CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter presents the research methodology of the study. It outlines a strategic discussion on how the research methodology is well developed in searching for the most significant sustainability principles of building and the strategies to integrate the principles into the project planning process to be addressed into the proposed framework.

Research methodology is a systematic way of solving research problems or a science of studies on how to carry research scientifically (Chaudhary, 1991). Sarantakos (1998) classified research methodology into qualitative and quantitative. Quantitative description limits what can be learned about the meanings participants give to events. However, qualitative studies allows researchers to capture all of the elements of an event that come together to make it the even that it is (Becker, 1996). Qualitative research is often refers to the meanings, concepts, definitions, characteristics, metaphor, symbols and descriptions of things, while quantitative research deals with quantifiable or numbers and measure of things (Berg, 1998).

> Quantitative research is based on observations that are converted into discrete units that can be compared to other units by using statistical analysis..Qualitative research, on the other hand, generally examines people's worlds and actions in narrative or descriptive ways more closely representing the situations as experienced by the participants..These two paradigms are based on two different and competing ways of understanding the world..(which) are related in the way research data is collected (words versus numbers) and the perspective of the researcher (perspectival versus objective)(and) discovery versus proof (Maykut and Morehouse, 1994:2-3).

Qualitative research is frequently defined by the absence of numbers. Two myths about qualitative research are that real qualitative researchers do not count and cannot count. This antinumber myths have led to the underutilization of numbers in qualitative research and to the simplistic view of qualitative research as non- or antinumber (Sandelowski, 2001). However, many prominent qualitative researchers such as Erickson (2007), Messing et al (2005), Onwuegbuzie and Daniel (2003), Maxwell

(2010), Sandelowski (2001; 2000), Hammersley (1992), Miles and Huberman (1984) and Becker, (1970), supported the inclusion of numerical data in qualitative research practices and reports. Numbers can play important role in qualitative analysis in illustrating analyses (Messing et al, 2005), to establish the significance of a research project, to document what is known about a problem and to describe a sample (Sandelowski, 2001; 2000). They are also useful for showcasing the complexity of qualitative work and to generate meaning from qualitative data, to document, verify and test researcher interpretations or conclusions and to re-present target events and experiences (Sandelowski, 2001:230).

> Reducing qualitative data to numbers can sharpen the focus on a key finding (Sandelowski, 2001: 233).

Both quantitative and qualitative content analysis entail counting responses and the numbers of participants in each response category, but in qualitative content analysis, counting is a means to an end, not the end itself, but rather a description of the patterns or regularities in the data that have, in part, been discovered and then confirmed by counting (Sandelowski, 2000). Numbers can complement and enhance narratives in qualitative research (Olson, 2000). Nevertheless, numbers should be used in the ways that produce trustworthy findings and evocative reports of the findings (Sandelowski, 2001).

Besides being classified into qualitative and quantitative, they were also combined into mixed method which aims to take the best from both of the methods and unite them (Bergman, 2009). Creswell et al (2003:212) defined mixed methods as 'the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of data at one or more stages in the process of research.' Considering the nature of the research investigation, the study used the mixed methods approach whereby the questionnaire survey applied quantitative element and the case study applied qualitative element of the research. The reason of mixing both types of data within one study is that neither quantitative nor qualitative methods are sufficient enough by themselves to capture the details information that is needed for the study. Creswell and Plano Clark (2011:8) highlighted that mixed methods are suitable when one data source may be insufficient, results need to be explained, exploratory findings need to be generalized, a second method is needed to enhance a primary method, a

theoretical stance needs to be employed and an overall research objective can be best addressed with multiple phases of projects. The use of mixed methods approach is in parallel to the arguments of Creswell and Plano Clark (2011) in order to achieve a comprehensive explanation of information gathered. The study takes a four-stage research approach (refer to Figure 4.1, p139), which followed a systematic process from the preliminary research, fieldwork, data analysis and framework development.

4.2 THE PRELIMINARY RESEARCH

As discussed in Chapter Two and Three, the dissertation reviews the related literature about sustainability principles of building, the sustainability integration strategies into the project planning process and their impact on influencing the project performances. It was finally identifies knowledge gaps in the uncertain strategies to integrate sustainability into the project planning process of buildings. Even though, there are many intellectual publications on the subject of sustainable building, but the one that related to the project planning process and the sustainability integration into this process are very few. Several papers were published, which discussed the importance of planning process towards delivering a sustainable building project successfully. Those papers however are more theoretical-based than research-based. The study attempts to bridge the gap by identifying and proposing a framework to integrate sustainability into Malaysian building projects through the project planning process.

4.2.1 The Theoretical Framework

According to Sekaran (2000:90-91), ‘a theoretical framework is a conceptual model of how one theorizes or make logical sense of the relationships among the several factors that have been identified as important to the problem.’ Thus, a theoretical framework for this research is formulated in order to offers the conceptual foundation to proceed with the research as illustrated in Figure 3.4 (p135). The review of available knowledge offered a starting list of 29 sustainability principles of buildings and 21 strategies to integrate sustainability into the project planning process to be investigated for their possible inclusion in the preliminary framework as listed in Table 3.8 (p132).

