is the climate change initiative started by Al Gore, the ex Vice President of United States;

- Deaths from global warming will double in just 25 years – to 300,000 people a year
- Global sea levels could rise by more than 20 feet with the loss of shelf ice in Greenland and Antarctica, devastating coastal areas world wide
- Heat waves will be more frequent and more intense
- Droughts and wildfires will occur more often
- The Arctic Ocean could be ice free in summer by 2050
- More than a million species worldwide could be driven into extinction by 2050

Al Gore, who is also the responsible person who set out the global warming issues in a stupefying film called "An Inconvenient Truth", in his statement;

"The evidence is overwhelming and undeniable. We're already seeing changes. Glaciers are melting, plants and animals are being forced from their habitat, and the number of severe storms and droughts is increasing. If the warming continues we can expect catastrophic consequences"

With regard to these vary facts, the global community has struggle to look back on what are the contributors to the environmental crisis in order to go forward on how to save the 'Mother Nature'. It is well documented that, the contributors to these include, among others manufacturing, transportation, land use change and forestry, electricity, fuel combustion and importantly *construction sites as well as building*.

1.1.2 Building and Construction Industry in Environment Perspectives

The construction, use and demolition of buildings generate substantial social and economic benefits to society, but may also have serious negative impacts, in particular on the environment. The facts published by the United Nations Environment Programme (UNEP), *'Sustainable Building and Construction Initiative (2006)'*, by taking into account the entire lifespan of a building or any construction, we know that the build environment is responsible in each country for;

i. 25 – 40% of the total energy use

ii. 30 – 40% of solid waste generation

iii. 30 – 40% of Global Green House Gas Emissions ($CO_2, N_2O, CH_4, HFC, PFC, SF_6$)

Furthermore, the areas of key concern also include production of construction materials, use and recycling, consumption of hazardous products, integration of buildings with other infrastructure and social systems, water use and discharge, etc. These are amongst the factors that relate building and construction industry to the environment that should be taken into account. The following tables show an estimate of the built environment contribution to global environmental issues;

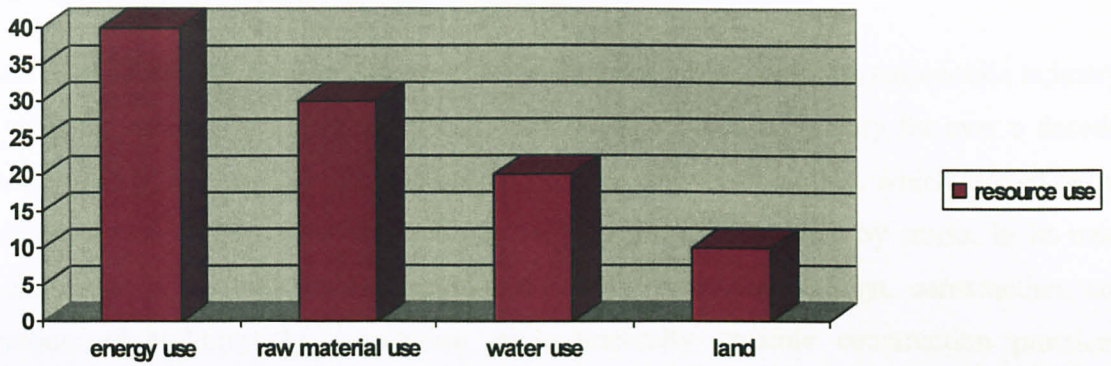


Figure 1 shows The Share of the Build Environment in Resource Use

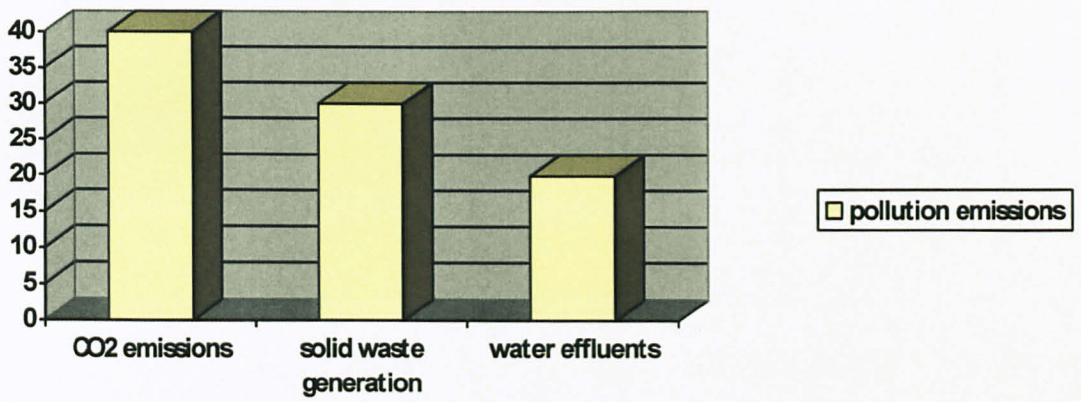


Figure 2 shows The Share of the Build Environment in Pollution Emission

It is now well proven fact that the build environment and construction sector is as much a contributor to the environmental issues. In conjunction to this, the *Green Building* movement has been introduced as an affirmative step towards tackling the issues with regard to building and construction sector and worldwide actions have already started in realizing the initiatives.

1.1.3 Overview of 'Green Building' Concept

While most of the talk has centered on changes that need to occur in the automobile industry, the building industry has been quietly addressing issues of sustainability for over a decade. Green Building, the concept of constructing resource efficient building, which started out as a fringe movement, has taken the building and construction industry by storm. In its most general form, green building is generally the resource efficient design, construction, and operation of buildings by employing environmentally sensible construction practices, systems and materials. If followed properly, green building techniques can provide a building owner with significantly lower operating and maintenance costs, increased comfort and environmental quality, and a higher resale value.

1.2 PROBLEM STATEMENT

On May 21st, 2009; Malaysia had launched its own rating system namely Green Building Index Malaysia (GBI), a firm steps following the global movement in the Green Building initiatives. It is an effort from the Building and Construction Industry to mitigate environmental issues especially from the industry. The main concern is how to promote Green Building concept and its rating system in the industry? And how the implementation strategy should be? In conjunction to that matter, an investigation to analyze the awareness, understanding, preparedness and perceptions of the people in the industry regarding Green Building and its rating system should be conducted.

1.3 OBJECTIVE AND SCOPE OF STUDY

The main objectives of this Final Year Project are:

- To be able to relate the current condition of environmental issues with the initiatives for development with regard to Building and Construction Industry
- To understand the concept of Green Building in Building and Construction Industry
- To determine the response of Malaysian towards Green Building (GB) and Green Building Rating System (GBRS) by;
    - ✓ Identifying the awareness and preparedness among Technical Professionals in Malaysia's Building and Construction Industry on GB and GBRS
    - ✓ Clarify on the respondents' understanding and perceptions on how Green Building can mitigate of climate change
- To propose on how to promote GB and GBRS and the implementation strategy in Malaysia's Building and Construction Industry

The scope of study of this project is to get feedback and response from the Technical Professionals from various field including; Construction and Structure, Mechanical and Electrical, Architect, Quantity Surveyor, Contract Manager, Town Planner and etc via a comprehensive quantitative survey. The selection of Technical Professional as the key study is because they are the decision maker in the industry, thus they will determine whether or not to apply Green Building concept in the upcoming project.

CHAPTER 2

LITERATURE REVIEW

2.1 DEFINITION AND CONCEPT OF GREEN BUILDING

According to the United Nations Environment Programme, UNEP, (2006);

- *"A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner to protect the occupant's health and reducing overall impact to the environment. The Green Building are designed to meet certain objectives such as efficient use of land and energy, water conservation, improved indoor quality and resource conservation"*

Referring to the United States Green Building Councils, (USGBC), Leadership in Energy and Environmental Design, (LEED) Reference Guide for New Construction & Major Renovation (Version 2.1, 2003)

- *"Green Building is synonymous with 'high performance building', 'sustainable design and construction' as well as other terms that refer to a holistic approach to design and construction. Green Building design strives to balance environmental responsibility, resource efficiency, occupant comfort, well being and community sensitivity. The Green Building design includes all players in an integrated development process, from the design team (building owners, architects, engineers and consultants), the construction team (material manufacturers, contractors and waste haulers), maintenance staff and building occupants. The Green Building process results in a high quality product that minimizes the owner's returns on investment."*

2.2 PRINCIPLES OF GREEN BUILDING

The principles of Green Building are simple: reduce energy consumption, draw on renewable resources where practical, conserve water, promote the best use of building materials, encourage waste management, protect the building site, and focus on health and environmental quality. All green building programs currently in existence focus on these principles to some degree. Thus, before discussing the current and future status of green building, it is important to understand in greater detail these fundamental principles of green building. David Heekin, Douglass Myers; (July 2001)

2.2.1 Reducing Energy Consumption

Green building focuses heavily on reducing energy consumption. In some cases, current technologies and practices exist that can easily and affordably reduce energy consumption in buildings by as much as 70%. This reduction in energy consumption clearly translates into real savings for homeowners as far as operating expenses are concerned. A few of the techniques used in green buildings to help reduce energy consumption are passive solar design, light-colored roofing material, energy efficient appliances, low emissivity windows, improved insulation, efficient lighting, and energy efficient air conditioning and heating systems

2.2.2 Drawing on Renewable Resources Where Practical

Green building advocates often take a very common-sense approach to renewable resources, advocating their use only when it is economically feasible to do so. Depending on factors such as tree coverage around the building, it may not be possible to utilize renewable resources, such as the sun, to help provide energy for a building. Where it is possible, the use of photovoltaic panels to provide energy to a home, solar thermal water heater to heat a home's water, and passive solar design to utilize the sun's positive effects in the winter are all encouraged.

2.2.3 Conserving Water

Another major principle of green building is water conservation. Depending on what area of the country one lives, this may be an important topic of concern. Green building promotes water conservation by employing techniques such as the installation of low-flow fixtures and toilets. It also advocates the use of greywater systems and rainwater harvesting systems where possible. Finally, it addresses the problem of outdoor irrigation by encouraging the use of native plant species, xeriscaping, and .smart irrigation systems.

2.2.4 Promoting the Best Use of Building Materials

Green building encourages builders to use the best materials available for the job. This often involves the use of recycled content material such as recycled content carpet, padding, insulation, and roofing material. It also involves the use of engineered lumber products, such as laminated wood, and the use of regionally produced products, such as lumber and concrete.

2.2.5 Encouraging Waste Management

Green building encourages waste management on the job site by encouraging job-site recycling plans and the reuse, donation, and selling of excess materials. Green building also emphasizes waste management by the eventual homeowner. Builders are encouraged to install outdoor composting stations and built-in kitchen recycling centers.

2.2.6 Protecting the Building Site

Part of resource efficiency is conserving the outdoor environment. Green building encourages the use of erosion control site plans and promotes the protection of existing trees. For any given site, green building also encourages the saving and reusing of topsoil, the maximization of the overall amount of pervious surface, and the replanting or donating of removed vegetation.

2.2.7 Focusing on Health and Environmental Quality

A healthy indoor environment is just as important as a healthy outdoor environment. Green building principles seek to not only increase the comfort level in the home, but also to help contribute to a healthy overall environment through the selection and use of environmentally sensible materials, such as low VOC paints and solvent free, low toxic finishes. Other techniques are also encouraged, including moisture control measures, radon mitigation, installation of exhaust fans in garages, and central vacuum systems that vent to the exterior.

2.3 ATTRIBUTES OF GREEN BUILDING

According to J.L LaSalle Maghraj, (2007); there is a substantial amount of documentation that has been produced on Green Building across the world. Green Buildings have been described in many ways and formats. An attempt has been made in many available published sources, including his own, 'Green Building Anthology', to compile the basic attributes of what a Green Building implies. The typical features of Green Buildings are outlined in the following table:

Table 1: Typical Feature of Green Buildings

No.	Building Attributes	Typical Features
1.	Buildings that strive for Energy Efficiency through	a) Appropriate orientation of the building b) Efficient HVAC systems c) Efficient lighting systems d) Use of alternative renewable energy sources such as Solar or Wind e) Effective insulation of walls and roofs f) Use of double glazed Ultra Violet reflective glass to prevent heat gain g) Appropriate balance of openings in façade and optimized shading h) Good management, maintenance & monitoring to facilitate continuous performance improvement i) Use of reflective material on roofs like Albedo roof finish
2.	Buildings that ensure Water Efficiency through	a) Recycling of waste water b) Rain water harvesting systems c) Water saving fixtures d) Sewerage treatment plant e) Water efficient landscaping

3.	Buildings that use local/recycled materials for construction	a) Use of rapidly renewable materials such as fly ash blocks b) Recycling of material from construction site c) Use of construction materials available locally d) Use of wood certified with the forest Stewardship Council
4.	Buildings that have Effective Waste Management	a) Re-use of construction waste b) Garbage disposal & compositing c) Recycling of waste water
5.	Ensuring Improved Indoor Environment Quality	a) Achieving optimum Indoor Air Quality b) Ensuring maximum daylight and natural views c) CO2 monitoring through sensors d) Allowing natural ventilation e) Use of Low VOC adhesive, sealants, paints, etc.
6.	Buildings using integrated and efficient Building Management Systems	a) Install outdoor composting stations b) Built-in kitchen recycling centers
7.	Buildings that strive to be on appropriate sustainable sites	a) Take serious of landscape and gardening features b) Replanting or donating of removed vegetation.
8.	Buildings that use innovative and holistic design features to achieve sustainable development	a) Includes moisture control measures b) Radon mitigation c) Installation of exhaust fans in garages d) Central vacuum systems that vent to the exterior.

2.4 INITIATIVES TAKEN TOWARDS GREEN BUILDING

In order to create an opportunity for Green Building to be in the world trends and being accepted and practiced in the building and construction industry, it is important to put serious initiatives in the communication of Green Building. At a global level, initiatives have been taken actively towards Green Building through Global Building and Construction Industry, Global Green Building Councils and Green Building Rating System. The main objective of these initiatives is to promote and to create awareness to both parties which include the people in the industry and the stakeholders, regarding Green Building. J.L LaSalle Maghraj, (2007)

2.4.1 Global Building and Construction Industry.

The global building and construction industry is a translation to Kyoto Protocol provisions for stabilizing climate change and reducing the concentration of Green house Gases (GHG) in the atmosphere. Some of the leading initiatives worldwide include UNEP's Sustainable Building and Construction Initiative, World Business Council on Sustainable Development's Zero-energy Buildings Project, Clinton Climate Initiative (CCI) and the initiatives by the respective national Green Building Councils, (GBC) as well as the World Green Building Council (World GBC). The green building councils have taken it upon themselves to jointly work towards introducing sustainability in the global building and construction sector.

2.4.2 Global Councils.

The World Green Building Council is a union of national councils whose mission is to accelerate the transformation of the global property industry towards sustainability. Current members are GBC Australia, Canada GBC, Emirates GBC, India GBC, Japan SBC, Mexico GBC, New Zealand GBC, Taiwan GBC, United Kingdom GBC, and the USGBC. Collectively, these nations represent over 50% of global construction activity, and touch more than eight thousand companies and organizations worldwide.

2.4.3 Green Building Rating System.

A consensus-based, market-driven national building rating system will accelerate the development and implementation of Green Building practices. While traditional regulatory methods have helped improve buildings' environmental conditions and performance and energy efficiency, voluntary programs provide a means to harness the market to advance these goals.

Great Britain (BREAM) and British Columbia (BPAC) have reported early success with their large scale voluntary rating system initiatives. Development and successful implementation of these nationally based rating systems have shown that identification and communication of a building's environmental efficiency and performance has raised the consciousness and associated selection criteria of the consumer. It has also stimulated the owner or builder's successful efforts in developing an environmentally advanced building. Technically sound rating systems would mean other segments of the building industry will also be given additional incentive to develop more environmentally advanced products and services to achieve a higher level of performance rating.

