CHAPTER TWO

SUSTAINABILITY IN BUILDING AND THE PROJECT PLANNING PROCESS

2.1 INTRODUCTION

The main objective of this chapter is to determine the key principles of sustainability integration into the project planning process for buildings. This is important to enable the study to be informed by the theory in this field, which shall inform the development of the preliminary framework of Integrating Sustainability through Project Planning Process in the next chapter. Specifically, this chapter aims to address research question one of this dissertation – 'what are the sustainability principles of buildings, how to integrate the principles into the building project planning process and their impact on influencing the project performances?'

This chapter is divided into three main sections. The first section begins by exploring and discussing the evolution of the sustainable development concept, covering the varying definitions of sustainable development and sustainable construction and their component to understand their key concepts. It then reviews the global efforts concerning sustainable development. This review enables the researcher to identify the important aspects and principles of sustainability that have been developed and accepted globally. This chapter then goes on to explore and investigate the extent of sustainability principles being incorporated in building project in the second section. It highlights the different between sustainable and green building and studying the sustainability framework and Building Performance Assessment Systems (BPASs) that currently exist. The experiences of developed countries that have already had their successful sustainable buildings and benefits of the project are also examined. The sustainability principles of building are also reviewed at the end of this section. The third section highlights the sustainability practices in project management. It mainly discusses several related concepts such as 'project', 'project management', 'project life cycle' and 'project planning processes'. It then reviews the strategies to integrate sustainability principles into the project planning process for buildings. This section also reveals on the performance of the project which influenced by the sustainability integration practices.

Finally, this chapter summarizes a list of sustainability principles of building, strategies to integrate the principles into the building project planning process and the key criteria of successful project performance.

2.2 THE CONCEPT OF SUSTAINABLE DEVELOPMENT AND SUSTAINABLE CONSTRUCTION

2.2.1 The Concept of Sustainable Development

'Sustainability' is not considered as a new concept as it was used since the 1970's (Grevelman and Kluiwstra, 2010) even though the practice during the time was still largely hold a preservationist philosophy. Dola (2003) highlighted that this concept only had gained global political recognition since it was introduced by the Brundtland Report titled 'Our Common Future' in 1987 at the United Nation Conference on Environment and Development. The report was the first which focuses on global sustainability which explicitly addressed the links between social, economic and environmental dimensions of development and sustainability towards devising a new development model, that of 'sustainable development'. From this moment on, it became increasingly important for organizations to be aware of this subject (Grevelman and Kluiwstra, 2010) and presently, as evidenced by Francis et al (2009) the sustainability concept has formed a foundation of most developments and socio-economic activities in the built and natural environments. Sustainable development has different views, meanings and interpretations to different people (Larsen, 2009). It is also viewed variously as a rubric, vision, philosophy, mission, goal, mandate, principle, marketing ploy, constraint, criteria and movement (Larsen, 2009). Sonny et al (2009) believed that it occurs due to the diverse area of study and the diverse rationality of different players who interpreted this term differently whereby in some situations lead to the transforming of this concept into the inharmonious tunes.

The concept of sustainability was argued as a non rigid doctrine instead of a complex concept, which there is in praxis no consensus about, apart from the overall, quite broad principles and inherently unclear (Labushagne and Brent, 2005). Today, the term is very commonly used but in effect the concept of sustainability is actively redesigned for the specific purpose at any given time and context. Brundtland report defined sustainable development as 'meeting the needs of the present generation without compromising the

needs of future generations' (WCED, 1987: p8). This definition has been strongly endorsed by The World Development Report 1992 (World Bank, 1992). The birth of the Brundtland report's sustainability concept has influenced environmental laws and planning in a wide range of countries worldwide.

There are currently over a hundred definitions of sustainability and sustainable development. However, most of them agreed that the concept aims to satisfy social, environmental and economic goals which are based upon the 'three pillar' of 'triple bottom line concept' (TBL) (Zainul Abidin, 2010a; Labushagne and Brent, 2005; Popea et al, 2004). TBL concept was developed in 1997 by John Elkington (Magis and Shinn, 2009; Edward, 1998) who then made public the definition in his article: 'Cannibals with Forks': The Triple Bottom Line of 21st Century Business' (Grevelman and Kluiwstra, 2010; McKenzie, 2004).

Some of the definitions based on TBL concept are as Magis and Shinn (2009) and Larsen (2009) stated that 'sustainability' is often thought of as comprised of three overlapping mutually dependent goals (TBL) which are a) to live in a way that is environmentally sustainable or viable over the long term, b) to live in a way that is economically sustainable, maintaining living standards over the long term and c) to live in a way that is socially sustainable at present and in the future. Francis et.al (2009) and Zainul Abidin (2010a) highlighted that the concept of sustainable development to be effectively attained, need to address the social, economic and the environmental aspects as represented by the concurrent overlap of the three dimensions of environment, economic and social as shown in Figure 2.1 (p28). World Commission on Environment and Development (WCED, 1987) report to the United Nation (UN), which stipulated that sustainable development required concerted attention to social, ecological and economic conditions. The World Bank (1992) further discussed that 'sustainable' is about ensuring that improvements in human welfare are lasting.

Larsen (2009), who was the lead U.S negotiator for four chapters of Agenda 21, the most comprehensive outputs of the 1992 Earth Summit in Rio de Janeiro, however emphasized that despite its complexity and proliferation ideas, sustainability is a concept that elicits passion and commitment. He declared his perspective on sustainability which is in its beginnings as a science, as a set of societal goals, as a set of values, and as an approach to dealing with problems in the real world. He believed that

its defining task is no less than harnessing global capitalism to human needs, securing human dignity in the world order and mediating the impacts of a world economy, population growth and human settlement patterns on earth that found suddenly finite.

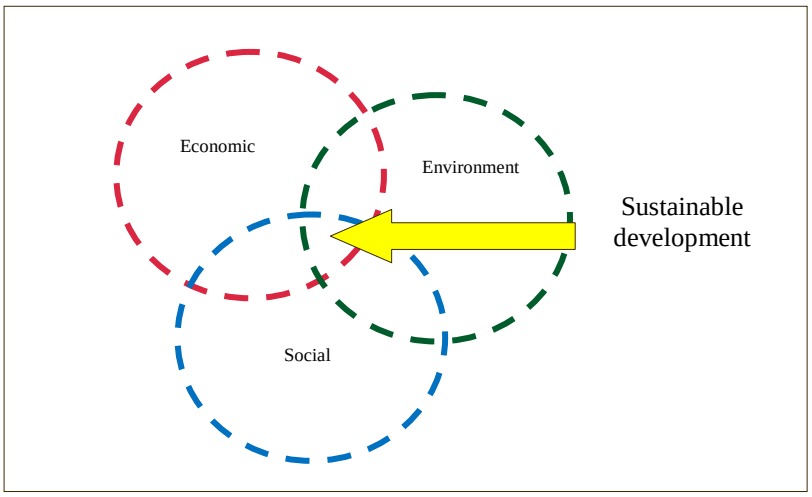


Figure 2.1: Underlying concept of sustainable development
Triple Bottom Line Model

It is clear that there is no common philosophy or definitions on sustainable development as reaching a consensus is a complicated. The term 'sustainable development' was used differently in 1970's as compares to 1980's and beyond, where 1970's was about conserving natural resources for continuous economic growth and in contrast, supported of sustainable development in 1980's to find way of making economic growth sustainable, especially through technological change (Pearce et al, 1989). Meanwhile, the term 'sustainable development' that has gain worldwide recognition today is towards to embrace and balance the relation between environment, economic and social aspects which will be used throughout this dissertation.

2.2.1.1 Sustainability Dimensions

Sustainable development refers to the process of development in a sustainable manner by integrating economic, social and ecological dimensions of objectives in order to achieve a comprehensive and holistic sustainable development. Most researchers argued that imbalance priority given among these three dimensions may result in failure to achieve sustainability such as highlighted in World Bank (1992) below;

> Economic development and sound environmental management are complementary. Development can contribute to improved environmental management and a healthy environment is essential for sustainable development (World Bank, 1992:1.1).

Environmental sustainability is a part of the TBL and no greater importance than social and economic aspects; however this aspect is easier to be identified. One of the meanings given for 'environmental sustainability' is the matters concerned with planetary protection and the maintenance of diverse eco-systems (Sayce et al, 2004). Thus, environmental sustainability should be implemented by managing efficiently for long term the renewable and non-renewable resources, reducing waste and pollution and ways to repair damage must be invented. The World Development Report (1992) highlighted that damage to the environment has three potential costs to present and future human welfare - human health may be harmed, economic productivity may be reduced and the pleasure or satisfaction obtained from an unspoiled environment may be lost (World Bank, 1992). The Report also highlighted that there are several principal health and productivity consequences of environmental mismanagement which are water pollution and scarcity, air pollution, solid and hazardous wastes, soil degradation, deforestation, loss of biodiversity and atmospheric changes. All economic activity involves transforming the natural world. Economic activity sometimes result in excessive environmental degradation due to the need of sharing natural resources and the true value of many environmental goods and services are not paid for by those who use them. Nevertheless, rising per capita incomes combined with sound environmental policies and institutions can form the basis for tackling both environmental and development problems.

The key to growing sustainably is not to produce less, but to produce differently. Edwards (1998) suggested that environmental sustainability adaptations into a building will benefits the stakeholders and the building itself. He also argued that most green buildings are economic when correctly designed and operated in a sustainable manner. Sayce et al (2004) highlighted that environmental sustainability of a building should consider some key aspects which are; 1) legal sustainability standards (which have to be met for most employment activities and the building itself in order to be sustainable), 2) location and transport system, 3) ecological issues and 4) adaptability (the adaptability of the building to meet new technologies and changing working practices)

Economic sustainability means different things to different groups of people depending on their relationship with the organization under consideration. It is usually considered in term of gross domestic product (GDP), real incomes and a range of indicators, including employment (Sayce et al, 2004). According to Pezzey (1992) economic

sustainability is a condition of maintaining economic welfare right into the future. He highlighted that economic sustainability focuses more on the portion of the natural resource base that provides physical inputs, both renewable and exhaustible, into the production process. However, Sayce et al (2004) concluded that economic sustainability is best assured by compliance with the other two heads of TBL which are environmental and social sustainability aspects. They highlighted that sustainability principles of a building should consider some key aspects which are; 1) the building works efficiently (efficient use of space and resources, 2) not creating waste, 3) creating employments or services and beneficial to community), 4) economic rate of return (owner income, prospective capital growth, stability, social cost benefits, job creation, recovery of polluted land, rates income etc.), 5) efficient use of land, the effect of the form of property tenure, 6) the quality of the transport access (sustainable building that serve public should be located to be accessible to all potential users including disability and to those who only depends on public transport), 7) building fabric maintenance/ durability and 8) adaptability (the ability of the building to changing circumstances.

'Social sustainability is a life-enhancing condition within communities and a process within communities that can achieve that condition' (McKenzie, 2004:12). Currently, social sustainability is the least developed of the three constructs and often is posited in relation to ecological or economic sustainability (McKenzie, 2004). As evidenced by Magis and Shinn (2009) consensus does not exist even on a definition of social sustainability. Most business sustainability efforts appear to interpret social sustainability as a charity, performed as an act of public relations. These are policies that encourage community involvement, volunteering and development of local communities. In urban planning, the understanding of social sustainability is conceived of as equity, without much thought as to what that might require or whether equity alone is sufficient for social sustainability (Magis and Shinn, 2009). A more thought-out and satisfactory definition of social sustainability is provided by Harris and Goodwin (2001:xxix), 'a socially sustainable system must achieve fairness in distribution and opportunity, adequate provision of social services, including health and education, gender equity and political accountability and participation.' Even though more concrete, Magis and Shinn (2009) claimed that this definition still misses the social process required to achieve economic and environmental sustainability that concern many for instances community involvement with the understanding that community engagement is necessary for successful implementation of particular

policies. Therefore, they concluded that social aspect of sustainability should be understood as both a) the processes that generate social health and well being now and in the future, and b) those social institutions that facilitate environmental and economic sustainability now and for the future.

Social sustainability is a new aspect in relation to building which is complements the existing aspects of economic and environmental sustainability. For a building, social sustainability is not yet one that has been reached in any quantifiable way. Sayce et al (2004) suggested that seven key issues of social sustainability should be assessed for a sustainable building which are, adaptability, cultural importance, appeal (lovability and likeability), construction legislation such as planning and building regulations that supports the sustainability issues, occupation legislations, locations/locality and social working environment quality such as quality of design, layout and social integration. While, research in behavioral sciences suggests that a good building habitat which fall within the realm of sustainable design supports connection to nature, sense of community and belonging, behavioral choice and control, opportunity for regular exercise, meaningful change and sensory variability and privacy when desired (Boyden, 2000 and Heerwagen and Orians, 1993).

With the current pace of development, these three dimensions of sustainability are increasingly in competition with each other. However, full environmental sustainability without economic and social sustainability cannot be a worthy objective and vice versa. In this respect, sustainability is seen as creating conditions for the achievement of sustainable development that involves continuous effort towards fulfilling current and future human needs within the constraints imposed by environment, economic, society and technology.

As discussed previously, differences in opinion can occur due to the dissimilarities in focus and priority. Another approach of viewing the interrelationship of the three components was given by Pearce (1993a) who argued that individual view on what is necessary to achieve sustainable development may range from weak to strong sustainability. A development is said to be weakly sustainable if the development is non-diminishing from generation to generation. This is by now the dominant interpretation of sustainability among economist, not ecologist and other natural scientist. Weak sustainability happens when manufactured capital of equal value can

take place of natural capital. It is means that natural materials and services can be replaced or duplicated with manufactured goods and services (Brekke, 1997). This idea also proclaims that natural capital can be used up as long as it is converted into manufactured capital of equal value. The problem with weak sustainability is that, while a monetary value can be assigned to manufactured goods and capital, nevertheless it can be very difficult to assign a monetary value to natural materials and services. This research noticed that weak sustainability does not take into account the fact that some natural material and services unable to be replaced by manufactured goods and services. The notion of weak sustainability has been ill received by many ecologist and ecological economists (Rao, 2000, O'Riordan and Voisley, 1998, Gowdy and O'Hara, 1997). This leads to the emergence of strong sustainability or the ecological version of sustainability.