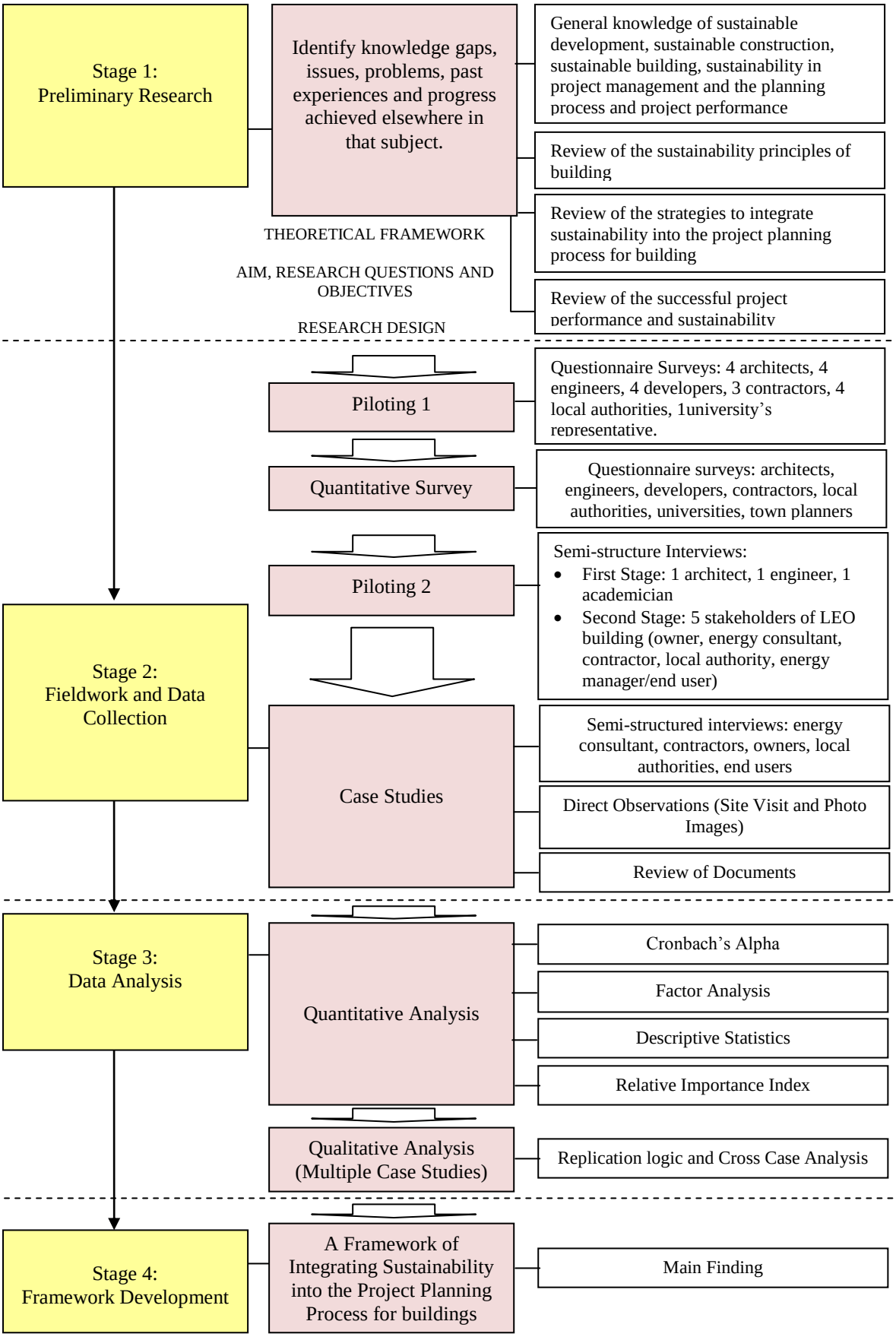

Figure 4.1: Stages of Research

The sustainability principles and strategies (the factors) then have gone through the refining processes through quantitative and qualitative techniques and case study by involving Malaysian project stakeholders to consider the local context. It is also to ensure the market acceptance and support from the industry. Review on the criteria of project success and the impact of sustainability integration practices on influencing project performances are also explored to support the framework development process. The framework development process is illustrated in Figure 4.2 below.

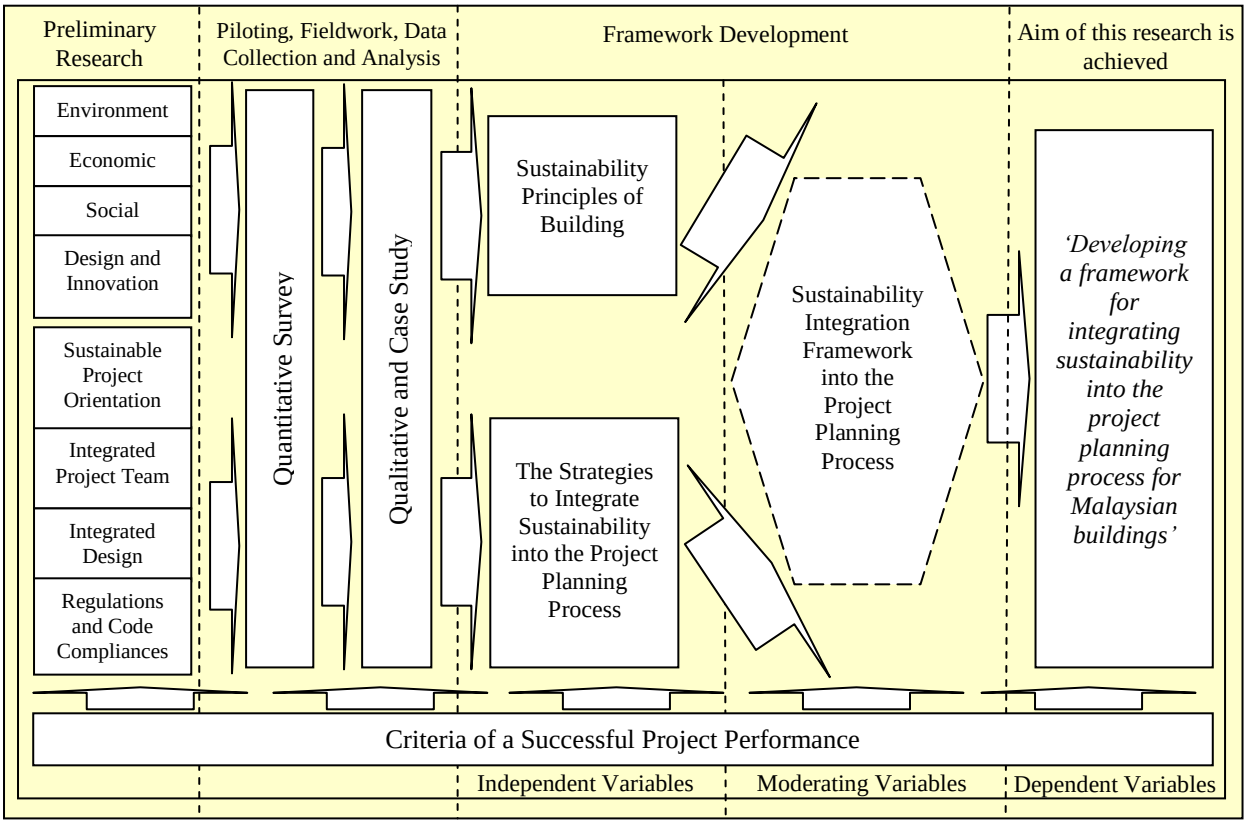

Figure 4.2: The Research Model for Developing the Sustainability Integration Framework into the Project Planning Process

4.2.2 The Research Design

There are various views among research scholars over the definition of research design. Chaudhary (1991:28) highlighted that, 'a research design is the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.' Kumar (1999) stated that research design is a procedural plan that is adopted by researchers to answer questions objectively, accurately, economically and validly. At the same as Thyer (1993) define research design as a detailed plan on how research study to be completed,

operate variables for measurement, selecting a sample, collecting data and analysing results of interest to study and for testing hypotheses. Whatever different the definitions, but the concept of research design is still towards the same purpose which is as a detailed plan which encompassed the research problem and research questions, sampling procedures and methods of data collection (Yin, 1994).

4.2.2.1 The Research Problem

Problem is defined as 'any situation where a gap exists between the actual and the desired ideal states', meanwhile, problem statement or problem definition is defined as 'clear, precise and succinct statement of the question or issue that is to be investigated with the goal of finding an answer or solution' (Sekaran, 2000:67). Sekaran (2000) highlighted that a researcher is in a position to narrow down the problem from its original broad base, and define more clearly the issue of concern after the literature review stage. The research problem serves as the foundation of a research study as Sekaran (2000) warned researchers that there is no amount of good research can find solution to the situation where the critical issue or the problem to be studied is not clearly identified. As emphasized by Sekaran (2000:68), problem definitions could be valid to any four of followings which the former two fall within the realm of applied research and latter two under basic research.

i. Existing business problems where a manager is looking for a solution.
ii. Situations that may not pose any current problems but which the manager feels can stand improvement.
iii. Areas where some conceptual clarity is needed for better theory building, or
iv. Situations in which a researcher is trying to answer a research question empirically because of interest in the topic

This study mainly falls on the first problem definition which is the 'existing problems where solutions need to be looking for. The research problem and the research questions are previously discussed in the first chapter of the dissertation (pp8-10).