Table 2: Indicative list of Green Building rating systems followed in respective countries

Rating System	Agency	Countries Following it
Asia		
Green Olympic Building Assessment System (GOBAS)	Ministry of Science and Technology (MoSTI), Qinghua University	China
GRIHA	The Energy Research institute (TERI)	India
LEED India	Indian Green Building Council (IGBC)	India
Green Mark	Building and Construction Authority (BCA)	Singapore
Hong Kong Building Environmental Assessment Method (HK-BEAM)	HK-BEAM Society, Business Environment Council (BEC)	Hong Kong
Ecology, Energy saving, Waste reduction and Health (EEWH)	Taiwan Green Building Council	Taiwan

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)	Japan Sustainable Building Consortium (JSBC),The institute for Building Environment and Energy Conservation	Japan
Europe		
Building Research Establishment Environmental Assessment Method, BREEAM	UKGBC	UK
Protocollo ITACA	Federal Association of the Italian Regions	Italy
ESCALE	CSTB	France
Eco Quantum	IVAM Environmental Research	Netherlands
Papoose	TRIBU	Finland
Eco Effect	Royal Institute of Technology, Stockholm	Sweden
Eko Profiles	The Norwegian Building Research Institute	Norway
Eco building Total Quality Assessment	Arge TQ	Austria
North America		
Leadership in Energy and Environmental Design, LEED	USGBC	USA, Thailand, UAE, Brazil, Sri Lanka, Chile, Israel, South Korea, Mexico, New Zealand, Republic of Panama, Puerto Rico, China,
LEED Canada	Canada GBC	Canada
Australia		
Green Star	Green Building Council Australia	Australia
NABERS/ABGR	New South Wales Department of Environment and Climate Change	Australia

2.5 GREEN BUILDING RATING SYSTEM

2.5.1 Overview

In this project, the author will use dedicated rating system, which are, *Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), Building Research Establishment Environmental Assessment Method, BREEAM, Leadership in Energy and Environmental Design, LEED and Green Star* as references in the study, as these rating system represent different region; Asia, United Kingdom, United States and Australia. Thus, the comparison will also be done between these four rating systems.

The rating system is developed by many countries to set standards incorporating various elements of green design in their own recipe. Since 2000, the number of environmental assessment methodologies around the world has been increasing rapidly. BREEAM (BRE Environmental Assessment Method) was the first system (launched in 1990) to offer an environmental label for buildings. There are now a number of different schemes around the world, most of which have been based on or inspired by BREEAM, but each has been adapted to suit the region in which they are to be used. BREEAM is aimed at developers, builders, designers and owner-occupiers, environmental labels and allow users to differentiate their buildings from those of their competitors.

Adaptations have been made for a variety of reasons, but predominantly to reflect differences in standard practice or cultures around the world, and also to reflect the different environmental issues that affect those regions.

The environmental assessment methodologies covered in this report include BREEAM, CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), Green Star and LEED (Leadership in Energy and Environment Design (launched in 1998). This report summarizes the approach used by each of these methods and includes a quick comparison of the environmental standards demanded to meet each rating.

A common theme of each assessment method is the reliance on existing building regulations and other third party standards. As any environmental assessment methodology needs to cover such a wide range of issues there is no other way that a system could remain up to date without significant initial investment and continual extensive maintenance. Also, reliance on existing third-party standards or regulations lends credibility to the system, especially among skeptics.

As well as comparing the scores and rating levels in each of the schemes, the major differences in the processes have been investigated. The major differences between the schemes have been highlighted in Table 3 and are discussed in more detail in the report.

2.5.2 Green Building Rating System Over the Region

The Green Building Rating Systems that are discussed in this report are the assessment tools that are available over the region. *CASBEE,* originated from Japan, *BREEAM,* originated from United Kingdom, *LEED,* originated from United States and *Green Star,* originated from Australia. The following discussion on the rating systems is based on the work done by Thomas Saunders, 'A Discussion Document Comparing International Environmental Assessment Methods for Buildings'

2.5.2.1 CASBEE

CASBEE was first launched in 2004 by the Japan Sustainable Building Consortium. The methodology used to calculate the score is called BEE (Building Environmental Efficiency) that distinguishes between environmental load reduction and building quality performance. This approach was first developed by IISBE (International Initiative for a Sustainable Built Environment) in the form of GBTool. This means that, of the three methods included in this comparison, it differ the most from BREEAM.

There are 4 different versions of CASBEE:

- CASBEE for Pre-Design, for projects at a very early stage to help with planning and site selection.
- CASBEE for New Construction to assess buildings during design and construction stages.
- CASBEE for Existing Buildings for buildings that have been occupied for at least one year.
- CASBEE for Renovation to help generate proposals for building upgrades and to assess improvements.

This study focuses on CASBEE for New Construction.

The Japanese have a tradition of close relations between government and industry. The JapanSBC was organized to lead a cooperative academic, industrial and government effort to create a nationally authorized green building rating system. The result is called the "Comprehensive Assessment System for Building Environmental Efficiency", better known as CASBEE, and it can be used to evaluate impacts throughout the life of a project. According to Professor Shuzo Murakami, Chair of JapanSBC, "CASBEE creates incentives for building owners, designers and users to develop high-quality sustainable buildings. The system meets both the political requirements and market needs for achieving a sustainable society."

Under CASBEE, all building permit applicants must submit the required data, part of which is displayed on a public website. Through the end of 2005, several major local governments including Nagoya, Osaka and Yokohama have introduced CASBEE to their own local regulatory directives, and there are more than 80 CASBEE projects in Nagoya alone.

Assessment Process

CASBEE is sold primarily as a "self assessment check system" to permit users to raise the environmental performance of buildings under consideration. It can also be used as labeling system, if the assessment is verified by a third party.

No change has been made to the methodology to make it applicable to the US or to the UK but the guidance has been translated into English. This makes CASBEE much more accessible internationally; it is therefore much more likely to be studied so that its applicability can be assessed.

Scoring and Weightings

CASBEE New Construction (NC) is a complex calculation methodology. Like BREEAM, CASBEE uses weightings to balance the value addressing issues with the number of measures available (the more measures available to improve environmental performance the more credits can be developed but this does not necessarily reflect the environmental impact of addressing the issues). However, the weightings applied to CASBEE are much more complex than BREEAM, LEED or Green Star.

Weightings are applied to each category; categories include "indoor environment", "outdoor environment onsite", "Energy" and "Resources & Materials". In each category there are headline issues such as "Service Ability", "lighting and illumination" and "building thermal load" to which another layer of weightings are applied. Under these headline issues there are individual issues including "noise", "ventilation" and "use of recycled materials" to which another layer of weightings applies. A final layer of weightings is applied to the sub-issues grouped under each of the individual issues. The sub issues include "ventilation rate", "CO2 monitoring", "Adaptability of Floor Plate", etc.

All the issues are split into two basic types – Quality measures, Q and Load Reduction measures, LR. Once the assessment is complete, the score is calculated. For most of these sub-issues it is possible to score between 1 and 5 points, zero is not available although in a small number of cases a credit can be removed from the assessment. This prevents a negative score for Q or LR.

There are five different ratings available:

C: BEE of 0 – 0.49

B-: BEE of 0.5 – 0.99

B+: BEE of 1 – 1.49

A: BEE of 1.5 – 2.99

S: BEE of 3.0 –5.00

2.5.2.2 LEED

LEED was first launched in 1998. The current version, LEED NC (New Commercial Construction and Major Renovation) projects version 2.2 was launched in 2005. It was set up by the USGBC (US Green Building Council) to improve the way that the construction industry addresses sustainability by providing a simple easy to use label. It focuses on "market transformation". There are 8 versions of LEED and 2 further versions under development:

- New Commercial Construction and Major Renovation projects
- Existing Building Operations and Maintenance
- Commercial Interiors projects
- Core and Shell Development projects
- Homes
- Neighbourhood Development
- LEED for Schools
- LEED for Retail
- LEED for Healthcare (under development),
- LEED for Labs (under development)

The version discussed here can be used to assess commercial, institutional and high rise residential buildings. Since the initial launch LEED has been used to certify 1823 buildings in the US. There are 4 different ratings available – Certified, Silver, Gold and Platinum.

The NC (new construction) version is used throughout the design and construction phase, but the actual label (certificate) is only available once the construction is completed.

Assessment process

The project team compiles the documentation required for the assessment. A trained assessor is therefore not required, although there is a credit available for appointing a LEED AP (LEED Accredited Professional) as part of the design team.

Once all the documentation has been compiled by the project team it is submitted to the USGBC who review the evidence and calculate the score. Assessments are completed either by using an online application procedure LEED Online, or as hard copy. The USGBC allow 25 working days to review LEED submissions although project teams can pay an additional $10,000 to receive an expedited review which would take 12 working days. LEED Online submissions take the USGBC 12 working days to assess. The total time between initial submission to the USGBC and issue of the certificate can vary from 27 working days to as many as 65 working days.

If the design team feels that the USGBC has made an unfair assessment the project team is given 25 working days to appeal. A charge of $500 is made for each credit assessment appealed against. Once the final score has been accepted by the project team the USGBC issue a certificate and a plaque with the rating on it. It is worth noting that they fully rebate certification fees for any project awarded LEED platinum certification.

LEED Accredited Professionals are not required to be licensed so far There are 45,162 LEED Accredited Professionals to become a LEED Accredited Professional an exam is taken, at a cost of $350 (for non USGBC members). It is likely that delegates will attend a LEED workshop at a cost of $495 (for non USGBC member) before taking the exam. In contrast the money that people charge for putting the paperwork together for a LEED assessment can be as much as $75,000 (1).

Scoring and Weightings

There are no weightings included in LEED, instead credits are worth one point and where there are multiple performance levels each level is worth one point. As there are no weightings the value of each issue is purely dependant on the number of points available.

The lack of issue category weightings combined with the checklist approach that LEED uses to evaluate the impact of the materials mostly increases the weighting of the materials section in LEED compared to the other methods in this study. In LEED the section is worth nearly 1/5th of the final score whereas in both BREEAM and Green Star the materials section is worth just 1/10th of the final score which more closely reflects the relationship between the embodied and operational energy of a building.

There are four different LEED ratings available;

Certified	: 26 – 32 points
Silver	: 33 – 38 points
Gold	: 39 – 51 points
Platinum	: 52 – 69 points

Due to the simplicity of the scoring system it is easy to calculate the value of addressing each issue.

2.5.2.3 Green Star

The first version of Green Star was developed in 2003 in a partnership between Sinclair Knight Merz and BRE. As BREEAM was used as the basis of the Green Star methodology the two methods are very similar. However, adaptations have been made in order to reflect the various differences between Australia and the UK, such as the climate, local environment and the construction industry standard practice.

Since the initial launch of Green Star the GBCA (Green Building Council Australia) have also adapted the assessment methodology to make the delivery mechanism more akin to the LEED approach. There are currently 5 different versions of the methodology to assess offices at different stages from design, to post construction, to fit out. The following versions of the tool are available too:

- Green Star - Office Design v3
- Green Star - Office As Built v3
- Green Star - Office Design v2
- Green Star - Office As Built v2
- Green Star - Office Interiors v1.1

Green Star - Office Design v3 was published in February, so this comparison has been based on Office Design v2. The main changes to the third version of Green Star have been outlined in below in 'Current Development Activities'

Assessment Process

Unlike a BREEAM assessment, which must be carried out by a licensed assessor, Green Star can now be used by any member of a design team or wider project team. To facilitate this, the assessor's manual is available to purchase for $555. As with LEED, 2 points are awarded where a member of the design team has received Green Star training and has achieved Accredited Professional status.

Although an assessment can be carried out by any member of a project team no score can be publicized unless the Green Star assessment is certified. In order to certify an assessment the GBCA commission a third party assessment panel to validate the self assessment rating and recommend, or oppose, a Green Star certified rating. Certification will only be awarded if a project achieves a score of at least 45 (Four Stars).

In order to become an approved assessor an individual must first qualify as an Accredited Professional. The organization the individual is a member of must be a member of the GBCA, and they must have been part of the Green Star technical working group of which there are 50 members.

The GBCA encourage users of the scheme to give feedback. Specific forms are made available to encourage feedback and ensure that it is in an appropriate format. GBCA will respond to these comments, officially, once every year, and produce a formal document setting out each comment received, and the formal response and action.

Scoring and Weightings

The mechanisms used to calculate a whole building rating are identical to those employed by BREEAM in the UK. Criteria are developed that, if complied with, will reduce a building's impact on the environment. Credits are therefore awarded for complying with the requirements of each of the criteria. These criteria are grouped into issue categories such as energy, water, indoor environmental quality, and it is to these categories that the weightings are applied.

Once all claimed credits in each category are assessed, a percentage score is calculated and Green Star environmental weighting factors are then applied. Green Star environmental weighting factors vary across states and territories to reflect the variety of environmental issues in each area.

The following Green Star certified ratings are available:

- 4 Star Green Star Certified Rating (score 45-59) signifies 'Best Practice'
- 5 Star Green Star Certified Rating (score 60-74) signifies 'Australian Excellence'
- 6 Star Green Star Certified Rating (score 75-100) signifies 'World Leadership'

One of the main differences to the UK version of BREEAM is in the addition of a section for Innovation credits. There are a maximum of 5 points available for the innovation credits and the total innovation points achieved are added to the weighted score calculated as set out below. This means that it is technically possible to score more than 100% although in reality it is virtually impossible.

2.5.2.4 BREEAM

BREEAM was first launched in 1990 and is currently updated annually to keep ahead of UK Building Regulations and to stay in line with current best practice. The first version of BREEAM was developed to assess the environmental performance of offices. Since then schemes have been developed to cover the following types of buildings;

- Retail, Industrial, Schools, Housing, Courts and Prisons
- Hospitals (NEAT (a self assessment method developed for the UK's Department of Health) is soon to be replaced with BREEAM Healthcare)
- Ecohomes (which has been adapted for England in partnership with the Department for Communities and Local Government for use in England as The Code for Sustainable Homes)
- Bespoke (tailored to any building not covered by a standard scheme)
- International (this version is based on any of the existing schemes which are adapted to assess any type of building and any region in the world).

Each of the assessment tools can be used at different stages of the building's life. BREEAM Design and Procurement (D&P) can be used during the design stage of a refurbishment project or for a new build or extension project. The Post Construction Review (PCR) is carried out once the construction is complete to verify the D&P assessment. The Fit Out assessment is carried out during major refits of existing buildings and a Management and Operation (M&O) assessment is carried out to assess the performance of a building during its operation.

There have been more than 100,000 buildings certified by BREEAM of which 1358 are non domestic buildings. There are currently more than 500,000 buildings registered of which 3177 are non domestic buildings. There are a total of 1473 registered assessors operating within 820 licensed assessor organizations.

Assessment Process

BREEAM assessments are carried out by licensed assessors. BRE trains, examines and licenses organizations and individuals to help design teams (or facilities management companies) gather the appropriate data and to carry out the assessments. The cost of becoming a BREEAM assessor is £950 ($1886) to complete the training, plus approximately £2500 ($4964) for a BREEAM offices license. The maximum recommended cost of £10,000, for a very large project to be BREEAM assessed, makes it difficult to justify unless an individual has already got some clients requiring a BREEAM assessment.

For each assessment, the assessor produces a report outlining the developments performance against each of the criteria, its overall score and the BREEAM rating achieved. This report is sent to BRE who review the report using a strictly defined quality assurance process. Once a report has successfully passed the Quality assurance process, BRE issues the client with a certificate that confirms the development's BREEAM rating.

All aspects of the BRE's operation of BREEAM are accredited under ISO9001. Assessors qualified to deliver the BREEAM assessments are also covered under a UKAS accredited competent person scheme. In addition, the operations relating to the certification of the BREEAM buildings versions are also covered under UKAS accredited product certification schemes.