The stronger definitions involve the recognition that natural and manufactured inputs are complements, rather than substitutes (Dola, 2003). Brekke (1997) sees sustainability as non-diminishing life opportunities which should be achieved by conserving the stock of human capital, technological capability, natural resources and environmental quality. It is means that the existing stock of natural capital must be maintained and enhanced due to the functions it performs unable to be duplicated by manufactured capital. According to Sustainable Aotearoa New Zealand inc. (SANZ, 2009) the concept of strong sustainability is based on the scientific fact that all human life and activity occurs within the limitations of planet Earth or the biosphere (environment) where humankind life, including societal functions such as the economy. They believe that without a functioning biosphere there can be no societal functions, including an economy or 'econosphere'. They stressed that in order for human civilisation to continue, the true model for sustaining the planet should be as shown in Figure 2.2 (p28). Giddings et al (2002) highlighted that placing the economy in the centre does not mean that it should be seen as the focus rather it is a subset of the others and is dependent upon them. Human society depends on environment although in contrast the environment would continue without society. The economy depends on society and the environment although society for many people did and still does without economy (Lovelock, 1991).

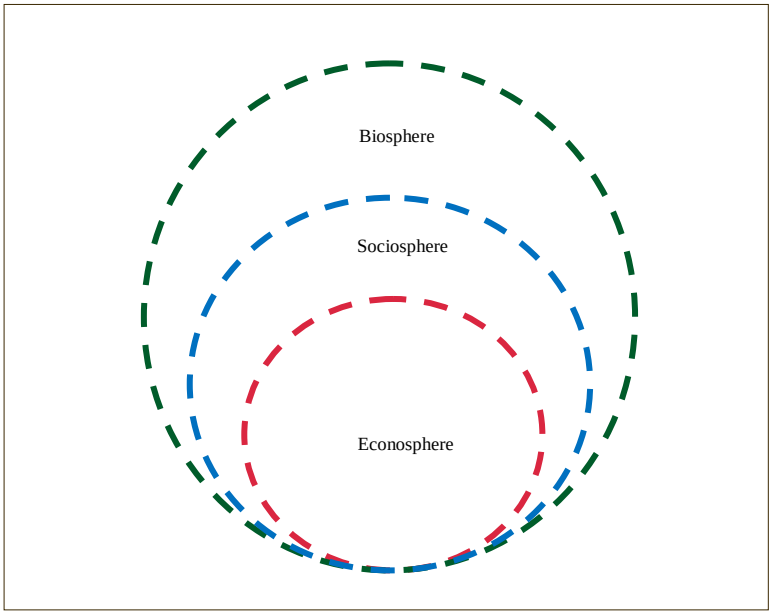


Figure 2.2: Strong Sustainability Model
(Source: SANZ, 2009)

The model in Figure 2.2 is very different to the current TBL model for sustainability that is widely used as shown previously in Figure 2.1 (p23). According to SANZ (2009), the TBL model unable to sustain the biosphere due to it places the same importance on the economy that it does on the resource the economy relies on to thrive. Added to that, they also highlighted that in general practice, TBL methods actually place the greatest importance on the economy, with societal and environmental value treated as secondary considerations. Therefore, they believe if humankind is to avoid major environmental and atmospheric catastrophes on a global scale, and the flow on effects of this, they need to shift beyond the threshold to the strong sustainability model which minimum amounts of a number of different types of capital (economic, ecological, and social) should be independently maintained, in real physical or biological terms. The major motivation for this insistence is derived from the recognition that natural resources are essential inputs in economic production, consumption or welfare that cannot be substituted for by physical or human capital. A second possible motivation is quasi-moral, namely acknowledgement of environmental integrity and rights of nature. In either case it is understood that some environmental components are unique and that some environmental processes may be irreversible (Ayres et al, 1998).

To sum up, sustainable development should not be perceived as independent but the three elements should be guaranteed to have a complete interaction among others and equally contributed to reach the same goal. Putting greater emphasis on one dimension

above the others is not impossible to be practiced by construction project stakeholders. Thus, throughout this study, the interrelations and balance between these three elements should be taken into account especially during the process of establishing the framework of integrating sustainability through project planning process in the next chapter.

2.2.2 The Concept of Sustainable Construction

Much has been said on the long-term future, the resources of the planet, the high levels of poverty, which are linked with the spread of disease, social unrest, population growth and the deterioration of environment (Chaharbaghi and Wilis, 1999; Sani, 1993). Although these issues could stem from various causes, construction activities are one of them as this sector consumes 25% of the virgin wood and 40% of the raw stone, gravel and sand worldwide each year (Dimson, 1996). In addition, the activities influence to the sustainable development from its impact to the output. Once a building is completely constructed and occupied, the design itself will help to maintain the comfort zone of the indoor environment continuously. However, the building will also impose in-use impact to the environment such as energy wastage, waste disposals, greenhouse emission, and soil contamination (Zainul Abidin, 2010a). Thus, the sector is responsible for massive solid waste generation, environmental damage and approximately a third of global greenhouse gases emissions (Zimmermen, et al, 2005 and De la Rue du Can, S and Price, 2008). Thus, construction sector has a potential contribution to progress in sustainable development and actions are needed to make the construction activities sustainable.

The construction industry is defined as all who produce, develop, plan, design, build, alter, or maintain the built environment, and includes building material suppliers and manufacturers as well as clients, end users and occupiers (Du Plesis, 2001). This industry can be generally divided into two categories; general construction and special trade works. General construction comprises of residential, non-residential and civil engineering works while, special trade works comprises of activities such as metal works, electrical works, refrigeration and air-conditioning works, painting work, carpentry, tiling and flooring works and glass works as Zainul Abidin (2010a:31) mentioned;

> Sustainable construction encompasses the complete life cycle of a structure from initial concept through to demolition and site remediation. It describes a process which starts well before construction in the planning and design stages and continues after the construction team has left the site (Zainul Abidin, 2010a: 31).

The concept of sustainability in construction has initially focused on issues of limited resources especially energy and on how to reduce impacts on the natural environment with emphasis on technical issues such as materials, building components, construction technologies and energy related design concepts (Zainul Abidin, 2009). The first definition of sustainable construction which was proposed by Charles Kibert in 1994, 'sustainable construction is the creation and responsible maintenance of a healthy built environment based on resources efficient and ecological principles' (Shari, 2011). Therefore, till today many researchers, developers, and the person who involved in construction are still convenient with this concept. For instances, BCA (2007) referred 'sustainable construction' to be the adoption of materials and products in building and construction that will require less use of natural resources and increase the reusability of such materials and products for the similar purposes, thereby reducing waste. They believed that sustainable construction enhances the resilience of the industry as such materials are readily available in the world market such as steel, glass, prefabricated parts and recyclable substitutes for concrete. Nevertheless, in defining 'sustainable construction' BCA (2007) was noticed to focus more on resources and environment measure. Thinking on social and economic measure has been relatively forgotten. They also related the concept of 'sustainable construction' with materials used and final product of a project without exploring the holistic process of construction including pre-construction phase, construction phase and post construction phase.

Zainul Abidin (2009) proclaimed that the appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to economic and social sustainability concerns as well as cultural heritage of the built environmental equally important. For instances, Agenda 21 on Sustainable Construction for Developing Countries (A21 SCDC) defined sustainable construction as 'a holistic process aiming to restore and maintain harmony between the natural and built environment and create settlements that affirm human dignity and encourage economic equity' (Du Plessis, 2002: 8). This definition bring the social and economic aspects of sustainability rather than only addressing the reduction of negative impact to the environment, as discussed in the earlier definitions. DETR (2000) highlighted that the construction industry can

contribute to the achievement of these sustainable development aims by being more profitable and more competitive, delivering buildings and structures that provide greater satisfaction, well-being and value to customers and users, respecting and treating its stakeholders more fairly, enhancing and better protecting the natural environment, minimizing its impact on the consumption of energy (especially carbon-based energy) and natural resources. Both statements has been agreed by Du Plesis (2001) as they highlighted that sustainable construction is a holistic system which is the sustainable development principles is applied into the whole construction cycle, encloses matters such as tendering, site planning and organization, material selection, recycling, and waste minimization. Therefore, this practice is not only help the environment but also able to improve economic profitability and improve relationships with stakeholder groups. Since sustainable building is a subset of sustainable development, it requires a continuous process of balancing all the three aspects; environment, economic and social. Thus, in realizing the sustainable project, it is a need to explore the strategies to integrate sustainability principles into the project management process or specifically 'the planning process' as focused in this dissertation.

2.2.3 Global Efforts Concerning Sustainability

The need to handle the environmental initiatives came to light in the early 1970s. Though, the initiatives have shifted to wider aspects which include social and economic development from 1987 onwards and the term 'sustainable development' was introduced for the initiatives in Brundtland Report in 1987 (Lowe and Zhou, 2003). Since then, many progressive world events had taken place to increase the sustainability agendas such as followings,

2.2.3.1 Agenda 21 (1992)

The significance of the construction sector to the success of sustainability was recognized at the Rio Earth Summit with the formulation of Agenda 21, which was a comprehensive program of action to help identify and clarify sustainable patterns of development (Edwards, 1999). Agenda 21 is among the most important international agreements which underlying the concept of sustainability, coming out of United Nations Conference on Environment and Development (UNCED) that was held in Rio de Janeiro, Brazil on 3rd to 14th June 1992. It is a 300-page plan for achieving

sustainability in the 21st century. The agreement on Agenda 21 was signed by 178 nations called for action to promote both social and economic development that conserves and manages the environment. The Agenda aims to provide a set of broad policy statements and objectives together with a framework for implementation that can be adopted at each level of government from the international to the local authority. The Agenda consist of 40 chapters of specific principles and objectives as listed in Appendix H (p349) which can be divided into four main categories which are social, economic, environment and institutional aspects as shown in Table 2.1 (Bell and Morse, 1999; United Nations, 1992a).

Table 2.1: The United Nation Working List of Sustainable Development Indicators

Category	Main Chapter Heading	Chapter numbers
Social aspects	combating poverty	3
	demographic dynamics and sustainability	5
	promoting education, public awareness and training	36
	protecting and promoting human health	6
	promoting sustainable human settlement development	7
Economic	changing consumption patterns	4
	financial resources and mechanisms	33
Environmental	promoting sustainable agriculture and rural development	14
	combating deforestation	11
	conservation of biological diversity	15
	protection of the atmosphere	9
	environmentally sound management of biotechnology	16
Institutional	science for sustainable development	35
	information for decision making	40
	Strengthening the role of major groups	23-32

Source: Bell and Morse, (1999:25)

Nevertheless, the Agenda did not establish any binding targets or commitments but it provided a conceptual framework under which international, national, regional and local organizations have to develop their own detailed implementation plans. As a result, the progress in the practical implementation of Agenda 21 has been varied from country to country, depending on local circumstances. Ultimately, the Rio Declaration on Environment and Development was adopted alongside Agenda 21 to provide a set of principles that countries should use in implementing the Agenda (Ling, 2012).

2.2.3.2 The Rio Declaration on Environment and Development (1992)

The Rio Declaration on Environment and Development (Rio Declaration) consist of 27 key principles as a blueprint towards achieving global sustainability. The principles, which are listed in Appendix I (p350) provide a useful guide on what actions, should be

implemented to realize sustainable development. The principles proposed that the need to consider environmental, economic and social issues in the development process. Among them are the needs for legislation on environmental and environmental impact assessment, public participation, information and community empowerment to support the principles (United Nations, 1992b). The principles are too conceptual to be easily implemented to the specific building and construction sector; however they are can be well integrated into the sector and the project planning process to support sustainable development. Both Agenda 21 and Rio Declaration encourage sustainability integration through integrative and participative approach in decision making which can be implemented in the planning process of building projects to make them sustainable. Some principles have long been practices in construction sector such as protection and promotion of human health conditions but to what extent the principles are effectively integrated and implemented in the project are still questionable.

2.2.3.3 The United Nations Framework on Climate Change (1992) and its Kyoto Protocol (1997)

The United Nations Framework on Climate Change (UNFCC) is an international environmental treaty negotiated at the UNCED. It is the global pact to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate systems (IPCC, 1990). UNFCC was open for signature in 1992 at the Rio de Janeiro and came into force in 1994. As of 2013, UNFCC has 195 parties. The parties have met annually from 1995 in Conferences of the Parties (COP) to assess progress in dealing with climate change (UNFCC, 2013a). In 1997, the UNFCC set off several negotiations, and the Kyoto Protocol was concluded at the third conference (COP3) in Kyoto, Japan which established legally binding obligations for developed countries to reduce their greenhouse gas emissions. The protocol entered into force in 2005 which under the protocol, countries' actual emissions have to be monitored and precise records have to be kept of the trades carried out. The Kyoto Protocol was also designed to assist countries in adapting to the adverse effects of climate change by facilitating the development and the technologies that can help to increase resilience to the impacts of climate change (UNFCC, 2013b). Thus, the Kyoto Protocol is an important first step towards a truly global emission reduction regime that will stabilize GHG emissions and provide the construction sector for the future international agreement on climate change.

2.2.3.4 The Millennium Declaration (2000)

United Nations Millennium Declaration was adopted following the Millennium Summit of United Nations in New York on the 8th September 2000 (United Nations, 2000) and agreed by 189 United Nations member states. The Declaration emphasizes that every individual has the right to dignity, freedom, equality, a basic standard of living that includes freedom from hunger, violence and encourages tolerance and solidarity. Millennium Development Goals (MDGs) which are eight international development goals have been established as the principal means of implementing the Declaration. The goals are to be fully achieved by 2015 as the followings;

1. Eradicating extreme poverty and hunger
2. Achieving universal primary education
3. Promoting gender equality and empowering women
4. Reducing child mortality rates
5. Improving maternal health
6. Combating HIV/AIDS, malaria and other diseases
7. Ensuring environmental sustainability
8. Develop a global partnership for development

The MDGs focus on three areas which are valorising human capital, improving infrastructure, economic and political rights towards increasing basic standards of living. Human capital focus is including improving nutrition, healthcare and education. The infrastructure improvements are through increasing access to drink water, energy and information technology, amplifying farm outputs through sustainable practices, improving transportation infrastructure and preserving environment. For the social, economic and political rights, the objectives include empowering women, reducing violence, increasing political voice, ensuring equal access to public services and increasing security of property rights (UNDP, 2011). The eighth goal, 'global partnership for development' is about to emphasize the role of developed countries in aiding developing countries in order to achieve the first seven goals through supporting fair trade, debt relief, increasing aid and access to affordable essential medicines and encouraging knowledge transfer in order to reduce world poverty. All the goals and targets of the Millennium Development are directly linked to sustainable development and recalled in the Johannesburg Plan of Implementation (JPI).