4.2.2.2 Methods of Data Collection

Data can be collected by using various methods such as face to face interviews, telephone interviews, computer assisted interviews and questionnaires that are either personally administered, sent through mail or electronically administered (Sekaran, 2000). It is very important to select the most appropriate research design and methods for trustworthiness and validity of a study (Groat and Wang, 2002; Sekaran, 2000; Yin, 1994). 'By observing something from different angles or viewpoints, they get a fix on its true location.'(Neuman, 2003:137). According to Sekaran (2000), data sources are divided into primary and secondary. Primary data sources are collected such as from individuals, focus groups and a panel of respondents specifically set up by the researcher whose opinions may be sought on specific issues from time to time. Meanwhile, secondary data sources can be obtained from company records or archives, government publications, industry analysis offered by the media, web sites, and the internet and so on.

In this study, the primary data are collected by using questionnaire based survey, case study interviews and observations while the secondary data are obtained from the company records, government publications, project documents, media, websites, and so on. One set of structured questionnaire is designed for Malaysian building project stakeholders as a general and another one set of in depth semi-structured interview questions is designed for the project stakeholders of the chosen case studies projects. Both questionnaire and interview questions were developed based on the literature reviews and further enhanced by employing the outcomes, suggestions and comments from the pilot study. The use of multiple techniques often referred to as 'triangulation' (Sekaran, 2000; Hartley, 1994) which is appropriate to investigate in depth the research questions and could strengthen reliability and validity of the research (Hammersley, 2009; Meriam, 1998). Hammersley (2009:23) explained that, 'if the data from contrasting sources confirm the original conclusion, then the conclusion can reasonably be held with more confidence than before.'

4.2.2.2.1 Pilot Study

Pilot study is very important to ensure questions for the questionnaire survey and case study interviews were comprehensive, realistic and workable, effective, reasonable time

period to answer, have the correct wordings and arrangement and consistent with the research objectives. Teijlingen and Hundley (2001:1) highlighted that, 'pilot studies' are a crucial element of a good study design. Conducting a pilot study does not guarantee success in the main study, but it does increase the likelihood'.

Pilot study is referred to so-called feasibility studies which are small scale version or trial run done in preparation for the major study (Polit et al, 2001). It also the specific pre-testing of a particular research instrument such as questionnaire or interview (Baker, 1994). A good research practices start with pilot study before the actual study is carried out (Naoum, 1998). Even though it is not compulsory, but it might give advance warning about where the main research project could fail, where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated (Teijlingen and Hundley, 2001).

a) Pilot Study for Questionnaire Survey

Several pilot studies for questionnaire survey among the Malaysian building project stakeholders were conducted during the period of October to December 2011 which is almost three months duration. The pilot study was conducted based on interview. The 'non-probability Convenience Sampling' method was used as sampling method. This method was selected because it is convenient and often use during preliminary research efforts to get a gross estimate of the results, without incurring the cost or time required to select a random sample. This method is recommended when the time is short and where information is needed in faster manner (Sekaran, 2000). One set of structured questionnaire survey questions was designed for the piloting purposes. In general, sample size calculations are not required for some pilot studies as long as they enough to provide useful information about the aspects that are being assessed for feasibility (Thabane et al, 2010). For this research questionnaire survey, the pilot study was done in two phase. The first phase was involved two architects, two engineers, two developers, two representatives from local authorities and two contractors. After several revisions, it was followed by the final phase of questionnaire survey pilot studies which were involved another two architects, two engineers, two developers, two from local authorities one academician and one contractors, made up the total of questionnaire survey's piloting respondents of twenty (refer to Table 4.3, p156). From these both phase of pilot studies, it was found that there were some unanticipated responses,

ambiguities and irrelevant scope of questions and suggested factors. For instances, 'the principles of design and sustainable innovation' were first combined into one factor, however, through the pilot study, the principles were suggested to be considered under a separate measure. 'Effluent consumption' was first included in the list of the factors but it was omitted due to the disagreements among the respondents. Following that, questions in the questionnaires were revised four times before satisfying results were produced.

b) Pilot Study for Case Study Interviews

Different from quantitative survey, some researchers argued that separate pilot studies are not necessary in qualitative approaches because the data collection and analysis of this approach is often progressive (Holloway 1997:121). Contamination also is less of a concern in qualitative research, where researchers often use some or all of their pilot data as part of the main study (Teijlingen and Hundley, 2001). However, piloting of qualitative approaches can be carried out if the researcher lacks of confidence or is a beginner, particularly when using the interview technique (Holloway 1997:121).

There are two stages of piloting for the case study interview of this research. The first stage was conducted among three respondents (one architect, one engineer and one academician) who claimed that they have been involved in at least one sustainable building project. This stage took only 2 weeks around August 2012. Fortunately, all the three respondents had the same perspectives which, this set of questions is understandable, comprehensive, realistic, workable, and consistent with the research objectives. The second stage of piloting was a project based study, which conducted among the stakeholders of LEO building project. The fieldwork and data collection for the pilot project took place in September 2012. The piloting exercise of this project was including semi-structured interviews with the stakeholders (owner, end user, energy consultant, contractor and local authority), access to relevant documents, observation and photography. The whole process took about one month. This set of questions just need some minor revisions and does not need any further piloting. This might be because of the questions were designed based on the questionnaire survey's outcomes which have been thoroughly analyzed and revised. Though, before proceed to the main study, the pilot interview questions were reviewed to include comments made by the

interviewees. Overall, the questions were redesigned and rearranged to make the questions are more straightforward and easier for interviewees to understand.

4.2.2.2.2 Questionnaires Survey

The quantitative approach by using questionnaire survey is believed as the best instrument to explore perceptions or opinions of the people on the issue studied (Bernard, 2000; May, 1997) and able to compare the data (May, 1997) toward producing the expected outcomes needed by this research. This technique was considered as the first level of primary data collection for this research in order to explore the opinions regarding the sustainability principles of building and to identify the strategies to integrate the sustainability principles through project planning process from the views of the local building project stakeholders. This approach also was chosen because it allows inductive generalizations of the research findings to be made (Sarantakos, 1998).

The questionnaire survey was devised with fourteen questions in total which were separated in three sections (refer to Appendix A, p310). It consisted of close-ended questions with sufficient space provided for the respondents to give additional information. Section A investigated the stakeholders' background including their education, experiences and involvement in sustainable building project and its planning process. It then investigates further stakeholders' views on the cycle of building which sustainability principles should be incorporated and their understanding on the impact of the sustainability integration towards successful project performance. Section B required the respondents to rank the twenty-nine listed sustainability principles of building according to their importance's to be addressed in the proposed framework. The last section, Section C in particular, required the respondents to rank the twenty-one listed strategies to integrate the sustainability principles of building into the planning process of the project according to their importance's to be addressed in the proposed framework. The sustainability principles and the integration strategies are required to be ranked on a five-point Likert scale of 1 (not at all important) to 5 (very important) as the case might be. At the end of this survey, it was expected that the real problems in integrating sustainability into building project in Malaysia are revealed and the list of the most significant sustainability principles of buildings and the strategies to integrate the principles into the planning process of Malaysian building project are

produced as the outcomes to be addressed throughout the development of the framework.

