APPENDIX M

INDIVIDUAL CASE ANALYSIS

1.0 THE LEO BUILDING

The LEO building is a Government Complex to house the Ministry of Energy, Green Technology and Water (KeTTHA) which formerly known as the Ministry of Energy, Water and Communication (MEWC) consisting of a six storey with two basement car park building on Parcel E, P.T. 111, Precinct 1, Putrajaya. The goal of this building development was to provide a good and comfortable working environment for the end-users through incorporation of certain energy efficient features in the building design. The proposed development of Parcel E has obtained approval at Building Development Plan (PB) level under the submission jurisdiction of Messrs. RSP Akitek Sdn Bhd on 08th April 2000. Being situated within the Parcel E Development, these building features had been designed to respond to the harmonizing architectural elements of the other Government Complexes. LEO was first occupied in September 2004. This is the first government building that has been designed as an energy efficient building which also becomes a demonstration project of feasibility of MS1525:2001 (Malaysian Standard: Code of Practice on Energy Efficiency and Use of Renewable Energy for Non Residential Buildings). The LEO building was designed to be a showcase building for energy efficiency and low environmental impact without compromising on users' comfort reinstating the role of the Ministry towards conserving energy in the future buildings of Malaysia.

1.1 Stakeholders Involvement

KeTTHA was the owner and Putrajaya Holdings (PjH) was the master developer of LEO project. To come out with the conceptual planning and preliminary design, PjH had appointed SNO architects (the architect), NDY sdn bhd (M&E engineer) and Syed Mansur sdn bhd (civil engineer) as their consultants and charrette sessions had been done during this stage among them. Putra Perdana Construction Sdn. Bhd. (PPC) was the main contractor of this project. They were appointed a bit late at the detail design stage and development of the project. Danish Agency for Development Assistance (DANIDA) was appointed by the government of Malaysia as the energy consultant for LEO project. DANIDA, in cooperation with PPC, consultants, specialist subcontractors, manufacturers and suppliers, determined to improve the building design to be the first energy efficient building in this country. The project commenced in 2001, prior to the development of the GBI rating system, thus, it did not go through the GBI certification process at the time. On top of the usual laws and guidelines that should be considered by the project team, they should also considered the MS1525 Code of Practice throughout the development of the building. A typical project planning process in Malaysia is involved with legislature and development plan. Preliminary discussion took placed between the planning consultants and the planning department at Putrajaya Corporation (PjC) during the layout plan, building plan or planning permission submission process (O1, E1, L1). Most of them were about to get approval (L1).

Respondents were asked about their involvement during the planning process of the LEO building project. The owner (O1) admitted that he was actively involved throughout the planning process of the project. The local authority involvement this stage was little as the respondent (L1) mentioned: *'We were only involved in the approval part of the project. We requested them to fulfil the existing technical requirement, laws and guidelines such as Urban Design Guidelines (UDG) and so forth'.*

DANIDA was involved a bit late in this project which is during the detail design stage as the energy consultant (E1) pointed out: *'It was two phase of planning process during pre-construction of the project. The first was planning process at the conceptual design stage including to get approval and budget view, I was not really much involved at this stage, but when came to the planning process at the details design stage, where PPC should develop detail*

design based on the conceptual, I was fully involved to give inputs into the design especially on energy efficient aspects. The architect produced the design first before we joined the project. So, it was quite limited to be done for LEO building. Some materials like wall materials and some of the design was already there and couldn't be changed'.

In discussing the involvement of the energy consultant in LEO project, the energy consultant (E1) said that he was involved in the detail design and development process, construction, migration, fine tuning, re-commissioning, monitoring and validating of the project. Until now, he is still continuing on monitoring the operation and maintenance of the building. The energy consultant (E1) highlighted that he was involved in consulting about decisions being taken by the others and when come to the area that need him to make decision, then he will make decision. *'It was some decision that they agreed and also sometimes the decision was taken as average. I was also involved in advising, for example in term of the selection of materials, the architect chooses the materials and we looked at the performance of the material.'* The role of energy consultant in the project was integrated. The architect, mechanical engineer and the rest of the professionals were also very clear with their own boundary. The most important thing is willing to listen and understand the issues as the energy consultant (E1) said*: 'we can't bring a bunch of egos to the charrette sessions because it is just doesn't work'.*

As a design and build contractor, PPC performed design and construction of the project, thus they appointed the same architect and engineer to continue with the detail design to ease the process. However, they appointed different engineer, their own M&E engineer (VY consult) during this stage. Through the planning process of detail design and development stage, the team had involved in series of charrette sessions; they called it as 'detail design workshop'. The client was also involved in this session (O1). The contractor (C1) mentioned that he was also sent to Norway and Denmark to visit other people works and adapted some of them into the LEO building. However, the contractor (C1) admitted that PPC were not fully involved in the planning process of the project as he mentioned: '*The architect and DANIDA had designed everything prior forwarding the design to us. We designed and built based on the concept that given to us. We had only taken care about the structure and M&E aspects of the building. We contributed more on the M&E part compared to the architectural part. Nevertheless, if there were something wrong with the design, we highlighted to them for instances, the specifications of the glazing in the design were confusing and not available in the market, so we did advise them the other glazing in order to achieve the required OTTV.'*

An ambitious goal was set for the energy efficiency of the building. Energy savings of more than 50% (BEI of 100 kWh/m2year) compared to the traditional new office buildings in Malaysia (200-300 kWh/m2year) should be achieved at an extra construction cost of less than 10%, giving a payback period of the extra investment of not more than 10 years. The project team optimized the overall design of the building and its energy systems for minimum energy consumption which was set to achieve the targeted energy savings. The cost target of maximum 10% extra costs for the energy efficiency measures and a comprehensive list of energy efficient features was integrated and confirmed through the project tender document. The energy manager and the end users of the building were responsible to operate the building in sustainable manners in order to achieve and maintain the energy saving target as the energy manager pointed out: *'I was informed about the building systems and the target since the early project planning process. I was also trained on how to operate, maintain and control the building system. As an energy manager, I have to ensure that energy index of this building is not more than 100kWh/m2/year. The challenges were when the number of employees increased, plug load also increased and the air-condition consumptions as well increased. So, we have to hardly control the energy consumption. We have our own contractor who is doing maintenance for this building and the systems and I am the one who monitor and control their works also monitor the building energy consumption. However, luckily the energy consultant is still helping us in monitoring the operation and maintenance works of this building so that this building is operated and maintained in sustainable manners' (M1).*

Table 1: Stakeholders' Involvement in Project Planning Process (LEO) [1]

Stakeholders' Involvement		Planning Process			Representing
		Conceptual Planning	**Preliminary Design**	**Detail Design and Development**	**Representing**
Owner (O1)	Extents of Involvement	Full	Full	Full	● Client ● Users ● Operation and Maintenance
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Energy/Facility Manager (M1)	Extents of Involvement	None	None	None	● User ● Operator
	Degree of Involvement	(D) Being Informed	(D) Being Informed	(D) Being Informed	
Energy/ Sustainability Consultant (E1)	Extents of Involvement	None	None	Full	● Design team and cost and economic ● Operation and Maintenance
	Degree of Involvement	(E) Not Being Involved	(E) Not Being Involved	(A) Most Occupying	
Main Contractor (C1)	Extents of Involvement	None	None	Substantial	● Construction Contractor ● Operation and Maintenance ● Materials and Equipment Suppliers ● Builders
	Degree of Involvement	(E) Not Being Involved	(E) Not Being Involved	(B) Being Involved	
Local Authority (L1)	Extents of Involvement	Little	Little	Little	● Legal Client ● Local Community ● Approval Party
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	

Note: Degree of Involvement: (A) Most Occupying (B) Being Involved (C) Being Consulted (D) Being Informed (E) Not Being Involved

Source: Adapted from Abdul Samad,(2007)

As shown in Table 1, it is clear that the owner had the *'most occupying'* involvement in the whole planning process of the project. They led and took decisions. The local authority is also had the '*most occupying'* involvement in the whole planning process, however, their involvement was too limited on taking decision for the approval reason. They were not involved at all in the charrete and discussions throughout the planning process of the project. Energy consultant had the *'most occupying'* involvement, but a bit late which is at the detail design and development stage of the project. The main contractor was being involved in generating information or options on the structure and M&E aspects as inputs to design decision being taken. Although the energy manager did not directly join the planning process of the project as compared to others, he was informed by the owner's representative about decisions being taken by the project planning team as he is the person who responsible on monitoring, maintaining and controlling the building systems in the future.

[1] relate to the Questions of Part A in the interview schedule (Appendix B, p307)

Although the planning process was almost typical as the conventional ones (O1, E1, C1, L1), nevertheless LEO project is the first classic example of integrated design especially during the detail design phase of the project. For instances, before the architect finalizing the detail design, the project team involved in a series of workshops; The project stakeholders sit down together including the owner, architect, structural and M&E engineers, energy consultant and the main contractor for discussions. The energy consultant was also represented the operation and maintenance stage because they are responsible for energy audit and monitoring the operation and maintenance of the building (O1, E1, C1). The contractor scope was a bit wider during the detail design stage as the contractor (C1) said: *'we had to gone through a bit detail during the detail design process than a typical project'.*

1.2 Sustainability Practices in LEO Building Project

This part aims to explore the extent of sustainability practices in LEO building project in order to define the gaps that should be bridged towards achieving sustainability. This part comprises of four issues; 1) The project goals 2) Sustainability principles consideration in LEO building project and 3) The project's strategy to achieve the goal for sustainable project 4) The strategies to integrate sustainability through project planning process. Each of the issues is described in the followings.

1.2.1 The Project Goals

The interviewees were asked the extent to which they were motivated to consider the sustainability principles of buildings (environmental, social, economic and design and innovation) as the main goals of the project that should be achieved. It was found that the interviewees (O1, M1, E1, C1, L1) agreed that the project had the goals on environmental, economic, social and sustainable design and innovation (refer Table 2) for instance, the main contractor (C1) said: *'PPC was very committed on sustainability. In term of social sustainability, they employed legal workers, taken care their charity and offered expensive wages to them. Thus, the workers were loyal to them. PPC has the quality and capacity'.*

Table 2: Stakeholders' Responses on the Sustainability Goals of LEO Project

Sustainability Goals	Conceptual and Detail Design			Construction	Operation and Maintenance
	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager
1. Environmental	●	●	●	●	●
2. Economic	●	●		●	●
3. Social	●	●		●	●
4. Design and Innovation	●	●	●	●	●
Total respondents					5

Note: ● the principle was considered in the project's goals

However, the local authority (L1) highlighted that the project was skewed towards environmental sustainability target as he mentioned: *'For a government building like LEO, economic and social aspects are not considered very much because it is not developed for profit'.* The answer was quite shocked as the local authority's exposure on the economic and social sustainability considerations of the building were quite low. This situation was though understandable due to the limited involvement of them throughout the project planning process. Without a common understanding on sustainability, it will be difficult to achieve synergy and consensus on the strategies to be formulated for the sustainable project.

1.2.2 Sustainability Principles Consideration during the Planning Process of LEO Building Project

The stakeholders except the main contractor and energy manager of LEO building project were asked to assess the sustainability principles that had been considered and documented during the project planning process. The project documents that prepared and handed out are among others include Development Proposal Report for Layout Plan and Building Development Plan, development brief, design requirements and specifications. As stated in the Development Proposal Reports, the concept of the building was to incorporates energy efficient elements which combines passive (Architectural) and active (Mechanical & Electrical) features. This building shall be a "Show Piece" for KeTTHA, reinstating the role of the Ministry towards conserving energy in the future buildings of Malaysia.

The result (refer Table 3) clearly shows that 14 out of 22 principles were included in the project documents that prepared for and referred by the owner and consultants throughout the project. The principles were clearly communicated among the owner and designers team and also appraised by them during the planning process of the project.

Other four principles which are *'concern on quality of land, river and sea', 'sustainable method'* and *'sustainable materials and resources and 'optimized materials and resources'* were also considered by them during the planning process even though the principles were not explicitly mentioned in the project documents. There are 4 principles not mentioned in any project documents and also did not considered by the owner and the design team during the planning process of the project which are *'efficient water consumption, 'transport management', 'improve local market presence' and 'indirect economic impact'.*

Meanwhile, only 10 out of 22 principles were mentioned clearly in the project documents that submitted to the local authority of Putrajaya. The principles were clearly considered by the local authority as the requirements that should be fulfill by the client and the team members. Transport management aspects such as parking requirements and the accessibility had been documented and communicated earlier during the approval submission process for the whole Parcel E of Putrajaya. However, it was not specifically discussed during the development of the individual building (L1).

Eight principles had been practiced by all project stakeholders and mentioned clearly in the project documents. The principles are *'efficient environmental management', 'site planning', 'energy efficient', 'air and emissions quality', 'urban design, visual impact and esthetic', occupational health and safety' and sustainable design and innovations'.* Other 3 principles which are *'efficient water consumption', 'improve local market presence' and 'indirect economic impact'* were not mentioned in any project document and had not been considered by all the stakeholders during the planning process of the project. Overall, the sustainability principles mentioned in the project documents was at a medium level and the consideration of the principles during the project planning process was at a high level.

Table 3: Interviewees' Comments on Sustainability Principles Consideration during the Planning Process of LEO Building Project

Sustainability Principles	Considered? Documented?				
	Owner	Energy Consultant	Local Authority	Σ Documented	Σ Considered
Environmental Sustainability					
1. Efficient environmental management	●*	●*	●*	3	3
2. Concern on quality of land, river and sea	●	●	●*	1	3
3. Site planning and management	●*	●*	●*	3	3
4. Energy efficient	●*	●*	●*	3	3

Sustainability Principles	Considered? Documented?				
	Owner	Energy Consultant	Local Authority	Σ Documented	Σ Considered
5. Air and emissions quality	●*	●*	●*	3	3
6. Sustainable method	●	●		0	2
7. Sustainable materials and resources	●	●		0	2
8. Optimize materials and resources used	●	●		0	2
9. Efficient water consumption				0	0
10. Transport management			●*	1	1
11. Urban design, visual impact and aesthetic	●*	●*	●*	3	3
12. Noise control	●*	●*	●	2	3
Economic Sustainability					
13. Whole life cost efficiency	●*	●*		2	2
14. Improve local market presence				0	0
15. Indirect economic impact				0	0
16. Economic benefit to the stakeholders	●*	●*	●	2	3
Social Sustainability					
17. Occupational health and safety	●*	●*	●*	3	3
18. Product responsibility	●*	●*		2	2
19. Training, education and awareness	●*	●*		2	2
20. Stakeholder participation	●*	●*		2	2
Design and Innovation					
21. Sustainable Innovation	●*	●*	●*	3	3
22. Sustainable Design	●*	●*	●*	3	3
Mentioned in the project documents	**14 (Medium)**	**14 (Medium)**	**10 (Low)**	**38** **Average: 13** **(Medium)**	**48** **Average: 16** **(High)**
Considered by the interviewees	**18 (High)**	**18 (High)**	**12 (Medium)**		
Total respondents				3	
Level of Practices: 22-20 Very High	*19- 16 High*	*15-11 Medium*		*10-7 Low*	*6-0 Very Low*

Note: ● Considered during the project planning process
**Mentioned in the project documents*

1.2.3 The Project Strategies to achieve the Goals for Sustainability

Realizing the goals and sustainability principles practiced by the interviewees, the interview went further to examine the strategies that they implemented throughout the LEO project to achieve the targets successfully. Twelve strategies were pointed out as shown in Table 4. Majority (4 out of 5) of stakeholders' from the conceptual and design, construction and operation and maintenance stage (owner, energy consultant, main contractor and energy manager) were providing '*regular awareness, brief and campaign on energy efficiency to the project team and to the building occupants in order to save energy by operating the building in sustainable manners'* in order to prepare the team members with the capability towards delivering a sustainable project. The strategies are related and supported the second, third, fourth and fifth strategies of sustainability integration into the planning process of building projects as address in the proposed framework (refer Table 5.63, part b, p217) up to some extent which are: *'the project should has specific sustainability goals and project priorities' 'The team should have the core knowledge of sustainable building', 'Team members are educated on sustainability issues including vendors' and 'Team members are fully informed on sustainability goals and priorities of the project.'* The stakeholders were also planned and designed the project towards fulfillment of '*the requirements of MS1525:2001*' as the project was a demonstration of feasibility of the standard. The strategies are related and supported the eighteenth and twentieth strategies of the proposed framework namely; *'government policies to encourage sustainable*

development' and 'compliance with code and regulatory tool of sustainability' up to some extent.

It was only 2 out of 5 stakeholders (owner and energy consultant) highlighted that they have practiced *'multidisciplinary collaboration and integrated design throughout the project planning process*' up to some extent to be among the strategies to reach the sustainability goals of the project. The design was also considered the end user needs by involving the owner (the users' representative) throughout the project planning process (O1, E1). The strategies are related and supported some of the sub strategies of integrated design process as suggested in the proposed framework (Table 5.63, p217) such as *'design should reflect the end user community', 'do whole building design and systems analysis', 'committed and collaborative team throughout the process', 'involve diverse set of stakeholders on the team', 'effective communication and incorporation of charette process'* and *'planning should reflect all the project stakeholders'.*

Three (3) out of 5 the stakeholders from conceptual, design and construction stage (owner, energy consultant and the main contractor) concerned 4 strategies namely, '*workshop among the stakeholders', 'visiting the energy efficient building', 'attending sustainable conference'* and '*attending a lot of seminars including presenting the progress and project performance among stakeholders in every single stage of development'* as their strategies to deliver the sustainability goals of the project successfully. The strategies are related and supported some of the proposed strategies in the framework such as *'committed and collaborative team throughout project', 'involve diverse set of stakeholders on the team', 'planning should reflects all the project stakeholders', 'incorporation of charette process', 'the team should have the core knowledge of sustainable building', 'team members are educated on sustainability issues including vendors', 'team members are fully informed on sustainability goals (energy efficiency) and priorities of the project.'*

Other three stakeholders (owner, energy consultant and energy manager) concerned the strategies of *'monitoring and controlling the building energy and operate the building in sustainable manners', 'monitor indoor environmental performance and occupant satisfaction'* and *'to get GBI certification as their strategies to achieve the project sustainability goals*' during operation and maintenance stages of the project. In order to achieve GBI points, they had also '*exchanged the existing equipments with the latest energy efficient equipments'* in order to reduce the building energy consumption. Local authority's strategy was related '*to mention the goal of sustainability in Structure Plan, Local Plan and Strategic Plan'.* The strategy is also related and supported the strategies of *'government policies to encourage sustainable development' and 'compliance with code and regulatory tool of sustainability'* up to some extent, in the proposed framework. However, the local authority (L1) admitted that the guideline and procedure has not changed much to promote sustainability. There is no specification was put on how to plan and manage sustainable development. The requirement to include specification of sustainability in local authority manual and guidelines depend on the willingness and creativity of individual local authority to implement it.

Table 4: The Project Strategies to Achieve the Sustainability Goals of LEO Project

	Strategies Practiced	Stakeholders					No. of times recorded
		Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	N
1.	Workshop among stakeholders to reveal the energy efficient and sustainability knowledge and worldwide experiences in order to enhance their awareness and capability.	●	●	●			3
2.	Multidisciplinary collaboration and integrated design	●	●				2
3.	Visiting the energy efficient building in Thailand and Copenhagen with the project team members	●	●	●			3

	Strategies Practiced	Stakeholders					No. of times recorded
		Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	N
4.	Attending sustainable conference in Oslo along with the key stakeholders	●	●	●			3
5.	A lot of seminars among stakeholders have been arranged in every single stage of development and also presenting the progress and project performance	●	●	●			3
6.	Regular awareness, brief and campaign on energy efficiency to the project team, and to the occupant to save energy and to operate the building in sustainable manners since the early planning process and over the course of the project.	●	●	●		●	4
7.	Monitoring and controlling the building energy and operate the building in sustainable manners	●	●			●	3
8.	Exchanged existing equipment with the latest energy efficient equipments	●	●			●	3
9.	Monitor indoor environmental performance and occupant satisfaction	●	●			●	3
10.	Fulfil the requirements of MS1525	●	●	●		●	4
11.	To get GBI certification	●	●			●	3
12.	Mentioned the goal of sustainability in Structure plan, Local plan and Strategic plan.				●		1
Total number of strategies practiced		11	11	6	1	6	35
Total respondents							5

Note: ● the strategies practiced by the interviewees

Generally, the strategies practiced by the stakeholders are relatively related to the sustainability integration strategies as tabulated in the proposed framework. The owner and energy consultant were found to have the highest numbers of efforts to achieve the goals of sustainability of the project (11 out of 12 cited strategies) and the local authority had the lowest involvement among the cited strategies (1 out of 12). As the stakeholders of this project were still new with this type of project, the strategies were found to be implemented up to certain extents. The strategies were realized skewed towards to implement 3 basic strategies of sustainability integration which are to *'prepare the stakeholders with the core knowledge of sustainable building', 'educate the stakeholders on sustainability'* and *'to inform the stakeholders on sustainability goals and priorities of the project'.*

Eight strategies to integrate sustainability into the project as listed in the proposed framework are not related to any strategy that have been mentioned by the stakeholders to reach the sustainability targets of the LEO project which are;

1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan
2. Team members' selection with sustainable development quality and capability
3. Bringing the team together as early as possible during planning process
4. Commissioning process is added during this process and described in a specific section
5. An integrated design/ sustainability coordinator is appointed as one of the project's team members
6. Local community representative is involved in support of the project

7. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.
8. Incentive to encourage sustainable development

LEO building was the pioneer project related to sustainability at the time it was developed. It was still not exists a clear route towards sustainable building projects and the exact process of the sustainability integration strategies. The only guideline that they had was MS1525:2001 in addition to the usual laws and guidelines that the project should fulfil. Thus, even though the project had their specific sustainability goals and project priorities but they were more towards energy efficiency goals instead of the comprehensive sustainability concept. The process of delivering the project was quite the same as a typical project (O1, E1, L1). Though, the project was a unique and being eyes opener in the industry.