The greatest appeal of the MDGs is their concise, simple structure and clear deadline agreed by the UN which helped the world to focus their attention and efforts on one joint aim, halving extreme poverty. It was reported that the MDGs are making real difference in people's live including continuous declining of global poverty and child deaths and great expanded access to safe drinking water. Investment in fighting malaria, AIDS and tuberculosis was also saved millions. The progress is targeted to be expanded in most of the world's countries by the target date of 2015 (United Nations, 2013; United Nations, 2012). Conversely, the MDGs were heavily criticised for not addressing environmental sustainability and gender equality in an adequate way and for omitting several other issues, such as human rights. The MDGs are also criticized for being too focused on aid flowing from the developed to the developing world and for not addressing the root causes of poverty adequately (CAFOD, 2012).

2.2.3.5 The Johannesburg Plan of Implementation (2002)

The Johannesburg Plan of Implementation (JPI) is the most important document to emerge from the World Summit on Sustainable Development (WSSD) in 2002 (Earth Summit 2002) which designed as a framework for action to implement commitment originally agreed to at the UNCED held in Rio de Janeiro (United Nations, 2002). It reaffirms on the earlier commitments to the Rio Declaration principles, Agenda 21, the programme for further implementation of Agenda 21 and the Millennium Declaration. The JPI contains of 11 chapters accelerating the implementation of Agenda 21 as listed in Appendix J (p353).

2.2.3.6 Post-2015 Development Agenda

The United Nations is working with governments, civil society and other partners to build momentum generated by MDGs and carry on with an ambitious post-2015 sustainable development agenda to be adopted by UN Member States at a summit in September 2015. The United Nations Conference on Sustainable Development, Rio+20 was held on 20-22 June 2012 in Rio de Janeiro, Brazil to mark the 20th anniversary of the 1992 UNCED, in Rio de Janeiro and the 10th anniversary of the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. The UN members adopted 'The Future We Want' outcome document, which set in motion many of the inter-governmental processes for the post-2015 development agenda, including Open

Working Group (OWG) on Sustainable Development Goals (SDGs), the Intergovernmental Committee of Experts on Sustainable Development Financing and High-level Political Forum. The discussions were focused on two main themes: How to build a green economy to achieve sustainable development and lift people out of poverty, including support for developing countries that will allow them to find a green path for development; and how to improve international coordination for sustainable development (United Nations, 2013; United Nations, 2012). The significant commitments of Rio+20 are reported as followings (Osborn, 2013):

- The launch of a process to develop a set of SDGs, which will build upon the MDGs and converge with the post-2015 development agenda
- The launch of a program of work in the area of measures of progress to complement gross domestic product in order to better inform policy decisions
- New guidelines on green economy policies
- Adoption of a 10-year framework of programs on sustainable consumption and production patterns
- An ongoing process to promote sustainability reporting by companies
- The launch of a process to prepare options on a strategy for sustainable development financing
- Establishment of a new higher-level political forum for sustainable development in the United Nations to replace the Commission on Sustainable Development (CSD)
- Strengthening of United Nations Environment Programme (UNEP)

One of the most significant outcomes of the summit is the decision to establish a new set of universally SDGs for the world to be integrated into the UN's post-2015 Development Agenda (United Nations, 2012). To foster an inclusive global conservation, the UN Development Group has coordinated national, global and thematic consultations. Through 'MY World Survey', the UN global survey for a better world, more than 1.4 million people have voted on which six development issues most impact their lives and the number of voters continues to grow. This is the platform where people are engaged throughout the post-2015 development process (United Nations, 2013).

Member States at the UN and stakeholders globally are currently mobilised around two important processes: post- MDGs and SDGs. The Post-2015 Development Agenda has become an umbrella term for both processes. The purpose of a post-2015 framework is to ensure that the issues of great significance to people living in poverty, and which collective international efforts have the most potential to deliver change, are goals at the centre of international policy which drive actual progress in the real world (CAFOD, 2012). At present the post-MDG process is led by the UN Secretary General, following a mandate from Member States at the MDG Summit in 2010, the SDGs process is organised through an intergovernmental OWG, following agreement at the 2012, Rio+20. Both processes have poverty eradication within the context of sustainable development as a primary objective, with the aim of using a global goal framework to achieve this. There is now broad agreement among many Member States that the two processes should be brought together to create one set of goals and to the best use of existing stakeholder engagement outputs. One process is needed going forward that will create a single post-2015 process and lead to a unified sustainable development framework for poverty eradication, characterised by one set of global goals (Stakeholder Forum and CAFOD, 2013).

CAFOD (2012) suggested that a post-2015 framework should not be a whole world framework in the sense that it sets goals that apply in the same way to every country in the world. It should be a framework within which every country will need to take some kind of action. There are a huge number of important issues in the world which are worth considering as potential themes for post-2015 goals. CAFOD (2012) proposed that all the possible issues are carefully assessed against three criteria:

1. Is it of great significance for people living in poverty?
2. Does it need to be addressed through international cooperation?
3. Will international goals on it drive actual progress in the real world?

The issues with the strongest case for inclusion in a post-2015 framework sit at the overlap of all of the three criteria.

2.3 SUSTAINABLE BUILDING PROJECT

Sustainable building is considered as an approach for the building industry to move towards sustainable development by taking into account environmental, social and economic issues (Akadiri et al, 2012). As the definition of sustainability is widen, the assessment of the buildings become increasingly complicated and detailed (Gething and Bordass, 2006). Most published works relating to the concept of sustainable building, however undeniably was influenced by the initial concept of sustainability which are about limited resources and to reduce impact of the natural environment. For instance, Kibert (2005) highlighted that the practice of sustainable building refers to the creation and operation of a healthy built environment based on resource efficiency and ecological design with an emphasis on seven core principles across the building life cycle which are, 1) reducing resource consumption, 2) reusing resources, 3) using recyclable resources, 4) protecting nature, 5) eliminating toxics, 6) applying life cycle costing, and 7) focusing on quality. It was noticed that most of the definitions of sustainable building tend to focus more on environmental measure which is regularly called as 'green building' while the other sustainable development measures have been relatively forgotten. Most published works also use to relate 'sustainable building project' with materials used and final product without exploring the holistic process of the building whole life. According to Adler et al. (2006) the definition of sustainable building should go far beyond the environmental aspect. In accordance with the three aspects of sustainable development, which are economic, social and environmental, sustainable buildings can benefit human well being, community, environmental health and life cycle costs. The differences between sustainable and green building are discussed in the following section.

2.3.1 Sustainable Building versus Green Building

In literature, two terminologies are often used to describe sustainable buildings namely 'sustainable building' and 'green building'. Lutzkendoft and Lorenz (2006) pointed out that a green building is meant to be a building that exhibits energy efficiency, resource depletion, impact on environment and protection of health and environment. On the other hand, for a sustainable building, other requirements including 'minimization of life cycle cost, protection and /or increase of capital value, protection of health, comfort and safety of workers, occupants, users, visitors and neighbors, and (if applicable) to the

preservation of cultural values and heritage' should also to be fulfilled on top of the green buildings requirements.

'Green' is commonly found in its ties to nature such as regeneration, fertility and rebirth which recently the colour is used as a symbol of environmental protection and social justice (Greenbuildingideas, 2011). Consequently, a variety of 'green' terms were used in construction industry such as 'green construction', 'green project' and so on. In 1980s, under the cover of sustainable development (Rees, 1989) and sustainable design (St. John, 1992), green building has proven to be successful in contributing toward sustainability. However, green buildings are argued to be skewed on environmental aspect such as deliver low energy consumption (Schumann, 2010). Nevertheless, currently the significance of the non technical issues such as economic, social and cultural aspects have been emphasized gradually (Zainul Abidin, 2009; Du Plesis, 2001; DETR, 2000) in most of definitions and concept of green building as highlighted in among the published works as revealed in Table 2.2;

Table 2.2: Definitions of Green Building

Authors	Definitions of Green Building
Beatlety (2008)	The way structures are designed, constructed and maintained in order to decrease energy and water consumption and costs, improve the efficiency and sustainability of the building systems and reduce the negative impact buildings impose on the environment and public health
McGraw Hill Construction (2006)	The careful design, construction, operation and reuse or removal of the built environment in an environmentally, energy efficient and sustainable manner may be used interchangeably with high performance building, green construction, whole building design, sustainable building and sustainable design
National Association of Homebuilders (2006)	The process of building that incorporates environmental considerations into every phases of the building process which is energy and water efficiency, resource-efficient building design and materials, indoor environmental quality, homeowner maintenance and the building's overall impact on the environment are all taken into account during the design, construction and operation of a building
Adler et al. (2006)	Green building is a way of enhancing the environment, which benefits human well being, community, environmental health and life cycle costs
USBGC (2003)	Buildings that are designed, constructed and operated to boost environmental, economic, health and productivity performance over conventional building
Cassidy (2003)	The practice of (1) increasing the efficiency with which buildings and their sites use energy, water and materials and (2) reducing impacts on human health and the environment through better planning, design, construction, operation, maintenance and removal process
Cole and Larsson (1999)	Reduction in resource consumption (energy, land, water, materials), environmental loadings (airborne emissions, solid waste, liquid waste) and improvement in indoor environmental quality (air, thermal, visual and acoustic quality)

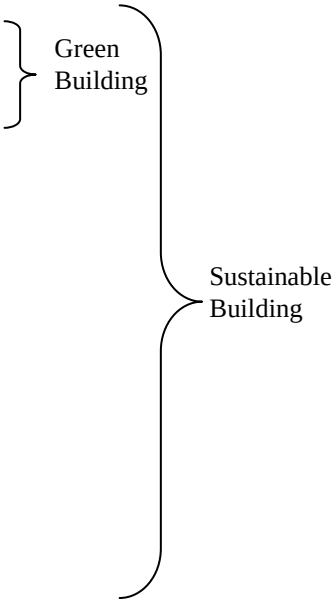
According to Wu and Low (2010) and Schumann (2010), green building belongs to the concept of sustainable development thus, instead of simply regarding green building as an assembly of new materials, technologies and other pieces of environment-friendly innovations, many researches agreed that it should be a holistic solution to achieve the sustainable development in the whole life of project toward sustainable construction. One consensus that repeatedly comes up from the literatures on green building standards is that of 'sustainable products'. However, based on the original definition of the term 'green' and 'sustainable', green building does not necessarily mean 'sustainable'. Building can be green in its ultimate application but not sustainable in its manufacture and initial use. Building as well can be 'green' if environmental aspects are incorporated, but not sustainable enough if economic and social aspects are left behind. A green building that made of sustainable materials and fits the BREEAM or LEED Certified program's guidelines is still unsustainable if the seemingly green building is constructed in a way that it harms the environment or workers. Even if there are clear differences in meaning and concept of green and sustainable buildings from the original term perspectives, however presently, both the terms and concepts are commonly used synonymously and interchangeably by the researchers and practitioners including in awarding sustainable and green building project. Therefore, it is very complicated to differentiate between green and sustainable building unless a thorough investigation is carried out through whole life of the building process. This situation arises due to lack of understanding on the exact concept of sustainability and due to the dilution of the term 'sustainable' itself by commercialization of green movement. Green building is easier to be recognized due to the known and measurable environmental criteria, whereas sustainable building is more complex as it goes beyond the environmental aspects (Adler et al., 2006) and the life cycle analysis of the building needs to be done in judging whether or not the building is categorized as a sustainable or otherwise (Edward, 1998). Responding to the criticism of lack of the reliability of many 'sustainability' claims, thus, there is a need for consistent indication of 'sustainability' for buildings in publications and competitions (Gething and Bordass, 2006).

Sustainable building is about the integration of sustainable development considerations throughout the whole life of building process (Yudelson, 2009). Akadiri et al (2012) and Hill and Bowen (1997) added that sustainable building is consisting of four principles; social, economic, biophysical and technical. To provide a clear understanding, Schumann (2010:6) differentiated the concept of green and sustainable

buildings as presented in Table 2.3. Gething and Bordass (2006) introduced a simple introduction to sustainability principles checklist for judging sustainable buildings. The checklist is used for judging the 2005 Royal Institute of British Architects (RIBA) Sustainability Award. The idea was not much on the normal technical issues (ecology, energy, water, materials etc) of building but more related to the process of decision making which starting with strategic aspects of the site until how the building was performing in use. The assessment checklist (Appendix K, p354) can be among the useful starting point to lead more precise understanding on sustainability integration in building projects.

Table 2.3: Differentiations of Sustainable and Green Building

Aspect	Sustainability Consideration
Ecological	- Use of resources - Air and Emissions - Waste management
Socio-cultural	- Well being, comfort - User satisfaction - Functionality
Economic	- Life-cycle costs - Value growth - Flexible use
Technical	- Durability of materials - Ability of deconstruction/recycling - Ease of maintenance
Process	- Planning - Building construction - Maintenance
Location	- Micro Location - Utilities - Infrastructure provision



Source: Adapted from Schumann (2010:6)

2.3.2 The Benefits of a Sustainable Building

Sustainable buildings impact the environment less during construction, provide healthier place for their occupants and are more cost-efficient over the life cycle than conventional structures (Doyle et al., 2009). The measurable and immeasurable benefits should to be revealed in order to persuade developers and clients to venture into this project. Several authors have found the net benefits of sustainability integration in building as follows:

2.3.2.1 Direct benefits

1. Reduce energy consumption, economies in operational cost and fuel bills either for owner or tenant

Research shows that sustainable building practices can considerably reduce the built environment's role in energy consumption (CBRE, 2009; and Edward, 1998). Depending on the level of improvement, these savings at least exceed 10% and could be well over 50% (CBRE, 2009). A survey of 99 green buildings in the United State showed they use an average of 30% less energy than conventional buildings. Meanwhile, other research in United State also found that Energy efficient design able to reduce building energy consumption by as much as 50% (The Economist, 2004). An example of a successful sustainable building is the head-quarters of the NMB in Amsterdam constructed in 1990, built to meet low-energy and high environmental standards, with plenty of user control over the temperature and humidity of working areas. It was reported to have saved more than £300 000 a year in energy costs against a conventional office building of similar size. The energy consumption is one-twelfth that of the bank's former building allowing the owner to calculate that the additional cost of plant and equipment was paid for in three months of occupation. Furthermore, NMB have found that absenteeism is 15% lower than in the old building adding considerably to the bank's performance. Therefore, it has proved a success in financial and productivity term. Although initial costs of sustainable construction can be higher than conventional projects, it is widely held that longer-term cost savings in operations and maintenance can help recover those costs. Sustainable buildings are expected to decrease operating costs between 8-9%, increase total building value by about 7.5% and increase occupancy rates by 3.5% (USGBC, 2006a; 2006b).