The time an assessment takes to complete varies according to the agreement between client and assessor, and the fee can vary between £2,000 and £10,000 ($3971-$19857). There is also a QA / certification fee which is paid, through the assessor, to BRE. This fee varies, between £740 and £1500 ($1469-$2979), according to the size of the building being assessed.

Once the assessment report is submitted to BRE for quality assurance and certification it will take 15 working days for the quality assurance checks to be carried out. If the report is complete and the assessment correct a BREEAM certificate is sent directly to the client. If revisions are required a feedback form is provided to the assessor stating the changes required. Once resubmitted to BRE the report will then be reviewed within 5 working days.

During the assessment process BRE provide support to the assessors. Providing help in interpreting the criteria and setting precedents, where necessary. A dedicated email address and phone line ensures that assessors receive a response within 48 hours of submitting a query. An extranet provides additional guidance for assessors on frequently asked questions, process updates, and precedents that have been set that have a bearing on subsequent assessments.

In order to become a BREEAM assessor an individual must complete the training at a cost of £950 ($1886). Once the exam and test assessment have been successfully completed the BREEAM assessor must pay a further £2500 ($4964) for a BREEAM offices license.

Scoring and Weightings

The BREEAM methodology calculates an environmental rating by awarding points, or credits, for meeting the requirements of series of criteria that, if complied with, would result in a reduction of the building's negative environmental impact and an increase in its environmental benefits. Each of the criteria is usually worth a single credit except where there is a large variation in the performance of buildings which meet the requirements of the criteria. For example Reduction in CO2 Emissions is assigned 15 credits awarded on a scale which runs from one credit for a building just above the minimum level required to meet UK Building Regulations, up 15 credits for a building which has net carbon emissions of zero. The criteria are grouped into issue categories (Energy, Water, Materials, etc)

Each of these environmental issue categories is weighted according to the perceived importance of the environmental issues that the section aims to address. The weightings are applied to the percentage score for each issue category. Once added together this gives the environmental score. The BREEAM rating is then awarded based on the score achieved. There is some slight variation between the rating bands for each version but the majority of ratings are awarded on the following scale:

Pass – 25%

Good – 40%

Very Good – 55%

Excellent – 70%

The issue category weightings were set following a consultation with a variety of construction industry stakeholders including academics, construction industry professionals, lobbyists and scientists.

2.5.3 Comparison of the Green Building Rating System

The most challenging aspect of this study was to develop a methodology that could be used to compare the relative environmental performance required to meet each of the ratings in each scheme. This is because the criteria in each one has been designed to recognize and encourage buildings which go further than would usually be achieved by designing or operating a building in line with local regulation and/or standard practice. The comparison of the variables in the assessment tools are described in the Table 3.

Table 3: Comparison of BREEAM, LEED, Green Star and CASBEE

Contents	**BREEAM**	**LEED**	**Green Star**	**CASBEE**
Launch Date	1990	1998	2003	2004
Ratings	PASS / GOOD / VERY GOOD / EXCELLENT/ OUTSTANDING	Certified / Silver / Gold / Platinum	One Star / Two Star / Three Star / Four Star / Five Star / Six Star	C / B- / B+ / A / S
Weightings	Applied to each issue category (consensus based on scientific / open consultation)	All credits equally weighted, although the number of credits related to each issue is a de facto weighting	Applied to each issue category(industry survey based)	Highly complex weighting system applied at every level
Information Gathering	Design / management team or assessor	Design / management team or Accredited Professional	Design team	Design / management team
Assessment	Trained assessors	USGBC	Accredited Professional	Design / management team

Third Party Validation	BRE	N/A	GBCA (Green Building Council of Australia) nominated assessors	Third Party Agencies eg JSBC (Japan Sustainable Building Consortium)
Certification Labeling	BRE	USGBC (United States Green Buildings Council)	GBCA	JSBC
Update Process	Annual	As required	Annual	As required
Governance	UK Accreditation Service (UKAS)	USGBC	GBCA	JSBC

2.5.4 What's Next on Rating System

As the Green Building movements grow, many green councils and organizations are working to establish rating systems that meets the specific needs of the local construction industry. In some locations, these efforts are taking the shape of adapting existing system to reflect local guideline, such as South Africa's plan to launch a national version of Green Star, UAE's adoption of BREEAM and LEED for Canada and India.

To assist local and national groups looking to design their own system, the International Initiatives for a Sustainable Build Environment has created the SBTool, a tool kit to aid in the development of a new rating system. Additionally, established system such as LEED, BREEAM and Green Star are making their system, training and expertise available on a global scale.

In October 2008, many of these international rating systems will be evaluated and compared in the new report Building Environmental Assessment Methods: A Critical Review of International Developments, by Dr. Raymond Cole (www.worldgbc.org).

2.6 BENEFITS OF GREEN BUILDING

Green Building save the resources in the entire lifecycle of the structure and it starts from Green design. Green design has environmental, economic and social elements that benefit all stakeholders, including owners and the occupants. The main advantages of Green Building can be categorized into three broad headings of environment benefits, economic benefits and health and safety benefits as follows:

Table 4: List of Environment, Economic and Health and Safety Benefits of Green Building

Aspects	Benefits
Environment	• Reduces environmental impact through energy efficiency and waste recycling • Reduction in energy requirements and carbon footprint
Economic	• Lower operational cost resulting from efficient resource use through reduction in energy and waste requirements • Maximizes owner's interest on investment and bottom line of firms • Increases the asset value • Reduces liability & improved risk management for the buildings • Gives a 'green' image to corporate adding to their prestige • Ensures optimal building and occupier performance • Additional revenue through carbon trading
Health & Safety	• Increases occupier retention, productivity and satisfaction • Improves health through better indoor air quality

2.7 CURRENT ENVIRONMENTAL PRACTICES IN MALAYSIAN INDUSTRY

There are obviously many environmental practices are in place in the Malaysian Construction Industry, especially as the government and legal requirements. But in this topic, the author will briefly describe three of them which are CIDM Best Practice: Industrialized Building System (IBS), ISO 14000 and OHSAS 18001 and Manual Baru Saliran Mesra Alam (MASMA) as these three are common to most of the construction company regardless of the size of the company and the grade.

3.2.1 Industrialized Building System (IBS)

The Industrialized Building Systems (IBS) is a construction process that utilizes techniques, products, components, or building systems which involve prefabricated components and on-site installation. From the structural classification, there are five IBS main groups identified as being used in this country, and these are:

i. **Pre-cast Concrete Framing, Panel and Box Systems**

Pre-cast columns, beams, slabs, 3-D components (balconies, staircases, toilets, lift chambers), permanent concrete formwork, etc;

ii. **Pre-cast Concrete Framing, Panel and Box Systems**

Pre-cast columns, beams, slabs, 3-D components (balconies, staircases, toilets, lift chambers), permanent concrete formwork, etc;

iii. **Steel Formwork Systems**

Tunnel forms, beams and columns molding forms, permanent steel formworks, etc

iv. **Steel Framing Systems**

Steel beams and columns, portal frames, roof trusses, etc;

v. **Prefabricated Timber Framing Systems**

Timber frames, roof trusses, etc;

vi. Block Work Systems

Interlocking concrete masonry units (CMU), lightweight concrete blocks, etc.

The use of IBS assures valuable advantages such as the reduction of unskilled workers, less wastage, less volume of building materials, increased environmental and construction site cleanliness and better quality control, among others.

These advantages also promote a safer and more organised construction site, and reduce the completion time of construction. Many world-class Malaysian developers have chosen IBS over the conventional methods for important projects such as the Petronas Twin Towers, Putrajaya, KL Sentral and KLIA.

2.7.2 ISO 14000

The ISO14000 is a standard for environmental management system that is applicable to any business, regardless of size, location and income. The aim of the standard is to reduce the environmental footprint of a business and to decrease the pollution and waste a business produces. The most recent version of ISO 14001 was released in 2004 by the International Organization for Standardization (ISO) which has representation from committees all over the world.

The ISO 14000 environmental management standards exist to help organizations minimize how their operations negatively affect the environment. The structure is similar to ISO 9000 quality management and both can be implemented side by side. In order for an organization to be awarded an ISO 14001 certificate, they must be externally audited by an audit body that has been accredited by an accreditation body

- ISO 14001 Environmental Management System – requirements with guidance for use
- ISO 14004 Environmental Management System – General Guideline on principles, systems and support techniques.
- ISO 14015 Environmental Assessment of Sites and Organizations

- ISO 14020 Series (14020 – 14025) Environmental Labels and Declarations
- ISO 14031 Environmental Performance Evaluation - Guideline
- ISO 14040 Series (14040 – 14049) Life Cycle Assessment, Discusses Pre-production Planning and Environment Goal Setting
- ISO 14050 terms and Definition
- ISO 14062 discusses making improvements to environmental impact goals
- ISO 14063 Environmental Communication – Guideline and Examples
- ISO 19011 specifies one audit protocol, for both 14000 and 9000 series standards together

3.2.3 OHSAS 18001

OHSAS 18001 was created via the concerted effort from a number of the worlds leading national standards bodies, certification bodies, and specialist consultancies. A main driver for this was to try to remove confusion in the workplace from the proliferation of certifiable OH&S. specifications.

A perhaps would be expected, a number of older documents were used in the creation process. These included:

- BS8800:1996 Guide to occupational health and safety management systems
- Technical Report NPR 5001: 1997 Guide to an occupational health and safety management system
- SGS & ISMOL ISA 2000:1997 Requirements for Safety and Health Management Systems
- BVQI SafetyCert: Occupational Safety and Health Management Standard

- DNV Standard for Certification of Occupational Health and Safety Management Systems(OHSMS):1997
- Draft NSAI SR 320 Recommendation for an Occupational Health and Safety (OH and S) Management System
- Draft AS/NZ 4801 Occupational health and safety management systems Specification with guidance for use
- Draft BSI PAS 088 Occupational health and safety management systems
- UNE 81900 series of pre-standards on the Prevention of occupational risks
- Draft LRQA SMS 8800 Health & safety management systems assessment criteria

It is worth noting that the certification bodies involved in creation hold about 80% of the world market for management system certification.

COMPATIBILITIES

OHSAS 18001 has been developed to be compatible with the ISO 9001 (Quality) and ISO 14001 (Environmental) management systems standards, in order to facilitate the integration of quality, environmental and occupational health and safety management systems by organizations, should they wish to do so.

The (OHSAS) specification gives requirements for an occupational health and safety (OH&S) management system, to enable an organisation to control its OH&S risks and improve its performance. It does not state specific OH&S performance criteria, nor does it give detailed specifications for the design of a management system.

APPLICATION AND BENEFITS

The OHSAS specification is applicable to any organisation that wishes to:

- Establish an OH&S management system to eliminate or minimize risk to employees and other interested parties who may be exposed to OH&S risks associated with its activities
- Implement, maintain and continually improve an OH&S management system

- Assure itself of its conformance with its stated OH&S policy
- Demonstrate such conformance to others
- Seek certification/registration of its OH&S management system by an external organisation
- Make a self-determination and declaration of conformance with this OHSAS specification.

3.2.4 Manual Baru Saliran Mesra Alam (MASMA)

The goal of this Manual is to provide guidance to all regulators, planners and designers who are involved in stormwater management. It identifies a new direction for stormwater management in urban areas in Malaysia.

Stormwater management within a catchment is often undertaken by a number of organisations. The challenge is to ensure that the administration of the planning, design and maintenance of stormwater management systems is consistent across the relevant Local, State and Federal Authorities and the professions of planning, environmental and civil engineering, and landscape architecture.

Under this new direction, stormwater management will have multiple objectives, including to:

- ensure the safety of the public
- control nuisance flooding and provide for the safe passage of less frequent and larger flood events
- protect property
- stabilise the landform and control erosion
- optimise the land available for urban development
- minimise the environmental impact of urban runoff on water quality
- enhance the urban landscape

CHAPTER 3

METHODOLOGY

3.1 Project Methodology

This chapter represents how the author carried out the project; 'Preparedness among Technical Professionals for Green Building in The Malaysian Construction Industry'. The followings are the description on each stage of the methodology starting from; Reevaluate the questionnaire form, Distributing the questionnaires form, Gathering information and feedbacks from the survey and do further research, Evaluate / assess the feedback and response from the survey and Conclusion and Recommendation. Figure 1 shows the complete diagram illustrating the methodology of this project.

3.1.1 Reevaluate the questionnaire form

The questionnaire form was set up with the co-operation of one of the Master student, Retno Rahardjati from Universiti Teknologi PETRONAS, UTP. The questionnaire was to determine the preparedness, awareness and understanding of the Technical Professionals in building and construction industry in Malaysia regarding the implementation of Green Building in Malaysia.

3.1.2 Distribute the questionnaire form

The questionnaires were distributed mainly to the Technical Professionals in the industry and comprises from all fields, including; Construction and Structure, Mechanical and Electrical, Architect, Quantity Surveyor, Contract Manager. The author distributed the questionnaire via several ways, sending via mail, attended the building and construction industry expo and also personally interviewed the personnel.

3.1.3 Gather information and feedbacks and do further research

During the interview session, there were many comments and arguments were discussed. These comments can be considered as valuable information for the research and lead to a positive development of the project. From the interview, the author is required to further research the Malaysia legal requirements in the building and construction industry, including ISO 14000, OHSAS 18001, Manual Baru Saliran Mesra Alam (MASMA) and overview on the CIDB initiatives.

3.1.4 Evaluate / assess the feedback and response from the survey

The feedbacks and responses from the quantitative survey are evaluated and assessed thoroughly and the data are transferred as valuable information to propose suitable alternatives in promoting Green Building and Green Building Rating System in the Building and Construction Industry in Malaysia.

The author has decided to use the 'Mean Factor Analysis' to analyze the raw data from the questionnaire. The data gathered is later tabulated in Microsoft Excel and the author will get a bar chart showing the number / percentage of responses accordingly to the items / variables, (note: the variables to indicate the level of awareness, understanding or preparedness). After that, the author will analyze the data using mean factor analysis method to get the mean value of each item / variable assessed and a specific line graph is drawn to show the trend. As the basis for the analysis, another line is introduced and labeled as 'Total Mean' which is the average of total mean. Any items / variables with its' mean value is less than the 'Total Mean' the items / variables are considered as 'Low Level', if the mean value is same as the 'Total Mean', then it is 'Moderate' and if the mean value is higher than the 'Total Mean' so, it is considered as 'High Level'.