1.2.4 The Practiced of Sustainability Integration Strategies into the Planning Process of LEO Building Project

Integrating sustainability consideration during planning process could minimize the negative effects of building project development. The owner and energy consultant of LEO building were asked to indicate in details the strategies that have been practiced to integrate sustainability into the project throughout the planning process. The local authority, contractor and energy manager have not been involved to answer this question as they were not able to give their opinion (L1, C1, M1).

Findings reveal that 16 out of 20 strategies were practiced among the owner and designers team during the project planning process (refer Table 5, p368). Four strategies were not practiced during the process which are *'team members' selection with sustainable development quality and capability', 'Local community representative is involved in support of the project', 'bringing the team together as early as possible during planning process', 'sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan'.* Malaysia was still infancy in sustainable building project at the time of LEO building was developed. The exposure towards sustainability integration strategies among the project stakeholders were also little. Thus, the strategy of *'team members' selection with sustainable development quality and capability'* was not able to be practiced as the owner (O1) and the contractor (C1) mentioned, *'Not much sustainability capability in Malaysia at that time. We opened the opportunity to everyone who is passionate to get involved in the project. They were trained throughout the process to get the knowledge and experiences towards delivering the project successfully' (O1).* The contractor proved the statement as he (C1) mentioned: *'At that time we were very fresh and new but we were very lucky to learn a new thing and working together with the team members. We were sent to the other country to visit and to get the knowledge and experiences. If not, we might be just followed the conventional specification. Talking about sustainable building, it was not many people really understand that. During the process, we have learned a lot. Today, PPB is the pioneer of green and sustainable building development and we have involved in many green building projects.'*

The local authority of Putrajaya was only involved in the approval part of the project. Other local community representative was not involved at all during this process. This situation is normal in the country. In the part of the stakeholders, it was such view that having more public and local authority input during this process sometimes would not add anything to the project and would create more complexity in decision making system.

The strategy of *'bringing the team together as early as possible during planning process'* was not implemented as the energy consultant and the contractor were only appointed during the detail design stage and the energy manager was only informed during the stage. The failure of practicing the strategies has caused of stoppage of the project to gain input from the stakeholders in the early stage of planning process. The sustainability and integrated design requirements and the process were also not properly documented at the time as the team members were in a learning process of delivering such project.

Table 5: Interviewees' Comments on Sustainability Integration Strategies into the Planning Process of LEO Building Project

Sustainability Integration Strategies	Stakeholders	
	Owner	Energy Consultant
Sustainable Project Orientation		
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	●	●
2. Specific sustainability goals and project priorities	●	●
Integrated project team		
3. The team should have the core knowledge of sustainable building	●	●
4. Team members are educated on sustainability issues including vendors.	●	●
5. Team members are fully informed on sustainability goals and priorities of the project.	●	●
6. Team members' selection with sustainable development quality and capability		
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	●	●
8. Local community representative is involved in support of the project		
Integrated design process		
9. Bringing the team together as early as possible during planning process		
10. Design should reflect the end user community	●	●
11. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.		
12. Do whole building design and systems analysis	●	●
13. Committed and collaborative team throughout the process	●	●
14. Involve diverse set of stakeholders on the team	●	●
15. Effective communication and incorporation of charette process	●	●
16. Planning should reflect all the project stakeholders	●	●
17. Commissioning process is added during this process and described in a specific section.	●	●
Regulations and code compliances		
18. Government policies to encourage sustainable development	●	●
19. Incentive to encourage sustainable development	●	●
20. Compliance with code and regulatory tool of sustainability	●	●
TOTAL	**16**	**16**
Level of the Strategies Practiced:	**High**	**High**
Total respondents		2
Level of Practices: 20-18 Very High *17- 14 High* *13-10 Medium* *9-6 Low* *5-0 Very Low*		
Note: ● Practiced during the project planning process		

Of the 16 practiced strategies, 4 strategies were not highlighted by the stakeholders earlier in the previous section. The strategies are;

1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan
2. An integrated design/ sustainability coordinator is appointed as one of the project's team members
3. Commissioning process is added during this process and described in a specific section
4. Incentive to encourage sustainable development

After in depth investigations, the interviewees revealed that sustainable concerns have been integrated during the establishment of the project scope, project charter, drawing, contract and the detailed project plan. However, their priority was towards to achieve energy efficiency of the building. *'A comprehensive list of energy efficient features was also integrated and confirmed through the project tender document (E1).'* Commissioning process was added during the project planning process and described in a specific section. This section was even implemented in traditional projects. *A sustainability coordinator or energy consultant (DANIDA) was appointed during the project planning process but a bit late which is at the detail design stage (O1, E1). 'DANIDA's consultancy was paid by the government of Denmark.'* It was an incentive that has been received by the project to be sustainable. Overall, the sustainability integration strategies that have been practiced during the planning process of the project was at a high level.

1.3 The Project Performances

This part aims to explore the performances of the LEO project at the conceptual and design, construction and operation and maintenance stage. The performances are discussed in the aspect of four main success criteria: 1) Sustainability Performances 2) Cost 3) Time 4) Quality and Stakeholders Satisfaction. The impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process (at the pre-construction stages) on influencing the project performances is discussed at the end of this part.

1.3.1 Sustainability Performances

The stakeholders were asked to assess the performance level of sustainability principles delivered by the project. The owner, energy consultant and local authority of the project were asked to assess the project's sustainability performances delivered at the conceptual and design stage, contractor was asked to evaluate the performances delivered at the construction stage and energy manager was asked to judge the sustainability performances at the operation and maintenance stage of the building. The results are illustrated in Table 6 below:

Table 6: Stakeholders' Responses on the Level of Sustainability Performances of LEO Project

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
Environmental Sustainability						
1. Efficient environmental management	3	3	3	3	3	3
2. Concern on quality of land, river and sea	3	3	2	2	3	3
3. Site planning and management	3	3	3	2	3	3
4. Energy efficient	4	4	2	4	4	4
5. Air and emissions quality	3	3	3	3	3	3
6. Sustainable method	2	4	2	2	2	2
7. Sustainable materials and resources	3	3	2	2	3	3
8. Optimize materials and resources used	2	2	2	4	2	2
9. Efficient water consumption	2	2	2	3	2	2
10. Transport management	2	2	1	2	2	2
11. Urban design, visual impact and aesthetic	3	3	3	3	3	3

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
12. Noise control	3	4	3	3	3	3
Economic Sustainability						
13. Whole life cost efficiency	3	4	3	4	3	3
14. Improve local market presence	2	4	2	4	2	3
15. Indirect economic impact	3	4	2	2	3	3
16. Economic benefit to the stakeholders	3	4	3	4	3	3
Social Sustainability						
17. Occupational Health and Safety	3	4	3	4	3	3
18. Product responsibility	3	4	2	4	3	3
19. Training, education and awareness	3	4	2	3	3	3
20. Stakeholders participation	3	4	2	4	3	3
Design and Innovation						
21. Sustainable Innovation	3	4	3	3	3	3
22. Sustainable Design	4	4	3	4	4	4
TOTAL SCORE	63	76	53	69	63	65
Average Rating	3	3	2	3	3	**3**
Level of Performances	Good	Good	Fair	Good	Good	**GOOD**
Note: 1 = Poor	*2 = Fair*		*3 = Good*		*4 = Excellent*	

a. Conceptual and Design Stage

Different responses have been revealed on the level of sustainability performances of the LEO project's that have been delivered at the conceptual and design stage. There are 5 sustainability principles have been placed by the owner and energy consultant to be at the same level but at the different level of performance by the local authority. The principles are as follows;

Excellent (4 Points)

1. Energy efficiency
2. Sustainable design

Good (3 Points)

3. Concern on quality of land, river and sea
4. Sustainable materials and resources

Fair (2 Points)

5. Transport management

However, all of them (owner, energy consultant and local authority) placed at the same level of performances for 6 principles as follows;

Good (3 Points)

1. Efficient environmental management
2. Site Planning and management
3. Air and emission quality
4. Urban design, visual impact and aesthetic

Fair (2 Points)

5. Optimized materials and resources used
6. Efficient water consumption

It was clear that the principles of *'optimized materials and resources used'* and *'efficient water consumption'* have been practiced at the 'fair' level during conceptual and design process of the project. Both principles were not mentioned in any project documents during planning process of the project. Though, the issue of *'optimized materials and resources used'* has been considered by owner and energy consultant during the early project planning process such as to use reuse elements and recycle content materials for the building and to separate reusable construction waste during construction stage. The contractor has practiced the waste separation during construction. However, the utilisation of sustainable materials and resources such as reused and recycled content materials was still at the 'fair' level as these materials were very limited in terms of their range and quantities in this country. The findings concurred by a recent research by Shari (2011:175-178) who pointed out that the using of reused or recycled components/materials were rarely practiced in Malaysia. The water efficiency performance was assessed to be at the 'fair' level at the conceptual and design stage of LEO building. It was no wondered as the principle was just ignored throughout this stage. This issue was still new in Malaysian construction industry at that time. The guideline such as GBI was also not yet developed. Overall, the stakeholders assessed the project sustainability performances of LEO building during conceptual and design stages to be at the 'good' level.

b. Construction Stage

Nine principles were responded as delivered at an excellent level during construction stage of the project as follows;

Excellent (4 points)

1. Sustainable design
2. Energy efficiency
3. Optimized materials and resources used
4. Whole life cost efficiency
5. Improve local market presence
6. Economic benefit to the stakeholders
7. Occupational health and safety
8. Product responsibility
9. Stakeholders participation

Seven principles were assessed as delivered at a good level during construction process.

Good (3 points)

1. Efficient environmental management
2. Air and emissions quality
3. Efficient water consumption
4. Urban design, visual impact and aesthetic
5. Noise control
6. Training, education and awareness
7. Sustainable innovation

Six principles were measured as delivered at a fair level during construction process.

Fair (2 points)

1. Concern on quality of land, river and sea
2. Site Planning and management
3. Sustainable method
4. Sustainable materials and resources
5. Transport management
6. Indirect economic impact

Overall, the stakeholders assessed the project sustainability performances of LEO building during construction stage to be at the 'good' level.

c. Operation and Maintenance Stage

Two principles were assessed as delivered at an excellent level during operation and maintenance stage as follows;

Excellent (4 points)

1. Energy efficiency
2. Sustainable design

Most of the principles (15 principles) were measured as delivered at a good level during operation and maintenance stage as follows;

Good (3 points)

1. Efficient environmental management
2. Concern on quality of land, river and sea
3. Site Planning and management
4. Air and emissions quality
5. Sustainable materials and resources
6. Urban design, visual impact and aesthetic
7. Noise control
8. Whole life cost efficiency
9. Indirect economic impact
10. Benefit to the stakeholders
11. Occupational Health and Safety
12. Product responsibility
13. Training and education
14. Stakeholders participation
15. Sustainable Innovation

Five principles were perceived as delivered at a fair level during this stage as follows;

Fair (2 points)

1. Sustainable method
2. Optimized materials and resources used
3. Efficient water consumption
4. Transport management
5. Improve local market presence

Overall, the stakeholders assessed the project sustainability performances of LEO building during operation and maintenance stage to be at the 'good' level.

Considering all cycles of the project that has been discussed, the stakeholders assessed the delivery of 2 principles at the excellent level which making the building project was exceptional in the quality as follows;

Excellent (4 points)

1. Energy Efficiency
2. Sustainable Design

Regarding the achievement, the energy consultant (E1) mentioned: *'The LEO building demonstrates the feasibility of the energy efficiency measures according to the new Malaysian Standard MS 1525:2001. Based on this code, the LEO building must have an energy consumption less than 135 kWh/m^{2}year but LEO managed to achieve the BEI of 100/kWh/m^2 which was better than the requirement of MS 1525:2001'.*

Most of the principles (16 principles) were assessed as delivered at the good level as follows;

Good (3 points)

1. Efficient environmental management
2. Concern on quality of land, river and sea
3. Site Planning and management
4. Air and emissions quality
5. Sustainable materials and resources
6. Urban design, visual impact and aesthetic
7. Noise control
8. Whole life cost efficiency
9. Improve local market presence
10. Indirect economic impact
11. Economic benefit to the stakeholders
12. Occupational health and safety
13. Product responsibility
14. Training, education and awareness
15. Stakeholders participation
16. Sustainable innovation

Some of the short comments given for the reasons of the answers were as follows;

> *'Putrajaya Holdings has implemented the Environmental Management System (EMS) since the beginning of Putrajaya development. EMS aimed to fulfil EIA requirements and to maintain Putrajaya lake's water quality towards achieving good environmental performance target' (O1).*

> *'We were still new about sustainable materials. DANIDA as well were not well known with the local product. As a result, they sometimes made mistakes when choosing the materials. By the time materials came, it was spoil. However, overall I would say the sustainable materials and resources selection in this project were not at the excellent level but it was still could be considered as good'. (C1)*

Four principles were measured as delivered at the fair level as follows;

Fair (2 points)

1. Sustainable method
2. Optimized materials and resources used
3. Efficient water consumption
4. Transport management

A number of stakeholders gave short comments the reasons for their answers for instances;

> *'Water harvesting was provided only for watering plants. This idea came later after the early planning process in order to achieve the GBI points'. (E1)*

> *'The local authority's requirement was to provide 30% less car parking space than the usual requirement in order to encourage the use of public transport. For me, the plan was good but the execution was not good. The public transportation services are unreliable and inefficient. People have to take more time to reach this building by public transport than by their own transport. Thus, park and ride area was provided but people not use it. Without tackling this issue, private transport ownership will continue to become a necessity rather than an option. This is the whole Putrajaya's problem, it is not only problem for this building. Currently, one parking area was provided nearby this building area in order to overcome insufficient parking space problem'. (O1)*

The main contractor (C1) admitted that unsustainable method of construction are a normal practice and not clearly mentioned in any project documents as he said; *'Method of construction was not mentioned clearly in any document for example the requirement is 'to break stones',*

but 'how to break it' is up to the contactors. It is a common practice among contractors to flatten the whole site, chop all the trees during site clearance even though the footprint is small, but we need a bigger site for operation.'

The stakeholders assessed the overall project sustainability performances of LEO building to be at the 'good' level.

1.3.2 Cost Performance

The capital budget of LEO project was around RM55 million and the final cost was around RM56.9 million. Ten percents (10%) of the total actual costs of the project which is around RM5 million was expended for energy efficient features of the building which was integrated and confirmed through the project tender document. The differences cost was about RM1.9 million which is more less 4% of the initial cost (O1, E1, C1). Return on investment analysis (ROI) has been undertaken as part of the decision making process on the project. Even though the upfront cost was a bit higher which is extra another 10%, however the extra costs will be paid back within the first 8 - 10 years of the building lifespan (O1, E1). It was clearly profitable for the rest of the building life time because the building has been saving about RM900 thousand energy cost annually (O1, E1).

Interviewees were asked to comment on what they thought about the planning process of LEO project, whether the planning process add more cost than a conventional project planning process. Positive responses were received from the owner and energy consultant of the project as they mentioned that the process was not increase the cost of the project. With regard to the cost issues, the energy consultant (E1) explained: *'This project had implemented integrated process. Even though may be the implementation was not perfect but it was able to reduce the cost by reducing changes order'.*

However, as the main contractor was not involved from early planning process thus, there were some issues came out during the construction phase of the project for instances the contractor (C1) mentioned: *'Among others…in architectural aspect, the designers had specified the types of glasses but the glasses cannot achieve the overall EE requirements. Specification of the glazing was also confusing and it was not available in the market. Thus, we advise the designers for other types of glazing in order to achieve the requirement of EE. I remember that the glass issues gave us a bit hassle where it took another around 4 months to get approval'.*

The contractor (C1) also pointed out: *'Most of the cost variation was due to the variation order especially on M&E side during construction of the project'.*

The building was planned to be an energy efficient building at the first time it was developed. After completion of the building, the owner decided to fulfill others green requirements in order to get GBI certification. Thus, another extra cost was expended as the owner (O1) mentioned: *'When at the first time we tried to get GBI certification, we realised that the building was not able to fulfil some requirement of the greens. Thus, we have to hold the application at that time. To get GBI certification, we had retrofitted the Building Control System throughout the year of 2004 to 2010. We upgraded some of equipments and software. The retrofitting process was completed in October to November 2011. We did GBI submission in July 2011 and LEO was successfully certified at Silver level of NREB category of GBI Malaysia in December 2011'.*

The cost of retrofitting and replacement of the old equipments and software in order to achieve sustainable target were quite expensive. It was due to the sustainability goals were not considered since the planning phase of the project as the energy manager (M1) mentioned: '*Now we use T5 and LED for meeting room instead of T8 for room and CFL for meeting room. However, it will depend on budget. The cost was quite expensive. If we have budget, then we will change the equipments for continuous energy saving'.*

However, the energy manager (M1) admitted that the replacement was beneficial to the organisation by generating saving throughout the building operation and maintenance period as he mentioned: *'Before relamping, we spent about RM155k/month. After relamping, we only have to spend around RM131k/month. Saving bill after relamping is about 23-24k/month, even though there was only second flour has been relamping. Relamping cost was about 330k. So, the ROI is only about 13 months'.*

Besides, the end users' attitudes also have contributed a lot to the building energy index as the energy manager (M1) said: *'We do keep campaign to switch off light from 1-2pm and do encourage other possible savings. Everybody understands already their role and responsibility here towards energy saving'.*

1.3.3 Time Performance

The proposed development of the whole Parcel E including LEO building had initially obtained approval at Building Plan (PB) level in April 2000 where LEO building was designed to be located at block E14. However, the original block designated for KeTTHA as approved under PB, did not allow for the additional space requirement requested by the end user. In 2001, it was decided to combine the area of Block E4 and E5, which originally dedicated to the Ministry of Education. These blocks have been redesigned as Block E4/5 to meet the new requirement of KeTTHA. The building plinths for Block E4 and E5 have been merged to create a single Block redesigned as E4/5. This reinforces KeTTHA as a single entity with its own identity, which is expressed architecturally as well as oriented strategically in relation to the rest of the Blocks and Ministries in Parcel E. The new plinth area for Block E4/5 is 5,022.27 m2, which is an increase of 964.27 m2 from the original combined plinth areas of Block E4 and E5 at 2,350 m2 and 1,708 m2 respectively. This increase is brought about by the introduction of a central atrium core that links both E4 and E5 together, forming Block E4/5. The new GFA for Block E4/5 is 22,976 m2, which is a reduction of 6,490 m2 from the original combined GFA of Blocks E4 and E5 at 16,914 m2 and 12,552 m2 respectively. This figure was derived from KeTTHA's new office space requirement (O1, L1). All of those conceptual planning, detail design and approval processes were last about one and a half years when then construction process was started in August 2002. The construction stage took about 24 months, where it was completed in 2004 and fully occupied in September 2004 (O1, C1, and M1).

Interviewees were asked to comment on the estimated time and actual duration of the project. This question was aims to assess duration and progress of the project whether it was delayed or delivered on time. Positive responses were received from the stakeholders (owner, energy consultant, local authority and main contractor) of the project as they mentioned that the project was completed within the given time period. With regard to this issue, the owner, local authority and main contractor said as follows;

> *'This project was completed in time. LEO was the earliest completed building among the rest of buildings in Parcel E development. Interestingly, LEO was started later than other buildings in the parcel. It was due to the integrated design process that has been practiced throughout the planning process.' (O1)*
>
> *'Estimated time for LEO construction period was about 2 years. Yes, LEO completion was in time'. (L1)*
>
> *'Even though we took around 4 months to get approval on M&E, a bit delayed, but we still able to complete the construction works within the given time frame'. (C1)*

Interviewees (owner, energy consultant, local authority, main contractor) then were asked to comment on the LEO project planning process, whether it took more time than a conventional project planning process**.** The interviewees agreed that the process was a bit longer that a conventional project. It involved charrete, study visit, learning process and many efforts especially because the stakeholders were not used to the project. However, the detailed planning

process has shortened the rest of the project duration. The contractor mentioned that their late involvement in the planning and design process made the project took longer time to resolved M&E and energy efficiency aspects of the building to get approval. If this situation could be overcome, the project might be completed earlier than the time it was completed. Thus, it was clear that the planning process did not take too much time than a conventional building. LEO has proved that the project was completed earlier than more less the same category and size of buildings at the same parcel E, even though it was started later than them and it delivered a new energy efficient concept, a fresh concept in this country. But, through integrated design process, it was successfully delivered earlier than others. This project had involved the contractor who responsible for the structure and M&E aspects later which was at the detail design stage. The contractor also had appointed a new M&E engineer (VY Consults) rather than employing the previous M&E engineer (NDY Sdn. Bhd.) who involved since the conceptual stage of this project. This situation might be one of the causes why they a bit delay to handled and get approval on this aspect. If this situation could be avoided, the project might be could be completed earlier than the time it was completed.