4.2.2.2.3 Case Study

'A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundary between phenomenon and context are not clearly evident' (Yin, 1994:13). This study is more focuses towards exploratory basis and examining contemporary events, therefore likely to lead the use of case studies as Yin (1994:8) stated 'the case study is preferred in examining contemporary events in which the relevant behaviors cannot be manipulated'. The nature of this research demand the use of case study approach as it seeks to clarify the case decisions such as the reasons why they were chosen, how they were implemented, their results and impacts. Hence, it benefits from the case study approach as highlighted by Schramm (1971 in Yin 1994:12) that the central tendency among all types of case study, is that try to illuminate a decision or set of decisions especially to discover the stakeholders' believe on what and how the proposed framework should be.

The case study approach was considered as the second level of primary data collection in this research where the current practices of sustainability principles and the integration strategies into the project planning process in the Malaysian sustainable building projects were studied in depth. This second level of primary data collection mainly focuses on 'what', 'how' and 'why' questions to obtain an in depth understanding of the sustainability principles that are integrated into the case building projects and how the principles are integrated into the project planning process. The impact of sustainability integration practices on influencing the project performances is also discussed. This research also seeks to explore the respondents preferences on the 22 sustainability principles of building and 20 strategies to integrate the principles into the project planning process (42 factors) that have been generated from the final outcomes of the previous quantitative approach as listed in Table 5.63 (p217) for the external validation purposes.

Yin (1994) highlighted that there are six sources of data and evidence for case study research which are documentation, archival records, direct observation, participant observation, physical artifacts and interviews. However, he further stressed that there

are no single source has an absolute advantage over the others and every case study not necessarily apply all methods. Processes involved in data collection for each case study of this research are face to face interview sessions, site observation and a review of available project documents. This reflects case study's unique strength in dealing with several different sources of evidence (Fellows and Liu, 2003; Yin, 1994).

a) Face to face interview sessions

In the context of this research, the qualitative approach by in- depth, open-ended semi-structured interview was used for data collection to provide an in depth picture of cases. Semi structured interview is considered an appropriate instrument for the research to have 'a great deal of freedom to probe various areas and to raise specific queries' about the study matters (Naoum, 1998:58). Researcher will have a list of themes and questions to be covered, although the questions may vary from an interview to another interview (Kahn and Cannel, 1957). Semi-structured interview allows for a certain level of flexibility, where when additional questions are required to clarify issues or to explore more, given the nature of a particular even within particular organization, it was possible to do that. The cases study interviews were focused on their involvement and sustainability practices of the projects and their opinion and preferences of the sustainability principles of building and the sustainability integration strategies within the particular projects to be addressed in the proposed framework. The influences of the sustainability integration towards the projects performances were also investigated during this session.

> …case study research can include both single and multiple case studies
> (Yin, 1994:14).

The nature and purpose of this study demand a multiple case studies approach to be employed. This approach was designed in this research to address the study's questions and generalize its findings through replication logic as the evidence from multiple cases and findings obtained through cross-case analysis is often more compelling and distinctive which makes the overall study more robust (Yin, 1994:45).

Face to face in depth interviews were carried out with the project stakeholders who are directly involved in the case studies projects. Twenty-five questions were devised in the

form of interview schedule (refer to Appendix B, p316) through considering those 1) brainstorming the research topic, 2) working through the list of topics carefully, 3) moving from general topics to specific themes, 4) thinking of questions related to each theme, 5) making sure that the questions are open, neutral, short and straightforward, 6) revising the questions after each interview if necessary and 7) becoming familiar with the schedule (Dawson, 2002; Bernard, 2000).

The interview questions were broken down into five parts. Part A comprises of three questions that investigated the extent and degree of the stakeholders' involvement in the project planning process. The degrees employed in question 2(b) (Most Occupying; Being Involved; Being Consulted; Being Informed; Not Being Informed) were based on 'Neumann's Continuum of Degree' or 'range of participation in decision making' (refer to Figure 4.3) which is claimed to be an appropriate tool for built environment research (Neumann, 2000:267).

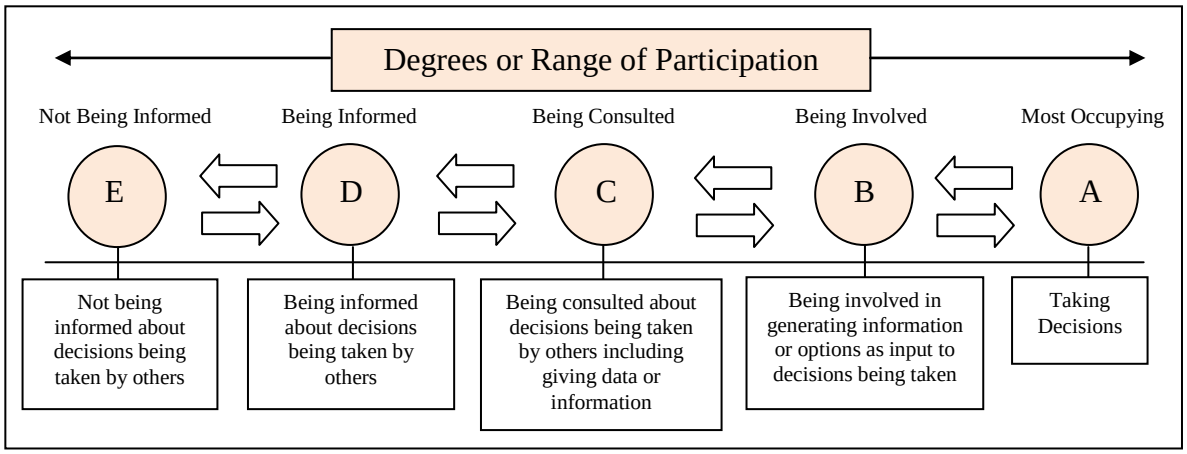

Figure 4.3: Neumann's Continuum of Degrees or Range of Participation in Decision Making
(Source: Neumann (2000:267)

Part B investigates the sustainability principles of building that had been practiced in the case studies projects. It also investigates the sustainability performance of the project and the respondents' preferences on the sustainability principles of building to be addressed in the proposed framework. Meanwhile, Part C explores the practiced strategies to integrate sustainability principles into the projects during planning process. It also gauges the respondents' preferences on the sustainability integration strategies into the project planning process to be addressed in the proposed framework.