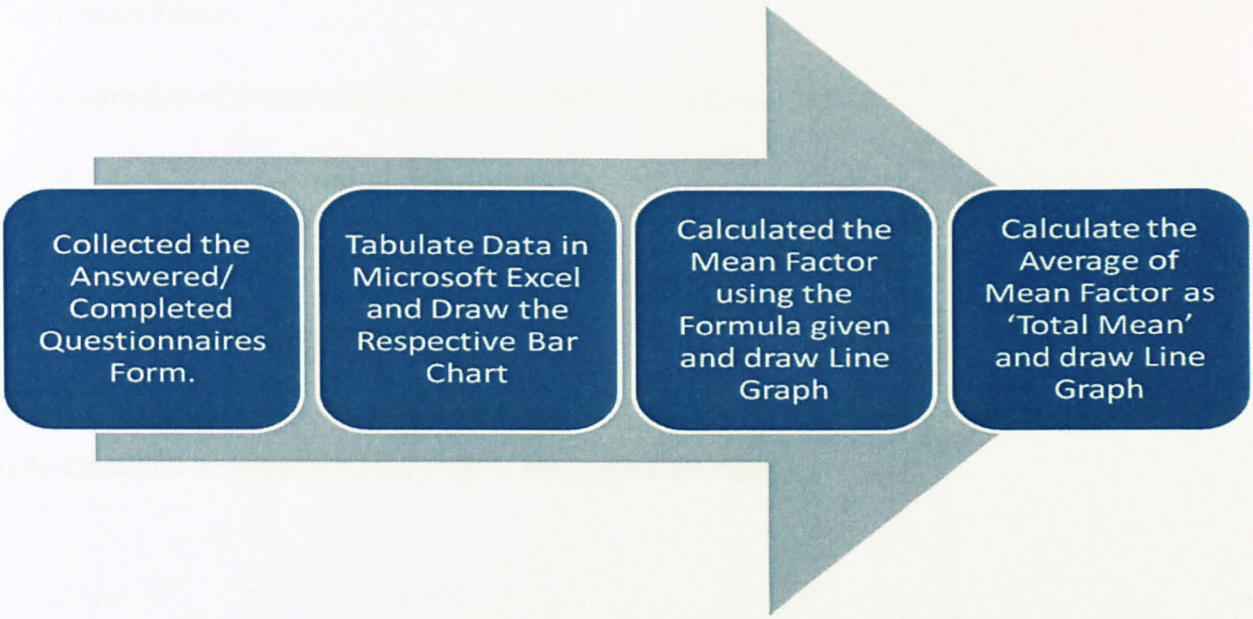


Figure 3: Diagram of Approach to Data Analyzing

Example:

Items / Variables	Very Insignificant = 1	Insignificant = 2	Neutral = 3	Significant = 4	Very Significant = 5	Mean Factor
Var1	A1	A2	A3	A4	A5	A
Var2	B1	B2	B3	B4	B5	B
Var3	C1	C2	C3	C4	C5	C

Table 5 shows the example of tabulated data from the questionnaire

Mean Factor:

= summation of number of response multiply by correspond level point (1, 2, 3, 4 or 5) divided by number of total respondents

= [(A1*1) + (A2*2) + (A3*3) + (A4*4) + (A5*5)] / [A1+A2+A3+A4+A5]

Total Mean Factor:

= Summation of mean values divided by number of items/variables, n

= [A + B + C…] / [number of items/variables, n]

3.1.5 Conclusion and Recommendation

At the end of this report, the author will conclude the finding of the survey and comment on how the author accomplished the project within the time frame.

3.2 Work Flow Diagram

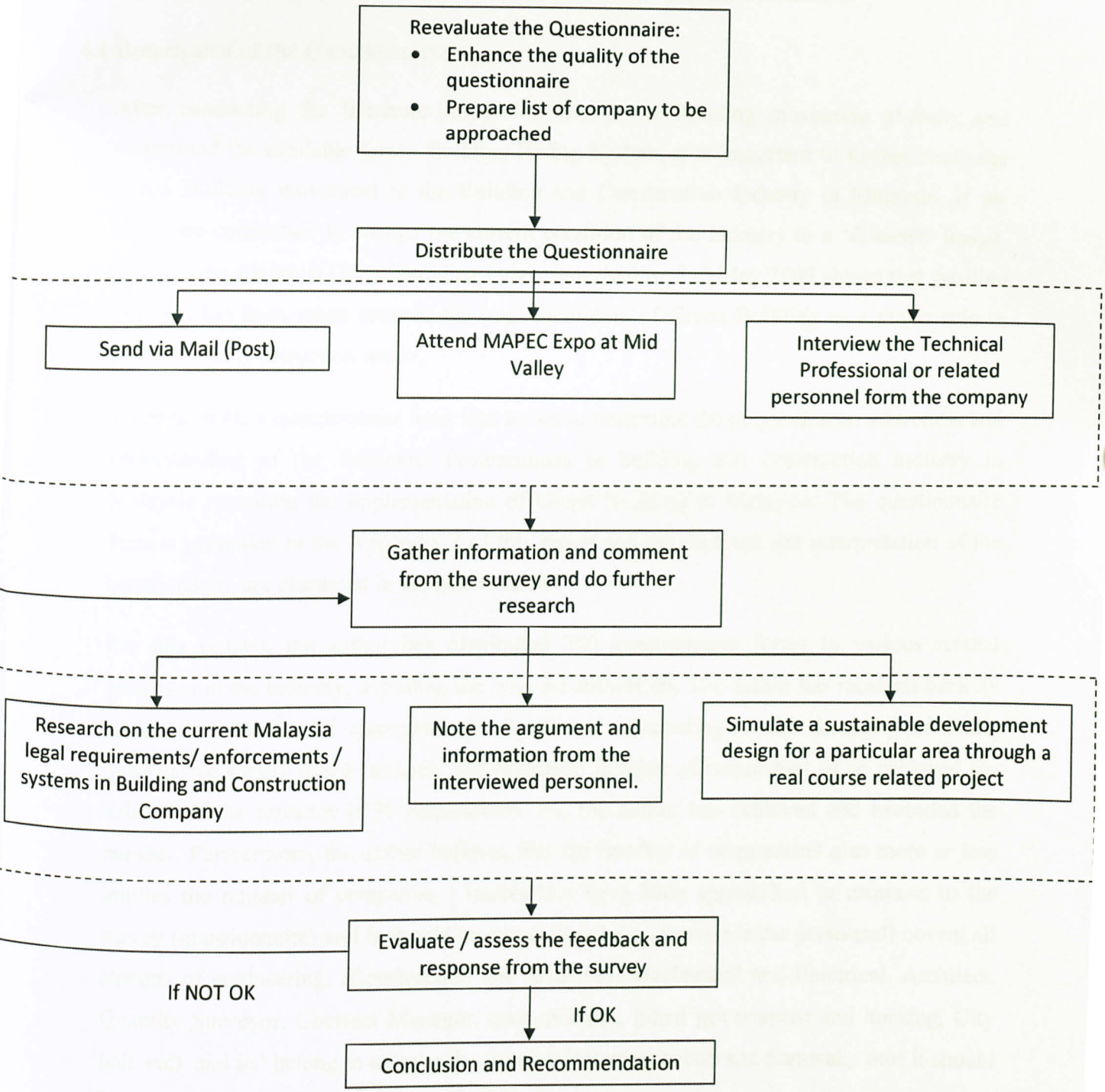


Figure 4: Work Flow Diagram

CHAPTER 4

QUESTIONNAIRE: RESULTS AND DISCUSSION

4.1 Description of the Questionnaire

After conducting the literature review on the Green Building movement globally and understand the available Green Building Rating System, it is important to further study the Green Building movement in the Building and Construction Industry in Malaysia, if we really are committed to change the current condition of the industry to a 'Greener' image. Besides, the Malaysia Green Building Index, launched on 21st May 2009 shows that positive progress has been taken towards the implementation of Green Building as a major role in building and construction sector.

To begin with, a questionnaire form was set up to determine the preparedness, awareness and understanding of the Technical Professionals in building and construction industry in Malaysia regarding the implementation of Green Building in Malaysia. The questionnaire form is presented in the Appendix 1 of this report and the findings and interpretation of the questionnaire are discussed in the next section.

For this project, the author has distributed 200 questionnaire forms to various related personnel in the industry, including the relevant authorities. The author has received back 38 responses from overall questionnaires distributed. According to the formality of doing quantitative survey based research, the minimum number of respondent to be achieved for validity of the research is 30 respondents. So, the author has achieved and exceeded the number. Furthermore, the author believes that the number of respondents also more or less implies the number of companies / bodies that have been approached to response to the survey (questionnaire) and it should be noted that the company (or the personnel) covers all streams of engineering, (Construction and Structure, Mechanical and Electrical, Architect, Quantity Surveyor, Contract Manager, town planner, Local government and housing, City hall, etc) and its' belong to all over the country including Sabah and Sarawak, thus it should be enough to picture the industry as a whole.

This Final Year Project 2, is a quantitative survey based project where the author aims to see numbers and percentage of the responses from Technical Professionals in the Malaysian Construction Industry regarding Green Building and its' Rating System. A survey based research is useful in describing the characteristics of a large population and many questions can be asked about a given topic which gives considerable flexibility to the analysis. A survey based research also involves testing a hypothesis, thus provides inferential techniques involve generalizing from a sample to the whole population. Consequently, very large sample are feasible, making the results statistically significant even when analyzing multiple variables.

4.2 Questionnaire: Results and Discussion

The following are the information from the questionnaire;

RESPONDENTS' PROFILES						
AGE	20-30		31-40		> 40	
	23.33%		26.67%		50.00%	
GENDER	MALE			FEMALE		
	66.67%			33.33%		
EXPERIENCE	< 3 YEARS	4-5 YEARS		6-10 YEARS	> 10 YEARS	
	6.67%	16.67%		16.67%	60.00%	
PROFESSION	C&S	M&E	ARCHITECT	QS	CM	OTHER
	40.00%	10.00%	13.33%	10.00%	13.33%	13.33%

Table 6 shows the Respondents' Profile for the survey conducted

4.2.1 The first question:

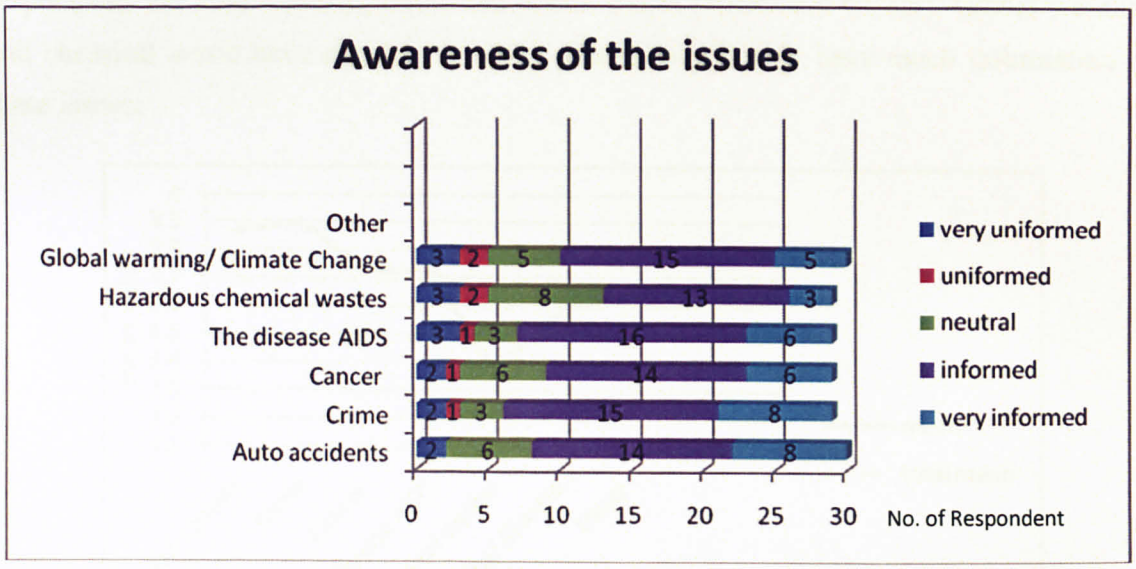


Figure 5 shows How informed public of following issues

4.2.2 The second question:

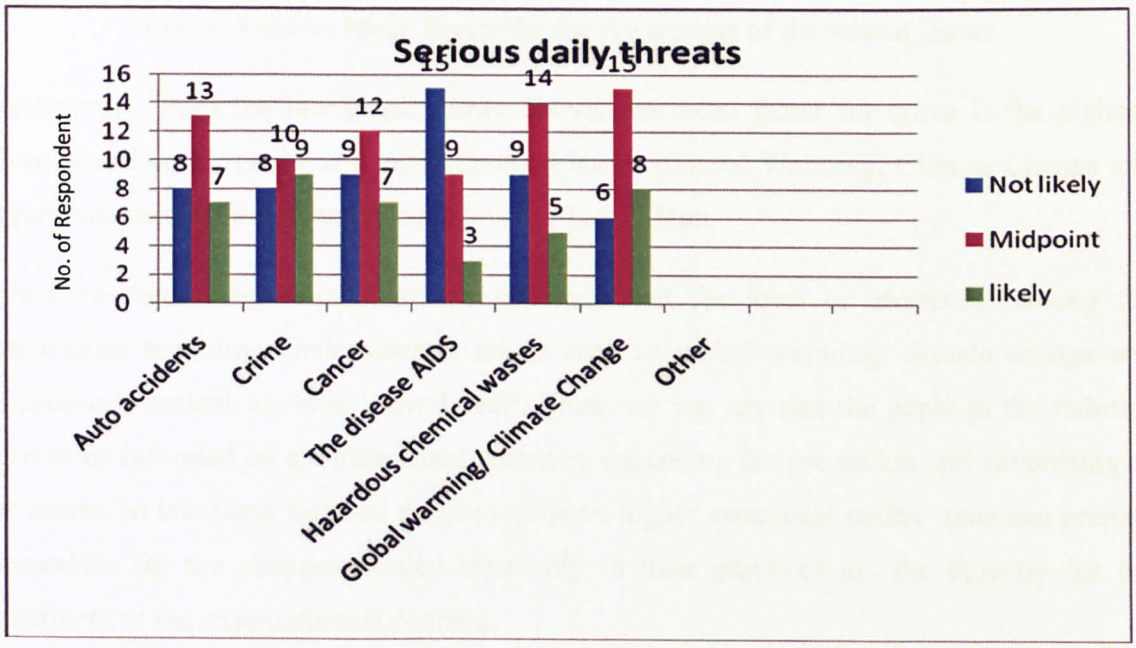


Figure 6 shows How likely public to experience serious threats from following issues

From the data tabulated in both graph, we can converse that the most informed issues for the respondents are auto accident, crime and health issues (AIDS and cancer). Global warming and chemical waste have midpoint marked, means they do not have much information on these issues.

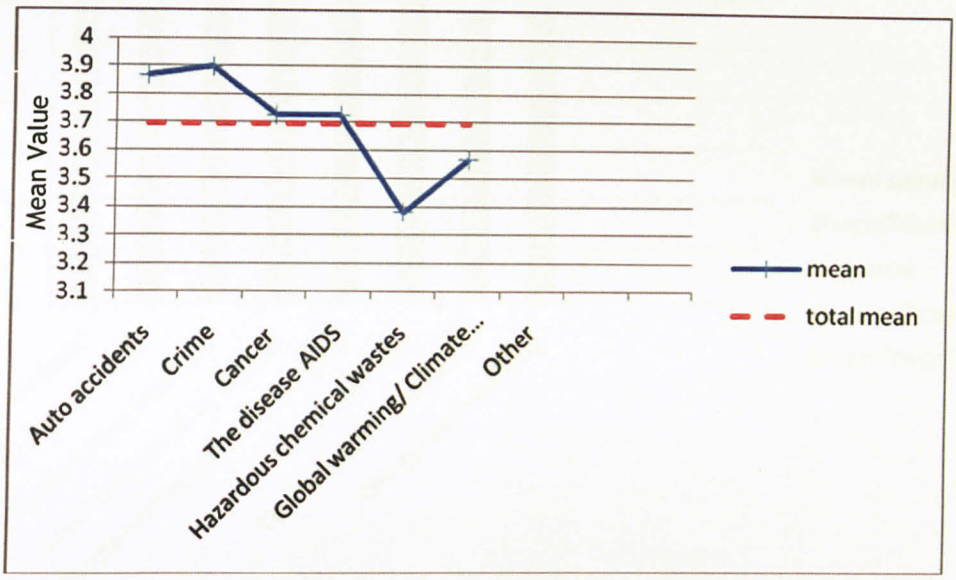


Figure 7 shows Mean Factor for the Awareness of the related issues

Furthermore, from the line graph shown above, the mean factor for crime is the highest. More than that, for health and environmental issues (Global Warming, Climate Change and hazardous waste) are reported to be below the Total Mean.

Based on these information, we can conclude that the level of awareness among the respondents regarding environmental issues such as global warming, climate change and hazardous chemical waste is 'Low Level'. Thus, we can say that the peple in the industry need to be informed on environmental issues by enhancing the promotion and advertising of the issues, so that these targeted people will have higher awareness on the issue and prepare themselves for the changes needed especially in their practices in the industry for the betterment of the environmental concern.