All respondents were asked to comment on any change during the project execution and its effect on the estimated cost and duration of the project. Three respondents (local authority, main contractor and energy manager) gave responses as some changes happened which involved the cost and duration of the projects. However, the project was still able to be completed within the given time. The changes involved were as follows;

- Conceptual and detail design stage- Some changes during approval process (changes were not about green requirements) (L1)
- Detail design and construction stage- Variation order on M&E aspects during construction of the project (C1)
- Operation and Maintenance stage- Retrofitting of the building to fulfill green aspects for GBI certification and renovations to fulfil increment number of occupants (O1,M1)

1.3.4 Quality and Stakeholders' Satisfaction Performance

In term of quality, the LEO building has been recognized by two prestigious awards. It won the first place in the 'Energy Efficient Building Best Practices Competition 2006' at the ASEAN level under the 'New and Existing Building' category by the ASEAN Centre for Energy. The award was presented at a special ceremony organized on 27 July 2006 in conjunction with the 24th ASEAN Energy Ministers meeting in Vientiane, Lao PDR. The LEO building also has been awarded with Silver Certificates for meeting the standard of the Malaysia GBI under the "Non Residential Existing Building' category on 1st December 2011. The building is able to reduce energy consumption until 100 kWh/m2/year compared to its first targeted achievement which is about 114kWh/m2/year. There was only minor complaint about the building performances have been received by the management and the rest of the stakeholders as they mentioned:

'Yes, we have received complaints but it was not very critical. It all about air conditioning and air supply whether too cold or too hot especially after renovation, for example this room was designed to be a corridor. Air diffuser was designed to allow air that very minimum for a corridor. But now, this space becomes a room. Air supply (cpm) should be higher for a room. So it becomes too hot and stuffy. The problem was because of the renovation. This building was designed for 200 occupants only, but now it is become 300 occupants. So, we have to look back the air diffusion..because it was diverted from the original design. The rest such as lighting, we received no complaint by people'. (M1).

'Some people said that the building is not beautiful. People expect energy efficient building should be futuristic in looks. For me, the comment was a credit for us, we able to convince people that a traditional building as well is able to be an energy efficient building. No need to be all glasses to reduce energy consumption'. (E1)

Meanwhile, the contractor and local authority have never been received any complaint or negative feedback about the building performances.

1.3.5 The Impact of Sustainability Practices on the Overall Performances of LEO building Project

Table 7 indicates the impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process on influencing the LEO project performances. The owner and energy consultant perceived that the sustainability practiced exerted a positive on the overall performances of the project. The contractor (C1) highlighted his own opinion in order to improve the planning process of LEO project as he mentioned: *'we (contractor) should be involved since the early planning process of the project, it will be better. If we are involved only during the construction stage, it will lengthen the project's duration. The developer and consultants have many different opinions and ideas but all of them will be tied back with the method of construction. We are the team who is going to implement the design on the site. If the project can have contractor in place to discuss, since the conceptual and design stage, I believe it will be fruitful to the project in term of duration. It also will more competitive during tender stage because we able to help with pricing alternative approaches to require comfort level in a sustainable building'.*

Table 7: Interviewees' Responses on the Overall Impact of LEO Sustainability Principles Practices and the Integration Strategies into the Project Planning Process on Influencing the Project Performances

Representing the Stakeholders of Planning Process		Owner	Energy Consultant
Rating		+2	+2
+3 Very Positive *+2 Positive*	*+1 Somewhat Positive*	*0 Negligible* *-1 Somewhat Negative*	*-2 Negative* *-3 Very Negative*

Besides, all stakeholders were asked to make some general comments on the full set of 22 sustainability principles of building and 20 integration strategies during project planning process as listed in the proposed framework (Table 5.63, p217) towards improving the overall performances of sustainable buildings. All of them have given their positive responses such as the owner and energy consultant mentioned:

> *'The framework is fine. It will reduce cost, changes and time and enhance the quality and sustainability aspects of the building'. (E1)*

> *'Overall, yes, the framework is excellent. We have expended extra money due to late consideration on sustainability principles in LEO project - green principles were considered later after the building was completely done'. (O1)*

1.4 Barriers to the LEO Project

This part identifies interviewees' perceptions on the major barriers or obstructions during the LEO project delivery. The most common barriers that were replied (all replies) are *'there was no clear aspect concerning sustainability and the integration strategies in the current building and the project planning standards and guidelines'* as the interviewees mentioned that the project was only referred to MS1525 in addition to the rest usually compulsory laws, standard and guidelines that they should comply to get approval from the local authority (O1, E1, C1, L1, M1). The main contractor (C1) added that there was no specific sustainability standard or guideline that they have referred for this project as he mentioned: *'We did not have a proper guideline. I believe MS1525 was only focus on energy efficient and renewable energy. It was not specifically designed for sustainable building. At that time, GBI as well was still not existed'.*

One of the contributing factors to the absence of sustainable building standards and the integration strategies guidelines was majority of the regulatory stakeholders have a very limited understanding on sustainable development. Lack of sustainable development knowledge and awareness among construction players (all replies) were also contribute to the lack of demand and misinterpretation about this project. The need to make additional investments on in technology, training and process was very often an excuse not to involve in this type of project. However, the project's client has a strong desire to incorporate energy efficient features into their building project which is very crucial to ensure the successful of the project. As this project was the first in Malaysia, the stakeholders took time to study the knowledge of sustainable project. They have been involved in workshops, seminars, charrette process and visiting sustainable building projects around the world. They had to spend time to learn. Fortunately, the stakeholders were guided by DANIDA throughout the process as the contractor (C1) said: *'during the process they (DANIDA) guided us, we were involved in many meetings so that any problem arises could be properly resolved together'.*

Luckily, the stakeholders of this project have given a very positive contribution towards this project as they were willing to learn and responsible for the successful performance of this project. Lack of sustainable development knowledge and awareness among construction players were also contribute to the lack of local sustainable materials, technology that adapted to the local climate and condition and local expert in this industry (4 out of 5 replies - cited by all stakeholders except local authority)

The third (3 out of 5) most cited barrier was about the *'lack of sustainability integration process and technical understanding'* that resulted to several process issues such as sustainability measures were not considered since early planning process as the project was first designed for energy efficient only (O1, E1, C1). Another process issues was the stakeholders such as the energy consultant and contractor were not involved during the early planning process. The maintenance of the building also was delivered by the contractor (outsider) who had never been involved in planning and design process. As the stakeholders were still new about the process during that time, there were some negative impacts that can be detected such as variation and changes order during detail design and construction stage and retrofitting and renovations were conducted to match the occupants' needs during operation and maintenance stage of the project. However, this barrier once again was contributed by the lack of sustainable development knowledge and awareness among the stakeholders and also due to the absence of a clear sustainability project standard and the integration strategies guidelines during the time.

The fourth most cited barrier during the project delivery (2 out of 5 replies) was about the funding issues (L1, M1). High investment on technology and materials was claimed by the energy manager and local authority as a challenge to the project delivery as the project was designed in the beginning more towards an energy efficient building. Extra money had to be expended in order to fulfill other sustainable features which involved retrofitting process on the building control systems, relamping facilities and upgraded some equipments and software. In choosing a new building systems and equipments, the energy manager also has to be more careful so that the choices are best suit to fit into the existing building system. Late consideration on sustainability issues which is after the building was completely done has resulted financial increment of this project in order to find the best suit systems and replacement of the existing systems.

1.5 Preferences of Sustainability Principles of Building and the Strategies to Integrate the Principles into the Project Planning Process

This part aims to gauge stakeholders' preferences on sustainability principles of building and the strategies to integrate the principles into the building project through planning process. It is then, measures the most significant sustainability principles should be integrated into Malaysian building projects and the strategies to integrate the principles into the building whole life efficiently through the project planning process. This part comprises of two issues as follows; 1)

sustainability principles of building 2) the strategies to integrate sustainability principles into the project planning process. Each of these issues is described in the followings.

1.5.1 Sustainability Principles of Building

The stakeholders were asked to assess the importance of each sustainability principle as listed in the proposed framework (stage 2) (refer Table 5.63, part A, p217) to be addressed during the formulation of the final stage of the proposed framework. Altogether, 22 principles were discussed with the interviewees. These are listed into 4 categories as shown in Table 8. It was found that 15 out of 22 principles were rated as 'very important' to be considered for a sustainable building as listed below;

5.0 points:

1. Energy efficient
2. Whole life cost efficiency
3. Product responsibility
4. Sustainable design

4.8 points:

5. Efficient environmental management
6. Air and emissions quality
7. Sustainable materials and resources
8. Optimized materials and resources used
9. Efficient water consumption
10. Transport management
11. Occupational health and safety
12. Sustainable innovation

4.6 points:

13. Concern on quality of land, river and sea
14. Site planning and management
15. Stakeholders participation

Other 7 principles were considered as 'important' (4.2 points to 4.4 points) including;

4.4 points:

16. Sustainable method
17. Urban design, visual impact and aesthetic
18. Noise control
19. Improve local market presence
20. Economic benefit to the stakeholders
21. Training and education

4.2 points:

22. Indirect economic impact

Table 8: Stakeholders' (LEO) Preferences on the Sustainability Principle of Building

Sustainability Principles	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Environmental Sustainability						
1. Efficient environmental management	5	5	4	5	5	4.8
2. Concern on quality of land, river and sea	5	5	3	5	5	4.6
3. Site planning and management	5	5	3	5	5	4.6
4. Energy efficient	5	5	5	5	5	5.0
5. Air and emissions quality	5	5	4	5	5	4.8
6. Sustainable method	5	5	2	5	5	4.4
7. Sustainable materials and resources	5	5	4	5	5	4.8

Sustainability Principles	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
8. Optimize materials and resources used	5	5	4	5	5	4.8
9. Efficient water consumption	5	5	4	5	5	4.8
10. Transport management	5	5	4	5	5	4.8
11. Urban design, visual impact and aesthetic	5	3	5	4	5	4.4
12. Noise control	5	5	4	3	5	4.4
Economic Sustainability						
13. Whole life cost efficiency	5	5	5	5	5	5.0
14. Improve local market presence	5	5	4	3	5	4.4
15. Indirect economic impact	5	5	3	3	5	4.2
16. Economic benefit to the stakeholders	4	5	4	5	4	4.4
Social Sustainability						
17. Occupational health and safety	5	5	5	4	5	4.8
18. Product responsibility	5	5	5	5	5	5.0
19. Training, education and awareness	5	5	4	3	5	4.4
20. Stakeholder participation	5	5	5	3	5	4.6
Design and Innovation						
21. Sustainable Innovation	5	5	4	5	5	4.8
22. Sustainable Design	5	5	5	5	5	5.0
TOTAL	**109**	**108**	**90**	**98**	**109**	**102.8**
Average Rating	**5.0**	**4.9**	**4.1**	**4.5**	**5.0**	**4.7**
Level of Importance	Very Important	Very Important	Important	Very Important	Very Important	Very Important

Average Rating: 5.0-4.5= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important
Shaded rows = the most important principles (5.0 points)

Overall, the stakeholders suggested that all the 22 principles are important to very important to be considered for building projects to ensure sustainability in the buildings whole life. No principle received below 4.0 points from any stakeholder. Clearly, the stakeholders believed that all the principles are important to very important to be integrated during the planning process of building project. Therefore, the 22 principles were highlighted by the interview analysis to be considered in the formulation of the final stage of the proposed framework. The user representatives (owner and energy manager) both have rated a total of 109 points (5.0) out of possible 110 points of the important level. The energy consultant (representing design team) has rated a total of 108 points (4.9), main contractor (representing construction contractor) rated 90 points (4.1) and the local authority (representing approval party) rated 98 points (4.5). Thus, all 5 stakeholders have rated the principles at the important to very important level of importance. This resulted in a very high average total score of 4.7 points (very important). A number of stakeholders gave short positive comments the reasons for their answers such as the owner and energy consultant mentioned;

'Yes, it must be done. In LEO, we are using sustainable materials like sustainable partition, low VOC paint, T5 and LED lamp. We mentioned the requirements in our procurement and we went through all those requirements'. (O1)

'When smoke haze spread in Malaysia including Kuala Lumpur and Putrajaya in 2006, the only building without haze was LEO building. LEO is the first building in Putrajaya who has rainwater harvesting system, air filter and ioniser. People sceptical about

insulation but we worked out for that towards achieving energy efficiency. It always happens that cold from Friday is still available throughout weekend without air conditioning.' (E1)

1.5.2 Strategies to Integrate Sustainability Principles into the Project Planning Process

The stakeholders were asked to assess the importance of the strategies to integrate sustainability principles into the project planning process as listed in the in the proposed framework (stage 2) (refer Table 5.63, Part B, p217) to be addressed during the formulation of the final stage of the proposed framework. Altogether, 20 principles were discussed with the interviewees and these are listed into 4 categories as shown in Table 9.

It was revealed that 15 out of 20 strategies were rated as 'very important' strategies (4.6 points to 5.0 points) to be practiced in order to integrate sustainability principles during planning process of building project. The strategies are listed below:

5.0 points:

1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan
2. Specific sustainability goals and project priorities
3. Bringing the team together as early as possible during planning process
4. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.
5. Government policies to encourage sustainable development
6. Incentive to encourage sustainable development
7. Compliance with code and regulatory tool of sustainability

4.8 points:

8. Committed and collaborative team throughout the process
9. The team should have the core knowledge of sustainable building
10. Team members are educated on sustainability issues including vendors
11. Team members are fully informed on sustainability goals and priorities of the project.
12. Local community representative is involved in support of the project

4.6 points:

13. Design should reflect the end user community
14. Planning should reflect all the project stakeholders
15. Team members' selection with sustainable development quality and capability

Other 5 principles were considered as 'important' (4.2 points to 4.4 points) which are;

4.4 points:

16. Do whole building design and systems analysis
17. Incorporation of charette process
18. Commissioning process is added during this process and described in a specific section

4.2 points:

19. Involve diverse set of stakeholders on the team
20. An integrated design/ sustainability coordinator is appointed as one of the project's team members

Overall, the stakeholders suggested that all the 20 strategies are 'important' to 'very important' to be implemented during planning process of building projects in order to integrate sustainability principles into the whole life of the building. No strategy was rated below 4.0 points from any stakeholder.

Clearly, all 20 strategies were highlighted by the interview analysis as important to very important to be considered in the formulation of the final stage of the proposed framework. A number of stakeholders gave short positive comments the reasons for their answers such as the

owner (O1) mentioned: *'The strategies are very helpful to integrate sustainability principles into the whole life of building such as multidisciplinary work from early planning process of the project'.*

The users' representatives (owner and energy manager) both have rated a total of 98 points (4.9) and 99 points (5.0) respectively out of possible 100 points. The energy consultant (representing design team) has rated 100 points (5.0), main contractor (representing construction contractor) rated 86 points (4.3) and local authority (representing approval party) rated 84 points (4.2). Thus, all 5 stakeholders have rated the strategies to be high to very high levels of importance. This resulted in a very important average total score of 93.4 (4.7) points. A number of stakeholders gave short positive comments the reasons for their answers such as the owner and energy consultant pointed out:

> *'It is good to consider sustainability as early as the early planning processes of a project. It will save money. This building for instances, at first we were only looking forward to make this building as an energy efficient building. It was a big challenge when we had to use an additional cost to make it green in order to achieve GBI points under NREB category. In term of the building systems, I think, for a new building, it is might be fine, where the contractor who get the tender will take care easily the whole building systems but for the completed building like LEO, we have to be more careful in choosing the building systems so that the new systems can fit into the existing systems.' (O1)*

> *'The proposed strategies are brilliant. When I was doing energy audit in other previous project, I always found that there was mistake which actually could be rectified during early planning process at the conceptual and design stage. For example, a very simple problem like when we want to switch on light at a corridor, but another corridor's light was also switch on. It was so wasting. Other problem such as ventilation problems, which I believe could be rectified during the early planning and design stage. I can see the problems, but it was very difficult to convinced people even though this country had already have a guideline since 1999, Energy Efficiency in Building Guidelines by Ministry of Energy, Telecommunications and Post. Since then, nobody use it. Then in 2001 MS1525 was produced, nobody also uses it. People thought that the guidelines were only good on paper and cannot be materialised in Malaysia. Luckily, when LEO building succeeds, it was really an eye opener for the industry and the government. LEO managed to achieve the BEI of 100/kWh/m^2 which was better than the requirement of MS 1525:2001. That was how we convinced PTM and KeTTHA to go for low energy building'. (E1)*

The project was excellent in energy efficiency and sustainable design aspects. Clearly, it was focused more towards environmental sustainability and sustainable design goals even though it was also considered several economic and social sustainability goals.

Table 9: Stakeholders' (LEO) Preferences on the Strategies to Integrate Sustainability Principles into the Project Planning Process

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Sustainable Project Orientation						
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	5	5	5	4	5	5.0
2. Specific sustainability goals and project priorities	5	5	5	3	5	5.0
Integrated project team						

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
3. The team should have the core knowledge of sustainable building	5	5	4	5	5	4.8
4. Team members are educated on sustainability issues including vendors.	5	5	4	5	5	4.8
5. Team members are fully informed on sustainability goals and priorities of the project.	5	5	5	5	5	4.8
6. Team members' selection with sustainable development quality and capability	4	5	4	5	5	4.6
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	4	5	5	3	4	4.2
8. Local community representative is involved in support of the project	5	5	4	4	5	4.8
Integrated design process						
9. Bringing the team together as early as possible during planning process.	5	5	5	5	5	5.0
10. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.	5	5	5	5	5	5.0
11. Design should reflect the user community	5	5	4	4	5	4.6
12. Committed and collaborative team throughout the process	5	5	5	4	5	4.8
13. Do whole building design and systems analysis	5	5	4	3	5	4.4
14. Involve diverse set of stakeholders on the team	5	5	2	4	5	4.2
15. Planning should reflect all the project stakeholders	5	5	4	4	5	4.6
16. Incorporation of charette process	5	5	4	3	5	4.4
17. Commissioning process is added during this process and described in a specific section.	5	5	4	3	5	4.4
Regulations and code compliances						
18. Government policies to encourage sustainable development	5	5	5	5	5	5.0
19. Incentive to encourage sustainable development	5	5	5	5	5	5.0

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
20. Compliance with code and regulatory tool of sustainability	5	5	5	5	5	5.0
TOTAL	**98**	**100**	**86**	**84**	**99**	**93.4**
Average Rating	**4.9**	**5.0**	**4.3**	**4.2**	**5.0**	**4.7**
Level of Importance	Very Important	Very Important	Important	Important	Very Important	Very Important

Average Rating: 4.5-5.0= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important

Shaded rows = the most important strategies (5.0 points)

2.0 THE GEO BUILDING

The GEO building is a demonstration project by Malaysia Energy Centre (PTM) for commercially feasible examples of sustainable initiatives for modern buildings in Malaysia and the region in order to promote the development of renewable energy in Malaysia. The objectives of this project were to achieve a sustainable office building of the future using green technology already available today (energy efficiency (EE), renewable energy (RE) and water harvesting system), demonstrates towards green building office, demonstrates grid connected BIPV system and demonstrates 10 to 15 years ahead some of the EE and RE technologies in Malaysian building industry. GEO was motivated from the design of LEO building. The building, which is formerly known as Zero Energy Office (ZEO) building was built at Bandar Baru Bangi. Unlike LEO, which was built with low carbon emission, GEO was first designed as a totally zero carbon emission office building, a better built and design. The building was planned to use RE in order to bring the building to a zero energy status. However due to some limitations such as technology barriers and so on, today the building was only able to achieve the BEI of 65kWh/m2/year without PV and the BEI of 30kWh/m2/year with PV installation (O2, E2, and M2).

The proposed development of GEO had obtained approval at layout plan level on 26th November 2004 and at building plan level on 7th April 2006. Construction work on the building started in 2006, which was followed by the successful installation and commission of the four solar building integrated photovoltaic (BIPV) systems in June 2007, leading to the completion of the building in October 2007. It was first occupied in November 2007 and it was the only building in Malaysia that integrates the EE and RE in one working demonstrator building. The building itself was being a research and demonstration building for new energy technologies in the Malaysian buildings (O2, E2). GEO implements EE measures through the overall design of the building. It was equipped with the facilities for energy research in the country (O2 and E2). The building had placed Malaysia on the regional map as the first completely self-sustainable building in Southeast Asia as it operates on the dynamics of both passive and active techniques and onsite RE generation, as exemplified in the solar BIPV system (E2). The building is seen as a feasible and timely solution to growing concerns surrounding the pressing issues of global warming and energy security. Since the migration of the office in October 2007, the building has been receiving an average of 80 to 90 visitors per month from educational background, professional and private sectors. Under the MBIPV project itself, GEO through its BIPV systems has been receiving wide publicity from local and international media. As a showcase project, it is expected that the BIPV systems serve as a good reference case for spinning of BIPV projects in Malaysia (O2 and E2).

2.1 The Stakeholders' Involvement

Interviewees were asked to comment on their involvement during the planning process at pre-construction stage of GEO building project. GEO is a conventional project which PTM were the owner, client and developer of the project. The client had appointed Ruslan Khalid Associate (RKA) to be the architect, Five – H Sdn Bhd to be the M&E engineers, IEN to be the energy consultant and Arup Jururunding to be the civil engineer. The owner (O2) pointed

out: '*At this stage, architect, engineers and energy consultant were at the same level in making decision. They provided options and we choose the best one'.* PTM also appointed PPC as the main contractor since they offered the best proposal as they have learnt a lot from the LEO project. PPC really utilised their experiences and lesson from LEO to be implemented in GEO project. GEO building project applied a holistic planning and design approach which involving all respective consultants who managed by the architect at the beginning before a project management consultant (PMC) which is KLCC Projects was appointed a year after (O2, E2). They were working together in order to achieve the client's zero energy vision. The initial architectural concept of the building was enhanced with super EE features, followed by the solar BIPV capacity to offset the remaining energy demand in order to fulfil the requirements which were integrated in the project tender.