2. Market advantage and lower long-term exposure to environmental or health problems

The evidence record for this is limited, but analysis from the US indicates that the sustainable buildings do attract higher rents than conventional ones and also enjoy higher rates of rental growth (CBRE, 2009). A survey by developer St James' on their Kennet Island sustainable residential scheme in Reading, England revealed that four-fifths of residents would pay up to £3,000 for each of a select group of green and

sustainable features, including solar PV tiles, solar hot water tiles, Power Pipe hot water heat exchangers, grey water recycling and wind turbine. A research by real estate experts in Australia found out that majority of Australian investors are willing to pay more for a Green Star building (Muldavin, 2011). The improved marketability subject of sustainable buildings is the main current competitive advantage which are easier to sell and lease, which reduces vacancy times and hence income losses (Muldavin, 2011 and McKee, 1998). The buildings are able to fulfil user satisfaction, benefits to health and comfort, increase company image, having commercial advantage for environmental ethics, value for money in long term, adding the sale value of buildings and simpler to re-lease in the future (Edward, 1998 and McKee, 1998).

3. Greater productivity of workforce

Sustainable buildings have social impacts on the health and wellbeing of building occupants. Design features that promote sustainability have resulted in lower absenteeism and higher productivity rates among employees. A study conducted after Lockheed Martin completed green engineering and design facility in Sunnyvale, California showed that absenteeism rates dropped by 15% in the new building. Another California study of test scores from 21,000 students concluded that students in classrooms with more natural light scored 29% higher on math tests and 26% higher on reading tests than students in rooms with less natural light (USGBC, 2003).

2.3.2.2 Indirect Benefits

Sustainable buildings contribute positively towards workforce attraction, quality of life and customer relationships (Heerwagen, 2000). There are three main indirect benefits of sustainable building have been revealed as follows:

1. Healthier to use

The use of more natural sources of light, solar energy and more organic materials in the green and sustainable building, end up to a healthier building than the traditional one (Heerwagen, 2000). As reported by Edward (1998) and USBGC (2003), the building has proven to contribute in lower levels of sickness and absenteeism.

2. Psychological advantage

People feel better in sustainable building. Research in the USA by Edward (1998) claimed that people are not only healthier but they claim an enhance sense of wellbeing. 1% absenteeism reduction in the building able to pays for the energy costs of a conventional building.

3. Enhances company image

Sustainable building is normally the result of holistic thinking by a team of professionals, including the client, who share similar sustainable ideas which spread from a company to its buildings, the building to the company and the company to the individual thereby enhance its image (Edward, 1998; and McKee, 1998).

4. Global benefits

The philosophy of sustainable buildings is about considering the whole range of environmental and ecological impacts. Therefore, the design and construction of the building has to consider global warming, ozone layer depletion, biodiversity, product miles and recycling (Zainul Abidin, 2009 and Edward, 1998).

2.3.3 Current Sustainability Framework and Building Performance Assessment Systems (BPASs)

Kaatz et al (2006) claimed that Building Performance Assessment Systems (BPASs) assist the delivery of buildings that better suited to their physical settings and that impact positively on their socio-economic and environmental aspects. Since the selection of principles reviewed was based on the framework that addresses the dimensions of sustainability, has a wide focus at a national, community or company level and have been proposed at a country level with slight modifications of the United Nation's framework, hence, reviewing BPASs is also useful for more precise understanding on sustainability principles of building to be addressed in developing the framework that proposed in this study.

Various techniques and methodologies exist to measure the sustainability principles of building. Some only consider very specific aspects of building performance such as

energy usage (for example Energy Star), materials used or waste generated during construction or operation. Others try to take a broader view, through a set of design and operational criteria. For commercial building for instance, the two most commonly used criteria are BREEAM (Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design) (CBRE, 2009). The development of assessment system for buildings has its origin in the 1990s as this was the year when the first BPAS, the BREEAM was introduced. Following the launch of BREEAM, many other BPASs were developed around the world. Cole (2006) stated that the BREEAM has become the source of many succeeding methods which many of them have similar roots such as LEED (United States), Green Star (Australia) and HK-BEAM (Hong Kong).

In the following sections four established international BPASs are described which are BREEAM (United Kingdom), LEED (United States), SBTool (Canada/International) and Green Star (Australia). Additionally, Green Mark (Singapore) which has been launched in 2005 and Green Building Index (GBI Malaysia) which is officially launched by the Malaysian Ministry of Work in 2009 are also reviewed in this study. Green Mark has been used by Malaysian developers and consultants to obtain a differential identification in the market (Shari, 2011). Green Mark seems applicable to Malaysian building for sustainability assessment due to similarity in the weather condition, social and cultural value but several adjustment are needed to suit local conditions. GBI Malaysia is obviously relevant to be reviewed as it is the existing BPAS implemented in the country.

2.3.3.1 BREEAM (UNITED KINGDOM)

BREEAM is the oldest BPAS in the world that has been developed. It was launched in 1990 by the Building Research Establishment (BRE), the national building research organization of United Kingdom. BRE gradually launched BREEAM for various building sectors such as offices, homes, education, healthcare, industrials, prisons and retails (BRE, 2013). BREEAM rates building on a scale of Pass (≥30), Good (≥45), Very Good (≥55), Excellent (≥70) and Outstanding (≥85). By setting sustainability benchmark and encouraging of innovations for achieving the target, BREEAM able to make greater sustainability and innovation in building projects and built environment. BREEAM has certified over a quarter of a million buildings and is now active in more

than 50 countries around the world (BRE, 2013). Up to 2005, BREEAM has been adopted in Canada and several European and Asian countries (Kibert, 2005). A BREEAM certified building is identifiable as having been planned, designed, constructed and operated in accordance with best practice sustainability principles. An extensive update of all BREEAM schemes in 2008 resulted in the introduction of mandatory post construction reviews, minimum standards and innovation credits. Awarding credits for innovation enables clients and design teams to boost their buildings' BREEAM performance and, in addition, helps to support the market for new innovative technologies and design or construction practices. The latest major update in 2011 resulted in the launch of BREEAM New Construction known as 'BREEAM 2011 New Construction' which is now used to assess and certify all new non-domestic UK buildings (BRE, 2011). Recently, BREEAM International 2013 has been developed and launched in June 2013 for use in countries (worldwide) without a BREEAM affiliated National Scheme Operator (NSP). It assesses new build projects which covers offices, industrial units, retail premises and self-contained dwellings building. BREEAM assesses the performances of buildings in the following areas;

1. Management - Overall management policy, sustainable procurement, integrated design process, responsible construction practices, construction site impacts, stakeholder participation, life cycle cost and service life planning.
2. Health and wealth being – Indoor and external issues affecting health and wealth being such as visual comfort, indoor air quality, thermal comfort, water quality, acoustic performance, safe access, hazards and private space.
3. Energy use - Operational energy, low and zero carbon technologies and energy efficient equipment (process)
4. Transport - Public transport accessibility, proximity to amenities, alternative modes of transport, maximum car parking capacity, travel plan and home office
5. Water - Water consumption and water efficiency
6. Materials – Environmental implication of building materials including life cycle impacts
7. Waste – Construction and operation waste management, recycled aggregate and speculative floor and ceiling finishes
8. Land use and ecology - Site selection, ecological value of site and protection of ecological features, enhancing site ecology, long term impact on biodiversity, building footprint

9. Pollution – Air, water, noise and night time light pollution issues
10. Innovation - New technology, process and practices

BREEAM works to raise awareness amongst owners, occupants, designers and operators of the benefits of taking a life cycle approach to sustainability. It also help them for successfully and cost effectively adopt solutions, and facilitates market recognition of their achievements (BRE, 2013).

2.3.3.2 LEED (UNITED STATES)

The LEED is the leading building assessment system in the United States and perhaps in the world (Kibert, 2005). LEED is owned and administered by the U.S. Green Building Council (USGBC) as the organization's members realized that the sustainable building industry needed a system to define and measure "green buildings." LEED was produced by a cross section of the USBGC's membership during a long, slow and laborious process that required producing a green building rating system that would meet the needs of the wide range of participants in the building industry (Kibert, 2005). The composition of the committee is included architects, real estate agents, a building owner, a lawyer, an environmentalist, and industry representatives. This cross section of people and professions added richness and depth both to the process and to the ultimate product (USGBC, 2009). The first LEED Pilot Project Program, also referred to as LEED Version 1.0, was launched at the USGBC Membership Summit in August 1998. After extensive modifications, LEED Green Building Rating System Version 2.0 was released in March 2000, with LEED Version 2.1 following in 2002 and LEED Version 2.2 following in 2005 (USGBC, 2009). The best known and only fully implemented LEED standard is LEED-New Construction (NC) version 2.1 for commercial building, which has evolved into a highly accepted measure of green building in the United States (Kibert, 2005).

The LEED family of rating systems and pilot programs included, LEED for New Construction and Major Renovations, LEED for Existing Buildings: Operation and Maintenance; LEED for Commercial Interiors, LEED for Core and Shell, LEED for Schools, LEED for Retail, LEED for Homes, LEED for Neighborhood Development and LEED for Healthcare (USGBC, 2013). The green building field is growing and changing daily. New technologies and products are being introduced into the market

place, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will evolve as well. The latest version of LEED New Construction and Major Renovations is LEED 2009 version 3.0 (LEED-NC v3). This system is a set of performance standards for certifying the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction. It was approved by USGBC Member on November 2008 and updated in April 2013 (USGBC, 2009). LEED is awarded to building according to the scale of Certified (40–49 points), Silver (50–59 points), Gold (60–79 points) and Platinum (80 points and above). Prerequisites and credits in the LEED 2009 for New Construction and Major Renovations address 7 topics:

1. Sustainable Sites (26 possible points)
2. Water Efficiency (10 possible points)
3. Energy and Atmosphere (35 possible points)
4. Materials and Resources (14 possible points)
5. Indoor Environmental Quality (15 possible points)
6. Innovation in Design (6 possible points)
7. Regional Priority (4 possible points)

LEED for New Construction addresses design and construction activities for both new buildings and major renovations of existing buildings. The system was designed primarily for new commercial office buildings, but it has been applied to many other building types by LEED practitioners such as of commercial occupancies include offices, institutional buildings (libraries, museums, churches, etc.), hotels, and residential buildings.

2.3.3.3 SBTool (CANADA/INTERNATIONAL)

The Sustainable Building Tool (SBTool), formerly known as Green Building Tool (GBTool) is a software system for assessing the sustainability performance of buildings. It is an implementation of the Green Building Challenge (GBC) assessment systems which has been developed since 1996 by international teams from fourteen countries (Kibert, 2005). Although SBTool was initiated in Canada, it is now internationally

followed system. The GBC process was launched by Natural Resources Canada, but responsibility was handed over to the International Initiative for a Sustainable Built Environment (iiSBE) in 2002 (iiSBE, 2006). The tool is implemented in the form of a sophisticated Excel spreadsheet that can be downloaded from the website of iiSBE. It is a flexible framework which can be configured to suit almost any local condition of building type (Larsson, 2012). The current version of the tool is SBTool2012 which covers a wide range of sustainable building issues, not just green building concerns (iiSBE, 2012 and Larsson, 2011).

SBTool2012 provides a clear distinction between guidelines for design features and operating strategies and performance factors. This distinction results from the realization that many rating systems, including previous versions of SBTools, have mixed the two, leading to systems that are excessively complex and prescriptive in nature. The scoring process in SBTool relies on a series of comparisons between the characteristics of object building and national or regional references for minimally acceptable practice, 'good practice' and 'best practice'. The SBTool system consists of two distinct assessment modules that are linked to phases of the life-cycle; one for 'Site Assessment', carried out in the pre-design phase; and another for 'Building Assessment', carried out in the design, construction or operations phases. The tool is also includes a section on the integrated design process (IDP) that will be useful guidance to designers working their way through the design process. The IDP parameters are not functionally linked to scoring but are linked for information purposes only to appropriate scoring benchmarks. The SBTool system allows assessments to be made in four distinct phases which is 1) pre-design phase: this phase is relevant to the selection of a project site and its characteristics 2) design phase: assessments of the potential operating performance of the project are carried out in this phase, based on pre-construction documents and data 3) construction phase: assessment in this phase covers the process of construction and does not result in an assessment of the potential operating performance and 4) operations phase: assessment in this phase focuses on the actual operating performance of the project, assessed at a time that is at least two years after occupancy. Eight assessment issues of SBTool2012 are (iiSBE, 2012):

1. Site location, available services and site characteristics (pre-design only)
2. Site regeneration and development, urban design and infrastructure (design, construction and operation stage)

3. Energy and resource consumption
4. Environmental loadings
5. Indoor environmental quality
6. Service quality
7. Social, cultural and perceptual aspects
8. Cost and economic aspects

2.3.3.4 Green Star (Australia)

Green Star assessment system was developed by the Green Building Council of Australia (GBCA) in 2003. It was built on existing rating systems including BREEAM system and LEED system with some adaptations to suit to the Australia local conditions (Reeder, 2010 and Kibert, 2005). Green Star was first developed for the assessment of office buildings in various stages of building life cycle such as design, construction, interiors and operation) and now different versions are available for retail, education, public building, industrial, healthcare office design, office as built and office interiors (GBCA, 2013 and Kibert, 2005). Green Star is a comprehensive, national, voluntary environmental rating system that evaluates the environmental design and construction of buildings and communities. Green Star was developed for the property industry in order to establish a common language, set a standard of measurement for built environment sustainability, promote integrated, holistic design, recognise environmental leadership, identify and improve life-cycle impacts and raise awareness of the benefits of sustainable design, construction and urban planning. The latest release of Green Star is Green Star –Office v3 rating tool in 2008 which combines both Green Star-Office Design and Green Star-Office As-built rating tools. It demonstrates the significant progress of the building and construction industry has made since the introduction of Green Star - Office Design v2 and Green Star - Office As Built v2. Green Star - Office v3 has been revised to award industry leadership through raised benchmarks, new credits and updated references to standards as well as relevant and clearer Compliance Requirements. Green Star –Office v3 covers the following categories:

1. Management (12 points)
2. Indoor Environmental Quality (27 points)
3. Energy (29 points)
4. Transportation (11 points)

5. Water (12 points)
6. Materials (25 points)
7. Land Use and Ecology (8 points)
8. Emissions (19 points)
9. Innovation (5 points)

A maximum of 148 points is achievable for Green Star Office Design. A grade of 1 to 6 stars is determined for the overall minimum score of 10, 20, 30, 45, 60 and 75 respectively, which is based on original BREEAM rating approach. However, GBCA certifies only the last three i.e. Four Star Green Certified, representing 'Best Practices', Five Star Green Certified, representing 'Australian Excellence' and Six Star signifying 'World Leadership' (GBCA, 2008).