4.2.3 The third question:

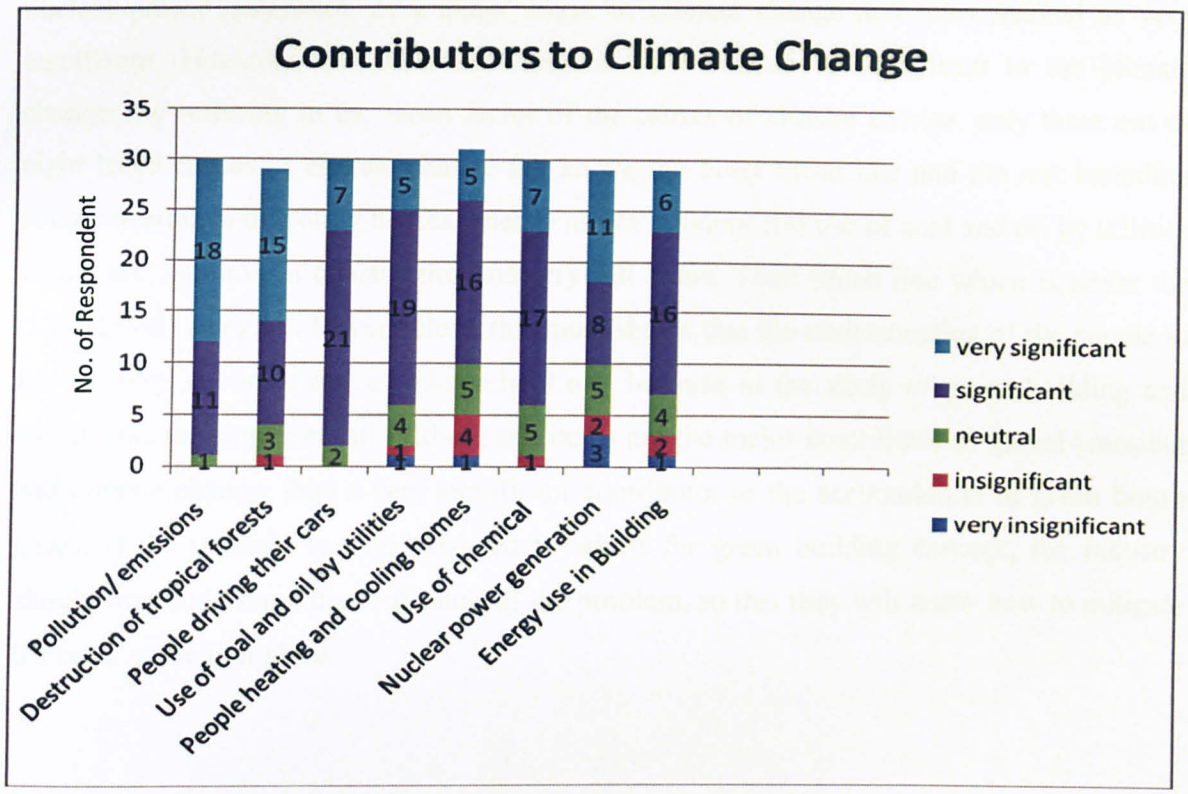


Figure 8 shows the Causes of climate change

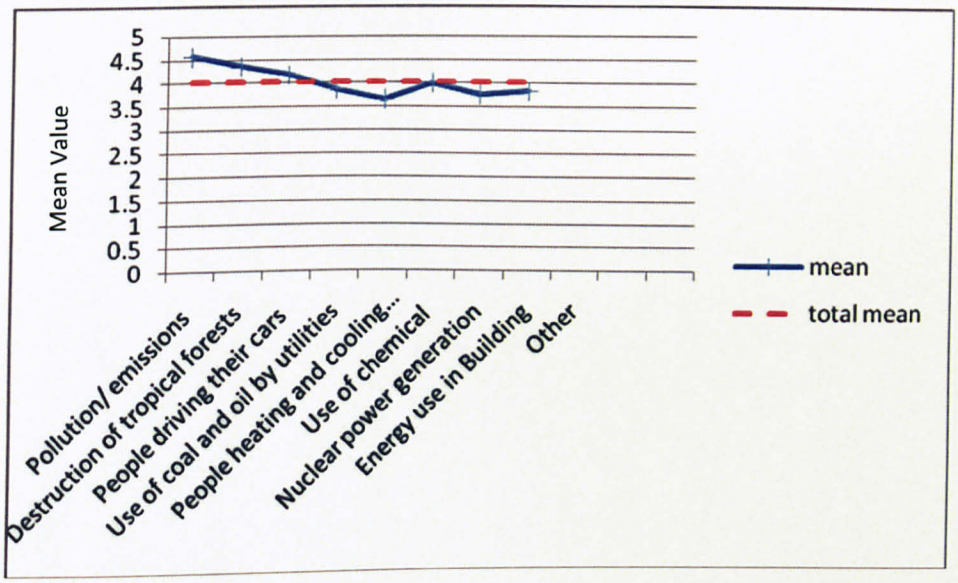


Figure 9 shows the mean factor for the causes of climate change

The respondents have chosen on pollution/emissions, destruction of tropical forest and nuclear power generation as a major cause of climate change and most marked as very significant. However, the other contributors were marked as significant to the climate change. By referring to the mean factor of the causes of climate change, only three out of eight listed causes of climate change fall above the Total Mean line and the rest including people heating and cooling homes, energy use in building and use of coal and oil by utilities which are common in construction industry fall below Total Mean line which is under the 'Low Level' category. Nevertheless, this must shows that the understanding of the people in the industry is considered as relatively 'Low' because in the study of green building and sustainable development, all of the listed items are the major contributor to global warming and climate change, thus a very significant contributor to the accumulation of green house gases. If the industry is well prepared to adjust for green building concept, the industry should first understand the root cause of the problem, so that they will know how to mitigate the issue at the first place.

4.2.4 The fourth question:

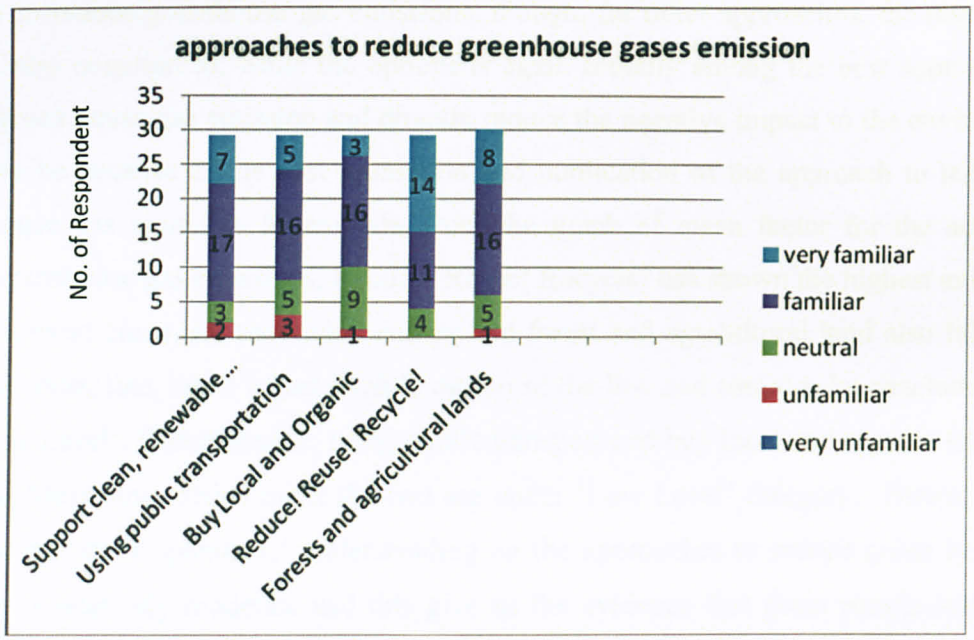


Figure 10 shows the actions to reduce greenhouse gas emissions

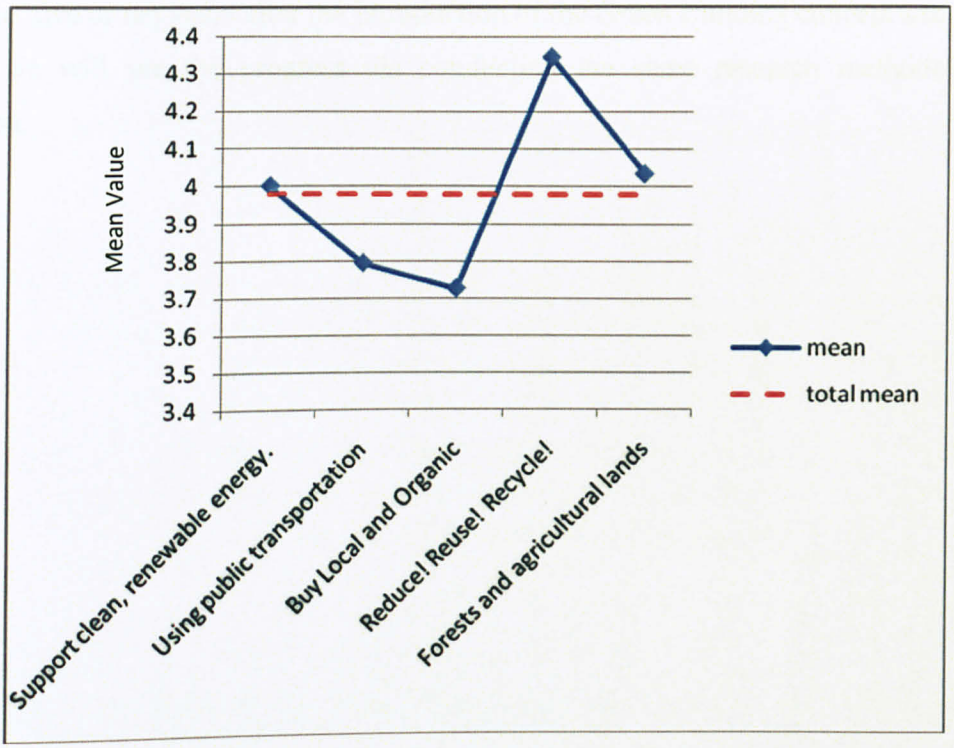


Figure 11 shows the mean factor for the actions to reduce greenhouse gas emissions

From the bar chart, we can converse that respondents are familiar with reduce! reuse! recycle! to reduce greenhouse gas emissions, though, for other approaches, the respondents are not very common to, while the options is again actually among the best approaches to reduce green house gas emission and directly reduce the negative impact to the environment. This may be because of the vast promotion and publication of the approach to reduce the green house gas emission. Meanwhile, from the graph of mean factor for the actions to reduce greenhouse gas emissions, Reduce! Reuse! Recycle! has shown the highest among all, though support clean and renewable energy and forest and agricultural land also fall above the Total Mean line, but it is just slightly on top of the line and can also be concluded as on 'Moderate Level'. Unfortunately, using public transport and buy local and organic fall below the Total Mean line, which make the two are under 'Low Level' category. Hence, we can conclude that the respondents' understanding on the approaches to reduce green house gas emission is relatively moderate and this give us the evidence that these people need to be educated and informed regarding the issue. This information also served as a platform for evaluation of the performance of the industry in the implementation of Green Building. In the next three, five or ten years after the introduction of the Green Building concept and its rating system, we will see the progress via conducting the same research methodology and evaluation.

4.2.5 The fifth question:

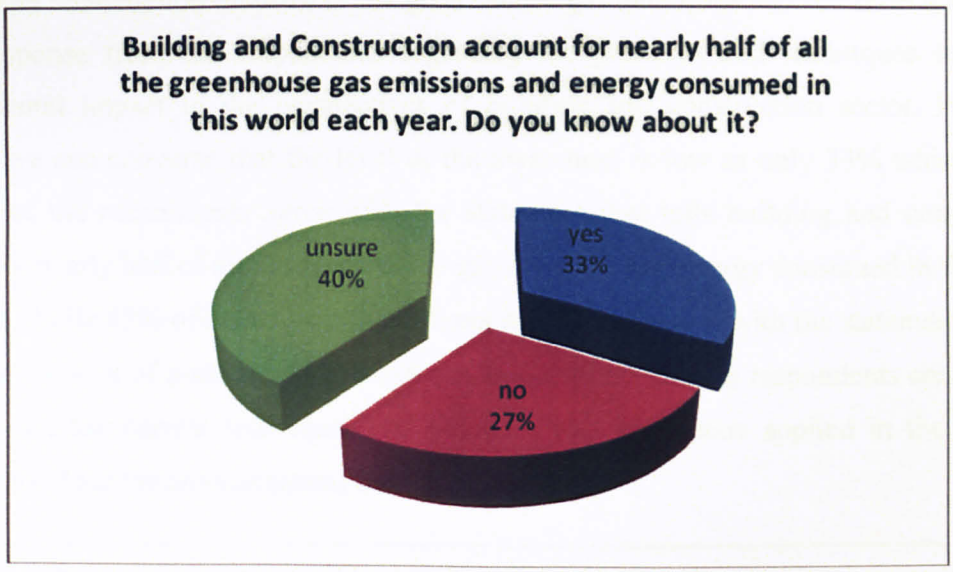


Figure 12 shows the awareness of the respondents about the share of building and construction industry to the green house gas emissions

4.2.6 The sixth question:

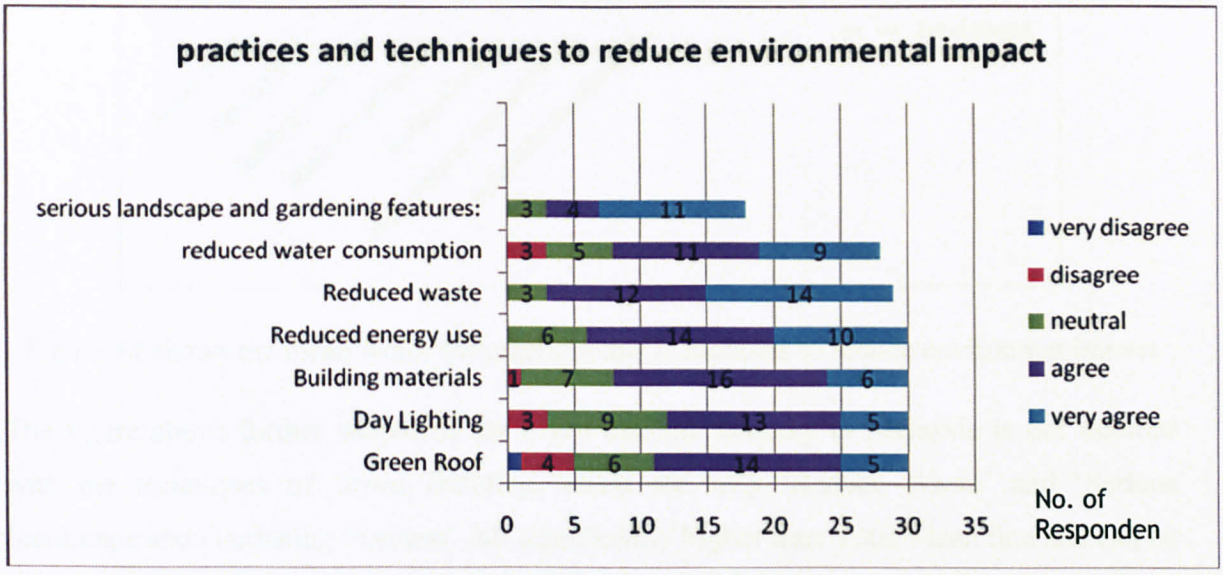


Figure 13 shows the practices and techniques to reduce environmental impact.