Since early planning process of the project, the overall energy design objectives for the GEO building were formulated as 'achieving zero energy consumption at the least construction costs'. This project also had implemented an integrated design concepts, where the active and passive energy systems were interwoven into the building itself, and several building elements also serve as energy systems. This concept had contributed in bringing the extra costs of the building down. Besides, advanced computer design tools have been used throughout the planning process and the design stage. The owner, architect, C&S and M&E engineers and the energy consultant were brought into the project from the beginning as the integrated design demanded a very integrated process. BIPV systems installed complement the EE concepts of the whole building. Four BIPV systems were incorporated into the building as part of the building element. All consultants were fully involved in the planning process, design and integration of the BIPV systems. The MBIPV team acted as the project manager for the BIPV systems of the building. From the concept, design, implementation up to commissioning, the MBIPV team had been fully involved in terms of advising and monitoring the progress projects. The positive part from this exercise shows that installation of BIPV system requires architect, electrical, mechanical and structural consultants' involvement as it covers many building aspect and not electrical system alone. This project could serve as an exemplary of BIPV applications in Malaysia. The building was also used passive solar orientation, an under floor air distribution system, day lighting and other alternative energies. Those key concepts drove the building design including selection of materials, the structural frame and the orientation of the building.

Owner's decision making role was very important in achieving the goal of the project. They were convinced by the energy consultant to go for zero energy building (O2). The owner involved in every single meeting conducted by the PMC. *'The consultants actually had many meetings among them that normally I did not involve...but I will participate in any meeting that involve decision making for the project'(O2).*

As shown in Table 10, local authority involvement was very limited during the process project which was mostly focused on the approval matters. In discussing the involvement of the local authority, the respondents (L2) said: *'Local authority was involved only for the layout and building plan approval regarding their compliances on all of the building plan requirements. We did not check at the building construction site and the progress of the building development. All of site compliances were approved by their architect and the architect should responsible for any incompliance. We went through the submission based on UBBL 1984 and Akta Jalan, Parit dan Bangunan 1974 compliances. The submission did not mention at all about their energy saving and so forth and we did not bother about that.'* The interviewee (L2) also mentioned that it was no conceptual presentation was done earlier and the submission was processed as the same as a typical project submission.The role of energy consultant in this project was the same as in the LEO Project. However, in GEO project, they were involved as early as the planning process of the project's conceptual phase as the interviewee (E2) said: *'We (project team members) developed the conceptual design and the detail specifications, then open for public tender. Around 20 contractors bid and around 5 of them did the submissions which is PPC was one of them. We next arranged another workshop for detailing the design. Before construction, we had another workshop especially to achieve zero energy targets.'*

Table 10: Stakeholders' Involvement in Project Planning Process (GEO) [2]

Stakeholders' Involvement		Planning Process: Conceptual Planning	Planning Process: Preliminary Design	Planning Process: Detail Design and Development	Representing
Owner (O2)	Extents of Involvement	Full	Full	Full	● Client ● Users ● Operation and Maintenance
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Energy/Facility Manager (M2)	Extents of Involvement	None	None	None	● User ● Operator
	Degree of Involvement	(D) Being informed	(D) Being informed	(D) Being informed	
Energy/ Sustainability Consultant (E2)	Extents of Involvement	Full	Full	Full	● Design team and cost and economic ● Operation and Maintenance
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Main Contractor (C2)	Extents of Involvement	None	None	None	● Construction Contractor ● Operation and Maintenance ● Materials and Equipment Suppliers ● Builders
	Degree of Involvement	(E) Not Being Involved	(E) Not Being Involved	(E) Not Being Involved	
Local Authority (L2)	Extents of Involvement	Little	Little	Little	● Legal Client ● Local Community ● Approval Party
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	

Note: Degree of Involvement:
(A) Most Occupying (B) Being Involved (C) Being Consulted (D) Being Informed (E) Not Being Informed

Source: Adapted from Abdul Samad (2007)

In discussing the involvement of the main contractor in GEO project, the interviewee (C2) claimed that they were first involved at the construction stage of the project as he mentioned: '*Before construction stage, I had never gone through the charrete process. The designers designed and we would get a comprehensive package that asked for our price. We were not requested to be involved during the design stage. During construction, it was always progress meeting or technical meeting arranged so that any problem on detailing can be raised and discussed. Any issue on design that was not practical to be constructed will be discussed during the meeting. The process was the same like the process implemented in other conventional project'.*

The energy manager and the end users of the building were responsible to operate the building in sustainable manners in order to achieve and maintain the energy saving target. The BIPV systems were officially handed over from PPC to the building owner on 24th October 2007 with 24 months defect liability period. With the transfer of ownership, PTM was expected to fully maintain the BIPV systems. The initiative and commitment in this aspect is important to ensure

[2] relate to the Questions of Part B in the interview schedule (Appendix B, p307)

that the BIPV systems are well taken care of. MBIPV team, on the other hand will oversee the systems performance and advise the building owner wherever necessary (O2, M2).

As tabulated in Table 10, it is clear that the owner had the *'most occupying'* involvement in the whole planning process of the project. They led and took decisions. The local authority is also has the '*most occupying'* involvement in the planning process, however, their involvement was too limited on taking decision for the approval reason only such as layout plan and building plan approval. They were not involved at all during the charrete process that was delivered throughout the planning process. The energy consultant had the *'most occupying'* involvement since the early planning stage of the project. The main contractor of was not being involved in the planning process. They were involved at the construction stage until the project was handed over. Any issue that related to the design and construction were raised during weekly progress meeting or technical meeting. Although the energy or facility manager did not directly join the planning process of the project as compared to others, as he was not yet appointed, he was always informed and trained by the owner's representative on monitoring, maintaining and controlling the building systems.

2.2 Sustainability Practices in GEO Building Project

This part aims to explore the extent of sustainability practices in GEO building project. This part comprises of four issues; 1) The project goals 2) Sustainability principles consideration in GEO building project and 3) The project's strategy to achieve the goal for sustainable project 4) The strategies to integrate sustainability through project planning process. Each of the issues is described in the followings.

2.2.1 The Project Goals

The interviewees were asked the extent to which they were motivated to consider the sustainability principles of buildings (environmental, social, economic and design and innovation) as the main goals of the project that should be achieved. It was found that the interviewees (O2, M2, E2, C2, L2) agreed that the project had the goals on environmental, economic, social and sustainable design and innovation (refer Table 11) up to some extent for instances, the owner had a target to become a showcase building for an energy efficient design and technology to Malaysian people and construction industry. They have outlined many objectives to reach the target such as to consider day lighting in the building design for occupants' health and safety and to provide open area in the building to encourage good communication among member of staff (environmental and social aspects). They also encourage people to use staircase instead of lift equipment by purposely hid the lift somewhere at quite hidden location. The lift facility was only provided for disable, pregnant women and elderly (O2).

Table 11: Stakeholders' Responses on the Sustainability Goals of GEO Project

Sustainability Goals	Conceptual and Detail Design			Construction	Operation and Maintenance
	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager
1. Environmental	●	●	●	●	●
2. Economic	●	●			●
3. Social	●	●			●
4. Design and Innovation	●	●		●	●
Total respondents					5

Note: ● the principle was considered in the project's goals

However, the local authority and the main contractor believed that the project was skewed towards environmental sustainability target as the local authority (L2) and contractor (C2) mentioned:

'I am aware that they were developing a building with an EE concept because they have presented the concept and little about environmental aspects to us once or twice times in order to get a fast track process. But it was no any report submitted to us about the rest of the aspects. I am not sure whether they had considered or not the rest of the sustainability aspects (L2)'.

'As far as I know, the project was more towards to provide a showcase of an EE building in this country. The rest sustainability aspects, I am not very sure (C2).'

The answers were quite shocked as the local authority and the main contractor were not well exposed to the sustainability goals of the project in term of social and economic aspects. It was even worst, the local authority also did not aware the goals of sustainable design and innovation of the project. It was quite worrying because without stakeholders' understanding on the sustainability goals of the project, this aspect might be discontinued after the sustainability baton passed to the next stakeholders. The main contractor for instance, is a very important stakeholder who should really understand the goal of this project as they are indirectly responsible for implementing the design team's vision and holding the project specifications firm against change request. They also coordinate the work of trades and subcontractors and have the responsibility for spending more than 90 percent of the project budget (Yudelson, 2009).

2.2.2 Sustainability Principles Consideration during the Planning Process of GEO Building Project

The planning process stakeholders of GEO project except the main contractor and energy manager of GEO building project were asked to assess the sustainability principles that had been considered and documented during the project planning process. The project documents that had been prepared and handed out are among others include Development Proposal Report for Layout Plan and Building Development Plan, project development brief, design requirements (ZEO design document) and project specifications. Fifteen out of 22 principles had been clearly included in the project documents that prepared for and referred by the owner and consultants throughout the project (refer Table 12). The principles were clearly communicated among the owner and designers team and also considered by them during the planning process of the project. Other six principles which are *'concern on quality of land, river and sea', 'sustainable method', 'sustainable materials and resources, 'optimize materials and resources used', 'urban design, visual impact and aesthetic' and 'improve local market presence'* were also considered by them during the planning process even though the principles were not mentioned in the project documents. One principle was not mentioned and not considered by the owner and designer team during the planning process of the project which is *'transport management.'*

Table 12: Interviewees' Comments on Sustainability Principles Consideration during the Planning Process of GEO Building Project

Sustainability Principles	Considered? Documented?				
	Owner	Energy Consultant	Local Authority	Σ Documented	Σ Considered
Environmental Sustainability					
1. Efficient environmental management	●*	●*	●*	3	3
2. Concern on quality of land, river and sea	●	●	●*	1	3
3. Site planning and management	●*	●*	●*	3	3
4. Energy efficient	●*	●*	*	3	2
5. Air and emissions quality	●*	●*	●*	3	3
6. Sustainable method	●	●		0	2
7. Sustainable materials and resources	●	●		0	2
8. Optimize materials and resources used	●	●		0	2
9. Efficient water consumption	●*	●*		2	2

Sustainability Principles	Considered? Documented?				
	Owner	Energy Consultant	Local Authority	Σ Documented	Σ Considered
10. Transport management				0	0
11. Urban design, visual impact and aesthetic	•	•		0	2
12. Noise control	•*	•*	•*	3	3
Economic Sustainability					
13. Whole life cost efficiency	•*	•*		2	2
14. Improve local market presence	•	•		0	2
15. Indirect economic impact	•*	•*		2	2
16. Economic benefit to the stakeholders	•*	•*		2	2
Social Sustainability					
17. Occupational health and safety	•*	•*	•*	3	3
18. Product responsibility	•*	•*		2	2
19. Training, education and awareness	•*	•*		2	2
20. Stakeholder participation	•*	•*		2	2
Design and Innovation					
21. Sustainable Innovation	•*	•*		2	2
22. Sustainable Design	•*	•*		2	2
Mentioned in the project documents	**15 (Medium)**	**15 (Medium)**	**7 (Low)**	**37**	**48**
Considered by the interviewees	**21 (Very High)**	**21 (Very High)**	**6 (Very Low)**	**Average: 12 (Medium)**	**Average: 16 (High)**
Total respondents				3	
22-20 Very High	*19- 16 High*	*15-11 Medium*	*10-7 Low*	*6-0 Very Low*	

Note: ● Considered during the project planning process
**Mentioned in the project documents*

Meanwhile, only 7 out of 22 principles were included in the project documents that submitted to Kajang Municipal Council. The principles were clearly considered by the local authority as the requirements to be fulfilled by the client and the team members exceptional of *'energy efficient'* aspect. Some of the energy efficient aspect was mentioned in the submission documents that had been submitted to the local authority to get a fast track approval process from them. However, it was not taken seriously during the approval submission as the subject was not a compulsory requirement for an approval reason as the local authority (L2) said; *'It was no detail requirement on sustainable building in UBBL or other requirements from our side (local authority), that's why we were not involved in such details. Up to today, we still don't really encourage sustainable project but we do support whoever is looking forward to deliver this kind of project.'*

Other 15 principles which are *'sustainable method', 'sustainable materials and resources', 'optimized materials' and 'resources used', 'efficient water consumption', 'transport management', 'urban design, visual impact and aesthetic', 'whole life cost efficiency', 'improve local market presence', 'indirect economic impact', 'economic benefit to the stakeholders', 'product responsibility', 'training and education', 'stakeholders' participation', 'sustainable design' and 'innovation'* were not mentioned in submission documents to the local authority and also not considered by them during the approval process of the project.

Clearly, 5 principles were mentioned in project documents and considered by both planning stakeholders and the local authority during the planning process of the project which are *'efficient environmental management', concern on quality of land, river and sea', site planning', 'air and emissions quality', 'noise control', and 'occupational health and safety'.* Meanwhile, one principle was not mentioned and not measured by them during the process which is *'transport management.'* Overall, the sustainability principles mentioned in the project documents was at a medium level and the consideration of the principles during the project planning process was at a high level.

2.2.3 The Project Strategies to achieve the Goals for Sustainability

The interview went further to examine the strategies that have been practiced by the GEO project stakeholders to achieve the goals of sustainability. Findings reveal that 12 strategies have been implemented as shown in Table 13. All five interviewees (owner, energy consultant, local authority, contractor, energy manager) highlighted that they have applied to and given incentives by the government for tax reduction of imported sustainable materials as these materials were not available in the country. Out of 92 kWp, 40 kWp was funded under the Malaysia Building Integrated Photovoltaic (MBIPV) Project through its showcase programme. The project have received technical assistance from the MBIPV Project on the system design concept, tender preparation and evaluation, project monitoring and for interconnection to the National Utility Company. It was also went through a fast track approval process which is an incentive given by the local authority to facilitate and encourage sustainability in building project within Kajang Municipal Council area. The strategies are supported the strategy of sustainability integration during building project planning process as recommended in the proposed framework (refer Table 5.63, part b, p217) which is *'providing incentive to encourage sustainable project'.*

Four interviewees (exceptional of the local authority) highlighted that they have given regular awareness, seminars, brief and campaign on energy efficiency to the project team and the building occupants to save energy by operating the building in sustainable manners. The team members also have been exposed to the sustainable knowledge and experiences throughout the project. The strategies are related and supported the strategy of sustainability integration in the proposed framework up to some extent which are; '*The team should have the core knowledge of sustainable building', 'Team members are educated on sustainability issues including vendors'* and '*Team members are fully informed on sustainability goals and priorities of the project'.* The stakeholders were also planned and designed the project towards fulfillment of '*the requirements of MS1525:2001*'. The strategies are related and supported the strategy of the proposed framework up to some extent which are *'government policies to encourage sustainable development' and 'compliance with code and regulatory tool of sustainability'.*

Three stakeholders of planning and construction stages (owner, energy consultant, contractor) concerned '*workshop among the stakeholders', 'visiting the energy efficient building', 'attending sustainable conference'* and '*attending a lot of seminars including presenting the progress and project performance among stakeholders in every single stage of developmen*t' to be their strategies to achieve the project's goals of sustainability. They have integrated energy efficient, some sustainability principles and the end users needs during the early planning process of the project. Other three stakeholders (owner, energy consultant and energy manager) who have been involved in operation and maintenance stage concerned the strategies of *'monitoring and controlling the building energy and operate the building in sustainable manners', 'monitor indoor environmental performance and occupant satisfaction'* and *'to get GBI certification as their strategies to achieve the project sustainability goals*' during operation and maintenance stages of the project. The practiced are related and supported the proposed strategies of '*Specific sustainability goals and project priorities', 'The team should have the core knowledge of sustainable building', 'Team members are educated on sustainability issues including vendors', 'Team members are fully informed on sustainability goals and priorities of the project', 'Design should reflect the end users community', 'Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan', 'Planning should reflect all the project stakeholders', 'Committed and collaborative team throughout the project', 'Incorporation of charette process', 'Do whole building design and systems analysis'* and *'Involve diverse set of stakeholders on the team',*

Local authority strategy was related to mention the goal of sustainability in Structure Plan, Local Plan and Strategic Plan. The strategy is also related and supported the strategies of *'government policies to encourage sustainable development' and 'compliance with code and regulatory tool of sustainability'* up to some extent, in the proposed framework. However, as the same as the local authority of LEO project, the local authority (L2) admitted that the

guideline and procedure has not changed much to promote sustainability. There is no specification was put on how to plan and manage sustainable development.

Table 13: Project Strategies to Achieve the Goals of GEO Project

	Strategies Practiced	Stakeholders					No. of times recorded
		Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	N
1.	Workshop among stakeholders to reveal the energy efficient and sustainability knowledge and worldwide experiences in order to enhance their awareness and capability.	●	●	●			3
2.	Consider energy efficient and some sustainability principles since the early project planning process	●	●				2
3.	Multidisciplinary collaboration and integrated design	●	●				2
4.	Visiting the energy efficient building in Thailand and Copenhagen with the project team	●	●	●			3
5.	Attending sustainable conference	●	●	●			3
6.	A lot of seminars among stakeholders have been arranged in every single stage of development and also presenting the progress and project performance	●	●	●			3
7.	Regular awareness, brief and campaign on energy efficiency to the project team, and to the occupant to save energy and to operate the building in sustainable manner since the planning process	●	●	●		●	4
8.	Monitoring and controlling the building energy and operate the building in sustainable manners	●	●			●	3
9.	Monitor indoor environmental performance and occupant satisfaction	●	●			●	3
10.	Fulfil the requirements of MS1525	●	●	●		●	4
11.	To get GBI certification	●	●			●	3
12.	Mentioned the goal of sustainability in Structure plan, Local plan and Strategic plan.				●		1
	Incentives-Fast track approval process and tax reduction for imported sustainable materials	●	●	●	●	●	5
Total number of strategies practiced		**12**	**12**	**7**	**2**	**6**	**39**
Total respondents							5

Note: ● the strategies practiced by the interviewees

Generally, the strategies practiced by the GEO stakeholders are relatively related to the sustainability integration strategies as tabulated in the proposed framework. The owner and energy consultant were found to have the highest numbers of efforts to achieve the goals of sustainability of the project (12 out of 12 cited strategies) and the local authority had the lowest involvement among the cited strategies (1 out of 12). The practiced strategies were found to be implemented up to certain extents. The strategies were realized skewed towards to implement 3

basic strategies of sustainability integration which are to *'prepare the stakeholders with the core knowledge of sustainable building', 'educate the stakeholders on sustainability'* and *'to inform the stakeholders on sustainability goals and priorities of the project'.*

Six strategies to integrate sustainability into the project as listed in the proposed framework are not related to any strategy that have been mentioned by the stakeholders to reach the sustainability targets of the GEO project which are;

1. Team members' selection with sustainable development quality and capability
2. Bringing the team together as early as possible during planning process
3. Commissioning process is added during this process and described in a specific section
4. An integrated design/ sustainability coordinator is appointed as one of the project's team members
5. Local community representative is involved in support of the project
6. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.

GEO building is a pilot project for an energy efficient building in this country. At the time it was delivered, the project still has no a clear route towards sustainability. As the same as the LEO project, GEO project referred to MS1525:2001 in addition to the usual laws and guidelines that they should fulfilled. The project was planned and designed more towards to achieve energy efficiency and renewable energy goals instead of sustainability as a whole. This project was a part of the government initiatives to encourage sustainable development. It was covered by the government incentives such as tax reduction for sustainable materials. The submission and approval process of this project was the same as a typical project however, in order to encourage sustainable project, they was given a fast track approval process by the local authority.

2.2.4 Sustainability Integration Strategies Practiced during the Planning Process of GEO Building Project

The owner and energy consultant of GEO building were asked to assess the strategies that have been practiced to integrate sustainability into the project throughout the planning process. Eighteen out of 20 strategies were practiced among the owner and designers team during the project planning process (refer Table 14). Two strategies were not practiced during the process which are *'Local community representative is involved in support of the project'* and *'sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan'.* As the same LEO project, the local community representative was not involved at all during this process and the local authority was only involved in the approval part of the project. The sustainability and integrated design requirements and the process were also not properly documented at the time as the team members were also in a learning process of delivering such project.

Table 14: Interviewees' Comments on Sustainability Integration Strategies during the Planning Process of GEO Building Project

Sustainability Integration Strategies	Stakeholders	
	Owner	Energy Consultant
Sustainable Project Orientation		
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	•	•
2. Specific sustainability goals and project priorities	•	•
Integrated project team		
3. The team should have the core knowledge of sustainable building	•	•

Sustainability Integration Strategies	Stakeholders	
	Owner	Energy Consultant
4. Team members are educated on sustainability issues including vendors.	●	●
5. Team members are fully informed on sustainability goals and priorities of the project.	●	●
6. Team members' selection with sustainable development quality and capability	●	●
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	●	●
8. Local community representative is involved in support of the project		
Integrated design process		
9. Bringing the team together as early as possible during planning process	●	●
10. Design should reflect the end user community	●	●
11. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.		
12. Do whole building design and systems analysis	●	●
13. Committed and collaborative team throughout the process	●	●
14. Involve diverse set of stakeholders on the team	●	●
15. Effective communication and incorporation of charette process	●	●
16. Planning should reflect all the project stakeholders	●	●
17. Commissioning process is added during this process and described in a specific section.	●	●
Regulations and code compliances		
18. Government policies to encourage sustainable development	●	●
19. Incentive to encourage sustainable development	●	●
20. Compliance with code and regulatory tool of sustainability	●	●
TOTAL	**18**	**18**
Level of the Strategies Practiced:	**Very High**	**Very High**
Total respondents		2
Level of Practices: 20-18 Very High *17- 14 High* *13-10 Medium* *9-6 Low* *5-0 Very Low*		
Note: ● Practiced during the project planning process		

Of the 18 practiced strategies, 4 strategies were not highlighted by the stakeholders earlier in the previous section. The strategies are;

1. Team members' selection with sustainable development quality and capability
2. Bringing the team together as early as possible during planning process
3. Commissioning process is added during this process and described in a specific section
4. An integrated design/ sustainability coordinator is appointed as one of the project's team members

The strategy of *'team member's selection with sustainable development quality and capability'* has been practiced in the GEO project. The selection priority of the team members was given based on their past experiences in sustainable projects for instances, the energy consultant and the main contractor were selected based on their excellent track record and experiences in delivering LEO building project (O2). The owner and the team members of the project were also brought together since the early planning process of the project exceptional of the

contractor due to the traditional contract that was employed. The contractor was not appointed until after the detail design was established and the project went to the construction stage. Similarly, commissioning process was added during the project planning process and described in a specific section. *A sustainability coordinator or energy consultant (IEN) was appointed since the initial stage of project planning process (O2, E2).* Overall, the sustainability integration strategies that have been practiced during the planning process of the project was at a very high level.