2.3.3.5 Green Mark (Singapore)

In January 2005, Building and Construction Authority (BCA), an agency under the Ministry of National Development, Singapore has launched the Green Mark for Buildings Scheme by adapting LEED and Green Star as the basis (BCA, 2013a). Under the assessment framework for new buildings, developers and design teams are encouraged to design and construct green, sustainable buildings which can promote energy savings, water savings, healthier indoor environments as well as the adoption of more extensive greenery for their projects. For existing buildings, the building owners and operators are encouraged to meet their sustainable operations goals and to reduce adverse impacts of their buildings on the environment and occupant health over the entire building life cycle. The are several Green Mark schemes currently being used which are Green Mark for New Non-Residential Building, Residential New Building, Existing Non-Residential Buildings, Existing Residential Buildings, Existing Schools, Office Interior, Landed House, Infrastructure, District, Restaurant, Supermarket, Existing and New Data Centre, Retails, Existing and New Parks (BCA, 2013b). The latest version of Green Mark Standards has been issued in October 2012 known as BCA Green Mark Certification Standards for New Buildings (GM Version 4.1) effective from 15th Jan 2013 onward. It covers for the New Non-Residential Building and Residential New Building assessment criteria as followings (BCA, 2012; BCA, 2013b):

1. Energy Efficiency
2. Water Efficiency
3. Environmental Protection
4. Indoor Environmental Quality
5. Other Green Features and Innovation

Based on an overall assessment, a building will be awarded one of the following four Green Mark ratings: Certified (50 to 74 points), Gold (75 to 84 points), Gold^{plus} (85 to 89 points) and Platinum (90 or more points). Three important requirements should be achieved to get Green Star award: 1) all relevant pre-requisites are to be complied 2) achieve minimum of 30 points from 'Energy category' and 3) achieve at least 20 points from other categories (BCA, 2012). Certified Green Mark buildings are required to be re-assessed every three years to maintain the Green Mark status. New buildings certified will subsequently be re-assessed under the existing buildings criteria. Existing buildings will be re-assessed under the existing buildings criteria (BCA, 2013b, BCA, 2012).

2.3.3.6 Green Building Index (Malaysia)

The Green Building Index (GBI) is Malaysia's recognized green rating tool for building to promote sustainability in the built environment. It was developed by collaboration between two Malaysian professional organizations namely the Malaysian Institute of Architects (PAM) and the Association of Consulting Engineers Malaysia (ACEM) and officially launched by Malaysian Ministry of Work in May 2009. The custodian all right s of PAM and ACEM in the GBI is the GreenBuildingIndex Sdn. Bhd. (GSB), a wholly owned subsidiary of PAM and ACEM (GSB, 2013a). GSB was form to administrate GBI accreditations and trainings of GBI certifiers and facilitators. GBI was developed specifically for the Malaysian tropical climate, environmental and developmental context, culture and social needs by taking experiences of Australian's Green Star and Singapore's Green Mark (which in turn learned from the US LEED) (GSB, 2013b). The are several categories currently being used in GBI which are GBI project for Non-Residential New Construction (NRNC), Residential New Construction (RNC), Industrial New Construction (INC), Non-Residential Existing Buildings (NREB), Industrial New Construction (INC), Industrial Existing Buildings (IEB) and Township. Up to 15th July 2013, there are 146 GBI certified buildings in Malaysia. The current

version of GBI rating schemes are GBI NRNC v.1.0, GBI RNC v.2.0, GBI INC v.1.0, GBI IEB v.1.0 and GBI Township Tool v.1.0. Buildings are awarded the GBI rating based on six criteria as followings (GSB, 2013a, GSB, 2013c).

1. Energy Efficiency
2. Indoor Environmental Quality
3. Sustainable Site Planning and Management
4. Material and Resources
5. Water Efficiency
6. Innovation

The GBI rating tools are reviewed annually. It was claimed to be developed specifically for the Malaysian tropical weather, environmental and development context, cultural and social needs. It was created in order to define green buildings by establishing a common language and standard of measurement, promote an integrated whole building design, recognise and reward environmental leadership, transform the built environment to reduce its environmental impact and to ensure new buildings remain relevant in the future and existing buildings are refurbished and upgraded properly to remain relevant. Malaysian construction players are encouraged to use GBI to validate environmental initiatives at the design stage of new construction or base building refurbishment or construction and procurement stage of building (GSB, 2012b). GBI Malaysia certification awards are given to buildings that comply with GBI requirements as illustrated in Table 2.4.

Table 2.4: Green Building Index Classification

Points	GBI rating
86+	Platinum
76-85	Gold
66-75	Silver
50-65	Certified

Source: GSB (2012b)

2.3.3.7 GRI Sustainability Reporting Framework

In 1997, the Global Reporting Initiatives (GRI) was introduced as an independent institution whose mission has been developed and disseminated globally applicable Sustainability Reporting Guidelines. It is an official collaborating centre of the United Nations Environment Programme (UNEP). The GRI Reporting Guidelines is an

organizational report that gives information about economic, environmental, social and governance performance. GRI Sustainability Reporting Guidelines Version 3 (G3 Guidelines) was launched in 2006 which feature sustainability disclosures that organizations can adopt flexibility and incrementally, enabling them to be transparent about their performance in key sustainability areas. The G3 Guidelines was updated in 2011 by realising the Guidelines Version 3.1 (G3.1 Guidelines) (GRI, 2014). In May 2013, GRI launched the fourth generation of Guidelines, known as the G4 Guidelines. Reports published after 31st December 2015 is required to be prepared in accordance with the G4 Guidelines (GRI, 2014).

GRI Guidelines is an excellent example of a company application of the United Nations Millennium Development Goal (MDGs) (Pinter et al., 2005). Hence, it is significant to be used to demonstrate organizational or team commitment to sustainable development for this study, to compare organizational performance and project planning process over time and to measure the organizational and project performance with respect to the whole planning process of the project. The framework sets out the principles and performance indicators that the organisation can use to measure their economic, environmental and social performance. Therefore, for the purpose of this study, the researcher believes that the principles and performance indicators of sustainability in the report are compatible to be used to gauge the sustainability principles of building that should be incorporated during the planning process of the project.

The G3.1 Guidelines is split up in three major subjects; economical, environmental and social (Appendix L, p356). The economic dimension of sustainability concerns the organisation's impacts on the economic conditions of its stakeholders and on economic systems at local, national and global levels. The Economic Indicators illustrate flow of capital among different stakeholders and main economic impacts of the organization throughout society. The environmental dimension of sustainability concerns an organisation's impacts on living and non-living natural systems, including ecosystem, land, air and water. Environmental indicators cover performance related to inputs (e.g, material, energy, and water) and output (e.g, emissions, and effluents, waste). In addition, they cover performance related to biodiversity, environmental compliance and other relevant information such as environmental expenditure and the impacts of products and services. While, the social dimension of sustainability concerns the impacts an organization has on the social systems within which it operates surrounding

the aspects of labour practices, human rights, society and product responsibility (GRI, 2011). The Sustainability Reporting Guidelines is a great opportunity for project stakeholder's organisation to think on how to integrate sustainability within their business and project strategies.

2.3.4 Review of the Sustainability Principles of Buildings

Most of the BPASs systems that were developed tend to evaluate towards environmental performance of buildings (CBRE, 2009; Cole, 2006; Du Plessis, 2005; Kaatz et. al, 2005; Todd et al, 2001). They are generally having similar categories such as energy, indoor environmental quality, site and waste management, water, building materials and innovations, however the number of criteria categorized under each category are varies. Different systems also often categorized similar criteria under different category. BPASs which address several non-environmental issues such as proper location and accessibility are also relate to the basic environmental concern. Very few BPASs address purely non-environmental issues such as health and safety, creating job for local people, excellent labour practices, economic aspects or others as highlighted in the five international key documents as discussed in the section 2.2.3 (p31-35). Besides of the key documents, GRI Guidelines also provides a clear guide in realizing sustainable development to its actual meaning as it addresses the TBL of sustainability. Thus, in addition to the consideration of BPAS systems and the international key documents of sustainability, sustainability principles mentioned in the GRI Guidelines are also valuable to provide a reference point for developing a more contextual framework in this study. Much can be learnt from the literature review for the study. In its early days, sustainable development was always related to the environmental aspects. Lately, sustainable development specifically in building and construction projects require simultaneous development of four interrelated dimensions – environmental, social, economic and technological (design/innovations/technical) (Reyes et al. 2014; Pons and Aguado, 2012; Terio and Kahkonen, 2011; Abeysundara and Babel, 2010). The dimensions will be used throughout this dissertation. Consequently, it was found that there are 29 sustainability principles that are related to building projects which should shape the proposed framework. The list of the principles was grouped under four subheadings- environmental, social, economic and design and innovation. The process of grouping of the principles into its own category was quite challenging as many issues do not fall neatly under one sector. Due to this reason, the

principles were put into categories in which it is considered most important, likely to be mentioned and has most impact. Thus, although the principles were put under certain sectors, it is accepted that other interpretations are possible, as there are conflicts in categorization between published works. The sustainability principles and the supporters are listed Table 2.5 (p69). The principles are listed below:

2.3.4.1 Environmental Sustainability Principles of Buildings

Environmental sustainability relates to the matters concerned with planetary protection and the maintenance of diverse ecosystems (Sayce et al., 2004:39). Thirteen main principles of environmental sustainability of buildings have been summarized from literature review which are - 1) optimizing of materials and resources used 2) sustainable materials and resources 3) sustainable method 4) energy efficient 5) efficient water consumption 6) noise control 7) urban design, visual impact and aesthetic 8) site planning and management 9) transport management 10) concern on quality of land, river and sea 11) air and emissions quality 12) conserving heritages and 13) efficient environmental management. Sustainability integration in building should be started at the early planning stage of the project development. The sustainability principles should be integrated into this process and to be continued throughout the building life cycle to its eventual deconstruction and recycling of resources to reduce the waste stream associated with demolition (Sayce et al, 2004; Hill and Bowen, 1997).

1) Optimizing of Materials and Resources Used: This principle contributes to the global resource conservation to reduce the material intensity and increase the efficiency of the economy (GRI, 2011; Schumann, 2010, Brent and Labuschagne, 2004). It is about achieving more with less (Akadiri et al., 2012). Since the building industry is a major consumer of natural resources, many initiatives pursued in order to create environmental sustaining buildings that focused on increasing the efficiency of resources use. Graham, (2003) pointed out that, several methods have been used to improve resource consumption efficiency such as using solar passive design to reduce the consumption of non-renewable resources, introducing methods for minimizing material wastage during building construction process and providing opportunities for recycling and reuse of building materials. Reused and recycled materials and products are suggested in every single life cycle of building (GSB, 2012b; GRI, 2011; Muldavin,

2010; Graham, 2003). The effort will ultimately serve to reduce environmental impact associated with extraction and processing of virgin resources (GSB, 2012b).

2) **Sustainable Materials and Resources:** Sustainable materials and resources is concerned with the prudent use of materials to reduce the negative impact to the environment and protect the users in terms of health and long term basis (Zainul Abidin, 2010). It must be taken into account during project planning phase, where selection of materials are based on the consideration of the environmental impacts generated from the use of the materials (Abeysundara et al., 2009), reducing the use of non-renewable materials and the use of non or less toxic materials (Akadiri et al, 2012; GSB, 2012b). Wilson (2000) suggested that creating an environmental sustaining building means matching the products and the materials to the specific design and site to minimize the overall environmental impact. He suggested ten criteria of sustainable materials which are 1) avoid ozone-depleting chemicals in mechanical equipment and insulation, 2) use durable product and materials, 3) choose low-maintenance building materials, 4) choose building materials with low embodied energy, 5) buy locally produced building materials, 6) use building products made from recycled materials, 7) use salvaged building materials when possible, 8) seek responsible wood supplies, 9) avoid materials that release gas pollutants and 10) minimise use of pressure-treated lumber. Kibert (2005) concluded that the materials are best to be selected from among environmentally responsible companies to encourages their efforts at pollution prevention during manucturing stage of the materials.

3) **Energy Efficient:** Energy efficient in building is concerned with renewable energy, reduce CO2 emission, building envelope performance and day lighting. Building consumes energy at each stage of building project from design and construction through operation and demolition (Schimschar et al., 2011). Thus, the total energy used for building includes the energy used in its construction, operation and maintenance, which is known as embodied energy, operational energy and transport energy- the energy used by the occupiers in travelling to and from the building during its lifetime (Aye et al, 2000; Lovelock, 2000). GSB (2012b) highlighted that a minimum energy efficiency performance to reduce energy consumption should be established by a building in order to reduce CO2 emission to the atmosphere. It can be achieved by reducing the outward transmission of heat, controlling ventilation and exploiting renewable sources of energy such as day lighting (GSB, 2012b; Department

of Standards Malaysia, 2007; Zainul Abidin, 2010a). Designing building within contextual climate and site also will contribute to the reduction of the overall energy consumption that will result in operational cost savings (Department of Standards Malaysia, 2007). Energy consumption has a direct impact on operational costs and exposure to fluctuations in energy supply and prices. Project that improved energy efficiency can result in cost saving and can lead to competitive advantages and market differentiation.