The fifth question directly asking the respondents on their awareness about the share of building and construction industry to the green house gas emissions and the sixth question is to get response from the respondents regarding the practices and techniques to reduce environmental impact in the perspectives of building and construction sector. From the findings, we can converse that the level of the awareness is low as only 33% which is less that half of the respondents agree with the statement that tells building and construction account for nearly half of all the green house gas emission and energy consumed in the world each year. While 63% of the respondents are not sure and disagree with the statement. Above all, due to the lack of awareness, the sixth question capture that the respondents are not very familiar with the current techniques and practices that have been applied in the industry globally to reduce the environmental impact.

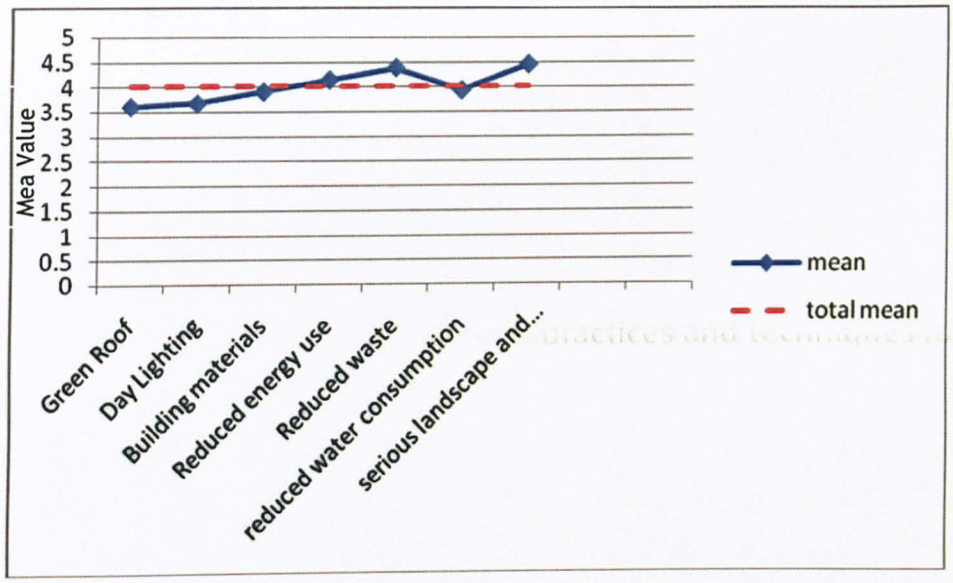


Figure 14 shows the mean factor for practices and techniques to reduce environmet impact

The figure above further supported the claim that the industry in Malaysia is not familiar with the techniques of Green Building. There are only 'Reduce Waste' and 'Serious Landscape and Gardening Features' fall significantly higher than Total Mean line and can be considered 'High Level' in term of knowledge in Green Building practices and techniques. Green Roof, Day Lighting, Building Materials, and Reduce Water Consumption fall below Total Mean line and are categorized as 'Low Level' while Reduced Energy Use is slightly

above Total Mean line and can be considered as 'Moderate'. This information is valuable to the industry as we can monitor in the next three, five or ten years time, which criteria of the green building principles are lacking and need improvement in the practices of the industry. We could concentrate for the recommendation for improvement in the particular area of green building attributes.

4.2.7 The seventh question:

60% of the respondents have given their opinion about green building, and all respondents said that green building is important to do for sustainable future and better way to improve environmental stability and sustainability

4.2.8 The eight question:

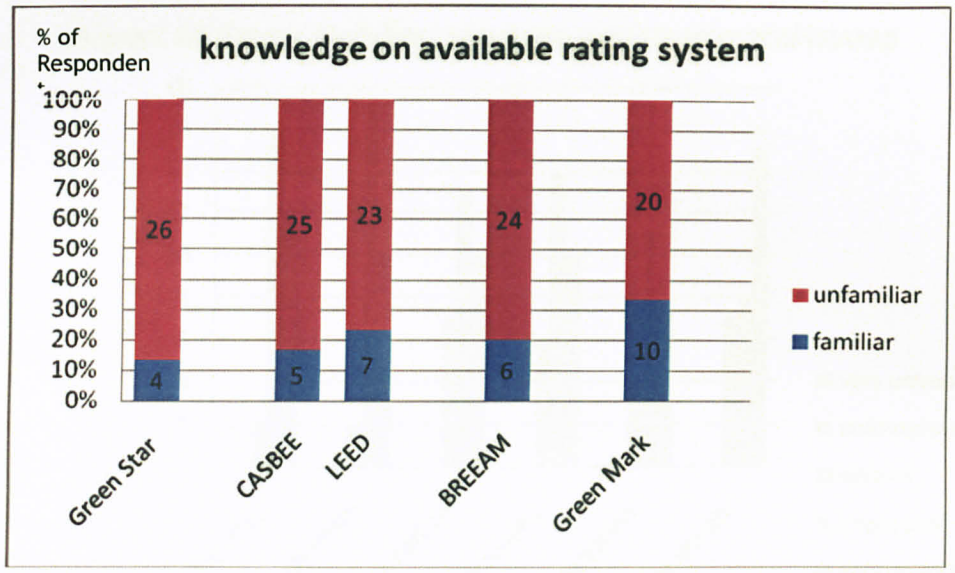


Figure 15 shows the familiarity of the respondents towards the available rating system regionally

This graph gives information on how familiar the respondents on green building rating systems which is an assessment tools to green building certification. Unfortunately, the Malaysian Construction Industry has relatively very low knowledge or familiarity towards the green building rating system, including Green Star, Australia; CASBEE, Japan; LEED, United States; BREEAM, United Kingdom; and Green Mark, Singapore. The data shows that about 80% of the respondents are not familiar with the rating system, even BREEAM which has been in the industry for over two decades. This implies that the Malaysian Construction Industry is not yet well prepared to apply the rating system in their project. There must be a thorough promotion and strategic implementation strategy in term of knowledge transfer of the Green Building concept and its rating system, especially regarding the Green Building Index Malaysia.

4.2.9 The ninth question:

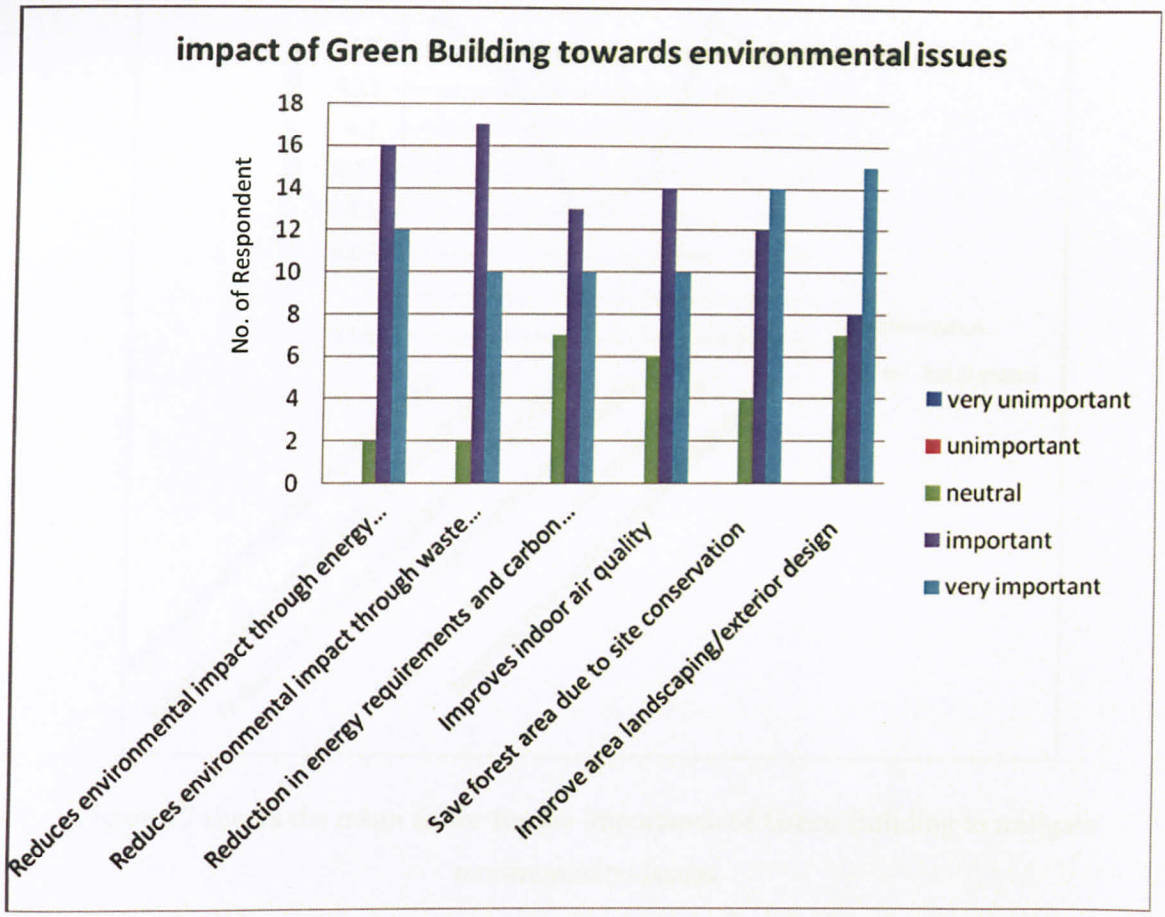


Figure 16 shows how important green building can work out for environmental issues

Again, this graph shows the respondents' understanding of the items or criteria in the assessment of rating system, especially Green Building Index Malaysia. We can conclude that respondents have fair agreement on the important of the rated or assessed criteria. This clearly means that the Green Building Index Malaysia has successfully integrated the right assessment criteria to fit the industry capacity and ability.

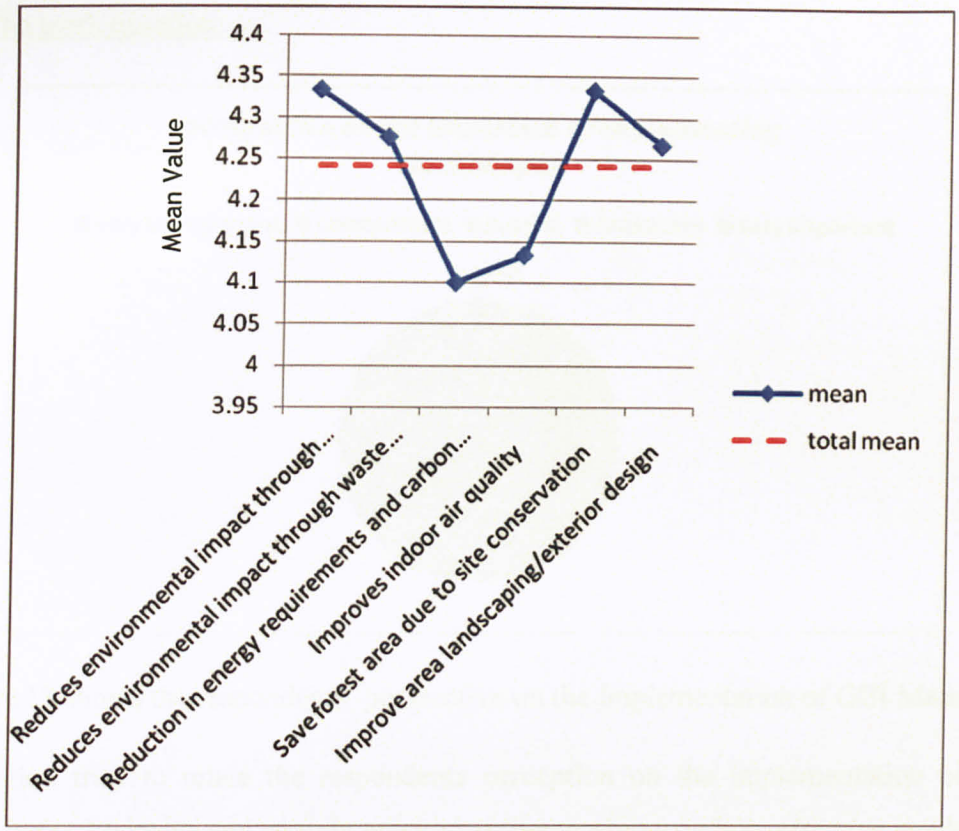


Figure 17 shows the mean factor for the importance of Green Building to mitigate environmental issues

The line graph above reported that only two out of six criteria or assessment items which indicate the importance of Green building in mitigating environmental issues fall below Total Mean line and the rest of the options fall above total Mean line. However, the Total Mean line itself is high as it indicate 4.240421, which is in point level of assessment it means significant / very significant. Thus, this shows that the respondents agree that Green Building can be implemented to mitigate environmental issues, reflecting to the principles and assessment items in the Green buildig itself.

4.2.10 The tenth question:

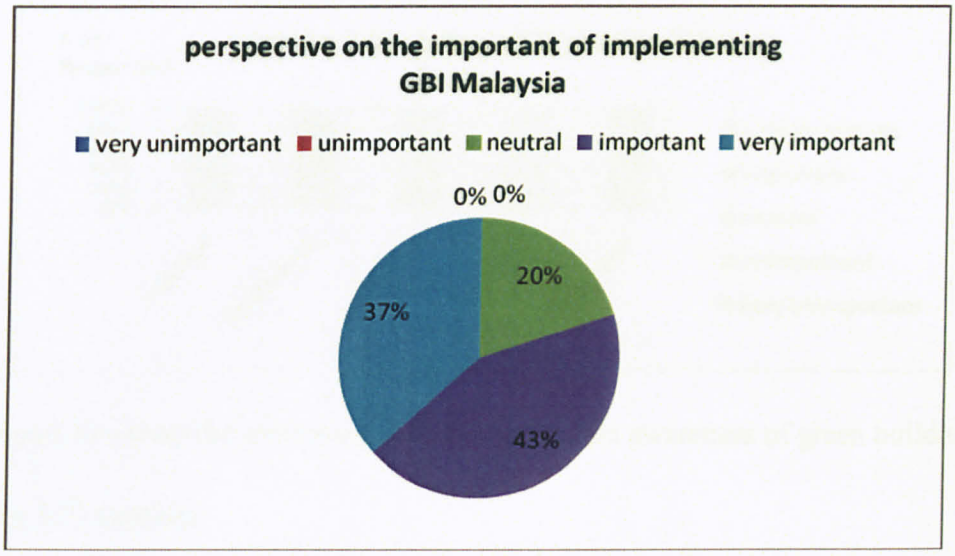


Figure 18 shows the respondents' perspective on the implementation of GBI Malaysia

The question tries to relate the respondents perception on the implementation of Green Building Index Malaysia and straight away gives perspectives on how effective would be the Malaysia Green Building Index for Malaysia building and construction in the next ten years. The graph shows that 80% of the respondents give positive feedback regarding the implementation of the rating system but they also stressed that the implementation strategy should be closely monitored for better results and collective member joining the system. With the introduction of Green Building Index Malaysia, it will also boost the industry in term of skills requirement, technology enhancement, cooperation with leading global company and etc. As mentioned by Managing director of Sime Darby Property Berhad, Datuk Tunku Badlishah Tunku Amran; "..the company is looking forward to create desirable, innovative and environmentally-friendly product by establishing new typologies, new materials and construction methodologies and collaboration with cutting-edge technology provider.."