Part D of the interview question is interrogating about the projects performances and how the sustainability integration and the project planning process influence the projects performances. These four parts of questions especially, formed the basis of the raking and contrasting cases which most of them employed well constructed Likert scales which most widely used response format. Likert scales also useful for this research 'wherein it is possible to compare the respondents' scores with a distribution of scores from some well defined group' (Kothari, 2004:86). The last part of the interview questions is designed to understand the barriers of integrating sustainability into the projects to be taken into account throughout the development of the framework.

b) Site Observation

Observation could shed light some information that the researcher was not aware previously. Merriam (1998:96) highlighted: 'observation is the best technique to use when activity, event or situation can be observed firsthand, when a fresh perspectives is desired, or when participants are not able or willing to discuss the topic under study.' It provides some knowledge of the context or to provide specific incidents, behavior and so on that can be used as reference points for subsequent interviews (Merriam, 1998). Site observation was done during the case study process of the study with the help of the owners of the projects. This is the important process as information of the situation and condition of the building performances could be proved based on the evidences available on site. Besides, sustainability performances of the building and the end users' satisfaction were observed during this session. Photographs were taken to strengthen the observation data obtained.

c) Documentary Sources

The data for the research were also acquired through reviews of relevant project documents such as drawings, layout and building plan, briefing documents, GBI submission reports, newspapers, development reports and photographs. Documentary evidence acts as a method to cross-validate information gathered from interview and observation given (Hodder, 1994). It also provides information and guidelines in assisting the researcher with her inquiry during the interview sessions. The use of multiples sources of data therefore enhances the validity and reliability of the findings.

4.2.2.3 The Sampling Procedures for Questionnaires Survey

Sampling is a process of selecting a subset of elements from within a population to fairly represent the population (Freedman et al, 1998). The reason of using sample in this research is due to the large size of population which is very hard for the researcher to survey and examine the entire population within the limited time, cost and resources (Sekaran, 2000). Therefore, all research involves sampling because no study, whether quantitative or qualitative can cover everything (Punch, 2001). Sampling design methods are divided into two main categories which are 'probability sampling method' and 'non probability sampling method'. Probability sampling method is includes random sampling, systematic sampling and stratified sampling. Meanwhile, non probability sampling method is includes convenience sampling, judgment sampling, quota sampling and snowball sampling. Sampling error is well defined for probability samples. It also minimizes selection bias and provides a basis for estimating the likely impact of sampling error. In contrast, the degree to which the samples differ from the population remains unknown in non probability sample (Freedman, 2011; Sekaran, 2000)

Judgment sampling was chosen for this study to obtain desire information from the project stakeholders who are having the experiences of involving in sustainable building project and/or knowledgeable on the project. Sekaran and Bougie (2009:277) highlighted that 'judgment sampling involves the choice of subjects who are most advantageously placed or in the best position to provide the information required'. Sustainable building project is still infancy in Malaysia and there are still limited stakeholders who are familiar with the project. Thus, judgment sampling was useful to select the respondents who reasonably be expected to have expert knowledge by virtue of having gone through the experiences and processes themselves and might perhaps be able to provide good data and information to the researcher. Sekaran and Bougie (2009:277) recommended that 'judgment sampling design is used when limited number or category of people have the information that is sought'. In this case, any type of probability sampling a cross section of entire population is not useful. The sampling design may limit the generalizability of the findings, however, it is the only practical sampling method to obtaining the information required from the specific persons that can give the information required (Sekaran and Bougie, 2009).

The target respondents of this study are the seven stakeholders groups of the Malaysian building project. These groups include of the developers, architects, engineers, town planners, local authorities, contractors and universities. In October until December 2011 (concurrent with the pilot study process), there are 4846 Malaysian building project stakeholders' companies were first approached by electronic mails and telephone calls asking whether they are able to provide a competent representative to be involved in the questionnaire survey. The approached companies were selected based on their contribution to the green and sustainable building projects, sustainability related research projects and/or publications and involvements in the formulation of Malaysian GBI and sustainability related policies, guidelines or other relevant government initiatives. Some of the companies were also recommended by the related professional bodies and the government institutions (refer Table 4.1).

Table 4.1: Total Malaysian Building Project Stakeholders

Types of Stakeholders	**No. of organizations**		**Sources of Recommendation**
	Area		
	Klang Valley	Non Klang Valley	
Developers	381	833	REHDA (2011)
Engineering Firms	85	64	ACEM and IEM (2011)
Architect Firms	710	296	PAM (2011)
Town Planning Firms	83	39	MIP (2011)
Contractors	953	1228	PKK (2011)
Local Authorities (including 5 authorized agencies by the state government to function as a local authority)	14	140	KPKT (2011)
Universities (Main local universities)	6	14	KPT (2011)
Total	**2232**	**2614**	

They are including, 1014 developers that are registered with the Real Estate and Housing Developers' Association of Malaysia (REHDA), 149 engineering firms that are registered with the Malaysian Institute of Engineers (IEM) and also registered members of consulting firm in the Association of Consulting Engineers Malaysia (ACEM) - ACEM is one of the bodies who involved in preparing GBI, Malaysia, 1006 corporate member firms of Malaysian Institute of Architects' (PAM), 122 planner firms that registered with Malaysian Institute of Planners (MIP), 2181 class A contractors companies that registered in the Malaysian Contractor Service Center (PKK), 20 representatives from Malaysian public local universities and 144 local authorities that are listed in KPKT (Ministry of Housing and Local Government of Malaysia) website.

Telephone calls were also conducted to the most priorities companies, which are the stakeholders of GBI Certified building projects (GSB, 2012a) and the ASEAN Energy Award projects (Chantanakome, 2006). The priority was given based on the judgment that the project stakeholders will be able to give useful inputs for the research as they have been directly involved in the prestigious sustainability related award winning projects. The different groups were targeted because they occupy the difference roles and involved in the different stage throughout the project life cycle; therefore their views are sought for this study.

In selecting the seven groups of respondents, the developers were selected as representing of the owners, financer and users, meanwhile, architects and engineers were selected to represent the design team. Preliminary discussion will normally take place between the planning consultants and the planning department at the respective local authorities during the layout plan, building plan or planning permission submission process. A registered town planner is a Principal Submitting Party (PSP) that should be engaged by the developer to prepare the layout plan and will act as PSP for all planning approvals at the planning permission stage (Abdullah et al, 2011). The inputs from planners are very important towards successful of a sustainable projects and its planning process. Thus, town planners were also selected as the respondents for this quantitative research. Besides, local authorities were chosen on the ground of being the legal client and approval party. Contractors were incorporated to represent the construction contractors, operation and maintenance personnel, material and equipment suppliers and builders. Last but not least, representatives from the local universities were involved to get inputs from the knowledge and academic institutions side. Inevitably, there are limitations associated with the choice of representatives contributed. It is important to record that, although only seven groups of stakeholders were contributed, this practical limitation is not intended to deny the importance of the perceptions of others involved in the building project.

After around two months, a total of 188 stakeholders companies finally gave positive replies and admitted that they able to give the useful inputs required by the study. One competent respondent was representing of an organisation. The respondents are including 37 developers (24 of them were received The Edge Property Excellence Awards in 2010 as the country's best property players from the consumer's perspective for their quantitative and qualitative attributes - The Edge Property. com, 2010), 48

professional architects, 9 professional engineers, 10 professional town planners, 71 contractors, 11 officers who are working in various local authorities and 2 representatives of public local universities (shown in Table 4.2).

Table 4.2: List of Respondents for Questionnaire Survey

Project Stakeholders	Respondents
Developers	**37**
Architects	**48**
Engineers	**9**
Town Planners	**10**
Contractors	**71**
Local Authorities	**11**
Universities	**2**
Total	**188**

4.2.2.4 The Replication Logic for Case Studies

> The research may be strengthened by the addition of a second case, or more….the researcher can develop contrasts within the case (Hartley, 1994:214).
>
> The replication logic whether applied to experiments or case studies must be distinguished from the sampling logic commonly used in surveys (Yin, 1994:47).