4) **Efficient Water Consumption:** Building construction and its operations draw heavily on water from the environment. Water is also consumed in the extraction, manufacturing and delivering of materials and products to site. As far as use of water within building industry is concerned, the first step is to reduce demand by using of water saving device in sanitary systems followed by to consider the reuse of grey water (Sayce et al, 2004). (GSB, 2009) pointed out several steps of water efficiency in building including to enhance the building rainwater harvesting systems, reduction of potable water consumption, waste water recycling, reducing potable water consumption for landscape irrigation and encourage water efficient fittings. They also encourage the incorporation of sub-meters to monitor and manage major water usage systems such as cooling towers, irrigation, kitchens and tenant spaces and linking sub-meters to Environmental Management System (EMS) to facilitate early detection of water leakage.

5) **Noise Control:** A comfort, well being, satisfied user and functional building are among the trademarks of a sustainable building (Schumann, 2010). Excessive noise can cause discomfort, annoying and disruptive to occupants and communities. Therefore, noise control method during the whole building process should be considered since the early planning process to achieve sustainability in building. Design flexibility of building towards noise reduction possible to be introduced to avoid discomfort (Ugwu and Chaupt, 2005). Acoustic comfort is achieved by controlling sources of noise from mechanical and electrical equipment and from sources exterior to the building (Akadiri et al, 2012). Some of the solutions to ensure acceptable noise level are maintained include such as employ acoustical ceiling, using furniture with sound absorbing surfaces on both sides, acoustic zoning such as locate photocopiers, locate fax machines away from the main office areas in a separate area, locate mechanical equipment room away from office and conference rooms. In addition, acoustic lining treatment should be used

for all AHU air system and air conditioning ducts, flexible joints and plenum boxes of diffusers (GSB, 2012b; Akadiri, 2012). Avoiding disturbance to neighbours is an important consideration as this may result in complaints and possible legal action which could consequently delay a project and increase overall costs (Coventry and Woolveridge, 1999).

6) **Urban design, Visual Impact and Aesthetic:** Urban design, aesthetic and visual impact protection are considered as one of the sustainability requirements in building (iiSBE, 2012; Ugwu and Chaupt, 2005; Akadiri et.al, 2012). SBTool2012 listed six requirements to be fulfilled under this category: maximizing efficiency of land use through development density, reducing need for commuting transport through provision of mixed uses, impact of orientation on the passive solar potential of building, building morphology and aggregate measure, impact of site and building orientation on natural ventilation of building during warm season and impact of site and building orientation on natural ventilation of building during cold season. Visual and aesthetic aspects are including pleasing architecture, visual interest, art on the walls or natural elements such as plants, fountain or an aquarium (Akadiri et al., 2012), visual quality such as visual privacy from exterior and others (iiSBE, 2012).

7) **Site Planning and Management:** Site planning and management principle is concerned with on site selection, brownfield development, development density and community connectivity, construction activity pollution control and storm water design (GSB, 2012b) which can contribute towards natural environment protection. Location of building is also a major consideration in the site planning and management aspect. The erection of a building will have a direct impact to the location surroundings, and will bring about change to the land itself and in turn may have an impact on economic (Akadiri et al., 2012; Schumann, 2010). Thus, during the planning stage, the building has to be ensured having a wider positive influence on the surrounding area rather than serving itself.

8) **Concern on Quality of Land, River and Sea:** Pollution has an adverse impact on the quality of land, water and air. Labuschagne et al, (2005) and Brent, (2004) highlighted that a sustainable project should optimizes and conserves the quantity and quality of land, river and sea by reducing acidification potential and human toxicity potential as well as eco-toxicity potential. For instances, in construction stage, the

construction should create a healthy, non-toxic environment by using less toxic materials and preservatives, avoid the release of chlorofluorocarbons (CFCs) and prevent pollution to water, ground and air resulting from the work on site, minimise the use of finite fuel and etc. Land contamination occurs due to spillage of hazardous materials or from the past use of the land which must be dealt with properly to prevent local problem from spreading (Zainul Abidin, 2010a). Besides of construction stage, there are also many form of environmental pollution arising from building use, including noise, smells, light and vibration to be avoided. A sustainable design should consider the risks in order to provide a healthy environmental impact (Sayce et al, 2004; Stansfield, 2001).

9) **Transport Management:** Suitable access to a building is essential whether it be for occupants, workers or for delivery goods. Decisions about occupation and ownership will be influenced by the quality of transport and transport access to the site by public or private means (Sayce et al, 2004). GSB (2012b) encourages locating projects within certain distances of existing or planned and funded public transports and bus and taxi stop, and the use of green vehicles. They also promote excellent pedestrianized system, excellent public transport system to reduce of car dependency, safer streets system and improved local services. Location with a good access to public transport will lower the transport energy than a location requiring a large proportion of people to arrive by a personal transport (Zainul Abidin, 2010a). To be sustainable, buildings that serve the public should be located to be accessible to all potential users, including who have access only to public transport and those with mobility difficulties or other disability (Sayce et al, 2004).

10) **Air and Emissions Quality:** Air pollution can be generated by building use, emission process and traffic emissions (Sayce et al, 2004). Air and emissions quality in construction project should be concerned with the regional quality which is the impact on human health, buildings and crops. It includes ensuring clean air, reduce acidification potential, photochemical ozone creation potential and human toxicity potential. Indoor air quality should be improved by prohibiting smoking in buildings and locating any exterior designated smoking areas far away from entries, outdoor air intakes and operable windows, install CO2 monitoring and control system to facilitate continuous monitoring, adjustment of outside air ventilation rates to the building, and ensure independent control of ventilation rates to maintain the ideal CO2 level. In

addition, detrimental impact on occupant health from finishes that emit internal air pollution should be avoided through the project such as by considering the low VOC paint and coatings, low VOC sealant and adhesive, low VOC carpet or flooring and no urea-formaldehyde composite wood and agrifiber products. Sick building syndrome is resulted from poor air quality (ventilation, air movement and humidity), lighting and airborne pollution which led to the health problems and loss in workers' productivity (GSB, 2012b; Edward, 1998).

11) **Conserving Heritage:** This category is about conserving heritage and footprint of project in archaeological site. Conserving heritage buildings reduces energy usage associated with demolition, waste disposal and new construction, and promotes sustainable development by conserving the embodied energy in the existing buildings. Life-cycle analyses of building fabric: structure, envelope, interior elements and systems and ongoing management and use need to be considered as part of the conservation process to achieve optimum energy efficiency outcomes (Rowe, 2009). In other cases a comparison may be needed between the demolition of an existing structure and its replacement with a new building rather than its retention and revitalisation. All materials wear out in time and need replacement, at which point it is necessary to consider whether replacement/repair, complete demolition or the replacement of major elements only is the most sustainable method (Sayce et. al, 2004).

12) **Efficient Environmental Management:** Effective environmental planning, management and control are vital to identify the environmental risk and to formulate and implement preventive actions to reduce adverse environmental impacts such as water, land and air pollution (Addis and Talbot, 2001). GSB (2012b) highlighted the important of efficient environmental management such as in conserving existing natural area and restore damaged area to provide habitat and promote biodiversity and maximize open space by providing a high ratio of open space to development footprint to promote biodiversity. Environmental management should consider the potential impacts of activities, products and services on biodiversity and land in protected areas, agriculture and rural development and areas of high biodiversity value outside protected areas, habitats are protected or restored including consideration on bio geographical factors, effort on conserving wild life, reduce the amount of tree felling, improve strategies, current actions and future plans for protect, enhance and managing impacts on biodiversity (Zainul Abidin, 2009; Ugwu and Chaupt, 2005).

13) **Sustainable Construction Method:** Construction is essentially an intensive transformation process that often involves assembling and transforming resources into physical artifacts. Building construction method should be harmonized with surrounding and minimise depletion of limited resources (CIOB, 2010). Akadiri et al (2012) listed several sustainable methods to achieve sustainability in buildings such as; choosing materials with low embodied energy, insulating the building enveloped, designing the building for energy efficient deconstruction and recycling of materials, design for low energy intensive transportation, developing energy efficient technological processes for construction, fitout and maintenance, use of passive energy design, design for waste management, utilizing durable materials, design for pollution prevention, utilizing non-toxic or less toxic materials, design for dual plumbing to used recycled water for toilet flushing or grey water system for site irrigation, collecting rainwater and grey water, water pressure reduction, adaptive reuse of existing building, locate construction project close to existing infrastructure. Ugwu and Chaupt (2005) suggested that reusability of moulds and formwork, use of prefabricated material and ease of quality control are among the points to be considered for sustainable method.

2.3.4.2 Economic Sustainability Principles of Buildings

The economic sustainability is concerned with the micro and macroeconomic benefit. Microeconomic focuses on the factors or activities which could lead to monetary gains from the construction project while macroeconomic relates to the advantages gained by the public and government from the project success (Zainul Abidin, 2010a). It is also concerned with the project impacts on the economic conditions of its stakeholders and the economic systems at local, national and global levels. Four (4) principles of economic sustainability of buildings were summarized from the literature reviews as follows;

1) **Economic Benefit to the Stakeholders:** Benefits to stakeholders indicate how the building project creates wealth and benefit for the stakeholders especially to the owner and occupants of the project. The concept of sustainability in buildings is intended to promote the utmost efficiency and to reduce final costs through integrated design since the early project planning process. Thus, a sustainable building project should be able to provide potential financial benefits to the project stakeholders and local economies (GRI, 2011; Zainul Abidin, 2009; Labuschagne et al, 2005).

Rehabilitation cost of ecosystem and risk management are essential to be measured during the project planning process (Ugwa and Chaupt, 2005).

2) **Improve Local Market Presence:** Sustainability in project will generate benefit on the communities and local economies such as through preparation of the needs assessment in order to determine infrastructure and other services needed (GRI, 2011). The project supports the use of local sourcing or indigenous resources through the consumption of materials and products that are extracted and manufactured within the region and employing local employees (USGBC, 2009, GRI, 2011, Edward, 1998). Inclusion of members from the local area can enhance human capital, the economic benefit to the local community and the project ability to understand local needs.

3) **Whole Life Cost Efficiency:** Sustainable building is continually performed for a very long time rather than only achieve short-term benefits (Akadiri et al, 2012; Cole, 2007). The life cycle assessment and whole life cost efficiency are very crucial to be taken into account in this project since the project is designed to be benefited towards the environment, social and economic in the long term basis (Edward, 1998). A detail cost assessment and life cycle analysis of how initial design and construction choices affect the long term cost of both operation and maintenance is very fundamental to be implemented (Bordass, 2000). It is because, integrating sustainability in building project is not just a matter of design and construction but also need whole life thinking including on what happens once the building is occupied (Schumann, 2010; Zainul Abidin; 2009; Ugwa and Chaupt, 2006).

4) **Indirect Economic Impact:** Indirect economic impacts (sometimes non-monetary) to the local communities and regional economies are an important part of a project economic influence in the context of sustainable development. 'Whereas direct economic impacts and market influence tend to focus on the immediate consequences of monetary flows to stakeholders, indirect economic impacts include the additional impacts generated as money circulates through the economy' (GRI, 2011, EC9:13). A sustainable project should has a positive indirect economic impacts such as economic impact in improving social or environmental conditions, enhancing skills and knowledge amongst a professional community or jobs supported in the supply chain, job creations and influence indirect positive economic impacts at the regional, national

or local level and growth the value of the project and surrounding area (Schumann, 2010; Labuschagne et al, 2005).

2.3.4.3 Social Sustainability Principles of Buildings

Social Sustainability is concerned with the benefits of the workers, stakeholders and future users. There is no single agreed definition of social sustainability. According to Zainul Abidin (2010a; 2009), Lombardi (2001) and Parkin (2000), social sustainability is concerned with human feeling: security, satisfaction, safety and comfort and human contributions: skills, health, knowledge and motivation. Sayce et al (2004) has listed seven principles which are adaptability, cultural importance, lovability and likeability, planning and building regulations, occupation legislation, and locality and working environment quality as the significant assessment tool for social sustainability of building. Meanwhile, Labuschagne et al (2005) summarized social sustainability for sustainable project life cycle should include internal human resources aspect, external population, stakeholders' participation and macro social performance aspect. However, for the purpose of this study, the social dimension of sustainability is referred to the impacts a project has on the social systems within which it operates surrounding the aspects of 1) employment, 2) labor/management relations, 3) occupational health and safety, 4) training and education, 5) fairness, 6) human right performance, 7) society, 8) product responsibility, 9) stakeholders participation and 10) macro social performance.

1) **Employment Benefits:** This principle is broadly based on the concept of decent work where organizations should contribute to the overall economic development and sustainability of the workforce. The quality of benefits (such as life insurances, health care, retirement provisions and others) is a key factor in retaining employees in an organization. A high turnover rate can indicate levels of uncertainty and dissatisfaction among employees. It should be avoided in order to achieve sustainability in projects as turnover has direct cost implications either in terms of reduced payroll or greater expenses for recruitment of workers (GRI, 2011). It also makes the organizations difficult to maintain a steady and successful operation of projects. Losing a single key worker can decrease the likelihood of a project's success (Lee and Mitchell, 2000). Maximization of the opportunities for individual employees such as accommodate individual preferences on working hours, regular appraisals, providing as much job security as possible can help to reduce turnover (Hutchinson and Purcell, 2003).

2) **Labor/Management Relations:** A stable and effective industrial relations system is a vital for the economic and social development of an organization. Collective bargaining, which is an integral component of industrial relations, is essential if sustained economic growth is to be achieved with equitable distribution of income, but also constitutes a dynamic process between employers and workers for settling their disputes relating to wages and other terms and conditions of employment based on the bargaining strength available to each side (Navamukundan, 1999). Collective bargaining is an instrument used by parties to facilitate collaborative efforts to enhance the positive social impacts of an organization. It is an important form of stakeholders' engagement in order to contribute to a stable society (GRI, 2011).

3) **Occupational Health and Safety:** This principle is related to the health and safety of the project's workforce and evaluates preventive measures as well as the occurrence and handling of health and safety incidents (Labuschagne et al, 2005). Reyes et al. (2014) suggested that health and safety including occupational health and safety to be an additional factor to be considered when quantifying the sustainability value of building projects. They highlighted that the attention should be paid to the planning process of the initial design stage because of its greater impact on accident reduction. Low injury and absentee rates are generally linked to positive trends in staff morale and productivity. This principle is also regarding to the protection of the user's or potential employees' in the completed building to ensure that working conditions, safety of the buildings user is maintained (Sayce et al, 2004). USGBC (2009) highlighted the importance of construction workers and building occupants' health and safety in sustainable building projects by imposing several requirements such as the need to develop an indoor air quality (IAQ) management plan and implement it after all finishes have been installed. The building also should be completely cleaned before occupancy towards reducing IAQ problems resulting from construction or renovation.