4.2.11 The 11th question:

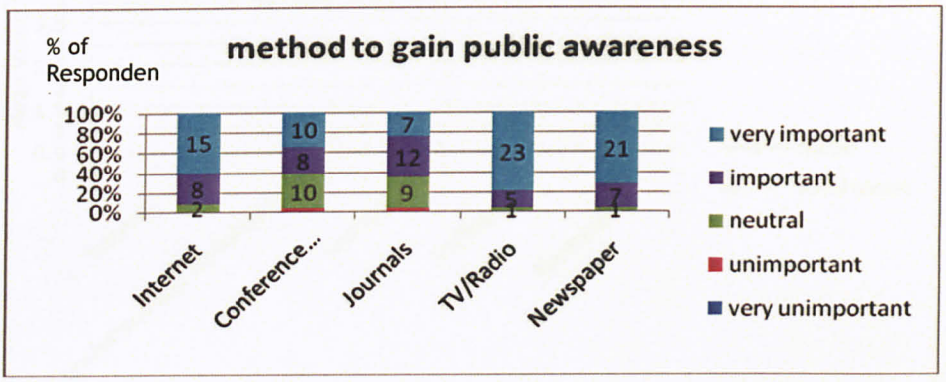


Figure 19 shows the preferred method to get public awareness of green building

4.2.12 The 12th question:

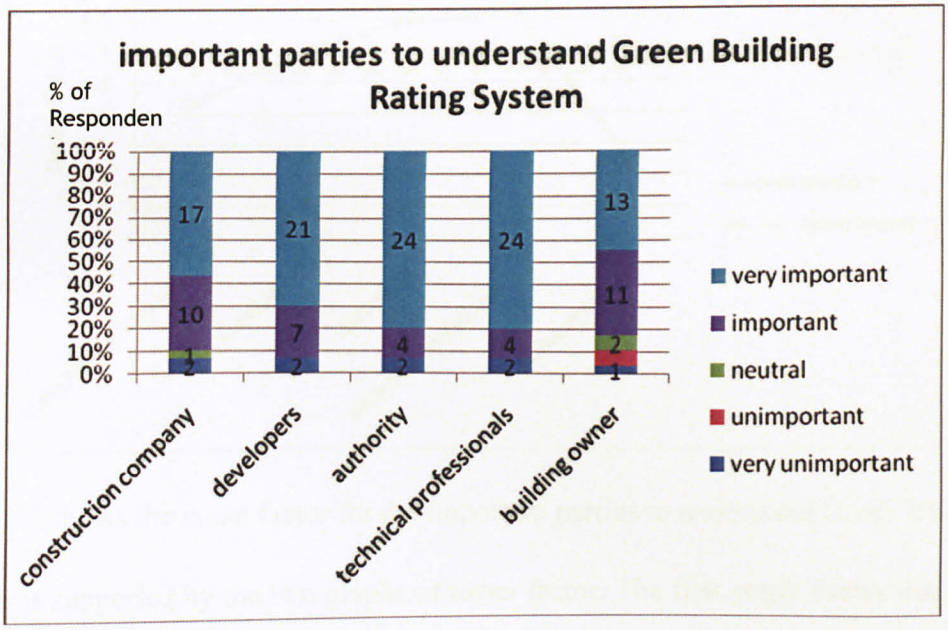


Figure 20 shown the important parties to understand the Green Building Rating System

From the previous results and graphs, we know that the respondents are relatively unfamiliar or uninformed regarding environmental issues, green building concept and its rating system. So, from the chart in figure 13, we can converse that the effective method to gain public awareness is by TV/Radio, Newspaper and the internet. This also reflect to the information in figure 14 that shows all parties must be informed and educated on the issues.

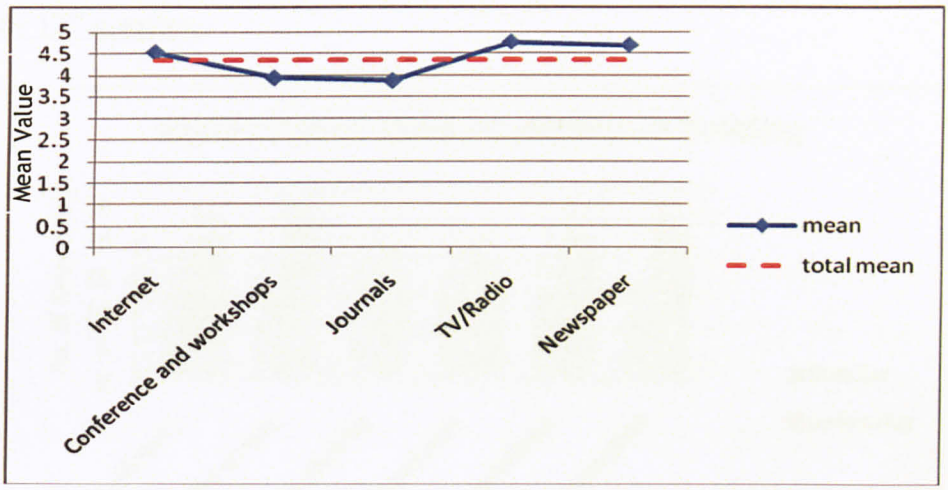


Figure 21 shows the mean factor for the method to gain public awareness of Green Building

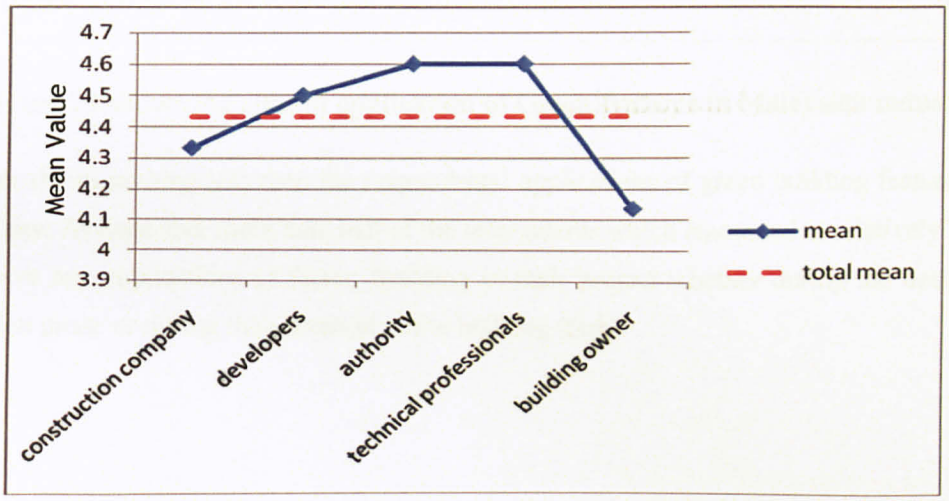


Figure 22 shows the mean factor for the important parties to understand Green Building.

The claim is supported by the two graphs of mean factor. The first graph shows that Internet, TV/Radio and Newspaper falls above Total Mean line while conference and workshops and Journals fall below Total Mean line. But the author agrees that for promotion purposes we should not limit the effort and strive for implementation can be in many different ways. The important person to understand Green Building should be all parties especially Developers, Authority and Technical Professionals as these groups fall above Total Mean line and have 'High Level' priorities.

4.2.13 The 13th question:

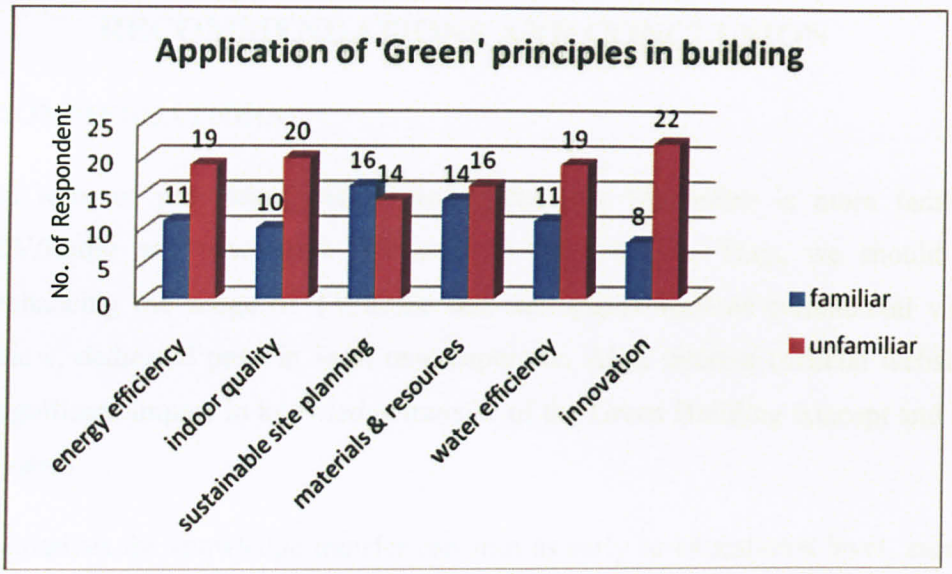


Figure 23 shows the current application of Green features in Malaysian industry

This graph shows nothing less then the respondents' applications of green building features in their project if any. As expected, more than half of the respondents which amounted to relatively 70% have not yet have any applications of Green Building in their project whether during the design phase, construction phase or during the operation of the building itself.

CHAPTER 5

RECOMMENDATIONS AND CONCLUSION

5.1 RECOMMENDATIONS:

5.1.1 In term of promotion and advertisement, our Malaysian is more familiar with TV/Radio and newspaper compared to other means. Thus, we should consider enhancing the usage of TV/Radio and newspaper such as commercial video, talk show, dedicated page in local newspaper etc. Also, internet (official website) has a significant impact in knowledge transfer of the Green Building concept and its rating system.

5.1.2 Initiatives for knowledge transfer can start as early as educational level, especially in higher education for an exposure. Education, training and communication of Green Building and its rating system can also reach to the developers, investors, utilities, suppliers, architects and occupants via various ways such as seminar, forum, conference and training sessions.

5.1.3 It is necessary to create the conditions and incentives that would encourage stakeholders in the sector to jointly and more actively pursue sustainable building and construction in a life cycle perspective. Such conditions could range from governmental policies, or economic incentives, to rating systems and coordination with key partners, such as the financing and insurance sector

5.2 CONCLUSION

Indeed, the environmental issues have been an epidemic to the whole world and there are possibilities that this phenomenon will continue and become a catastrophic if left without any actions taken. Considering that building and construction sector is the major contributor to the global warming and the increasing accumulation of Green House Gases (GHG), through various activities such as manufacturing, transportation, land use change and forestry, electricity, heat, fossil fuel combustion and construction sites as well as building. Therefore, Green Building is a significant initiative in mitigating these environmental concerns.

The objectives of Green Building as described by the United Nations Environment Programme, (UNEP), which are efficient use of land and energy, water conservation, improved indoor quality and resource conservation is what brings the Global Building and Construction industry and Global Councils strives to make Green Building as something reality which then creates Green Building Rating System as the guideline and assessment criteria for the people in the industry to follow the trend.

Although it may have started out as a fringe movement, green building techniques are now becoming more mainstream everyday. As technology and marketing increase, it will only serve to make these techniques easier to accomplish and more affordable to incorporate into the building, structures, and homes of every local community.

As the current condition of Malaysian Construction Industry shows in this survey research, the awareness on global environment issues is still moderate and the understanding of the Green building concept, practices and techniques is relatively low. Thus, it reflects the preparedness of the industry on Green Building Rating System and the Green Building Index Malaysia to be in the same level as well. This shows that there is an education / knowledge gaps in the industry that should be filled in and the author believe that the knowledge transfer for Green Building can be done through Professionals Bodies and Authorities / Agencies.

Appendix 2

UNIVERSITI TEKNOLOGI PETRONAS

UNIVERSITI TEKNOLOGI PETRONAS
CIVIL ENGINEERING

Questionnaire of Pilot Project Green Building Rating Systems Awareness

INTRODUCTION

Dear respondents,
This research is a Master's thesis study and FYP report. As a part of the research; I am distributing questionnaires to the person who are concern on Green Building. Your views and opinion are important for the research. Your response will help us to better understand the awareness and application of Green Building Rating Systems.

The questionnaire consists of a variety of closed and open ended questions. Your participation is voluntarily. Your name will not be used in any reporting of the research and your rights will be protected. Your answers will be reported and aggregated with other respondents.

If you have any enquiries regarding this survey procedure or wish to make suggestions, please contact the researcher.

Thank you.

Mohamad Khairilfreez bin Zainudin
FYP II Student
HP: 012-3134131
Email: tocky_khairil@yahoo.com

THE PURPOSE of QUESTIONNAIRE

1. To identify the awareness among Technical Professionals in the Malaysian Construction Industry on Green Building Rating Systems
2. To determine the respondents' understanding and perceptions on how green building can mitigate of climate change.

Researcher:

Retno Rahardjati
MSc Student

Mohamad Khairilfareez B. Zainudin
FYP Student

Supervisor:
Dr. Mohd Faris Khamidi
Lecturer
Civil Engineering
University Technology Petronas

2. How **likely** are you, during your lifetime, to experience serious threats from the following? Tick one on each line from not likely, midpoint, likely.

	Not likely	Midpoint	likely
Auto accidents			
Crime			
Cancer			
The disease AIDS			
Hazardous chemical wastes			
Global warming/ Climate Change			
Other:			

3. The world is warming up and climate has changed.
Which of the following do you think **most significant** contributes to Climate Change? Tick one on each line.

	1	2	3	4	5
	very insignificant	**insignificant**	**neutral**	**significant**	**very significant**
Pollution/ emissions					
Destruction of tropical forests					
People driving their cars					
Use of coal and oil by utilities					
People heating and cooling homes					
Use of chemical					
Nuclear power generation					
Energy use in Building					
Other					

4. The followings are among the approach to reduced greenhouse gas emissions. Tick one on each line you **familiar** with.

	1	2	3	4	5
	very unfamiliar	**unfamiliar**	**neutral**	**familiar**	**very familiar**
Support clean, renewable energy.					
Using public transportation					
Buy Local and Organic					
Reduce! Reuse! Recycle!					
Forests and agricultural lands					
Other:					

5. Buildings and their construction account for nearly half of all the greenhouse gas emissions and energy consumed in this world each year. Do you know about it?
   Yes ☐ No ☐ Unsure ☐

6. Green building brings together various practices and techniques to reduce and ultimately eliminate the negative impacts of buildings and constructions. Which one do you prefer to be the best solutions for your company/institution/organization in contributing building environmental issues? Tick one on each line you **agree** with.

	1	2	3	4	5
	very disagree	**disagree**	**neutral**	**agree**	**very agree**
Green Roof					
Day Lighting					
Building materials					
Reduced energy use					
Reduced waste					
Reduced Water Consumption					
Other: (serious landscape and gardening features, etc.)					

7. What is your opinion about green building?
   .....
   .....
   .....

8. Many countries have developed their own standards of rating system for buildings. Below are some examples of building environmental assessment tools currently in use:
   Tick which one you familiar with?

Green Building Rating Systems	**familiar**	**unfamiliar**
Australia, Green Star		
Japan, Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)		
United States, LEED Leadership in Energy and Environmental Design		
United Kingdom, BREEAM (Building research Establishment Environmental Assessment Method)		
Singapore, Green Mark		
Other:		

9. How green building can work out on environmental issues (through building and construction industry, global councils, green building rating system)? Tick one on each line the most important for you.

Environment Benefits	1	2	3	4	5
	very unimportant	unimportant	neutral	important	very important
Reduces environmental impact through energy efficiency					
Reduces environmental impact through waste recycling					
Reduction in energy requirements and carbon footprint					
Improves indoor air quality					
Save forest area due to site conservation					
Improve area landscaping/exterior design					

10. On April 2009, Malaysia had launched new confederation for green building assessment tools, namely Green Building Index Malaysia. Do you think the implementation of GBI will be beneficial and important to the Building and Construction Industry in Malaysia? Tick one from 1=very unimportant, 2=unimportant, 3= neutral, 4=important, 5=very important.

	1	2	3	4	5
	very unimportant	unimportant	neutral	important	very important
GBI for Malaysia sustainable building in the future					

11. What method is effective to gain public awareness on Green Building Index Malaysia? Tick one on each line. 1=very unimportant, 2=unimportant, 3= neutral, 4=important, 5=very important

	1	2	3	4	5
Internet					
Conference / Seminar / workshops					
Journals					
TV/Radio					
Newspaper					
Others:					

12. Green Building Index Malaysia (GBI) is developed by Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM). It is a profession driven initiative to lead the property industry towards becoming more environmental friendly. Who do you think will have the responsibility and opportunity to involve in this initiative?