It is impossible for the researcher to cover all sustainable building project in Malaysia in this research given limited time and resources. Hence, the cases chosen for this study were based on their current achievement relating to sustainability aspects. Each case were carefully selected so that it either (a) predicts similar results (a literal replication) or (b) produces contrasting results but for predictable reasons (a theoretical replication) (Yin, 1994). The choice of case studies selection for this research was specified as one that fits all of the following criteria. They were predicted to have a literal replication.

- The winner of ASEAN Energy Award
- A building with a full GBI Malaysia certificate
- The awards are received before 1st October 2012
- Completed and fully occupied building

The selection criteria of the cases were due to the researcher's believes that a successful sustainable building (the product) starts with sustainability integration during the project planning process and the sustainability aspects are considered throughout the project and building life cycle. Thus, the selected case study projects should be a sustainable building that has been completed and fully occupied, so that the building whole life at least until operation and maintenance stage can be interrogated.

A successful performance of a sustainable building project comes from the effectiveness of sustainability integration into the project since the early planning process. The idea makes the researcher believed that the winner of ASEAN Energy Award by the ASEAN Center for Energy (ACE) and a building with a full GBI Malaysia certificate as significant to be the selection criteria of the cases as these two achievements and recognitions are based on the consideration of the sustainability related measures of performances. Thus far, in term of sustainability related appreciation, the Malaysian sustainable buildings have been only awarded and certified by these three prestigious bodies – ACE and GBI Malaysia and also by Singapore GreenMark. The selected cases should be awarded before 1st October 2012 because this is the time where the actual case study fieldwork of this research began.

In discussing the number of literal and theoretical replications, Yin (1994:50) stated that the number of literal replication is a matter of flexible, judgmental choice which the selection of the number of replications depends upon certainty the researcher want to have in their multiple case results. For the number of theoretical replications, the important consideration is related to the complexity of external validity. When external conditions are not thought to produce much variation in the phenomenon being studied, a smaller number of theoretical replication is needed.

> …because a sampling logic should not be used, the typical criteria regarding sample size also irrelevant (Yin, 1994:50).

Up to October 2012, Malaysia has only a total of three sustainable buildings which won the first place of ASEAN Energy Awards and fully certified by GBI Malaysia (refer to Table 3.6, p122 and Table 3.7, p128 in Chapter Three). Therefore, the three sustainable building projects were selected to be the case study of this research as follows;

- LEO (Low Energy Office) Building, Putrajaya (completion in 2004 – a GBI Certified building (Silver - NREB) since 2011 and the Winner of 2006 ASEAN Energy Award (New and Existing Building Category) (refer to Appendix D, p323)
- GEO (Green Energy Office), Bandar Baru Bangi (completion in 2007- a GBI Certified building (certified - NRNC) since 2009 and the Winner of 2006 ASEAN Energy Award (On-Grid Category) (refer to Appendix E, p330)
- Diamond Building, Putrajaya (completion in 2010 – a GBI Certified building (Platinum - NRNC) since 2011 and the Winner of 2012 ASEAN Energy Award (New and Existing Building Category) (refer to Appendix F, p341)

4.3 FIELDWORK

4.3.1 Distribution of Questionnaire

The questionnaire survey were distributed either direct approach to the respondents either personally or through the help of enumerators who were appointed for this quantitative survey, using telephone interview, postage mail and electronic mail. The time spent for questionnaires distribution was approximately seven months and a half including the time spent for pilot study of two months (October to November 2011).

The questionnaires have been distributed to the 188 stakeholders companies who have given positive replies, agreed to involve in the questionnaire survey and judged to be competent in giving the useful input for the research. However, after two months of the questionnaire distribution, only a total of 14% responded by the initial deadline period (15^{th} December 2011 – 15^{th} February 2012). Due to the low response of the initial period, the researcher has lengthen the period of collecting completed questionnaire and to enhance the effort including to personal and telephone survey. However, by the end of May 2012, 188 samples were successfully obtained, making the overall response rates of 100% (refer Table 4.3, p156).

Table 4.3: Pilot Study and Distribution of Questionnaire for the Actual Fieldwork

Date / Steps	1st – 31st October 2011 (1 month)	1st – 30th November 2011 (1 month)	1st – 15th December 2011 (2 weeks)	15th December 2011 – 31st May 2012 (5 months)
Pilot Study (four times revisions in total)	First Phase Piloting - First and second Questionnaire Revision (10 respondents)	Second Phase Piloting – third Questionnaire Revision (10 respondents)	Final Questionnaire Revision	
Distribution of Questionnaire				Valid returned: 188 (100%)

4.3.2 Case Study

Case study interviews and fieldwork took place after the completion of quantitative survey analysis because the design of the interview questions is based on the quantitative results. The actual fieldwork for personal case studies interviews, site observations and review of available project documents were conducted from 1st September 2012 to 31st December 2012 which is about four months duration as depicted in Table 4.4 below.

Table 4.4: Pilot Study and Case Study Fieldwork

Date / Steps	19th – 31st August 2012 (2 weeks)	1st – 30th September 2012 (1 month)	1st – 31st October 2012 (1 month)	1st November 2012 – 30th November 2012 (1 month)	1st December 2012 – 31st December 2012 (1 month)
Pilot Study	Piloting and Interview Questions Revision (3 respondents)	Piloting case study project and revision			
Case Study Fieldwork and Interview Session		Interview Session, Site Observation and Project Documents Reviews: Project 1 (5 sessions)		Interview Session, Site Observation and Project Documents Reviews: Project 2 (5 sessions)	Interview Session, Site Observation and Project Documents Reviews: Project 3 (5 sessions)

Beginning August 2012, email requests and telephone calls for interview appointments were sent to the initially 7 main stakeholders of each project which are involved in total of 21 respondents (3 owners, 3 developers, 3 architects, 3 energy consultants, 3 local authorities, 3 contractors and 3 energy/facility managers). However, due to the age of the projects and the cross cases analysis reason, it was only five groups of project stakeholders were still available to be interviewed consisting of 3 owners, 3 energy

consultants, 3 local authorities, 3 contractors and 3 energy/facility managers), making the total respondents of 15. The date and time for interview session was set beforehand since many of the respondents have very tight work schedules. It was not surprisingly that there were instances where appointment for interviews had to be cancelled and rescheduled due to the reason that the respondents had to attend to other important matters. Many reminder emails and follow up phone calls were made from time to time, whenever necessary to those respondents who were approached for the in depth interview either agreed to participate or suggested a more relevant person to contact in their respective organizations.

The overall completion of the interview process took about four months of duration from 1st September 2012 to 31st December 2012. Each interview lasted about 90 minutes to 150 minutes depending on the respondents' willingness to spare their time and to provide additional information. Besides interviews with the stakeholders, the data for the research were also obtained through reviews of relevant documents such as drawings, plan, briefing documents, GBI submission reports, newspapers, project reports, site observations and photographs. The case studies profile, the field work and the data collection information for each building project are summarized in Appendix D (p323), Appendix E (p330) and Appendix F (p341).