4) **Training, Education and Awareness:** Maintaining and improving human capital, particularly through training and education that expands the knowledge base of employees and project stakeholders is a key element in organizational and sustainable project development. It is a part of preventative strategy for managing the health and safety of workforce such as preventing serious diseases contributes to the health, satisfaction and stability of the workforce and helps maintain the organization's social license to operate in a community or region (Reyes et al., 2014; GRI, 2011). Thus, it is

important provide training and education to the project stakeholders in order to enhance awareness, readiness and competency of them on sustainability knowledge and issues of building (ASHRAE, 2006). Sustainable construction skills among construction workers should be improved to ensure the construction activities are delivered in sustainable manners (CIDB, 2007a). Skills and knowledge of maintenance and operation staff should be improved as they responsible to realize the goals of sustainability during operation and maintenance stage and throughout the rest life cycle of the building. Besides, the building occupants should be educated to increase their awareness to contribute towards conserving energy, water and reducing waste (GBCA, 2008).

5) **Fairness:** Fairness is concerned on the level of diversity within a project's organization provides insights into the human capital of the organization. It is policies and institutions that have the overall effect of integrating diverse groups and cultural practices in a just and equitable fashion (Polese and Stren, 2000) which include equality in distribution and opportunity, adequate provision of social services, including health and education, gender equity and political accountability and participation (Harris and Goodwin, 2001). Equality of remuneration is a factor in retaining qualified employees in the workplace (GRI, 2011; Labuschagne et al, 2005). In a sustainable building, equal basis of employment can be maintained by (but not limited to) providing access and facilities for disabled (Sayce et al, 2004).

6) **Human right:** Human right concerns on how the project maintains and respects the basic rights of a human being. Incidents typically include 'points of impact' on stakeholder groups as well as risks for the organization where violations have occurred in term of discriminations, child or young labours, compulsory labour and violations rights of indigenous people. Sustainable building project should prepare the capacity and knowledge enabling the project to effectively address human rights, including training and internal procedures such as employee training on policies and procedures concerning aspects of human rights that are relevant to the project. A project can affect human rights directly, through their decision, action and operations, and indirectly, through their interaction and relationships with others, including governments, local communities and suppliers. Therefore, there is a need to consider the operations within the project that have been subject to human rights reviews. The project's integration of human rights into its external business relationships either through investments or suppliers is very important to achieve sustainability.

7) **Society Performance:** This principle is related to the impacts a project have on the communities in which they operate, and how the project organization's interactions with other social institutions are managed and mediated in term of bribery and corruption, public involvement, monopoly practices and compliance with laws and regulations other than labour and environmental (GRI, 2011). To achieve excellent society performance, the project should encourage local community engagement, volunteering, public or community participation involve in local democracy, prevent and mitigate the potential or actual negative impacts on local communities (Taylor, 2003). The community involvement are including encroachment upon concerned areas, benefits provided to local communities such as service infrastructure, mobility infrastructure, regulatory and public services, provision of social amenity, recreation amenity and accessibility to jobs and amenities (GRI, 2011). Community engagement is very important for successful implementation of policies (Magis and Shinn, 2009)

8) **Product Responsibility:** This principle addresses the effects of the building projects on users. Sustainable building projects are expected to exercise care in the planning and design of their products and services to ensure they are fit for their intended use, quality and do not pose unintended hazards to health and safety through their life cycle in order to achieve the sustainability value (Reyes et al., 2014). A review of the literature identified several methods in enhancing buildings responsibility such as assess the quality of workmanship of construction works prior to hand over (GSB, 2009; CIDB, 2006b), maximize personal safety and security for users to access and use the building, ensure the functionality, efficiency (iiSBE, 2012; ASHRAE, 2006), adaptability, loveability and likeability (Sayce et al, 2004) of the building. Added to that, sustainable building features should be contextually suitable and sensitive to local cultural conditions (Cole, 2007). It is important to ensure that development makes use of, where appropriate, indigenous knowledge and technology and maintains or enhances local cultural and heritage value (Shari, 2011).

9) **Stakeholders Participation:** According to Labuschagne et al (2005) and Zainul Abidin (2009), sustainable project should involve stakeholders of the project including by providing information, community forums and preparing planned stakeholders meetings for the selected audiences. Stakeholders' voice should be allowed to influence the decision making. It is important to provide channels for the stakeholders to complaint through the project (Labuschagne et al, 2005). Users' participation should be

increased during the planning and development process to ensure their requirements are met (Edwards, 1998). It is likewise, inter-disciplinary work between the project team members such as architects, engineers, costing specialists, operation people and other relevant actors should be employed from the beginning of the project planning and design process (ASHRAE, 2006; BRE, 2013), therefore the building's sustainability impacts are made.

10) **Macro Social Performance:** Macro social performance principle concentrates on the contribution of an organization to the environmental and financial performance of a region or nation. Macro social performance is concerned on socio-economic performance which address the external economic impact of the company's business initiatives such as have suppliers who concern towards sustainability, economic welfare (contribution to GDP, taxes etc.) and trading opportunities (contribution to foreign currency saving etc.). It should also concerns on socio-environmental performance which considers the contributions of an operational initiative to the improvement of the environmental monitoring abilities of society, as well as the enhancement of legislation and the enforcement thereof, are included in this principle (Labuschagne et al, 2005).

2.3.4.4 Design and Innovation Principles of Sustainability in Building

Design and innovations aspects (GSB, 2013a; Muldavin, 2010; Edward, 1998) are very important to be considered towards achieving sustainability in building project. It should be initiated by considering all sustainability principles discussed previously in the section of 2.3.4.1 until section 2.3.4.3 in order to provide healthy and comfortable environments for human activities. Reyes et al. (2014) pointed that buildings should be designed to allow for their safety throughout the building life cycles, which stress on the workers and end-users safety. A product that performs well and save energy, but if it is unable to positively affect the occupants' comfort and enhance productivity, it is not a sustainable product (Sev, 2009). A review of literature show that, a sustainable building design should be innovated through it passive and active designs including their shape, private space, adaptability, accessibility, buildability and replaceability, design flexibility, energy efficiency, indoor environmental quality and other dynamic and endlessly innovations (GSB, 2012b; Ugwu and Chaupt, 2005; Edward, 1998) towards protecting health and comfort and protecting physical resources. An example of this is the installation of certain high-efficiency systems such as high-efficiency glazing or

increased day lighting, which resulted to the reduction of the capital cost and operating costs of the HVAC system. Sustainable building systems are naturally interdisciplinary. Muldavin (2010) highlighted four main systems for sustainable building high performance which are 1) designing with energy and water efficient systems 2) designing with indoor environmental quality (air and emission quality) 3) using sustainable materials and resources and 4) planning for sustainable site management. MS1525:2007 highlighted that 'design solutions must strive to optimise the benefits provided by the specific environment and to use environmentally friendly materials of high quality and durability in order to decrease waste' (Department of Standards Malaysia, 2007:4). Design that consider crime prevention, plan for fire protection and resist natural hazards are also among the most recommended to create an environment in which people feel safe to live, work or doing any social activities (Akadiri et al, 2012). A sustainable building should be functional (Sayce et. al, 2004) as Kometa et al. (1995) opine that there would be no point in undertaking a project if it does not fulfill its intended function at the end of the day. Quality, technical performance, and functionality are closely related and considered to be important to the owner, designer, contractor and the rest of the stakeholders (Chan and Chan, 2004).

Table 2.5: Sustainability Principles of Buildings and the Supporters

Sustainability Principles of Building		Supporters
ENVIRONMENTAL SUSTAINABILITY		
1.	Optimise materials and resources used	AS1, AS2, AS3, AS4, AS5, AS6, G1, G3, T1, B6, B7, B9, P2, P3, P5, P6, P7
2.	Sustainable materials and resources	AS1, AS2, AS3, AS4, AS5, AS6, G1, T1, B2, B6, B9, P2, P3, P4, P5, P7
3.	Energy efficient	AS1, AS2, AS3, AS4, AS5, AS6, G1, G3, B1, B2, B6, B10, P2, P3, P4, P6, P7
4.	Efficient water consumption	AS1, AS2, AS3, AS4, AS5, AS6, G1, T1, B2, B6, P2, P3, P4, P5, P6, P7
5.	Noise control	AS1, AS3, AS4, AS5, AS6, G1, G2, P2, P3, P4, P5
6.	Urban design, visual impact and aesthetic	AS3, B2, P2, P3, P5
7.	Site Planning and management	AS1, AS2, AS3, AS4, AS5, AS6, G1, G3, T1, B2, B6, P2, P3, P5
8.	Transport management	AS1, AS2, AS3, AS4, AS5, AS6, G1, B2, B6, B10, P4, P5
9.	Concern on quality of land, river and sea	AS1, AS2, AS3, AS4, AS5, AS6, G1, T1, B10, P2, P3, P4, P5, P6, P7
10.	Air and emissions quality	AS1, AS2, AS3, AS4, AS5, AS6, G1, G3, T1, B2, B10, P2, P3, P5, P6, P7
11.	Conserving heritage	AS3, B6, P3
12.	Efficient environmental management	AS1, AS2, AS3, AS4, AS5, AS6, G1, G3, B10, T2 , P2, P3, P4, P5
13.	Sustainable method	AS1, AS2, AS3, AS5, AS6, G1, B6, B10, P2, P3, P4, P5
ECONOMIC SUSTAINABILITY		
14.	Economic benefit to the stakeholders	AS3, G1, B6, P2, P3

'Table 2.5, Continued'.

Sustainability Principles of Building	Supporters
15. Improve local market presence	AS2, G1, GOV1, B6, B10, P2, P5
16. Whole life cost efficiency	AS1, AS3, G3, T1, B2, B6, B11, P2, P3, P5, P10, P13, P14, P15, P16
17. Indirect economic impact	AS2, G1, GOV1, T1, B6, P3, P6
SOCIAL SUSTAINABILITY	
18. Employment Benefits	G1, P5, B2, B6, P3, P7
19. Labor/Management Relations	G1, P6, P12
20. Occupational Health and Safety	AS1, AS2, G1, T1, B2, B6, P1, P3, P5, P6, P7, P9, P11
21. Training, Education and Awareness	AS1, G1, GOV1, B10, P1, P4, P6
22. Fairness	G1, B6, B8, B9, B10, P6, P7
23. Human right performance	G1, P5, P7
24. Society Performance	AS3, G1, B4, P3, P8
25. Product responsibility	AS1, AS2, AS3, AS5, G1, GOV2, T1, B5, B6, B10, P1, P2, P4, P6
26. Stakeholders participation	AS1, AS3, B3, B4, B5, B6, P2, P6, P7, P8
27. Macro social performance	P3, P6, P7
DESIGN AND INNOVATION	
28. Sustainable Design	AS1, AS2, AS3, AS4, AS5, AS6, G3, B1, B2 , B6, B10, P1, P2, P3, P4
29. Sustainable Innovation	AS1, AS2, AS4, AS5, AS6, B10, P1, P5

Note:

Building Performance Assessment Systems:
AS1 = BREEAM International 2013 (BRE, 2013)
AS2 = LEED 2009 for New Construction and Major Renovations (USBG, 2009)
AS3 = SBTool2012 (iiSBE,2012)
AS4 = Green Star –Office v3 (GBCA, 2008)
AS5 = Green Building Index- NRNC (GSB, 2009)
AS6 = Green Mark Certification Standards for New Buildings - version 4.1 (BCA, 2012)
Standard and Guidelines:
G1 = G3.1 Guidelines (GRI, 2011)
G2 = Planning Guidelines for Environmental Noise Limits and Control (Department Of Environment Malaysia, 2007)
G3 = MS1525 (Department of Standards Malaysia, 2007)
Government Documents:
GOV1 = Construction Industry Master Plan Malaysia 2006-2015 (CIDB, 2007a)
GOV2 = Quality Assessment System for Building Construction Work (CIDB, 2006b)
Books:
B1 = Value Beyond Cost Savings, How to Underwrite Sustainable Properties (Muldavin, 2010)
B2 = Environmental Concerns in Malaysian Construction Industry (Zainul Abidin, 2010)
B3 = Green Building through Integrated Design (Yudelson, 2009)
B4 = Emergent Principles of Social Sustainability (Magis and Shinn, 2009)
B5 = ASHRAE Green Guide (ASHRAE, 2006)
B6 = Building Sustainability in the Balance: Promoting Stakeholder Dialogue (Sayce et al, 2004)
B7 = Building Ecology-First Principles for a Sustainable Built Environment (Graham, 2003)
B8 = Volume Introduction (Haris and Goodwin, 2001)
B9 = The Social Sustainability of Cities: Diversity and the Management of Change (Polese and Stren, 2000)
B10 = Green Buildings Pay (Edward, 1998)
B11= RICS Green Gauge 2008/09: RICS Members and the Sustainability Agenda (Dixon, 2009)
Thesis:
T1 = Impact of Sustainability on Property Value (Schumann, 2010)
T2 = Incorporating Sustainable Development Principles into the Local Plan Preparation Process: The Case of Selected Localities in Southern Region of Peninsular Malaysia (Dola, 2003)
Papers:
P1 = Health and safety criteria for determining the sustainable value of construction projects (Reyes et al., 2014)
P2 = Design of a Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector (Akadiri et al., 2012)
P3 = Sustainable Construction in Malaysia - Developers' Awareness (Zainul Abidin, 2009)
P4 = Rapid Asessment Checklist for Sustainable Buildings (Gething and Bordass, 2006)
P5 = Key Performance Indicators for Infrastructure Sustainability – A Comparative Study between Hong Kong and South Africa (Ugwu and Chaupt, 2005)

'Table 2.5, Continued'.