2.3 The Project Performances

This part aims to explore the performances of the GEO project and the impact of the sustainability practiced on overall performances of the building project. The performances are discussed in the aspect of: 1) Sustainability Performances 2) Cost 3) Time 4) Quality and Stakeholders Satisfaction. The impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process on influencing the project performances is discussed at the end of this part.

2.3.1 Sustainability Performances

The stakeholders were asked to assess the performance level of sustainability principles delivered at every cycle of the project. The owner, energy consultant and local authority of the project were asked to assess the project's sustainability performances delivered at the planning stage, contractor was asked to evaluate the performances delivered at the construction stage and energy manager was asked to judge the sustainability performances at the operation and maintenance stage of the building. The results are illustrated in Table 15.

Table 15: Stakeholders' Responses on the Level of Sustainability Performances of GEO Project

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
Environmental Sustainability						
1. Efficient environmental management	4	3	4	2	4	3
2. Concern on quality of land, river and sea	4	4	2	3	4	3
3. Site planning and management	3	3	3	3	3	3
4. Energy efficient	4	4	2	4	4	4
5. Air and emissions quality	4	2	2	3	4	3
6. Sustainable method	4	4	2	2	4	3
7. Sustainable materials and resources	2	2	2	2	2	2
8. Optimize materials and resources used	2	4	2	3	2	3
9. Efficient water consumption	3	3	2	1	3	2
10. Transport management	1	2	2	1	1	1
11. Urban design, visual impact and aesthetic	4	4	2	4	4	4
12. Noise control	4	4	2	2	4	3
Economic Sustainability						
13. Whole life cost efficiency	4	4	2	1	4	3
14. Improve local market presence	3	4	2	4	3	3

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
15. Indirect economic impact	3	4	2	3	3	3
16. Economic benefit to the stakeholders	4	4	2	4	4	4
Social Sustainability						
17. Occupational Health and Safety	4	4	2	3	4	3
18. Product responsibility	4	4	2	2	4	3
19. Training, education and awareness	4	4	2	3	4	3
20. Stakeholders participation	4	4	2	4	4	4
Design and Innovation						
21. Sustainable Innovation	4	4	2	4	4	4
22. Sustainable Design	4	4	2	4	4	4
TOTAL SCORE	77	79	47	62	77	68
Average Rating	4	4	2	3	4	**3**
Level of Performances	Excellent	Excellent	Fair	Good	Excellent	**GOOD**
Note: 1 = Poor	*2 = Fair*		*3 = Good*		*4 = Excellent*	

a. Conceptual and Design Stage

Difference in responses of project performances occurred for the conceptual and design stage of GEO project. There are 14 sustainability principles have been placed by the owner and energy consultant to be at the same level but at the different level by the local authority as follows;

Excellent (4 Points)

1. Concern on quality of land, river and sea
2. Energy efficient
3. Sustainable method
4. Urban design, visual impact and aesthetic
5. Noise control
6. Whole life cost efficiency
7. Economic benefit to the stakeholders
8. Occupational health and safety
9. Product responsibility
10. Training, education and awareness
11. Stakeholders participation
12. Sustainable Design
13. Sustainable Innovation

Good (3 Points)

14. Efficient water consumption

However, all of them (owner, energy consultant and local authority) placed at the same level of performances for 2 principles as follows;

Good (3 Points)

1. Site Planning

Fair (2 Points)

2. Sustainable materials and resources

It was clear that the principles of *'sustainable materials and resources'* has been practiced at the 'fair' level during planning process. The principle was not mentioned in project documents

during planning process of the project. The owner and energy consultant practiced the issue during planning process, however, these materials were very limited in this country, and thus it was used within the limited range and quantities. Overall, the stakeholders assessed the project sustainability performances of GEO building during conceptual and design stages to be at the 'good' level.

b. Construction Stage

Seven principles were measured as delivered at an excellent level of performance during construction stage as follows;

Excellent (4 points)

1. Energy efficient
2. Urban design, visual impact and aesthetic
3. Improve local market presence
4. Economic benefit to the stakeholders
5. Stakeholders participation
6. Sustainable design
7. Sustainable innovation

Seven principles were measured to be delivered at a good level of performance:

Good (3 points)

1. Concern on quality of land, river and sea
2. Site Planning
3. Air and emissions quality
4. Optimized materials and resources used
5. Indirect economic impact
6. Occupational health and safety
7. Training, education and awareness

Five principles were measured as delivered at a fair level during construction process:

Fair (2 points)

1. Efficient environmental management
2. Sustainable method
3. Sustainable materials and resources
4. Noise control
5. Product responsibility

Three principles were perceived as delivered at a poor level during construction process:

Poor (1 point)

1. Efficient water consumption
2. Transport management
3. Whole life cost efficiency

Overall, the stakeholders assessed the project sustainability performances of GEO building during construction stage to be at the 'good' level.

c. Operation and Maintenance Stage

Most of the principles (15 principles) were measured as delivered at an excellent level during operation and maintenance stage as follows;

Excellent (4 points)

1. Efficient environmental management
2. Concern on quality of land, river and sea
3. Energy efficient
4. Air and emissions quality
5. Sustainable method
6. Urban design, visual impact and aesthetic
7. Noise control
8. Whole life cost efficiency
9. Economic benefit to the stakeholders
10. Occupational health and safety
11. Product responsibility
12. Training, education and awareness
13. Stakeholders participation
14. Sustainable Design
15. Sustainable innovation

Four principles were perceived as delivered at a good level of performance during operation and maintenance stage:

Good (3 points)

1. Site Planning
2. Efficient water consumption
3. Improve local market presence
4. Indirect economic impact

Two principles were measured as delivered at a fair level of performance during operation and maintenance stage:

Fair (2 points)

1. Sustainable materials and resources
2. Optimized materials and resources used

One principle was perceived as delivered at a poor level during this stage:

Poor (1 point)

1. Transport management

The stakeholders assessed the project sustainability performances of GEO building at the operation and maintenance stages to be at an 'excellent' level.

Considering of all project stages, the stakeholders assessed the delivery of 6 principles at the excellent level which making the building project was exceptional in the quality. The principles are as follows;

Excellent (4 points)

1. Energy efficiency
2. Sustainable design
3. Urban design, visual impact and aesthetic
4. Economic benefit to the stakeholders
5. Stakeholders participation
6. Sustainable innovation

A short comment given by the energy consultant (E2) for the innovations aspect was: *'GEO building demonstrates 10-15 years ahead some of the energy efficient and renewable energy technologies in Malaysian building industry. GEO managed to score full point of GBI assessment in Innovation aspect'.*

The owner (O2) has given a short comment on how the building beneficial to them: *'The operation and maintenance cost of this building was very low. In regards to the day lighting systems, it was already 5 years without any maintenance work. There are only 2 technicians appointed for the electrical, mechanical and air conditioning systems and our water bill also is very low as low as RM200 per month because we are using rain water for irrigation and cooling tower.'*

Most principles (13 principles) were measured as delivered at the good level:

Good (3 points)

1. Efficient environmental management
2. Concern on quality of land, river and sea
3. Site planning and management
4. Air and emissions quality
5. Sustainable method
6. Optimized materials and resources used
7. Noise control
8. Whole life cost efficiency
9. Improve local market presence
10. Indirect economic impact
11. Occupational health and safety
12. Product responsibility
13. Training, education and awareness

Two principles were perceived as delivered at the fair level as follows;

Fair (2 points)

1. Sustainable materials and resources used
2. Efficient water consumption

One principle was perceived as delivered at a poor level:

Poor (1 points)

1. Transport management

The owner (O2) highlighted: *'We don't have any public transport services within this area since this building was first constructed. People have to make a phone call for a taxi to get a public transport.'* Overall, by considering all cycles of the building that has been discussed, the stakeholders assessed the project sustainability performances of GEO building to be at the 'good' level. Overall, the stakeholders assessed the project sustainability performances of GEO building during operation and maintenance stage to be at an 'excellent' level. Considering all cycles of the project that has been discussed, the stakeholders assessed the project sustainability performances of GEO building to be at a 'good' level.

2.3.2 Cost Performance

The capital budget of GEO project was around RM16 million and the final cost was around RM20 million. Thirty three percents (33%) of the total actual costs of the project which is around RM7 million was expended for energy efficient features of the building which was integrated and confirmed through the project tender document. The differences cost was about RM4 million which is more less 25% of the initial cost (O2, E2). ROI has been undertaken as part of the decision making process on the project where the RM7 million will be paid back within the first 34 years of the building lifespan (O2, E2). It was clearly profitable for the rest of the building life time because the building has been saving about RM160-RM170 thousand energy cost annually (O2, E2).

Interviewees were asked to comment on what they thought about the planning process of GEO project, whether the planning process add more cost than a conventional project planning process. Positive responses were received from the owner and energy consultant of the project as they mentioned that the process was not increase the cost of the project. With regard to the cost issues, the owner (O2) explained: *'It was no additional cost for the planning process. 'We spent RM3 million for energy efficiency and RM3 million for renewable energy. Obviously, we paid extra cost for the imported materials not for the planning processes.'*

Problem arose during construction stage where not all that have been planned could be implemented during the construction stage and could be achieved during occupancy of the building such as lack of air movement. The building also was not achieved the target of zero energy during occupancy as the owner mentioned that GEO is only able to achieve the BEI of 30-35 kWh/m2/year (O2). Lack of experiences and knowledge as well made this issue happened as highlighted by the owner and energy consultant;

> *'This is a research project. We don't have any previous experiences on many aspects regarding this project. Sometimes simulation was different from the real ones, so it was involved changes later and of course resulting in cost variation.'(O2)*

> *'The technology, such as radiant cooling at that time did not even used in any Asian country'. (E2)*

The main contractor was not involved during the project planning process, however, there were many times of progress meeting have been done in order to observe their progress and to resolve any raising issues as the contractor (C2) mentioned: *'There were many things that we did half way due to some problems. When we have problem, we will discuss and change the drawing. If you ask everybody during that time, everybody was also still new. If we were involved during planning and design process at that time, we were also cannot gave a proper input into the project.'*

The local authority (L2) mentioned that for approval requirements, GEO project did not do any major change. There were only twice times of amended submission have been done by the PSP.

The energy manager (M2) admitted that the project was beneficial to the organisation by generating saving throughout the building operation and maintenance period as he mentioned: *'The operational cost is very low. Currently, we only pay RM4000 for the electricity cost. Compare to a conventional building at the same size, which is around RM40,000. It was already 5 years without any maintenance work for lighting systems. The water bill also is very low as low as RM200 per month because we are using rain water for irrigation and cooling tower. PV was so expensive therefore, it was affecting our ROI.'*

The energy consultant (E2) added: *'The maintenance cost is very low. We only had 2 technicians (electrical and mechanical), a facility manager and an assistant. Client appointed their own O&M contractor. They don't have any problem with operation and maintenance. We trained them to operate and maintain the building'.*

2.3.3 Time Performance

The proposed development of GEO building had obtained approval at layout plan level on 26th November 2004 and at Building Plan (PB) level on 7th April 2006. The GFA of GEO building is 4,152m^2 (O2, L2). All of those conceptual planning, detail design and approval processes were last about more less one and a half years when then construction process was started in March-April 2006. The construction stage took about 19 months, where it was completed in October 2007 and fully occupied in November 2007 (O2, C2, and M2).

Interviewees were asked to comment on the estimated time and actual duration of the project. This question was aims to assess duration and progress of the project whether it was delayed or

delivered on time. The stakeholders (O2, E2 and L2) mentioned that the timeframe was not a very serious matter for that project as it was a research project. However, the energy consultant (E2) mentioned that the project had problem during construction stage as some of the design was not appropriate to be implemented during this stage which increase the construction period. It was confirmed by the main contractor (C2) as he mentioned that the project was delayed around one year during construction stage due to the changes order.

Interviewees (owner, energy consultant, local authority) then were asked to comment on the GEO project planning process, whether it took more time than a conventional project planning process**.** The interviewees agreed that the process was a bit longer that a conventional project. It involved charrete, study visit, learning process and many efforts especially because of the stakeholders were not used to the project. However, the detailed planning process has shortened the rest of the project duration. In GEO project, the stakeholders had no enough knowledge and experiences on sustainable building and the new technologies implemented especially in order to suit the technologies to the local climate and condition. This situation has delayed the construction process for about one year due to the changes order. It was believed that the delayed was not because of the planning process but due to the lack of knowledge and expertise during planning process. If this situation could be overcome, the project might be completed earlier than the time it was completed. Thus, it was clear that the planning process did not take too much time than a conventional building and the project should be accelerated due to zero or minor change order.

All respondents were asked to comment on any change during the project execution and its effect on the estimated cost and duration of the project. Three respondents (owner, energy consultant, main contractor and local authority) gave responses as some changes happened which involved the cost and duration of the projects. The changes involved were as follows:

- Conceptual and design stage- Twice changes submission regarding the energy efficient aspects during approval process (L2)
- Detail design and construction stage- Variation order on EE and RE aspects during construction of the project (O2, C2)

2.3.4 Quality and Stakeholders' Satisfaction Performance

The GEO building has been recognized by two prestigious awards. It won the first place in the 'Renewable Energy Competition 2009' at the ASEAN Energy award 2009. GEO is officially Malaysia's first GBI Certified Building. The building has been awarded at the certified level for meeting the standard of the Malaysia GBI under the "Non Residential New Construction' category on 24th July 2009. It was very impressive as GEO was designed at a time when the awareness of building green was still at its infancy in the country, but the building able to score full points under the 'Energy Efficiency' and 'Innovation' criteria of the GBI with the BEI of 65kWh/m2/year without PV and the BEI of 30kWh/m2/year with PV installation (O2, E2, and M2). Today, GEO continues to function as a showcase building to facilitate and explore the concept of sustainability in buildings and assisting to create opportunities for the involvement of other relevant industries. It is also exemplifying the use of energy efficiency, with solar BIPV setting a new standard for sustainable building in the ASEAN region. There was only minor complaint about the building performances have been received by the owner and the contractor as they mentioned;

'Till now, daylight and energy consumption are fantastic. We just have problem on air movement which is too slow, the environment is stuffy. We suppose to add more diffuser for a good air movement' (O2).

'Not many complaint. I only heard that the occupants complaint about the air temperature which is a bit hot for people who sitting near the roof light.' (C2)

Meanwhile, the local authority has never been received any complaint or negative feedback about the building performances.

2.3.5 The Impact of Sustainability Practices on the Overall Performances of GEO building Project

Table 16 indicates the impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process on influencing the GEO project performances. The owner perceived that the sustainability practiced exerted a positive on the overall performances of the project. The energy consultant measured that the sustainability practiced exerted a very positive on the overall performances of the project. The owner and the energy consultant highlighted their opinion in order to improve the planning process of GEO as follows:

'It is good to consider sustainability since the early planning processes of the project in order to deliver a successful sustainable building without increasing the project cost. This building for instances, we have considered several sustainability aspects during planning process especially on energy efficiency and innovations aspects as this is a research energy efficient building. GEO has been awarded with Certified certificates for meeting the standard of Malaysia GBI without any retrofitting or renovation activities. If we have a clear sustainable building project guideline earlier, I believe GEO building will be able to achieve a Platinum level of GBI.' (O2)

'What I can learn from this project is we should appoint a professional project manager first before designer, what we did was we appointed designer first at 2002 to manage the project. Second, the energy consultant is very important in this project to give advice and monitor the sustainability aspects of the project' (O2)

'The government should give a very high commitment because normally people will go for the economic first and environment will come later. Private sector always decides to have green to increase market rate.' (E2)

'Malaysian construction industry should have their own guidelines on sustainable and energy efficient building which is suit to the local climate and conditions. They also should have their own local expert who will be leading the project'. (E2)

The main contractor (C2) highlighted his own opinion in order to improve the planning process of GEO as he mentioned:

'To improve the project, the government should play a very important role through incentive for buying sustainable materials and production of sustainable materials. At this stage the government should pays more attention to promote the materials by giving subsidy so that the product will survive in the market because a lot of people using it and it will become common it the market. The government also should make sustainable building concept is compulsory at certain extent. A lot of things that people don't want to do except you make it compulsory. The government should make certain sustainable principles as a compulsory during building approval process if everybody has to go to the same way, it will build competition and it can be promoted efficiently. The sustainable principles and the planning process should have the clear written guidelines or otherwise it will be more complicated when everyone try to do the best based on their own understanding.'(C2)

The local authority (L2) added:

'Knowledge should be transferred to everybody because the success of this building depends on the whole life sustainability delivery of it. Otherwise, it might be stopped until the design stage only. Knowledge is very important to ensure that the owner of the building operates the building in a sustainable manner. The GEO project has installed many energy efficient systems and equipments but there is no one local technical expert on

those systems. Many systems and technology are from over sea. Products from over sea sometimes are not match to our local climate and conditions. What I can say, we are not ready but we want. We have to prepare ourselves. We should have alternative and mitigation methods if any problem happens with the building in the future before we decide to commit with this project.' (L2)

Table 16: Interviewees' Responses on the Overall Impact of GEO Sustainability Principles Practices and the Integration Strategies into the Project Planning Process on Influencing the Project Performances

Representing the Stakeholders of Planning Process		Owner	Energy Consultant
Rating		+2	+3
Note: +3 Very Positive *+2 Positive*	*+1 Somewhat Positive*	*0 Negligible* *-1 Somewhat Negative*	*-2 Negative* *-3 Very Negative*

Besides, all stakeholders were asked to make some general comments on the full set of 22 sustainability principles of building and 20 integration strategies during project planning process as listed in the proposed framework (Table 5.63, p217) towards improving the overall performances of sustainable buildings. All of them have given their positive responses on the listed factors.

2.4 The Barriers to the GEO Project

This part identifies interviewees' perceptions on the barriers or obstructions during the GEO project delivery. The most common barriers that was replied (all replies) was *'there was no clear aspect concerning sustainability and the integration strategies in building and the project planning standards and guidelines'* as the interviewees mentioned that the project was only referred to MS1525 in addition to the rest usually compulsory laws, standard and guidelines that they should comply to get approval from the local authority (O2, E2, C2, L2, M2). One of the contributing factors to the absence of sustainable building standards and the integration strategies guidelines was majority of regulatory stakeholders have a very limited understanding on sustainable development. Lack of sustainable development knowledge and awareness among construction players (all replies) were also contribute to the lack of demand and misinterpretation about this project. The stakeholders took time to study the knowledge of sustainable project. They have been involved in workshops, seminars, charrette process and visiting sustainable building projects around the world as the owner (O2) highlighted: *'we didn't have enough knowledge and experience on the project. The consultants took more time during design stage. We have to do a lot of research and visit overseas project. We also have to appoint experts from Germany and Denmark to collaborate and consult our consultants. The problem was during construction, because not all that we planned could be implemented during the construction stage of the project'.*

Lack of sustainable development knowledge and awareness among construction players were also contribute to the lack of local sustainable materials and local expert in this industry (all replies) as the energy consultant (E2) said: *'we adapted foreign technology and we referred to the foreign standard and guidelines such as ASHRAE which is not a hundred percent suitable to our climate and condition. We should have our own expert to lead the project. We should learn from the project so that we will not have the same problem in the next building project.'*

The rest of the listed barriers of the project were not cited by the stakeholders as they had fully support of funding by the government and had a good collaboration among the members of the project team.

2.5 Preferences of Sustainability Principles of Building and the Strategies to Integrate the Principles into the Project Planning Process

This part aims to gauge GEO project's stakeholders' preferences on sustainability principles of building and the strategies to integrate the principles into the the project planning process. It is then, measures the most significant sustainability principles should be integrated into Malaysian building projects and the strategies to integrate the principles into the building whole life efficiently through the project planning process. This part comprises of two issues as follows; 1) Sustainability Principles of Building 2) The Strategies to Integrate Sustainability Principles into the Project Planning Process. Each of these issues is described in the followings.

2.5.1 Sustainability Principles of Building

The stakeholders were asked to assess the importance of each sustainability principle as listed in the proposed framework (stage 2) to be addressed during the formulation of the final stage of the proposed framework. Altogether, 22 principles were discussed with the interviewees. These are listed into 4 categories as shown in Table 17.