4.4 ANALYSIS OF RESULTS

Data collected from the questionnaire survey were analyzed using Statistical Package for Social Sciences (SPSS) Version 17.0 for Windows software and Microsoft Office Excel 2007 by employing quantitative analysis method, while, for the case study, qualitative content analysis, replication logic and cross case analysis were utilized as outlined in the following sections.

4.4.1 Quantitative Analysis

In the effort to analyze the collected quantitative data, four method of analysis have been utilized: Cronbach's alpha Measurement, Factor analysis, Descriptive statistic (frequency, descriptive analysis and cross tabulation) and Relative Important Index (RII). Section A of this research's questionnaires applied to the frequency analysis, descriptive and cross tabulation analysis. Section B and C of this research's

questionnaires applied to the frequency and descriptive analysis, cronbach's alpha measurement and factor analysis. A framework of integrating sustainability through project planning process Stage 1 was then developed from the analysis findings (Table 5.60, p213). RII was next employed to indicate the weighting value of each factor and assigning the appropriate weighting levels to each of the final selected factors. A framework of integrating sustainability into the project planning process Stage 2 was then formulated (Table 5.63, p217) before moving to the qualitative stage for the external validation and further refining process.

a) Descriptive Statistic

Descriptive statistics involve arranging, describing, summarizing and presenting data into meaningful information. Frequency analysis is employed to identify the nature of population sample and analyzed their understanding and ability with regards to the questionnaire (Norusis, 2002). While, descriptive analysis was used to generalize the result of the research and explain the situation of the research outcomes which can be explained in the form of frequency, centered probability (mean, mode and median) and distribution (variation, dispersion and standard deviation) (Naoum, 1998). Cross tabulation technique was used in this study to compare different scores from various respondents in order to evaluate whether there are significant differences between those groups of respondents.

b) Cronbach's alpha

Cronbach's alpha was utilized to analyses the quantitative data in order to measure the internal consistency and reliability of the variables in this study (explained details in Chapter Five). Even if a high value for Cronbach's alpha indicates good internal consistency of items in the scale, dimensionality of the scale is still need to be determined by factor analysis method (Gliem and Gliem, 2003).

c) Factor Analysis

Factor analysis is a data reduction technique used to reduce a large number of variables to a smaller set of underlying factors that summarise the essential information contained in the variables. It represents a broad category of approaches and mathematical

procedures for determining the latent variable structure of observed variables (Nunnally, 1978) which is used to evaluate construct validity (McCoach, 2002). It was advisable to reduce the variables and measure them well rather than have a large number and not address them properly (Jugdev and Muller, 2005). The factor menu in SPSS allows seven methods of factor extraction (Coakes, 2009). However, the most frequently used of these methods are principal components (PCA) and principal axis factoring (PAF). There is much debate in the literature over which method is the most appropriate. However, this study demonstrates only PCA because it assumes that all variability in an item should be used in analysis compared to PAF that that only uses the variability in an item that is common with other items (StatSoft, 2003). The purpose of applying the PCA in these sections B and C is to enhance the results of the previous cronbach's alpha. Alpha reliability was only indicated good internal items in the scale without considering dimensionality of the scale. In compliment, PCA is able to examine relationships between the variables and explains what these factors represent and therefore, it was useful to reduce a large number of variables to a smaller set of underlying factors that summarize the essential information contained in the variables for external validity. PCA on the set of 29 factors of sustainability principles of building and 21 factors of the integration strategies into the project planning process (50 factors) as listed in the preliminary framework with an orthogonal rotation of varimax was used to assess construct validity of the scores obtained from the quantitative survey.

The findings of Cronbach's Alpha Measurement and Factor Analysis are significant to provide accurate estimate of internal consistency and indicate how well the factors in the set are correlated each other. They are also important in reducing the factors and select only the important factors from the preliminary framework.

d) Relative Important Index

For the purpose of indicating the weighting value of each factor that has been selected through the previous quantitative method, the data was analyzed using RII approach. By using mean values (MS), the resulted RII value was transformed into three important levels: high ($0.8 \leq RII \leq 1$), medium ($0.5 \leq RII \leq 0.8$) and low ($0 \leq RII \leq 0.5$) (Tam et al, 2007). The RII ranges are from zero to one and the factors will be ranked based on the biggest value. It was measured based on the following formula (Tam et al, 2000).

$$RII = \frac{\text{Sum of weights } (W1 + W2 + W3 + \ldots\ldots + Wn)}{A \times N}$$

'W' is the weights given to each factor by the respondents and will ranges from 1 to 5 where '1' is not at all important and '5' is very important, 'A' is representing of the highest weight (i.e. 5 in this case), and 'N' is representing of the total number of respondents (i.e. 188 in this case). Put differently, RII is calculated by dividing the mean of the weightings assigned by the respondents with the highest weighting.

$$RII = \frac{\text{Mean}}{5}$$

Finally, the results of all these quantitative methods were generalized by employing a triangulation measures as their validity checking (Hammersley, 2009). The factor of the proposed framework that is omitted by any one of the refining methods will be removed from the lists as it is not fulfill one or more of the requirements throughout the refining process. The findings then were brought forward to the case study method for the external validation.

4.4.2 Case Study and Qualitative Analysis

The goal of qualitative phase was to get inputs from the relevant local stakeholders, who have been directly, involved in the planning process of the selected projects in order to further refine the proposed framework (stage 2). Initially, each case was analyzed separately. Each individual case's conclusions were then considered to be the information needing replication by other individual cases. All three individual cases and the multiple results were then developed for the summary report. This was followed by cross case analysis where similarities and differences among cases are studied. 'For each individual case, the report should indicate how and why a particular proposition was demonstrated (or not demonstrated). A cross case, the report should indicate the extent of the replication logic and why certain cases were predicted to have certain results, whereas other cases - if any – were predicted to have contrasting results' (Yin, (1994:49-50). The processes are illustrated in Figure 4.4.

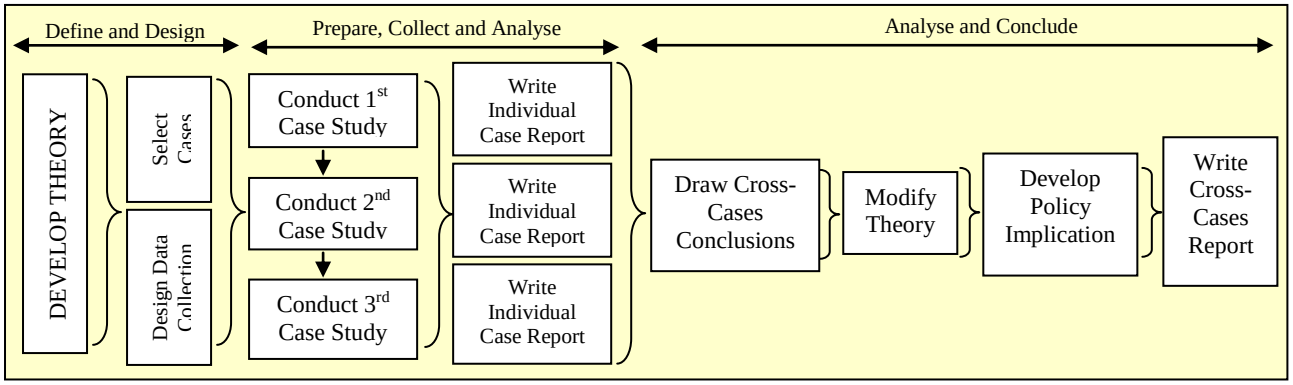

Figure 4.4: Case Study Method: The Replication Logic Approach of this Research
Source: Adapted from COSMOS Corporation (in Yin, 1994:49)

Each respondent was assigned a code number for instances, O1 is for the respondent who is the owner for the case study number one and O2 is for the respondent who is the owner for the case study number two. The complete list of the code numbers are shown in Table 4.5 below.