	1 very unimportant	2 unimportant	3 neutral	4 important	5 very important
Construction Company					
Developers					
Authority					
Technical Professionals from all fields					
Building Owner					

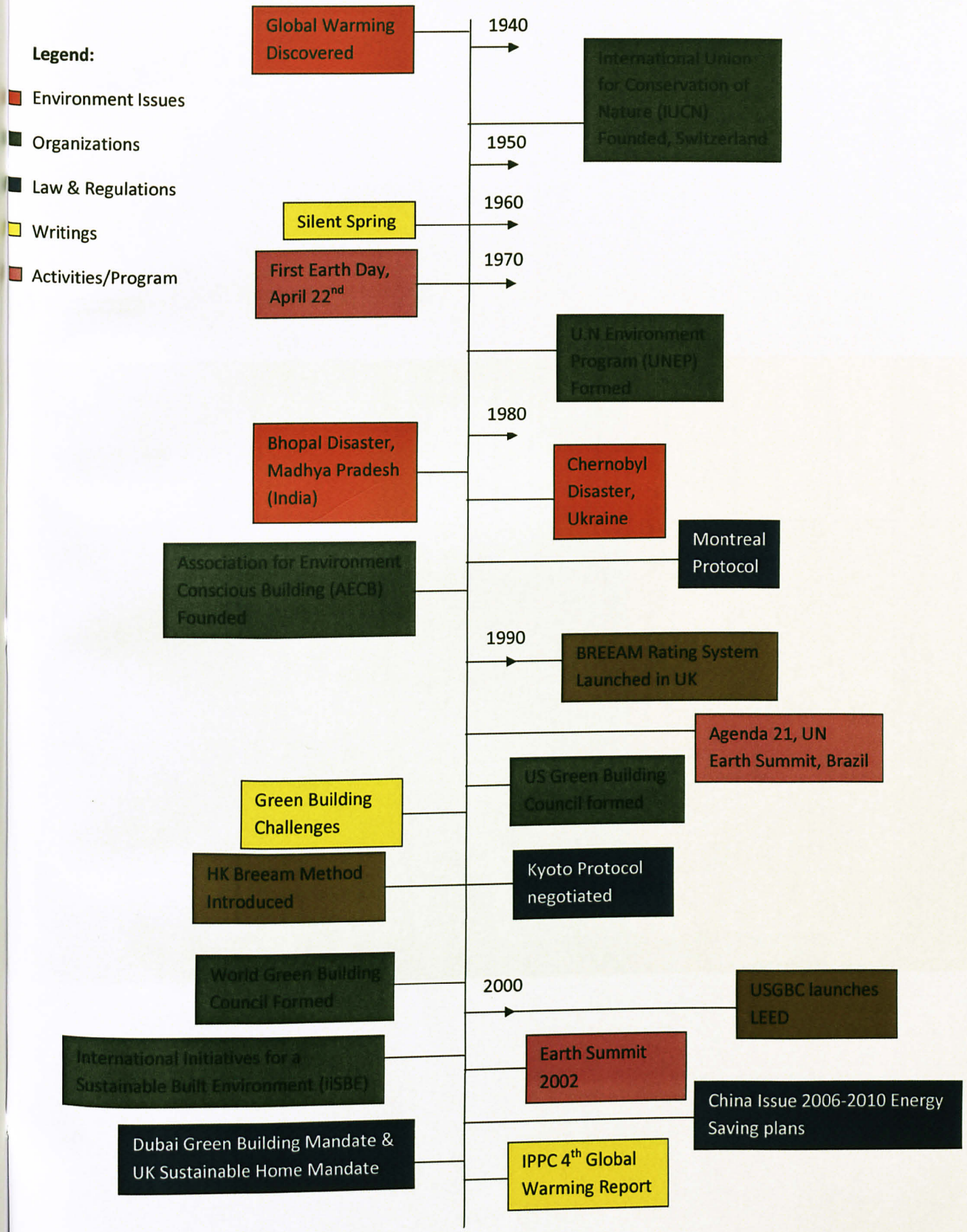
13. Which of the criteria listed in GBI below that you are familiar with and state how can you apply the criteria in your Building Project?

Rated Criteria	Familiar	Application in Building
Energy Efficiency		
Indoor Environmental Quality		
Sustainable Site Planning and Management		
Materials and Resources		
Water Efficiency		
Innovation		

❖ Thank you for your cooperation in answering this questionnaire. Your kind support is very much appreciated and the outcome will help this project to success.

Global Green Building Milestones

APPENDIX 3



World Business Council for Sustainable Development

ROADMAP FOR A TRANSFORMATION OF ENERGY USE IN BUILDINGS

Actor	Levers		Short term milestones	Medium term milestones	2050 Objective
Government authorities	Control & regulatory instruments	Building energy codes	- Introduce mandatory codes in new and existing buildings - Tighten requirements over time	- Codes to request zero net energy for new buildings	Building energy codes for new and existing buildings are stringent and enforced
		Appliance standards	- Expand scope of appliance standards & labeling to cover all equipment - Create common standards to enable communication between appliance energy data and utilities	- Introduce and tighten requirements on energy performance over time	- Appliance energy use is minimized - Standards are stringent and enforced - Information flows between utilities and appliances
		Energy performance labeling & measurement	- Create labeling regulation (e.g. EU Energy Performance Certificates) - Define and enforce common energy use measurement system that include kWh/m².year, total kWh and kWh/person.year	- Mandate energy label in every country - Develop "carot and stick" measures based on label - Mandate retrofit or replace poor performing buildings based on label and actual energy use	- Labels set conditions for subsidies and other benefits or constraints
		Energy performance audits	- Introduce energy performance inspections into health & safety procedures for existing commercial buildings - Train inspectors & carry out labeling of existing building stock - Introduce energy audits for new buildings (like structural checks)	- Carry out regular inspections in commercial buildings - Carry out energy audit of all existing buildings	- All buildings have been audited - Regular audits are mandatory - Energy audits are recognized and accurate
		Metering	- Mandate individual metering and controls in multi-tenant residential buildings, offices & retails	- Inspect metering and controls compliance	- All residential and commercial units have individual metering and controls
		Procurement regulation	- Set fast track applications for low energy buildings - Set energy performance as selection criteria in public procurement	- Ensure that energy efficiency is a key consideration in all purchases by the government	Not applicable if proposed codes and regulations are enforced
		Legal	- Create empowered body to remove legal constraints that would hamper energy retrofits (e.g. voting rights, envelope ownership, allow new building lines for insulation, etc.)	- Body to implement changes in the legal framework	- Legal barriers to energy efficiency are removed
	Economic & market-based instruments	Utilities	Create mechanism to reward utilities for end-user energy savings		- Utilities have included end-user energy savings in their business model
		Institutional investors	Set targets on real estate portfolio based on energy performance for pension funds and other large investors and property owners	- Tighten target over time - Control target compliance	- Institutional investors demand energy efficient buildings
		Urban planning	Set new rules that incentivize energy efficient developments (e.g. vary density depending on building energy performance)		- New zero net energy buildings replace existing inefficent buildings
	Fiscal instruments & incentives	Capital subsidies, grants, subsidized loans, taxes etc.	- Introduce direct subsidies on first cost only for holistic retrofit packages - Grant tax exemptions based on a building's energy performance improvement - Incentivize renewable energy solutions for communities - Incentivize best available technologies to promote innovation and performance	- Subsidize zero net energy new buildings - Introduce a price of carbon as a mean to fund subsidies of energy efficient new buildings - Use sustained price signals on energy to increase the amount of financially justified efficiency investments	- Financial support / penalties are linked to actual energy performance and improvements. - Poor performing buildings are replaced by new zero net energy buildings
		Research & development	Subsidize R&D programs for new designs, technologies & materials for energy savings & support the transition from late-stage R&D to commercialization	- Maintain subsidies as needed to achieve significant cost and performance improvements of the most promising technologies	R&D delivers high performing materials and equipments that enable zero net energy buildings
	Support, information & voluntary action	Tenant behavior	Property tax reduction for energy efficient behavior compared to building's label expected performance		Tenants are incentivized to become more energy aware and to reduce energy consumption
		Education & training of professionals & the general public	- Launch extensive training programs for professionals - Communicate energy usage and performance information for all public buildings - Launch sustained information campaigns on energy use and savings in buildings	Introduce energy awareness courses in education programs	A new energy aware culture exists amongst citizens
Developers	Education, training and communication		- Take part in the education & training effort needed to promote energy savings for owners, users & facility managers - Communicate energy performance targets of new developments		Developers understand and value energy efficiency and include it in projects as standard practice
	Finance		- Address split incentive problem by engaging with new tenants to share cost and benefits of energy savings investments - Adopt lifecycle cost approach when taking design decisions - Demand preferred financial conditions from capital providers for near zero net energy new developments	- Demand preferred financial conditions from capital providers for near zero net energy refurbishments	Developers have financial interest to develop energy efficient buildings
	Specifications		- Set ambitious energy performance target as primary design goal - Require the use of energy management systems and individual metering	- Tighten targets for building operations & performance - Use Integrated Design Contract (IDC) tender format with emphasis on energy performance requirements	Developers include ambitious energy efficiency targets as primary design goals
	Procurement		- Restructure contractual terms to encourage early contractor involvement as part of the design team - Base design team fee structure and incentives on successful energy performance	- Introduce specific decision making process on all components that affect operational energy use	Developers include ambitious energy efficiency targets in their procurement process
Investors	Education, training and communication		- Take part in the education & training effort on energy efficiency - Voluntarily adhere to a globally recognized principles or codes of conduct - i.e. Principles for Responsible Investment (UNEP/Global Compact) or The Equator Principles - Transparently report on energy efficiency practices - Actively engage owners/fund managers in dialogue around energy efficiency	- Publicly share best practices	
	Specifications		- Evaluate risks using broader measures such as energy price/availability, climate change, regulation - Add energy efficiency metrics and goals to investment practices - Explicitly require disclosure of energy efficiency strategies. - Rank potential investments based on expected performance,- Target fixed income investments in securities that address energy efficiency	- Actively seek creation of securities (new constructions or energy efficient retrofits) backed by certified energy efficient buildings or cash flow from energy savings	Utilities promote a new energy aware culture amongst customers and other stakeholders
	Asset portfolio		- Benchmark existing portfolio through energy audits of managed/owned properties to identify most obvious targets for energy efficiency improvements - Review portfolio exposure to regulatory, reputation & environmental risk associated with climate change - Set targets on number of owned/managed buildings based on their energy performance - Explicitly incorporate energy efficiency goals into portfolio management - Evaluate investments on the basis of risk/return	- Tighten targets on number of owned/managed buildings based on their energy performance - Increase performance standards for owned/managed building operations and performance	
	Finance		- Include energy performance in property valuation method - Deposit available cash in financial institutions who have lending programs targeted at energy efficiency retrofits - Use energy efficiency analysis to enhance traditional decision- making. - Target investment funds that focus on energy efficiency - Robustly model risk/returns - including first costs, operating costs, savings & sale value/reversion based on supply/demand, quality, design, identity, brand	- Adopt lifecycle cost approach to investment decisions - Assign value to energy efficiency through financial mechanisms and funding sources	
Utilities	Education, training and communication		- Stimulate customers to save energy by launching information campaigns, providing advice and launch sustained advertising campaigns - Take part in the education and training effort needed to promote energy savings and efficiency	- Regularly survey customers and craftsmen to understand their knowledge and information needs with respect to energy efficiency - Reinforce current knowledge and deliver new information on a regular basis	Utilities promote a new energy aware culture amongst customers and other stakeholders
	Distribution network		- Develop smart meters for improving knowledge of final energy use - Transition to smart electricity grid using digital technology to save energy	- Provide customers with smart solutions to promote energy efficiency - Develop smart boxes to manage energy use - Integrate more local renewable energy with centralized low carbon energy systems where possible	Utilities manage existing smart grids
	Commercial offer		- Develop pricing schemes that incentivizes energy savings - Launch commercial offers to promote energy savings i.e. energy audits, consulting, technical support with energy efficient solutions, financial support - Develop Energy Performance Contracting (EPC), i.e. schemes enabling energy services companies (ESCO) or other players to offer innovative contracts guaranteeing the level of services and energy savings to the customer - Develop financing schemes on investments with return on energy savings	- Maintain successful commercial offers and adjust them to changing customer needs	Commercial offer and pricing rewards energy savings
	Demand side management		- Incorporate tools to allow local feedback to end users on consumption and expenses	- Integration of technology to allow information transfer between equipment and systems - Allow metering and bi-directional utility power flow	Peak demand is better managed and the smart grid optimises energy flow between suppliers and customers
	Energy mix		- Make energy generation evolve towards lower carbon content - Invest in renewable energy solutions for buildings	- Execute strategy for lowering carbon content of existing generation and bringing clean generation assets on line	Energy mix has lowest possible carbon content
Suppliers and manufacturers	Education, training and communication		- Provide contractors and end-user with training and operations	- Ensure all customers receive & understand information & training - Simplify products where feasible to lower the skill level necessary for use	Suppliers understand the crucial role they play, in developing an energy aware customer base
	Appliance standards		- Develop international definitions, standards & metrics - Cooperate with government authorities to create appliance standards and labels	- Adopt standards in all countries - Equip appliances with information sharing capability for utilities	- Compliance to highest appliance standard
	Marketing		- Develop marketing campaigns to promote building's energy performance rather than single components - Revisit equiment pricing in line with energy efficieny	- Sustain awareness throughout customer base	Suppliers join forces with government authorities in favor of energy efficiency
	Research and Development		- Increase efficiency of current equipment - Develop economical new technologies and applications to support zero net energy buildings - Integrate technology to allow information transfer between equipment and systems - Provide tools to allow local feedback to end users on consumption and cost	- Phase-out low performing equipment - Incorporate new technologies into product lines for common use - Bring to market metering and controls to management energy efficiency	Suppliers provide market with affordable next generation energy efficient solutions
Architects Engineers, Contractors, Craftsmen	Education, training and communication		- Enroll in energy efficiency training program - Include energy efficiency in educational programs and training to owners and occupiers - Reward those who attain a high level of proficiency - Provide voluntary certifications for projects to promote energy efficient constructions and use	- Support continuing education on energy efficiency, eventually making it an essential job requirement or performance criterion	- Designers and contractor implement energy efficiency as a standard practice
	Design process		- Apply common measurement system - Adopt an integrated design process (IDP) with design team - Promote use of energy efficient design and technologies - Incorporate ICT into design & construction process - Consider energy performance-based fee structure	Adopt IDC (Integrated Design Contract) format with emphasis on energy performance requirements	Zero net energy designs are the norm
	Design		- Develop holistic approach of energy efficiency in design - Use passive design strategies as first step toward improving energy efficiency - Develop energy efficient design solutions for retrofits - Implement energy efficiency in all new constructions - Plan local energy production to minimize requirements for grid energy where efficient and environmentally responsible - Design new buildings for flexibility and ease of implementation in future retrofits and alternative uses	Adopt new available efficient technologies and design	Know how on zero net energy buildings is widely applied across the sector
Occupiers	Education, training and communication		- Require information on energy performance through voluntary certification systems and programs - Receive training in how to operate one's building(s)	- Acceptance of new energy efficiency features, including those that affect appearance	- Building occupants fully comprehend and value energy efficiency
	Behavior and mindset		- Raise demand for high performing buildings - Recognize personal behavior as the first step towards reducing energy usage - Develop energy aware culture and respond to information about personal behavior and effect on energy usage	- End-users recognise change in demand	Occupiers are at the origin of a new energy aware culture