It was revealed that 18 out of 22 principles were rated as 'very important' to be considered for a sustainable building as listed below;

5.0 points:

1. Efficient environmental management
2. Sustainable design
3. Stakeholders' participation

4.8 points:

4. Concern on quality of land, river and sea
5. Site planning and management
6. Sustainable materials and resources
7. Efficient water consumption
8. Noise control
9. Whole life cost efficiency
10. Occupational health and safety
11. Product responsibility
12. Sustainable innovation
13. Training, education and awareness

4.6 points:

14. Energy efficient
15. Air and emissions quality
16. Sustainable method
17. Optimized materials and resources used
18. Economic benefit to the stakeholders

Table 17: Stakeholders' (GEO) Preferences on the Sustainability Principle of Building

Sustainability Principles	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Environmental Sustainability						
1. Efficient environmental management	5	5	5	5	5	5.0
2. Concern on quality of land, river and sea	5	5	4	5	5	4.8
3. Site planning and management	5	5	4	5	5	4.8
4. Energy efficient	5	5	4	4	5	4.6
5. Air and emissions quality	5	5	4	4	5	4.6
6. Sustainable method	5	5	4	4	5	4.6
7. Sustainable materials and resources	5	5	5	4	5	4.8

Sustainability Principles	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
8. Optimized materials and resources used	5	5	4	4	5	4.6
9. Efficient water consumption	5	5	5	4	5	4.8
10. Transport management	5	5	3	4	5	4.4
11. Urban design, visual impact and aesthetic	5	3	4	5	5	4.4
12. Noise control	5	5	4	5	5	4.8
Economic Sustainability						
13. Whole life cost efficiency	5	5	5	4	5	4.8
14. Improve local market presence	5	5	4	3	5	4.4
15. Indirect economic impact	5	5	4	2	4	4.0
16. Economic benefit to the stakeholders	5	5	4	4	5	4.6
Social Sustainability						
17. Occupational health and safety	5	5	4	5	5	4.8
18. Product responsibility	5	5	4	5	3	4.8
19. Training, education and awareness	5	5	5	5	5	4.8
20. Stakeholders participation	5	5	5	5	5	5.0
Design and Innovation						
21. Sustainable Innovation	5	5	4	5	5	4.8
22. Sustainable Design	5	5	5	5	5	5.0
TOTAL	**110**	**108**	**94**	**96**	**107**	**103.2**
Average Rating	**5.0**	**4.9**	**4.3**	**4.4**	**4.9**	**4.7**
Level of Importance	Very Important	Very Important	Important	Important	Very Important	Very Important

Average Rating: 4.5-5.0= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important
Shaded rows = the most important principles (5.0 points)

Other 4 principles were considered as 'important' (4.0 points to 4.4 points) including;

4.4 points:

19. Transport management
20. Urban design, visual impact and aesthetic
21. Improve local market presence

4.0 points:

22. Indirect economic impact

Overall, the stakeholders suggested that all the 22 principles are important to very important to be considered for building projects to ensure sustainability in the buildings whole life. No principle received below 4.0 points from any stakeholder. Clearly, the stakeholders believed that all the principles are important to very important to be integrated during the planning process of building project. Therefore, the 22 principles were highlighted by the interview analysis to be considered in the formulation of the final stage of the proposed framework. It was no negative comment received from the stakeholders of GEO project. The local authority (L2) gave short positive comments on the reasons for their answers as he mentioned: *'For me the sustainability principles are good and practical. The idea to develop a sustainability framework is also good as we (local authority) still do not clearly expose to the concept. We have a sustainable development unit in planning department, but the unit is mostly focus on safety aspect such as providing CCTV etc. We also do not have a clear guideline on how to ensure the sustainability concept is implemented. We heard a lot of sustainability concept especially outlined by JPBD, even sustainability has been mentioned in the local plan, but it was still no*

clear specification was put on how to plan, design, manage and administer the sustainability aspects.'

The users' representatives (owner and energy manager) both have rated a total of 110 points (5.0) and 107 respectively out of possible 110 points of the important level. The energy consultant (representing design team) has rated a total of 108 points (4.9), main contractor (representing construction contractor) and local authority (representing approval party) has rated a total of 94 points (4.3) and 96 points (4.4) respectively. Thus, all 5 stakeholders have rated the principles at the important to very important level of importance. This resulted in a very high average total score of 4.7 points (very important).

2.5.2 Strategies to Integrate Sustainability Principles into the Project Planning Process

The stakeholders of GEO project were asked to assess the importance of the strategies to integrate sustainability principles during project planning process as listed in the proposed framework (stage 2) to be addressed during the formulation of the final stage of the framework. Altogether, 20 principles were discussed with the interviewees and these are listed into 4 categories as shown in Table 18.

Fifteen out of 20 principles were rated as 'very important' strategies (4.6 points to 5.0 points) to integrate sustainability principles during a building project planning process as below;

5.0 points:

1. Design should reflect the user community
2. Committed and collaborative team throughout the process.
3. Government policies to encourage sustainable development
4. Incentive to encourage sustainable development
5. Compliance with code and regulatory tool of sustainability

4.8 points:

6. Bringing the team together as early as possible during planning process
7. Do whole building design and systems analysis
8. Commissioning process is added during this process and described in a specific section.

4.6 points:

9. Specific sustainability goals and project priorities
10. Involve diverse set of stakeholders on the team
11. Planning should consider all the project stakeholders
12. Incorporation of charette process
13. Team members are educated on sustainability issues including vendors.
14. Team members are fully informed on sustainability goals and priorities of the project.
15. An integrated design/ sustainability coordinator is appointed as one of the project's team members

Other 5 principles were considered as 'important' (4.0 points to 4.4 points) which are;

4.4 points:

16. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan
17. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.

4.3 points:

18. Team members' selection with sustainable development quality and capability
19. The team should have the core knowledge of sustainable building

4.0 points:

20. Local community representative is involved in support of the project

Table 18: Stakeholders' (GEO) Preferences on the Strategies to Integrate Sustainability Principles into the Project Planning Process

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Sustainable Project Orientation						
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	5	5	4	3	5	4.4
2. Specific sustainability goals and project priorities	5	5	4	4	5	4.6
Integrated project team						
3. The team should have the core knowledge of sustainable building	4	5	4	4	4	4.2
4. Team members are educated on sustainability issues including vendors.	5	5	4	4	5	4.6
5. Team members are fully informed on sustainability goals and priorities of the project.	5	5	4	4	5	4.6
6. Team members' selection with sustainable development quality and capability	4	5	4	4	4	4.2
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	5	5	4	4	5	4.6
8. Local community representative is involved in support of the project	4	5	3	4	4	4.0
Integrated design process						
9. Bringing the team together as early as possible during planning process.	5	5	5	4	5	4.8
10. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.	5	5	4	3	5	4.4
11. Design should reflect the user community	5	5	5	5	5	5.0
12. Committed and collaborative team throughout the process.	5	5	5	5	5	5.0

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
13. Do whole building design and systems analysis	5	5	5	4	5	4.8
14. Involve diverse set of stakeholders on the team	5	5	4	4	5	4.6
15. Planning should reflect all the project stakeholders	5	5	4	4	5	4.6
16. Incorporation of charette process	5	5	4	4	5	4.6
17. Commissioning process is added during this process and described in a specific section.	5	5	5	4	5	4.8
Regulations and code compliances						
18. Government policies to encourage sustainable development	5	5	5	5	5	5.0
19. Incentive to encourage sustainable development	5	5	5	5	5	5.0
20. Compliance with code and regulatory tool of sustainability	5	5	5	5	5	5.0
TOTAL	**97**	**100**	**87**	**83**	**97**	**92.8**
Average Rating	**4.9**	**5.0**	**4.4**	**4.2**	**4.9**	**4.6**
Level of Importance	Very Important	Very Important	Important	Important	Very Important	Very Important

Average Rating: 4.5-5.0= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important

Shaded rows = the most important principles (5.0 points)

Overall, the stakeholders suggested that all the 20 strategies are 'important' to 'very important' to be implemented during planning process of building projects. No strategy was rated below 4.0 points from any stakeholder. Clearly, all 20 principles were highlighted by the interview analysis as important to very important to be considered in the formulation of the final stage of the proposed framework. There was no negative comment received from any stakeholder. A number of stakeholders gave short positive comments the reasons for their answers as follows:

'Yes, most of the strategies are very important to be implemented. We (contractor) should be appointed as a design and build contractor. In GEO project, the contract was a conventional, thus we did not involve since the early planning process. When we first joined the project, the detail design was established and we just construct based on the design.' (C2)

'We should have clear written guidelines on sustainable building project or otherwise it will be more complicated which everyone will try to do the best based on their own understanding.' (E2)

'Knowledge should be transferred to everybody who is influenced by the building whole life. Everybody should aware on the sustainability matters of the building or otherwise, it might be stopped until design stage only.' (L2)

The users' representatives (owner and energy manager) both have rated a total of 97 points (4.9) of possible 100 points. The energy consultant (representing design team) has rated 100 points (5.0), main contractor (representing construction contractor) rated 87 points (4.4) and local authority (representing approval party) rated 83 points (4.2). Thus, all 5 stakeholders have rated the strategies to be high to very high levels of importance. This resulted in a very important average total score of 93.6 (4.7) points. A number of stakeholders gave short positive comments the reasons for their answers such as the owner and energy consultant pointed out:

'It is good to consider sustainability since the early planning processes of a project to deliver a successful sustainable building without increasing the project cost. This building for instances, we have considered several sustainability aspects during planning process especially on energy efficiency and innovations aspects as this is a research energy efficient building. LEO has been awarded with Certified certificates for meeting the standard of Malaysia GBI without any retrofitting or renovation activities. If we have a clear sustainable building guideline earlier, I believe LEO building will be able to achieve a Platinum level of Malaysia GBI.' (O2)

'What I have learned from this project is, this project should have their local sustainability expert who should lead this project in decision making in order to fulfill the user's need and to consider the local climate and condition. For instances, thermal comfort aspect as outlined in ASHRAE is not practical to be 100% adopted in Malaysia. GEO building has problem on this issue. We should improve several systems and technical things due to this problem. The technology was still new at that time such as on radiant cooling systems. PPC called expertises from Germany to teach about the systems. Because of different climates and conditions from the country where the technology was developed, I found the defect during construction stage. The problem increased the timeframe of the project'. (E2)

3.0 THE DIAMOND BUILDING

The new Energy Commission (ST) Headquarters's, Diamond building is the next showcase of sustainable and green building design in Malaysia after LEO and GEO building. This building is the first sustainable building in Malaysia certified with both Green Mark Platinum Rating by Singapore's Building and Construction Authority (BCA) and GBI Malaysia Platinum Rating. The Diamond building is also the first outside of Singapore obtained the Green Mark platinum rating as the owner (O3) said: *'A Platinum for Green Mark from Singapore had been awarded to the comprehensive approach for the building envelope, atrium design, mechanical and electrical system, daylight system, landscaping and material selection.'*

The Diamond building is an intelligent and sustainable design that showcases latest technologies of reducing overall building energy consumption and water usage, promote sustainable building materials use and provide enhanced indoor environmental quality, all in line with global green building practices. This eight storeys building with three levels of basement inspired by the concept of building sustainability as well as achieving the lowest energy consuming building in the world by adopting RE integrated with aesthetic concerns. The total gross floor area of this building is 14,229 m^2 (excluding car park) in a total site area of 4,928.11 m^2. The Diamond targets to reduce energy use by 60%, with energy index of 85kWh/m2 per year at 2,800 hours usage, as compared to a normal office building in Malaysia, which has an energy index of 200kWh/m2/year. Till today the building is able to achieve up to the BEI of 65kWh/m2 per year without PV and 55kWh/m2 per year with PV. The Diamond building was also built to integrate the essence of Malaysian culture, urban character in its surroundings, and celebrate them through designs and ideas of sustainability in order to attain the delicate balance of modern comfort with environmental responsibilities (O3).

3.1 The Stakeholders' Involvement

Energy Commission was the owner and client of the project. They appointed Senandung Budiman Sdn. Bhd as the developer and PPC as the main contractor of the project. Both, Senandung Budiman and PPC are the subsidiary of Putra Perdana Bhd. (PPB). They were chosen because they were very committed, smart and having experience in the development of successful LEO and GEO building project. They utilised their experiences and lesson from both previous project to do improvement in the development of Diamond building project (O3). As the same as the LEO building project, Diamond building project applied holistic planning and design approach which involving all respective consultants. The project commenced in 2005, prior to the development of the Malaysia GBI rating system, thus, it did not go through the GBI certification process at the time. However, on top of the usual laws and guidelines and MS1525, they were also working towards to be achieving GreenMark Platinum results and the compromises that had to be made in this project to achieve the goal. When things threatened that goal, they were willing to prioritize and give up things to keep the Platinum rating integral. Preliminary discussion during conceptual and detail design took placed between the planning consultants and the local authority at Putrajaya Corporation (PjC) during the layout plan, building plan or planning permission submission process.

Interviewees were asked to comment on their involvement during the planning process of Diamond building project. The owner (O3) admitted that he was actively involved throughout the planning process of the project as he pointed out: *'We had been involved in every meeting conducted by the project team'.*

The local authority involvement at this stage was limited to the approval part as the respondent (L3) responded: *'The president of PJC will decide for the project approval such as planning approval, building approval, road and infrastructure and earthwork. In term of how they developed the building, design and solar panel instalment and so on during the project planning process and development phase were all up to them as long as they followed all of the technical requirements of Putrajaya such as the* building height, plinth area and so on'. The owner (O3) added that the local authority and the technical department had not been involved during the charrette process. *'All of the requirements were actually well documented and can be referred. Local authority came and checked after the building was completed to ensure that the technical requirements were fulfilled (O3)'.*

An integrated design concept had been implemented in which the EE and green target were decided since the planning process at the conceptual and design stage of the building project. At the start of the project, the consulting team went on a series of study trips, which included trips to Singapore in 2005 to study their experience on sustainable buildings. In Thailand, the project team members were impressed with the work of architect Dr Soontom Boonyatikam, who eventually became the principal architect for the Diamond building. Computer simulation of the 'diamond' form of the building was conducted to ensure that the daylight and energy performance is achieved for this building. Detailed daylight simulation to ensure adequately distributed daylight and hourly energy simulation of the building to ensure reduced energy use are being conducted (O3, E3). The team members worked closely each other to achieve the design guidelines including GreenMark and EE requirements (MS1525) as the energy consultant (E3) highlighted: *'we did a lot of simulation in the computer as Diamond building meant to be a landmark building in terms of sustainability. This building is what I would call a textbook example of integrated design'*

No discussion of integrated design would be complete without examining the contractor's role in the process because they are responsible for implementing the design team's vision and holding the project's specifications firm against change request. Even though PPC was not engaged from the beginning of the project due to the procurement procedure of construction project in the country, however, indirectly they were actually involved right from the beginning as PPC and Senandung Budiman Sdn Bhd are came from the same umbrella (PPB) and working in the same building. The contractor (C3) said: *'As the main contractor, I was formally*

appointed for the construction stage of the project. But since the developer was our sibling company, thus I was also being involved to give inputs at least to provide pricing and constructability review as the design is evolving since the conceptual stage of the project'. The contractor involvement during the project planning process of detail design stage was quite full as this is a design and build project. The contractor had to ensure the target could be implemented during construction stage. *'We were also a part of the team members, so we jointly decided for the details design decision. We looked at all aspects, we develop, we design and we construct (C3)'.*

Table 19: Stakeholders' Involvement in Planning Process (Diamond) [3]

Stakeholders' Involvement		Planning Process			Representing
		Conceptual Planning	**Preliminary Design**	**Detail Design and Development**	
Owner (O3)	Extents of Involvement	Full	Full	Full	● Client ● Users ● Operation and Maintenance
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Energy/Facility Manager (M3)	Extents of Involvement	None	None	None	● User ● Operator
	Degree of Involvement	(D) Being Informed	(D) Being Informed	(D) Being Informed	
Energy/ Sustainability Consultant (E3)	Extents of Involvement	Full	Full	Full	● Design team and cost and economic ● Operation and Maintenance
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Main Contractor (C3)	Extents of Involvement	Substantial	Substantial	Full	● Construction Contractor ● Operation and Maintenance ● Materials and Equipment Suppliers ● Builders
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	
Local Authority (L3)	Extents of Involvement	Little	Little	Little	● Legal Client ● Local Community ● Approval Party
	Degree of Involvement	(A) Most Occupying	(A) Most Occupying	(A) Most Occupying	

Note: Degree of Involvement:

(A) Most Occupying (B) Being Involved (C) Being Consulted (D) Being Informed (E) Not Being Informed

Source: Adapted from Abdul Samad (2007)

[3] relate to the Questions of Part B in the interview schedule (Appendix B, p307)

The owner (O3) mentioned that ST's staffs had been prepared with a series of talks for their new experience and they also were brought to the building just to have them experience it before they moved to the building. Besides, there were regular talks on sustainability by experts for the staffs were also ongoing as the staffs will become the organisation and the building little ambassadors who share their experiences with others. Returns on investment of The Diamond building were listed by the energy consultant (E3) as follows,

- Savings of RM1 million annually in operating costs – about RM950, 000 from EE and RM45,000 from solar power generation.
- It reduced carbon dioxide emissions of 1,400 tonnes per year.
- Building energy index of 65kWh/m2 per year (without photovoltaic) and 55kWh/m2/year (with photovoltaic). The index is the annual amount of electricity used per square metre of a building.
- Photovoltaic cells installed: 71.4kWp, which yields about 1,400kWh/m2/year.
- Energy savings of 53% to 61% in overall electricity usage, including lighting and computers, and 34% in cooling.
- The eco-friendly measures cost RM3.4 million – about 6% of the total construction cost. The estimated payback time is three and a half years.

As shown in Table 19, it is clear that the owner had the *'most occupying'* involvement in the whole planning process of the project. They led and took decisions. The local authority is also has the '*most occupying'* involvement in the whole planning process, however, their involvement was too limited on taking decision for the approval reason only. While, the energy consultant had the *'most occupying'* involvement since early planning stage until operation and maintenance stage of the project.

The main contractor was being substantially involved during conceptual and preliminary design stage but full involvement since detail design until handing over in taking decision. Construction stage inputs had been given full consideration during conceptual and preliminary design. The team members always took inputs and included the main contractors throughout the early planning process. Although the energy manager did not directly join the planning process of the project as compared to others, he was informed by the owner's representative about decisions being taken by the project planning team as he is the person who responsible on occupancy, operation and maintenance stage of the building after completion.

3.2 Sustainability Practices in Diamond Building Project

This part aims to explore the extent of sustainability practices in Diamond building project in order to define the gaps that should be bridged towards achieving sustainability. This part comprises of four issues; 1) The project goals 2) Sustainability principles consideration in Diamond building project and 3) The project's strategy to achieve the goal for sustainable project 4) The strategies to integrate sustainability through project planning process. Each of the issues is described in the followings.

3.2.1 The Project Goals

The interviewees were asked the extent to which they were motivated to consider the sustainability principles of buildings (environmental, social, economic and design and innovation) as the main goals of the project that should be achieved. It was found that the interviewees (O3, M3, E3, C3, L3) agreed that the project had the goals on environmental, economic, social and sustainable design and innovation (refer Table 20) up to some extent for instance, the building was designed to showcase technologies that support environmental sustainability. The design aimed to provide occupants with a healthy and productive working environment such as by promoting day lighting and using materials of low VOC content. The project also was aimed to achieve economic sustainability standard by taking into account the cost saving, minimizing and optimizing resources used and employing ROI calculation (M3, E3). The sustainability goals were clearly communicated among the project stakeholders and

implemented since the project planning process and throughout the construction and operation and maintenance stage of the project as the main energy consultant (E3) highlighted: *'We did consider the sustainability goals of the project including the accessibility, the traffic impact and how to merge the building with the surrounding area. To me, this building is a quite successful sustainable building as it is energy efficient, use RE system, reduce carbon footprint, water efficient and most of the material usage were sustainable.'*

Table 20: Stakeholders' Responses on the Sustainability Goals of Diamond Project

Sustainability Goals	Planning (Conceptual and Detail Design)			Construction	Operation and Maintenance
	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager
5. Environmental	●	●	●	●	●
6. Economic	●	●		●	●
7. Social	●	●		●	●
8. Sustainable Design and Innovation	●	●	●	●	●
Total respondents					5

Note: ● the principle was considered in the project's goals

Only the local authority believed that the project was focused merely towards environmental sustainability target as the interviewee (L3) mentioned: *'The building's goal was having the elements of environmental sustainability and sustainable design and innovation up to some extent. I am aware that the main goal of this project is about to prepare the building as a green building showcase'.* Local authority is an approval party who plays an important role in encouraging sustainable development in their covered area. It was quite shocked as the local authority was not well exposed to the social and economic sustainability goals of the project.

3.2.2 Sustainability Principles Consideration during the Planning Process of Diamond Building Project

The planning stage stakeholders (owner, energy consultant and local authority) of Diamond building project were asked to assess the sustainability principles measured and documented during the project planning process of the project. The project documents that prepared and handed out among others are including Development Proposal Report for Layout Plan and Building Development Plan, project development brief, design requirements and project specifications.

Nineteen out of 22 principles were mentioned clearly in the project documents prepared by the consultants (refer Table 21). The principles were clearly communicated among the owner and designers team and also measured by them during the planning process of the project. Other 3 principles which are *'sustainable method', improve local market presence' and 'indirect economic impact'* were also appraised by them during the planning process even though the principles were not mentioned in the project documents. However, only 11 out of 22 principles were included in the project documents that had been submitted to the local authority of Putrajaya. The principles were clearly measured and considered by the local authority as the requirements to be fulfilled by the client and the team members for the project approval. Two principles, which are *'efficient water consumption'* and *'economic benefit to the stakeholders'* were not clearly mentioned in the submission documents, but the principles had been communicated and considered by the local authority and the entire stakeholders during the process. Meanwhile, the rest 9 principles, which are 'sustainable method', *'sustainable materials and resources', 'optimized materials and resources used', 'whole life cost efficiency', 'improve local market presence', 'indirect economic impact', 'product responsibility', 'training and education' and 'stakeholders participation'* were not mentioned in submission documents to the local authority and also not measured by the local authority during the approval process of the project. Eleven principles had been practiced by all project stakeholders and mentioned clearly in the project documents. The principles are *'efficient environmental management', 'concern on quality of land, river and sea', 'site planning', 'energy efficient', 'air and emissions*

quality', 'transport management', 'urban design, visual impact and esthetic', 'noise control', 'occupational health and safety', 'sustainable design' and 'innovations'. It was no one principle had not been considered by all the stakeholders during the planning process of the project. Overall, the sustainability principles mentioned in the project documents was at a high level and the consideration of the principles during the project planning process was at a high level.