Table 4.5: List of Respondents

Name of Building / Respondents	**LEO**	**GEO**	**DIAMOND**
Owner	Ministry of Energy, Green Technology and Water-KeTTHA)	Malaysia Energy Centre (PTM)	Malaysia Energy Commission (ST)
Code number	**O1**	**O2**	**O3**
Energy Consultants	DANIDA	IEN Consultants	IEN Consultants
Code number	**E1**	**E2**	**E3**
Main Contractor	Putra Perdana Construction Sdn. Bhd. (Design & Build Contractor)	Putra Perdana Construction Sdn Bhd	Putra Perdana Construction Sdn. Bhd. (Design & Build Contractor)
Code number	**C1**	**C2**	**C3**
Local Authority	Putrajaya Corporation	Kajang Municipal Council	Putrajaya Corporation
Code number	**L1**	**L2**	**L3**
Energy Manager (End User/operator)	KeTTHA	PTM	ST
Code number	**M1**	**M2**	**M3**

The data from the interviews were analyzed using content analysis which involved the process of 'identifying', 'coding', 'categorizing', 'classifying' and labeling the primary patterns in the data (Patton, 2002; Boyatzis, 1998). Sandelowski (2000) highlighted that content analysis is the analysis strategy of choice in qualitative studies. As Merriam (1998:160) explained that 'in one sense, all qualitative data analysis is content analysis in that it is content of interviews, field notes and documents that is analyzed'.

4.5 FRAMEWORK DEVELOPMENT

The findings of this research have recommended a framework to integrate sustainability into the project planning process relevant to Malaysian context (Table 6.20, p251). The proposed framework consist of the sustainability principles of building and the integration strategies into the project planning process that considered the local building project stakeholders views based on their knowledge and experiences on sustainable building project. This framework is very useful to guide the effective integration of sustainability principles into the upcoming practices of building project. The framework will provide an essential guide during the project planning process towards delivering a successful sustainable building project in Malaysia in the future.

4.6 SUMMARY

This research applied mixed methods approach (quantitative, qualitative and case study) to achieve the research objectives. The quantitative method was conducted through quantitative survey as a mean of getting inputs from the Malaysian building project stakeholders as a general. Qualitative method was employed through multiple case study approach to investigate the sustainability integration practices in the local sustainable building projects.

There were various techniques employed to gather data for the research namely; questionnaire survey, face to face interviews, site observations and photography and project documents reviews. The graphical representation of research summary is portrayed in Figure 4.5 (p164). It shows the sequence of the research, methods and outputs of the research from every single stage. Descriptive statistic, Cronbach's alpha, PCA and RII have been employed for the quantitative analysis.

Cross case analysis and literal replication logic have been utilized for the multiple case study and qualitative analysis. Following a systematic process of structured four stages research approach (refer to Figure 4.1, p139) and employing all of those selected methods were able to strengthen the quality of the research design especially on the validity and reliability of the research findings as shown in Table 4.6 (P163). Last but not least, the major findings of this research was a recommendation of a framework to

integrate sustainability into the project planning process for Malaysia buildings as illustrated in Table 6.20 (p251).

Table 4.6: Quality of the Research Design

Tests	Case Study Tactic	Quantitative Survey Tactic	Phase of Research in which Tactic Occurs	
			Case Study	Quantitative Survey
Construct Validity (correct operational measure)	- Use multiple source of evidence (interviews; questionnaire survey; documents; photographs; direct observation) - Establish chain of evidence (explicit links between questions asked, the data collected and the conclusions drawn)		- Data collection - Data collection composition	
	- Have key informants review draft case study report	- Principle Component Analysis	- Data collection - Data collection composition	- Data Analysis
Internal Validity (Establishing a causal relationship: Explanatory or causal studies)	- Do explanation- building (cross case analysis)	- Cronbach's Alpha	- Data Analysis	
External Validity (Findings can be generalized)	- Use replication logic in multiple-case studies	- Principle Component Analysis	- Research Design	- Data Analysis
Reliability (minimizes errors and biases in a study such as data collection procedures can be repeated with the same result.)	- Use case study protocol- procedures; general rules; instruments - Develop case study data base – proper documentation (a formal assembly of evidence distinct from the final case study report).	- Cronbach Alpha - Principle Component Analysis	- Data collection	- Data Analysis

Source: Adapted from Yin (1994:33)

RESEARCH AIM:

'Developing a framework for integrating sustainability into the project planning process for Malaysian buildings.'

RESEARCH METHODS:
MIXED METHOD (QUANTITATIVE, QUALITATIVE, CASE STUDY)

TWO LEVELS OF PRIMARY DATA

LEVEL 1: QUANTITATIVE SURVEY
Research Question:
RQ5: What are the most significant sustainability principles of buildings and how the principles should be integrated into the planning process of Malaysian building project?
Research Methods:
- Questionnaire-based approach (Malaysian building project stakeholders)

Sources of Evidences:
- Questionnaire survey

Data Analysis:
- Descriptive statistic
- Cronbach alpha
- Factor Analysis
- Relative Important Index

Outputs:
- Their awareness and experiences and other inputs on the subject matter.
- Malaysian building project stakeholders' preferences on sustainability principles of building and the strategies to integrate the principles into the project planning process (the factors) to be addressed in the proposed framework (Stage 1 framework).
- Weight and importance level of the factors (Stage 2 framework)

LEVEL 2: QUALITATIVE (CASE STUDY)
Research Questions:
RQ3: Do project stakeholders integrate the sustainability principles into the project planning process of Malaysian sustainable building project? What? How?
RQ4: How the sustainability integration practices into the planning process influence the project performance?
RQ5: What are the most significant sustainability principles of buildings and how the principles should be integrated into the planning process of Malaysian building project?

Research Methods:
- Multiple Case Study, literal replication

Sources of Evidences:
- Interviews, Documentations, Direct Observation, Photography

Data Analysis:
- Qualitative Content Analysis,
- Individual case analysis
- Cross-case analysis

Outputs:
- Sustainability principles and the integration strategies practiced in the case studies' projects.
- The impact of sustainability practices on influencing the projects performances.
- Their experiences on the barriers, issues and other inputs on the subject matter.
- The case studies projects stakeholders' preferences on the most significant sustainability principles of building and the strategies to integrate the principles into the project planning process (the factors) to be addressed in the proposed framework.
- Refined and validated framework (Final Framework).

Figure 4.5: Summary of the Research Methodology