Table 21: Interviewees' Comments on Sustainability Principles Consideration during the Planning Process of Diamond Building Project

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

22-20 Very High *19- 16 High* *15-11 Medium* *10-7 Low* *6-0 Very Low*

Note: ● Considered during the project planning process
**Mentioned in the project documents*

3.2.3 The Project Strategies to achieve the Goals for Sustainability

The interview went further to examine the strategies that have been practiced by the Diamond project stakeholders to achieve the goals of sustainability. Fourteen strategies were pointed out as shown in Table 22.

Table 22: Project Strategies to Achieve the Goals of Diamond Project

	Strategies Practiced	Stakeholders					No. of times recorded
		Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	N
1.	Workshop among stakeholders to reveal the energy efficient knowledge and worldwide experiences in order to enhance their awareness and capability.	●	●	●			3
2.	Bringing the team together as early as possible since early planning stage	●	●	●			3
3.	Consider energy efficient and some sustainability principles since early planning process	●	●	●	●		4
4.	Multidisciplinary collaboration and integrated design	●	●	●			3
5.	Visiting energy efficient buildings abroad with the project team	●	●	●			3
6.	Attending sustainable conference	●	●	●			3
7.	A lot of seminars among stakeholders have been arranged in every single stage of development and also presenting the progress and project performance	●	●	●			3
8.	Regular awareness, brief and campaign on energy efficiency to the project team, and to the occupant to save energy and to operate the building in sustainable manners since the early planning process	●	●	●		●	4
9.	Monitoring and controlling the building energy and operate the building in sustainable manners	●	●			●	3
10.	Monitor indoor environmental performance and occupant satisfaction	●	●			●	3
11.	Fulfil the requirements of MS1525	●	●	●		●	4
12.	To get GBI/ GreenMark certification	●	●	●		●	4
13.	Mentioned the goal of sustainability in Structure plan, Local plan and Strategic plan.				●		1
14.	Incentives- *100-200k under SOLAR 2000 incentive and assessment tax is reduced*	●	●	●	●	●	5
Total number of strategies practiced		13	13	11	3	6	46
Total respondents							5

Note: ● the strategies practiced by the interviewees

All interviewees highlighted that the project has received government incentives which is around RM100,000 to RM200,000 for the PV systems under the SOLAR 2000 programme. The local authority has decided to reduce assessment tax of the building, which the amount is lower than a similar size of a conventional commercial building. The strategies are supported the strategy of sustainability integration during building project planning process as recommended in the proposed framework (refer Table 5.63, part B, p217) which is *'providing incentive to encourage sustainable project'.*

Interviewees (4 out of 5) from the planning and construction stage including the local authority of the Diamond project mentioned that they have considered and practiced energy efficient and some sustainability principles since the early project planning process. Interviewees (4 out of 5) from the planning, construction and operation and maintenance stage exceptional of the local authority highlighted that regular awareness, brief and campaign on energy efficiency to the project team, and to the occupant to save energy and to operate the building in a sustainable manner since the planning process has been employed in order to prepare the team members with the capability towards delivering a sustainable project outcomes. The requirements of MS1525 and a Platinum level of BCA Singapore GreenMark and GBI Malaysia later on have the main guides throughout the project. The strategies are related and supported the strategy of sustainability integration in the proposed framework up to some extent which are; '*The team should have the core knowledge of sustainable building', 'Team members are educated on sustainability issues including vendors'* and '*Team members are fully informed on sustainability goals and priorities of the project', Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan', Government policies to encourage sustainable development'* and *'Compliance with code and regulatory of sustainability'.*

Three stakeholders of planning and construction stages (owner, energy consultant and contractor) concerned '*workshop among the stakeholders', 'bringing the team together as early as possible since early planning stage', 'multidisciplinary collaboration and integrated design', 'visiting the energy efficient building', 'attending sustainable conference'* and *'a lot of seminars among stakeholders have been arranged in every single stage of development including presenting the progress and project performance*' to be their strategies to achieve the project's goals of sustainability. Other 3 stakeholders (owner, energy consultant and energy manager) who have been involved in operation and maintenance stage concerned the strategies of *'monitoring and controlling the building energy and operate the building in sustainable manners' and 'monitor indoor environmental performance and occupant satisfaction'* to be their strategies to achieve the goals of sustainability during operation and maintenance stages of the project.

The practiced are related and supported the proposed strategies of '*Specific sustainability goals and project priorities', 'The team should have the core knowledge of sustainable building', 'Team members are educated on sustainability issues including vendors', 'Team members are fully informed on sustainability goals and priorities of the project', 'Bringing the team together as early as possible during planning process', 'Do whole building design and systems analysis', 'Design should reflect the end users community', 'Committed and collaborative team throughout the project', 'Planning should reflect all the project stakeholders', 'Incorporation of charette process',* and *'Involve diverse set of stakeholders on the team'*.

As the local authority of LEO and GEO project, the local authority of Diamond project has also mentioned the goal of sustainability in Structure Plan, Local Plan and Strategic Plan. The strategy related and supported the strategies of *'government policies to encourage sustainable development' and 'compliance with code and regulatory tool of sustainability'* up to some extent, in the proposed framework

Generally, the strategies practiced by the Diamond stakeholders are relatively related to the sustainability integration strategies as tabulated in the proposed framework. The owner and energy consultant were found to have the highest numbers of efforts to achieve the goals of sustainability of the project (13 out of 14 cited strategies) and the local authority had the lowest involvement among the cited strategies (3 out of 14). The practiced strategies were found to be implemented up to certain extents. The contractor and local authority involvement in the project however were realized to be increasing as compared to the LEO and GEO projects.

Five strategies to integrate sustainability into the project as listed in the proposed framework are not related to any strategy that have been mentioned by the stakeholders to reach the sustainability targets of the project which are;

1. Team members' selection with sustainable development quality and capability
2. Commissioning process is added during this process and described in a specific section
3. An integrated design/ sustainability coordinator is appointed as one of the project's team members
4. Local community representative is involved in support of the project
5. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.

Diamond project has been guided by MS1525:2001 and BCA GreenMark during the planning process in addition to the usual laws and guidelines to achieve sustainability. The Diamond project design strategy was also encapsulated through four main aspects, namely energy efficiency, water efficiency, indoor environmental quality and outdoor environmental quality. The holistic approach for the building envelope, atrium design, mechanical and electrical systems, day lighting system, landscaping and material selection enables the design of an environmentally sustainable building. As the building incorporates a combination of new concepts and ideas for a sustainable building, the rest two sustainability aspects which are social and economic aspects were also integrated to get the optimum stakeholders' satisfaction results.

3.2.4 Sustainability Integration Strategies Practiced during the Planning Process of Diamond Building Project

The owner and energy consultant of Diamond building were asked to indicate in details the strategies that have been practiced to integrate sustainability into the project throughout the planning process. Findings reveal that 18 out of 20 strategies were practiced among the owner and designers team during the project planning process (refer Table 23). Two strategies were not practiced during the process which are *''Local community representative is involved in support of the project',* and *'sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan'.* As the same LEO and GEO projects, the local community representative was not involved at all during this process and the local authority was only involved in the approval part of the project. The sustainability and integrated design requirements and the process were also not properly documented at the time as the team members were also in a learning process of delivering such project. However, the sustainability principles that have been mentioned in the Diamond project documents are the highest as compared to the rest two projects.

Table 23: Interviewees' Comments on Sustainability Integration Strategies into the Planning Process of Diamond Building Project

Sustainability Integration Strategies	Stakeholders	
	Owner	Energy Consultant
Sustainable Project Orientation		
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	●	●
2. Specific sustainability goals and project priorities	●	●
Integrated project team		
3. The team should have the core knowledge of sustainable building	●	●
4. Team members are educated on sustainability issues including vendors.	●	●
5. Team members are fully informed on sustainability goals and priorities of the project.	●	●
6. Team members' selection with sustainable development quality and capability	●	●
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	●	●

Sustainability Integration Strategies	Stakeholders	
	Owner	Energy Consultant
8. Local community representative is involved in support of the project		
Integrated design process		
9. Bringing the team together as early as possible during planning process	●	●
10. Design should reflect the end user community	●	●
11. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.		
12. Do whole building design and systems analysis	●	●
13. Committed and collaborative team throughout the process	●	●
14. Involve diverse set of stakeholders on the team	●	●
15. Effective communication and incorporation of charette process	●	●
16. Planning should reflect all the project stakeholders	●	●
17. Commissioning process is added during this process and described in a specific section.	●	●
Regulations and code compliances		
18. Government policies to encourage sustainable development	●	●
19. Incentive to encourage sustainable development	●	●
20. Compliance with code and regulatory tool of sustainability	●	●
TOTAL	**18**	**18**
Level of the Strategies Practiced:	**Very High**	**Very High**
Total respondents	2	
Level of Practices: 20-18 Very High 17- 14 High 13-10 Medium 9-6 Low 5-0 Very Low		
Note: ● Practiced during the project planning process		

Of the 18 practiced strategies, 3 strategies were not highlighted by the stakeholders earlier in the previous section. The strategies are;

1. Team members' selection with sustainable development quality and capability
2. Commissioning process is added during this process and described in a specific section
3. An integrated design/ sustainability coordinator is appointed as one of the project's team members

The strategy of *'team member's selection with sustainable development quality and capability'* has been practiced in the Diamond project. The selection priority of the team members was given based on their past experiences in sustainable projects. Commissioning process was added during the project planning process and described in a specific section. *A sustainability coordinator or energy consultant (IEN) was appointed since the initial stage of project planning process (O3, E3).* The team members were working together and complement each other in deciding a final decision as the energy consultant (E3) said: *'We were working closely with the owner other team members to achieve the project targets. We conducted extensive computer simulation of the Diamond building to ensure that the expected daylight, energy performance and occupants' comfort level were met'.* Overall, the sustainability integration strategies that have been practiced during the planning process of the project was at a very high level.

3.3 The Project Performances

This part aims to explore the performances of the Diamond project and the impact of the sustainability practiced on overall performances of the building project. The performances are discussed in the aspect of: 1) Sustainability Performances 2) Cost 3) Time 4) Quality and Stakeholders Satisfaction. The impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process on influencing the project performances is discussed at the end of this part. For the reason of this study, the criteria of cost, time, quality and stakeholders' satisfactions (project management success) are

going to be focused in the study. The criteria of building success and market success category are measured under the sustainability performance part of the study.

3.3.1 Sustainability Performances

The stakeholders were asked to assess the performance level of sustainability principles delivered by the project. The owner, energy consultant and local authority of the project were asked to assess the project's sustainability performances delivered at the conceptual and design stage, contractor was asked to evaluate the performances of the construction stage and energy manager was asked to judge the sustainability performances of the operation and maintenance stage of the building. The results are illustrated in Table 24.

Table 24: Stakeholders' Responses on the Level of Sustainability Performances of Diamond Project

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
Environmental Sustainability						
1. Efficient environmental management	4	4	3	4	4	4
2. Concern on quality of land, river and sea	3	3	2	4	4	3
3. Site planning and management	4	3	3	4	4	4
4. Energy efficient	4	4	3	4	4	4
5. Air and emissions quality	3	3	3	4	4	3
6. Sustainable method	2	2	2	3	4	3
7. Sustainable materials and resources	3	3	2	3	3	3
8. Optimized materials and resources used	4	3	2	4	3	3
9. Efficient water consumption	4	4	2	4	4	4
10. Transport management	3	3	1	4	2	3
11. Urban design, visual impact and aesthetic	4	4	3	4	4	4
12. Noise control	4	3	3	4	3	3
Economic Sustainability						
13. Whole life cost efficiency	4	4	3	4	4	4
14. Improve local market presence	4	4	2	4	3	3
15. Indirect economic impact	3	3	2	4	3	3
16. Economic benefit to the stakeholders	3	4	3	4	4	4
Social Sustainability						
17. Occupational health and safety	4	3	3	4	4	4
18. Product responsibility	3	3	2	3	4	3
19. Training, education and awareness	4	4	2	4	4	4
20. Stakeholders participation	4	4	2	4	4	4
Design and Innovation						
21. Sustainable innovation	4	4	3	4	4	4
22. Sustainable design	4	4	4	4	4	4

Project Stages	Conceptual and Design			Construction	Operation and Maintenance	Average Rating
Sustainability Performances	Owner	Energy Consultant	Local Authority	Main Contractor	Energy Manager	
TOTAL SCORE	79	76	55	85	81	78
Average Rating	4	4	3	4	4	**4**
Level of Performance	Excellent	Excellent	Good	Excellent	Excellent	**EXCELLENT**
Note: 1 = Poor	*2 = Fair*			*3 = Good*		*4 = Excellent*

a. Conceptual and Design Stage

Difference in responses of project performances occurred for the conceptual and design stage of Diamond project. There are 14 sustainability principles have been placed by the owner and energy consultant to be at the same level but at the different level by the local authority as follows:

Excellent (4 Points)

1 Efficient environmental management
2 Energy efficient
3 Efficient water consumption
4 Urban design, visual impact and aesthetic
5 Whole life cost efficiency
6 Improve local market presence
7 Training, education and awareness
8 Stakeholders participation
9 Sustainable innovation

Good (3 points)

10 Concern on quality of land, river and sea
11 Sustainable materials and resources
12 Transport management
13 Indirect economic impact
14 Product responsibility

However, all of them (owner, energy consultant and local authority) placed at the same level for 3 principles as follows;

Excellent (4 Points)

1. Sustainable Design

Good (3 Points)

2. Air and emission quality

Fair (2 Points)

3. Sustainable method

It was clear that the principle of *'sustainable method'* has been considered by the stakeholders as at a 'fair' level of practice during planning process. The principle was not clearly mentioned in the project documents and practiced at a very limited level during this stage. Overall, the stakeholders assessed the project sustainability performances of Diamond building during conceptual and design stages to be at an 'excellent' level.

b) Construction Stage

Twenty principles were measured as delivered at an excellent level during construction stage as follows;

Excellent (4 points)

1. Efficient environmental management

2. Concern on quality of land, river and sea
3. Site planning and management
4. Energy efficient
5. Air and emissions quality
6. Optimized materials and resources used
7. Efficient water consumption
8. Transport management
9. Urban design, visual impact and aesthetic
10. Noise control
11. Whole life cost efficiency
12. Improve local market presence
13. Indirect economic impact
14. Economic benefit to the stakeholders
15. Occupational health and safety
16. Product responsibility
17. Training, education and awareness
18. Stakeholders participation
19. Sustainable design
20. Sustainable innovation

Two principles were perceived as delivered at a good level during construction stage as follows;

Good (3 points)

1. Sustainable method
2. Sustainable materials and resources

Overall, the stakeholders assessed the project sustainability performances of Diamond building during construction stage to be at an 'excellent' level.

c) Operation and Maintenance Stage

Most of the principles (16 principles) were assessed as delivered at an excellent level during operation and maintenance stage as follows;

Excellent (4 points)

1. Efficient environmental management
2. Concern on quality of land, river and sea
3. Site planning and management
4. Energy efficient
5. Air and emissions quality
6. Sustainable method
7. Efficient water consumption
8. Urban design, visual impact and aesthetic
9. Whole life cost efficiency
10. Economic benefit to the stakeholders
11. Occupational health and safety
12. Product responsibility
13. Training, education and awareness
14. Stakeholders participation
15. Sustainable design
16. Sustainable innovation

Five principles were perceived as delivered at a good level during operation and maintenance stage as follows;

Good (3 points)

1. Sustainable materials and resources
2. Optimized materials and resources used
3. Noise control
4. Improve local market presence
5. Indirect economic impact

One principle was perceived as delivered at a fair level during operation and maintenance process as follows;

Fair (2 points)

1. Transport management

Considering of all project stages, the stakeholders assessed the delivery of 12 sustainability principles at the excellent level which making the building project was exceptional in the quality as follows;

Excellent (4 points)

1. Efficient environmental management
2. Site planning and management
3. Energy efficient
4. Efficient water consumption
5. Urban design, visual impact and aesthetic
6. Whole life cost efficiency
7. Economic benefit to the stakeholders
8. Occupational health and safety
9. Training, education and awareness
10. Stakeholders participation
11. Sustainable design
12. Sustainable innovation

The shape of the Diamond building was an optimum passive design approach to achieve energy efficiency. The tilting façade allows self shading for the lower floors, protection from direct sun rays into the building and a smaller footprint, resulting in a larger area for landscaping. The sunken garden located at the basement serves as a void space which provides natural ventilation to the parking area at the basement level. The building is oriented in accordance with the solar path, minimizing the areas impacted by direct sunlight. The building was installed with active features such as PV, day lighting systems natural and artificial and insulated concrete roof for energy efficiency. In general, the expected electricity generated is 102,000 kWh per year which is equivalent to RM40k cost savings annually or an avoidance of 63,000kg annual carbon dioxide (CO_2) emission. The diamond was designed to obtain 50% of its day lighting needs from natural lighting. Insulated concrete roof was installed to reduce heat absorption in the building; the roof top area was insulated using boards with a thickness of 100mm. It was tightly insulated both horizontally and vertically (E3).

In term of water efficiency, the owner (O3) highlighted that rainwater harvested is used for toilet flushing and combined with efficient water fittings such as dual flush toilets, waterless urinals and water taps equipped with aerators reduces potable water usage by more than 65%. To further optimize the water efficiency of the building, grey water collected from the wash basins is also recycled to irrigate the wetland at the ground floor. The diamond is the form adopted in relation to the main concept and design philosophy which is a distinctive design for being on tourist map and city landmark objective. By incorporating the ideas of energy efficiency and sustainability components, the building consists of eight storey layout with a central atrium crowned by technically articulated sky dome. Utilizing fresh cues of modern building forms, distinctive materials and colours, the buildings relates to not only to the technical requirements but also to the surrounding architecture creating a unique blend (O3). As

the same as the LEO and GEO building project, the Diamond project did not calculate the whole life cost of the building but only limited to the operation and maintenance stage as the energy consultant (E3) mentioned: *'By right we should as well calculated the replacement cost such as the lamping systems etc in 20 years or more...but we did not do the calculation. We only did the ROI calculation. For the performance I put 'excellent' because in Malaysia currently the demolishing stage is not what the industry's demand as an added value.'*

Ten principles were perceived as delivered at the good level as follows;

Good (3 points)

1. Concern on quality of land, river and sea
2. Air and emissions quality
3. Sustainable method
4. Sustainable materials and resources
5. Optimized materials and resources used
6. Transport management
7. Noise control
8. Improve local market presence
9. Indirect economic impact
10. Product responsibility

Sustainable building materials are used for this building, where the usages of materials are reduced and priority is given to the materials that has no or less impact to the environment. Materials and resources use was optimized and reduced such as via doing away with suspended ceilings, except for small areas to conceal the ducts. This reduces the material used as compared to conventional buildings. Sustainable materials were used such as green labeled plasterboards which have low VOC emission and has 30% recycled content for the ceiling and the internal partitions. The floor carpeting is also green labeled for low VOC emission and has at least 10% recycled content. The interior paint used in the building is also of low VOC content. The workstations contain material that protects against UV rays (O3). The main contractor (C3) confirming the argument as he said: *'Materials selection was very important. It was the GreenMark and GBI requirements as well, we used recycled content materials, we also give priority on meeting the requirement of low VOC materials and we use as much as possible the local product'.*
The materials that were used whenever feasible are non-toxic, recycled and recyclable, renewable, local, standard sizes, and modular, pre-cut to reduce waste, certified wood, durable and long lasting. Recycled aluminum was used for the suspended ceiling in this building. Prefabricated components were used for this building in order to minimize waste and labour trimming to fit. During the construction stage, wastes are minimized to reduce disposal to landfill. On-site separation of materials and waste material sorting policy were implemented, where containers were clearly labeled and construction personnel were trained in material sorting policies. However, as highlighted by the energy consultant, it was quite difficult to get sustainable materials in Malaysia and as a result; it was imported from abroad (E3).

Indoor and outdoor environmental quality of the building is at an 'excellent' level. Extensive landscaping and s sunken outdoor garden ensure not only connection to greenery but also provide a cool and shaded ambient environment for the occupants. A green roof help to further reduce urban heat and effect whereby the hardscape areas are reduced and replaced with soft green landscape as the energy manager (M3) mentioned: *'The indoor and outdoor environmental quality are excellent, the air is very fresh and we also control the CO_2. Cooling is provided via radiant cooling slabs that have chilled water pipes embedded in the concrete slab itself. This is complimented with the conventional cold air supply system. The noise from the ducts is also reduced significantly to improve the acoustic comfort'.*

In term of transport management, the main contractor and the energy consultant mentioned;

'When we prepared the layout, ingress and egress, the circulation, the bus stop facilities, accessibilities, parking and so on were well planned. We even upgraded the bus stop facilities. In that sense, it was all perfect. The main problem is about public transport services, we are not the party who should provide the public transport services. It is out of our control'. (C3)

'Diamond building has variety of transport facilities including bicycle facilities. I can say the building provide good facilities for staff as Putrajaya should rely of 75% on public transport. Transport management is a half of environmental issues, public transports services are very important to be properly managed...which is not really happened at Diamond building.'(E3)

Overall, the stakeholders assessed the project sustainability performances of Diamond building during operation and maintenance stages to be at an 'excellent' level. Considering all cycles of the project that has been discussed, the stakeholders assessed the sustainability performances of Diamond building to be at an 'excellent' level.

3.3.2 Cost Performance

The capital budget of Diamond project was around RM87 million and the project has been completed within the budget which is RM64.6 million has been spent for the building and the rest RM22.4 million has been spent for interior design. Six percents (6%) of the total building costs of the project which is around RM3.6 million was expended for energy efficient features of the building which was integrated and confirmed through the project tender document (O3, E3). ROI has been undertaken as part of the decision making process on the project where the RM3.6 million will be paid back within the first 3 to 4 years of the building lifespan (E3). It was clearly profitable for the rest of the building life time because the building has been saving about RM1 million energy cost annually (O3, E3).

Interviewees were asked to comment on what they thought about the planning process of the Diamond project, whether the planning process add more cost than a conventional project planning process. Positive responses were received from the owner and energy consultant of the project as they mentioned that the process was not increase the cost of the project. With regard to the cost issues, the energy consultant (E3) explained: *'I think we have seen the idea of conventional approach where many previous works did not work properly. You can still get the function of the building but it was not up to the satisfaction level. For example after the architect produce a detail wonderful design, they will pass the design to the mechanical and electrical engineer to lie it up and cool it down. The engineer will then designed the cooling system and should come back to the architect to improve their design to cool down the building. At the end of the project, no one is happy, the variation cost increase, the design was spoiled and the building is not comfortable to be in.'*

The main contractor (C3) highlighted that the cost of planning process was increased a bit due to the about 30% extra scope and detailing involved in the planning process. However, they argued that the total cost of the project was still within the budget of 87 million. The local authority (L3) mentioned that the project team has submitted amendment proposal in 2009 in order to adapt green requirements, about rain harvesting, solar panel and glass but it was not a major change.

The energy manager (M3) admitted that the project was beneficial to the organisation by generating saving throughout the building operation and maintenance period as he mentioned: *'For maintenance and operation, we don't have a big problem. The most challenging part was to fit the dome line curtain inside the atrium. To change the motor, we have to find the equipment that fit to the space and can reach to the top. The rest was fine.'* He added: *'The building saves in operation and maintenance. Some building spends 40k monthly for electricity. Diamond only spends 20k monthly which is the same cost with a conventional 4 storeys building. Most of mechanical things of the buildings are the same with a conventional building.*

The different is only on the slab cooling systems. Diamond building's slab cooling so far no needs any maintenance. We just have to make sure it is not choked, but so far it is still working smoothly, the situation is seldom happened.'

3.3.3 Time Performance

Diamond building project was started in year 2005 where the conceptual planning and detail design processes were last about more less in two years time. The construction process was started in September 2007. The construction stage took about 2 and a half years, when it was completed in March 2010 and fully occupied in June 2010 (O3).

Interviewees were asked to comment on the estimated time and actual duration of the project. This question was aims to assess duration and progress of the project whether it was delayed or delivered on time. The local authority (L3) mentioned that the project was delayed about 8 months to 1 year during the planning process, but it able to be completed earlier than the estimated time. It was also confirmed by the main contractor (C3) as he mentioned that the project did not delay throughout the construction stage. The owner, energy consultant and energy manager highlighted the project has gone smoothly which was completed about 15 days ahead of the given timeframe.

Interviewees (owner, energy consultant, local authority) then were asked to comment on the Diamond project planning process, whether it took more time than a conventional project planning process**.** However, the detailed planning process has shortened the rest of the project duration. There is not many problems cited by the stakeholders, the problems was only around the lack of local sustainable materials and local expert on sustainable building in order to adapt the technology and the knowledge to the local climate and condition. Luckily, some of them have been experienced in the previous LEO and GEO building projects.

All respondents were asked to comment on any change during the project execution and its effect on the estimated cost and duration of the project. All respondents gave responses as only minor change happened throughout the project and the change was not affected too much towards the cost and duration of the project.

3.3.4 Quality and Stakeholders' Satisfaction Performance

Although the Diamond building incorporates combination of new concepts and ideas for a sustainable building, the occupants' comfort and satisfaction was placed at the highest priority. The building has been awarded with Platinum Certificates for meeting the standard of the Malaysia GBI and the Singapore BCA Green Mark in 2011. Diamond building has gained international recognition as it was named the most energy efficient building at the ASEAN Energy Awards 2012 held in Phnom Penh, Cambodia in September 2012. Subsequently, in the month of October 2012 the building won the second place in the Commercial Building-New Category in the prestigious ASHRAE Technology Award 2013 by American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). The building also championed the New Commercial Buildings category in the Emerson Cup 2012 for India and Southeast Asia by the Emerson Climate Technologies.

There was only minor complaint about the building performances have been received by the owner, energy consultant, contractor and the energy manager as they mentioned:

> *'At the first 3 months yes, we did receive complaints such as lighting seems not enough. People took time to adapt with the new day lighting environment. Now, everything is fine. Another thing is water, people comment about the water flow that was too slow. It was also about how people adapt to the new systems to use water as efficient as they can. Air quality was claimed a bit stuffy at the first few month but people adapted to the environment already. Parking space is one of the issues where the parking space is not*

enough as Putrajaya local authority encourage the use of public transport. Unfortunately, the transport services provided in this area are currently quite dissatisfied.'(O3)

'We received complaint on air movement, which was also happened in GEO building. The M&E engineer was already addressed the issue and try to avoid it from happening again in Diamond building but after the building was completed, we are still received complaint on the same problem. However, it was nothing serious and people get use to it already.' (E3)

'Minor, only on detailing issues from our (contractor) side.' (C3)

'We received complaints only the first three months because people are not use to it. They use to live in an office that too cold and full of artificial lighting systems. Last time we have problem on GDC (gas district cooling) Putrajaya, all buildings in Putrajaya were too hot. But at Diamond building we were still fine. We still can work comfortably. That is the advantage of this building as compared to the others. We noticed that at the corner area of slab cooling areas, the pup pipe is not run well. At that area the radiant cooling is not so effective. So this area is not cool enough. To overcome this issue, the staff made it as filing rooms.' (M3)

Meanwhile, the local authority has never been received any complaint or negative feedback about the building performances.

3.3.5 The Impact of Planning Process on the Overall Outcomes of Diamond building

Table 25 indicates the impact of the sustainability principles and the integration strategies that have been practiced throughout the early project planning process on influencing the Diamond project performances. The owner and energy consultant assessed that the planning process of Diamond building exerted a very positive on the overall performances of the building.

Table 25: Interviewees' Responses on the Overall Impact of Diamond Sustainability Principles Practices and the Integration Strategies into the Project Planning Process on Influencing the Project Performances

Representing the Stakeholders of Planning Process		Owner	Energy Consultant
Rating		+3	+3
Note: +3 Very Positive *+2 Positive*	*+1 Somewhat Positive*	*0 Negligible* *-1 Somewhat Negative*	*-2 Negative* *-3 Very Negative*

The energy consultant (E3) highlighted their opinion in order to improve the planning process of Diamond project as follows: *'The Malaysian government should make sustainable building concept as a compulsory in construction industry at certain extent during building approval process so that everybody has to go to the same way. This industry should have their own guidelines on sustainable and energy efficient building which suit to the local climate and conditions. They also should have their own local expert and local materials to support this project. Sustainability representative should be available in every single cycle to keep track on sustainability issues.'*

The local authority and main contractor highlighted their own opinion in order to improve the planning process of Diamond as follows,

'The team members should consider our (Malaysian) local traditional design, culture, climate and other conditions to be considered in delivering this project. Our traditional building is more beautiful I think..this building no needs to be very futuristic and glass oriented.' (L3)

'We constructed the building, thus I think we should also the best team who should maintain the building for certain time so that we can monitor the building performance because it involved systems like EE and EMS. This is a continuous project. This is not a normal project where when the building constructed then you just leave it to the owner for operation.' (C3).

Besides, all stakeholders were asked to make some general comments on the full set of 22 sustainability principles of building and 20 integration strategies during project planning process as listed in the proposed framework (Appendix O, p486) towards improving the overall performances of sustainable buildings. All of them have given their positive responses on the listed factors.

3.4 The Barriers to the Diamond Project

This part identifies interviewees' perceptions on the barriers or obstructions during the Diamond project delivery. The most common barriers that was replied (all replies) was *'there was no clear aspect concerning sustainability and the integration strategies in building and the project planning standards and guidelines*' (O3, E3, C3, L3, M3). One of the contributing factors to the absence of sustainable building standards and the integration strategies guidelines was majority of regulatory stakeholders have a very limited understanding on sustainable development. Lack of sustainable development knowledge and awareness among construction players (all replies) were also contribute to the lack of demand and misinterpretation about this project. The stakeholders took time to study the knowledge of sustainable project. They have been involved in workshops, seminars, charrette process and visiting sustainable building projects around the world as the owner (O3) and main contractor (C3) highlighted:

'Because of lack in knowledge, we appointed the developers as our representative in order to deliver this project successfully. In term of cost, we have no problem; payment to the contractors and consultants as well all gone smooth because we already had the budget. One more problem was awareness problem, we should then educate our staff about this building and how to operate and maintain the building accordingly 6 months before moving to the building including switching off the computer switch and so on. Even though the first target is 85kWh/m2/year, The BEI of this building is currently able to be reduced until 55kWh/m2/year and we ever reach until 45kWh/m2/year.'(O3)

'We have the key targets like BEI, OTTV, RTTV and other few parameters such as, how we monitor the energy consumption which all of them were very new in the local industry. Nobody was really familiar on sustainable building project that time. We worked only based on the given guidelines and full collaborations with the consultants.'

Lack of sustainable development knowledge and awareness among construction players were also contribute to the lack of local sustainable materials, technology that adapted to the local climate and condition and local expert in this industry (cited by all stakeholders exceptional of local authority) as the energy consultant (E3) said: *'it was quite difficult to get sustainable materials and technology in Malaysia'.*

The rest of the listed barriers of the project were not cited by the stakeholders as they had fully support of funding by the government and had a good collaboration among the members of the project team.

3.5 Preferences of Sustainability Principles of Building and the Strategies to Integrate the Principles into the Project Planning Process

This part aims to gauge stakeholders' preferences on sustainability principles of building and the strategies to integrate the principles into the building project through planning process. It measures the most significant sustainability principles should be integrated into Malaysian building projects and the strategies to integrate the principles into the building whole life

efficiently through the project planning process. This part comprises of two issues as follows; 1) Sustainability Principles of Building 2) The Strategies to Integrate Sustainability Principles into the Planning Process. Each of these issues is described in the followings.

3.5.1 Sustainability Principles of Building

The stakeholders were asked to assess the importance of sustainability principle as listed in the proposed framework (stage 2). Altogether, 22 principles were discussed with the interviewees. These are listed into 4 categories as shown in Table 26.

Table 26: Stakeholders' (Diamond) Preferences on the Sustainability Principle of Building

Sustainability Principles	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Environmental Sustainability						
1. Efficient environmental management	5	5	4	5	5	4.8
2. Concern on quality of land, river and sea	5	4	5	5	5	4.8
3. Site planning and management	5	4	4	5	5	4.6
4. Energy efficient	5	5	5	5	5	5.0
5. Air and emissions quality	5	4	5	5	5	4.8
6. Sustainable method	4	3	4	5	5	4.2
7. Sustainable materials and resources	5	5	5	5	5	5.0
8. Optimize materials and resources used	5	5	4	5	5	4.8
9. Efficient water consumption	5	4	5	5	5	4.8
10. Transport management	5	5	4	5	4	4.6
11. Urban design, visual impact and aesthetic	5	5	5	4	4	4.6
12. Noise control	5	5	5	3	5	4.6
Economic Sustainability						
13. Whole life cost efficiency	5	5	5	5	5	5.0
14. Improve local market presence	5	5	5	3	4	4.4
15. Indirect economic impact	4	5	4	3	4	4.0
16. Economic benefit to the stakeholders	5	4	5	5	4	4.6
Social Sustainability						
17. Occupational health and safety	5	5	5	4	5	4.8
18. Product responsibility	5	4	5	5	5	4.8
19. Training, education and awareness	5	5	5	3	5	4.6
20. Stakeholder participation	5	5	5	3	5	4.6
Design and Innovation						
21. Sustainable innovation	5	5	5	5	5	5.0
22. Sustainable design	5	5	5	5	5	5.0
TOTAL	**108**	**102**	**104**	**98**	**105**	**103.4**
Average Rating	**4.9**	**4.6**	**4.7**	**4.5**	**4.8**	**4.7**
Level of Importance	Very Important	Very Important	Very Important	Very Important	Very Important	Very Important

Note: Average Rating: 4.5-5.0= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important

Shaded rows = the most important principles (5.0 points)

It was found that 19 out of 22 principles were rated as 'very important' to be considered for a sustainable building as listed below;

5.0 points:

1. Energy efficiency
2. Sustainable materials and resources
3. Whole life cost efficiency

4. Sustainable design
5. Sustainable innovation

4.8 points:

6. Efficient environmental management
7. Concern on quality of land, river and sea
8. Air and emission quality
9. Optimized materials and resources used
10. Efficient water consumption
11. Occupational health and safety
12. Product responsibility

4.6 points:

13. Site planning and management
14. Transport management
15. Urban design, visual impact and aesthetic
16. Noise control
17. Economic benefit to the stakeholders
18. Training, education and awareness
19. Stakeholders' participation

Other three sustainability principles were considered as 'important' (4.0 points to 4.4 points) including;

4.4 points:

20. Improve local market presence

4.2 points:

21. Sustainable method

4.0 points:

22. Indirect economic impact

Overall, the stakeholders suggested that all the 22 principles are important to very important to be considered for building projects to ensure sustainability in the buildings whole life. No principle received below 4.0 points from any stakeholder. Clearly, the stakeholders believed that all the principles are important to very important to be integrated during the planning process of building project. The 22 principles were highlighted by the interview analysis to be considered in the formulation of the final stage of the proposed framework. There was no negative comment was received from the stakeholders of Diamond project.

The user representatives (owner and energy manager) both have rated a total of 108 points (4.9) and 105 (4.8) respectively out of possible 110 points of the important level. The energy consultant (representing design team) has rated a total of 102 points (4.6), the main contractor (representing construction contractor) and the local authority (representing approval party) scored 104 points (4.7) and 98 (4.5) respectively.. Thus, all 5 stakeholders have rated the principles at the important to very important level of importance. This resulted in a very high average total score of 4.7 points (very important).

3.5.2 Strategies to Integrate Sustainability Principles into the Project Planning Process

The stakeholders of Diamond project were asked to assess the importance of the strategies to integrate sustainability principles into building during the project planning process as listed in the in the proposed framework (stage 2) to be addressed during the formulation of the final stage of the proposed framework. Altogether, 20 principles were discussed with the interviewees and these are listed into 4 categories as shown in Table 27.

Table 27: Stakeholders' (Diamond) Preferences on the Strategies to Integrate Sustainability into the Project Planning Process

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
Sustainable Project Orientation						
1. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan	5	5	5	4	5	4.8
2. Specific sustainability goals and project priorities	5	5	5	3	5	4.6
Integrated project team						
3. The team should have the core knowledge of sustainable building	5	5	5	5	5	5.0
4. Team members are educated on sustainability issues including vendors.	5	4	5	5	5	4.8
5. Team members are fully informed on sustainability goals and priorities of the project.	5	5	5	5	5	5.0
6. Team members' selection with sustainable development quality and capability	4	5	5	5	4	4.6
7. An integrated design/ sustainability coordinator is appointed as one of the project's team members	4	4	5	3	4	4.0
8. Local community representative is involved in support of the project	4	4	5	4	4	4.2
Integrated design process						
9. Bringing the team together as early as possible during planning process.	5	5	5	5	5	5.0
10. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.	5	5	5	5	5	5.0
11. Design should reflect the user community	5	4	5	4	5	4.6
12. Committed and collaborative team throughout the process	5	5	5	4	5	4.8
13. Do whole building design and systems analysis	5	5	5	3	5	4.6
14. Involve diverse set of stakeholders on the team	5	3	5	4	5	4.4
15. Planning should reflect all the project stakeholders	5	4	5	4	5	4.6
16. Incorporation of charette process	5	5	5	3	5	4.6
17. Commissioning process is added during this process and described in a specific section.	5	5	5	3	5	4.6
Regulations and code compliances						
18. Government policies to	5	5	5	5	4	4.8

Strategies of Sustainability Integration	Owner	Energy Consultant	Main Contractor	Local Authority	Energy Manager	Average Rating
encourage sustainable development						
19. Incentive to encourage sustainable development	5	5	5	5	4	4.8
20. Compliance with code and regulatory tool of sustainability	5	5	5	5	5	5.0
TOTAL	**97**	**93**	**100**	**84**	**95**	**93.8**
Average Rating	**4.9**	**4.7**	**5.0**	**4.2**	**4.8**	**4.7**
Level of Awareness:	Very Important	Very Important	Very Important	Important	Very Important	Very Important

Average Rating: 4.5-5.0= Very Important 4.4-3.5=Important 3.4-2.5= Neutral 2.4-1.5= Not important 1.4-0= Not at all important

Shaded rows = the most important principles (5.0 points)

Seventeen out of 20 principles were rated as 'very important' strategies (4.6 points to 5.0 points) to be practiced in order to integrate sustainability principles into the planning process of building project. The strategies are listed below:

5.0 points:

1. Bringing the team together as early as possible during planning process
2. Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.
3. The team should have the core knowledge of sustainable building
4. Team members are fully informed on sustainability goals and priorities of the project.
5. Compliance with code and regulatory tool of sustainability

4.8 points:

6. Sustainable concern during establishment of project scope, project charter, drawing, contract and detailed project plan
7. Committed and collaborative team throughout the process
8. Team members are educated on sustainability issues including vendors.
9. Government policies to encourage sustainable development
10. Incentive to encourage sustainable development

4.6 points:

11. Specific sustainability goals and project priorities
12. Team members' selection with sustainable development quality and capability
13. Design should reflect the user community
14. Do whole building design and systems analysis
15. Planning should reflect all the project stakeholders
16. Incorporation of charette process
17. Commissioning process is added during this process and described in a specific section.

Other 3 principles were considered as 'important' (4.0 points to 4.4 points) which are;

4.4 points:

18. Involve diverse set of stakeholders on the team

4.2 points:

19. Local community representative is involved in support of the project

4.0 points:

2. An integrated design/ sustainability coordinator is appointed as one of the project's team members

Overall, the stakeholders suggested that all the 20 strategies are 'important' to 'very important' to be implemented during planning process of building projects in order to integrate sustainability principles into the whole life of the building. No strategy was rated below 4.0 points from any stakeholder and it was no negative comment received from any stakeholder. The users' representatives (owner and energy manager) both have rated a total of 97 points (4.9)

and 95 points (4.8) respectively out of possible 100 points. The energy consultant (representing design team) has rated 93 points (4.7), the main contractor (representing construction contractor) rated 100 points (5.0) and local authority (representing approval party) rated 84 points (4.2). Thus, all 5 stakeholders have rated the strategies to be high to very high levels of importance. This resulted in a very important average total score of 93.8 (4.7) points. A number of stakeholders gave short positive comments the reasons for their answers such as the energy consultant (E3) suggested regarding the principle number 7:

> *'Yes, the strategy (number 7) is important to be practiced. The issue of sustainability is something extra in this industry. It will be given a low priority by the stakeholders if it is not properly guided. So, it is significant to have a sustainability coordinator for the project team too to take the 'sustainability responsibility' such as to monitor the implementation of sustainability like waste management plan on site and etc. The representative's responsibility might be including to collect construction waste date and monitor how many of them should be recycled or reused. They need someone to keep track on this'.*

4.0 SUMMARY

This individual case report analysis has given an account of, and the reason for, the perceptions of sustainability principles and the strategies to integrate the principles into the project planning process held by the stakeholders and their perceptions about the project practices and performances. It also explores their belief about the influences of the projects planning process on the performances of the project. Cross-cases analysis is discussed separately in Chapter 6. In general, stakeholders' involvement in the planning process of all three projects was imbalanced, with low to very low or not at all of the operation and maintenance personnel involvement. The energy consultant and main contractor have not been involved in early planning stage of LEO building project, meanwhile the main contractor was only at a medium level of involvement during the detail design stage of the project. In GEO project, even though the energy consultant has been involved since early planning process of the project, but the main contractor was not involved at all during the process. In the Diamond project, the stakeholders' involvement was improved by including the main contractor in decision making during the planning process, however, the local authority and operation and maintenance personnel were still not fully involved in the planning process of the project especially on sustainability aspects. Late and imbalanced stakeholders' involvement will increase the cost and time of the project. It also decreases the sustainability performances, quality and stakeholders' satisfaction of the project. For instances, contractor should be engaged right from the beginning at the very least to provide pricing and constructability reviews towards the planning and design of the building project. They should be exposed to sustainability goals throughout the whole life of the project as they are responsible for implementing the design team's vision and holding the project's specification firm against change requests. Sustainability knowledge and awareness among the stakeholders are very crucial. Malaysian construction industry should have their local sustainability expert for sustainable building projects so that the planning process, design and technology to be implemented suit to the local climate, culture and conditions. Lack of sustainability knowledge among the stakeholders and no local sustainability expert in this country has given negative effect to this project, where all of the three projects should adopted foreign technology including modified equipments from oversea to suit the climate and conditions that always not suitable enough. Thus, this country should learn more about a sustainable building project and should has its own expertise who familiar enough with the need of this country. Collaboration work with foreign teams also is very important to improve their knowledge on how to deliver a successful sustainable building. The overall performances of LEO and GEO projects of the principles are at a good level and Diamond project are at an excellent level. The stakeholders perceived that the project planning process exerted either a very positive or positive influence on the overall performances of the project. The process has sometimes lengthened the time of conceptual and design but have shortened the overall project duration. It was not increase the cost of the project but has obviously improved the project performance. It is clear that the quality of the buildings have impressed people as they have been recognized by several prestigious sustainability related awards.