P6 = Environmental and Social Impact Considerations for Sustainable Project Life Cycle Management in the Process Industry (Labuschgne et al, 2005)
P7 = Sustainable Life Cycle Management: Indicators to assess the sustainability of engineering projects and technologies (Brent and Labuschagne, 2004)
P8 = The human resource side of sustainability (Taylor, 2003)
P9 = Responsibilities toward the Coming Generations: Forming a New Creed (Lombardi, 2001)
P10 = Cost and value: fact and fiction (Bordass, 2000)
P11 = Sustainable Development: the Concept and the Practical Challenge (Parkin, 2000)
P12 = The true challenge: To bring about equitable and meaningful income distribution in society (Navamukundan, 1999)
P13 = A Social Ontology for Appraising Sustainability of Construction Projects and Development (Edum-Fotwe and Price, 2009).
P14= Multicriteria Sustainability Assessment of Residential Buildings (Zavrl, M. S., et al, 2009)
P15= Pre-construction Evaluation Practices of Sustainable Housing Projects in the UK (Essa and Fortune, 2008)
P16= Economic Challenges of Sustainable Construction (Lowe and Zhou, 2003)

2.4 SUSTAINABILITY PRACTICES IN PROJECT MANAGEMENT

Sustainable project management process is paramount towards encouraging sustainable construction. The rationale for integrating sustainability in construction project management, which has been the subject of several publications such as from Kamara et al (2001) and Labuschagne and Brent (2005) are based on the direct relevance of the goals and objectives of sustainable project in construction industry. The alignment between the aspects of project management and sustainability however is still very rare and there is almost no attention for the integration of sustainability in project management (Labuschagne and Brent, 2005). In order to effectively discuss the sustainability integration during planning process as outlined in the first objective of this research, the field of project management and project planning should be understood. This section will refer to both fields as outlined below.

2.4.1 Project

According to the PMBOK guide (PMI, 2008), a project is a temporary endeavor to create a unique product, service or result and has a clear beginning and end. It may involve only one person, or thousands. It may last several days, or many years. It may be undertaken by a single organization, or by an alliance of several stakeholders. Kerzner (2003), defined 'project' as a temporary undertaken that has a specific objective and a definite beginning and end. Meanwhile, Clement and Gido (2006) argued that a project is an endeavor to accomplish a specific objective through a unique set of interrelated tasks and the effective utilization of resources. Nevertheless, numerous researchers, planners and construction professionals frequently cite PMBOK definition on 'project' and there are some of them have revised and redeveloped it to

suit their particular context in relation to gaining successful project. Conventional projects are completed in isolation that is built using the tools and techniques itemized in PMBOK. Sustainability, however mentioned that nothing sustainable can occur in isolation and that to ensure sustainable development one must continuously examine one's activities in the light of their surroundings economic, social and environmental. Project management techniques favor the discrete nature of projects creating disconnect between these two fields in both theory and practice. The definition of 'project' itself is having minimal sustainability consequences. It is more concentrate on deliverables of the project without considering sustainability as one of the most significance criteria in delivering a successful project performance (Labuschagne and Brent, 2005).

2.4.2 Project Management

Project management can be defined as the 'the application of knowledge, skills, tools and techniques to project activities to meet project requirements' (PMI, 2008). Office of Learning Technologies, Human Resources Development Canada (HRDC, 2003), highlighted that project management is the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations of a project. It requires an understanding of the broader contextual environment of the project and the ability to balance conflicting demands between available resources and expectations, differing stakeholder priorities, identified needs and project scope, quality and quantity. Project management processes ensure the effective flow of the project throughout its existence (PMI, 2008). It involves the process of establishing a plan and then implementing that plan to accomplish the project objective (Clement and Gido, 2006). 'A process is a set of interrelated actions and activities performed to achieve a pre-specified product, result or service (PMI, 2008:37)'. Project management is accomplished through the appropriate application and integration of five process groups - initiating, planning, executing, monitoring and controlling and closing (PMI, 2008).

- Initiating Process Group – Those processes performed to define new project or a new phase of an existing project by obtaining authorization to start the project or phase. Project Charter is developed during this process.
- Planning Process Group – Those processes required to establish the scope of the project, refine the objectives and define the course of action required to attain

the objectives that the project was undertaken to achieve. Project Management Plan (PMP) is developed during this process.

- Executing Process Group – Those processes performed to complete the work defined in the project management plan to satisfy the project specifications. PMP is updated during this process.
- Monitoring and Controlling Process Group – Those processes required to track, review and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes. PMP is updated during this process.
- Closing Process Group – Those processes performed to finalize all activities across all Process Groups to formally close the project or phase.

The application of the project management processes is iterative and many processes are repeated during the project. The integrative nature of project management requires the Monitoring and Controlling Process Group interact with the other Process Groups as shown in Figure 2.3 below.

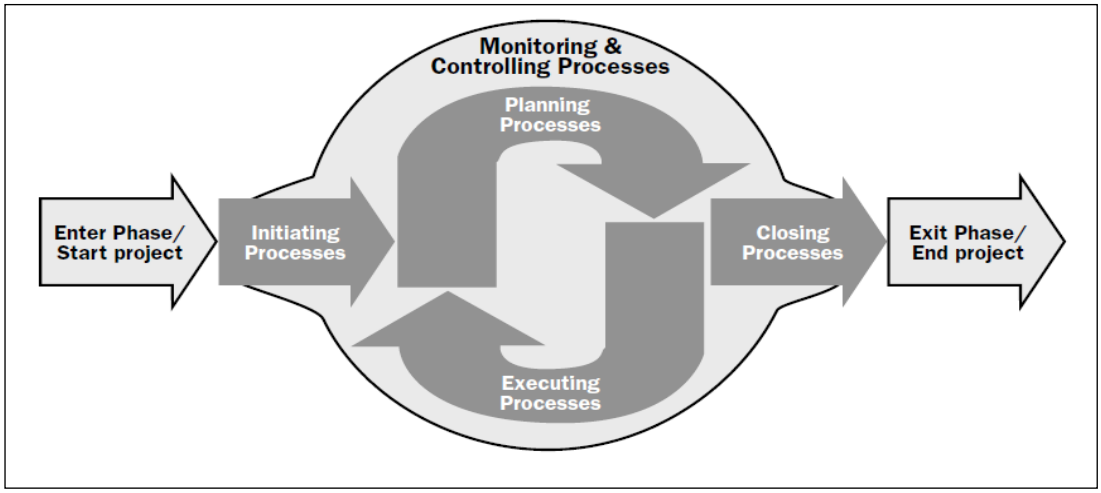


Figure 2.3: Project Management Process Group
(Source: Source: PMI (2008:40)

Planning Process Group provides the Executing Process Group with the PMP and project documents, and as the project progresses, it often entails updates to the project management plan and the project documents (PMI, 2008). Figure 2.4 illustrates how the Process Groups interact and shows the level of overlap at various times. When large or complex projects are separated into distinct phases or subprojects such as feasibility study, concept development, design or else, all of the process groups are repeated within each phase until the criteria for phase completion have been satisfied (PMI, 2008).

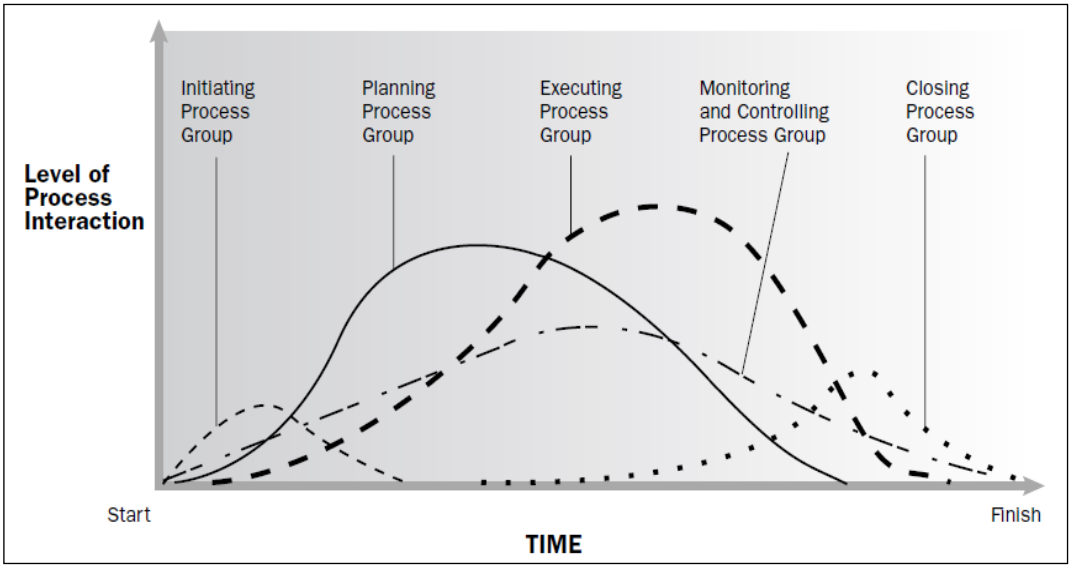


Figure 2.4: Process Groups Interact in a Phase or Project
(Source: PMI (2008:41)

2.4.3 Project Life Cycle

Project life cycle defines the inter-related phases of a project and provides a structure for governing the progression of the work (APM, 2012). Since project life cycle may be viewed as a process through which a project is implemented from the beginning to the end (Kerzner, 2003), the life cycle of the project must be taken into discussion of this research as it is important in order for project management to support the objectives of sustainability (Labuschagne et al, 2005). Life cycles are differ across industries and business sectors (APM, 2012). Today, there is no agreement among industries, or even companies within the same industry, about the life cycle phases of a project because of the complex nature and diversity of projects (Kerzner, 2003).

PMBOK divided a project life cycle into four stages- starting the project, organizing and preparing, carrying out the project work and closing the project (PMI, 2008:16). For construction project, CIOB (2010) segregated the life cycle into eight phases – inception, feasibility, strategy, preconstruction, construction, engineering services commissioning, completion, handover and occupation and post-completion review/project close out report. A project life cycle is different from a product life cycle. Generally, a project life cycle is contained within one or more product life cycles. The last product life cycle phase is generally the product's retirement (PMI, 2008). The project and product life cycles are shown in Figure 2.5 below.

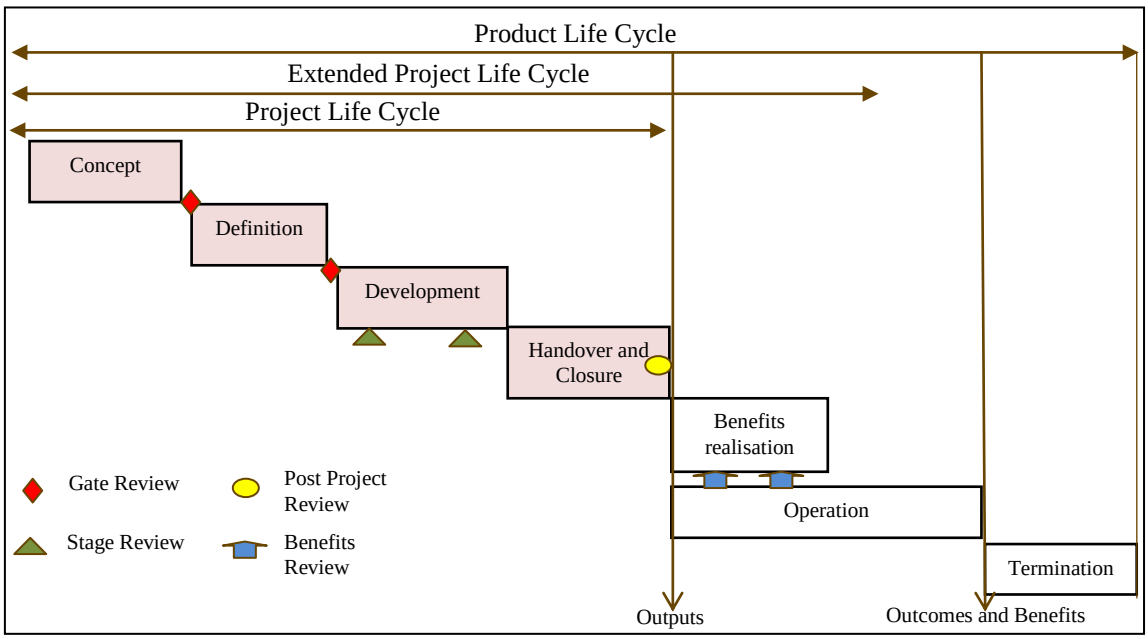


Figure 2.5: Linear Project Life Cycle and Product Life Cycle

Source: Adapted from APM (2012:27)

A typical linear project life cycle and product life cycle are suggested as below (APM, 2012:27-28).

- Concept – this phase develops an initial idea and creates an outline business case and schedule. At this stage, the owner usually assigns a project manager to direct and coordinate the conceptual phase of a proposed new building. The major activities involved in this stage include product development, process development or process license, marketing surveys, setting project scope and design basis, capital cost estimating, project financing, economic feasibility studies and board approval of the project (Clark, 2002; Ritz, 1994). Sufficient analysis is performed to ensure whether the project likely to be viable and worth to be invested (APM, 2012).
- Definition – Once the board has given its approval to proceed with the project, the owner is ready to enter the proposal phase and select a contractor. This phase including preparing a contracting plan, prequalifying contractor slate, preparing a request for proposal (RFP), receiving and analysing the proposals, selecting the best proposal and negotiating contract. The preferred solution is identified and ways of achieving it are refined. The PMP is developed at this stage (APM, 2012).
- Development – The PMP is put into action
- Handover and Closure – The project outputs are handed over and accepted by the sponsor on behalf of the users.

- Benefits realization – where appropriate, a project may include a benefits realization phase.

The full product life cycle also includes;

- Operation – Continuing support and maintenance
- Termination – Closure at the end of the product's useful life

A building life cycle is usually divided into four main stages which are pre-construction stage, construction stage, building usage (operation and maintenance) and phase out and disposal (Kohler and Lützkendorf, 2002; Fay et al, 2000). Sustainability integration should encompass the complete life cycle of a building from initial concept through to demolition and site remediation. It describes a process which starts well before construction in the planning and design stages and continues after the construction teams have left the site (Zainul Abidin, 2010). It involves all those stakeholders that develop, plan, design, build, alter or maintain the built environment and includes building materials manufacturers and suppliers as well as clients and end user or occupiers. Each of the numerous stakeholders in the process of planning, designing, financing, constructing and operating and maintaining construction project has a different perspective on management of construction project. Thus, it is advantageous to bring the different specialities and parts of the process fit together. Sustainable project can result from excellent coordination and communication among specialists or otherwise waste, cost overrun and delay might be happened (Hendrickson, 2000).

However, there is no single best way to define the ideal structure of project even in the same organisation may have significant variation. Some projects have only one phase as shown in Figure 2.6 (p77); other projects may have multi-phases with sequential or overlapping phases as illustrated in Figure 2.7 (p77).

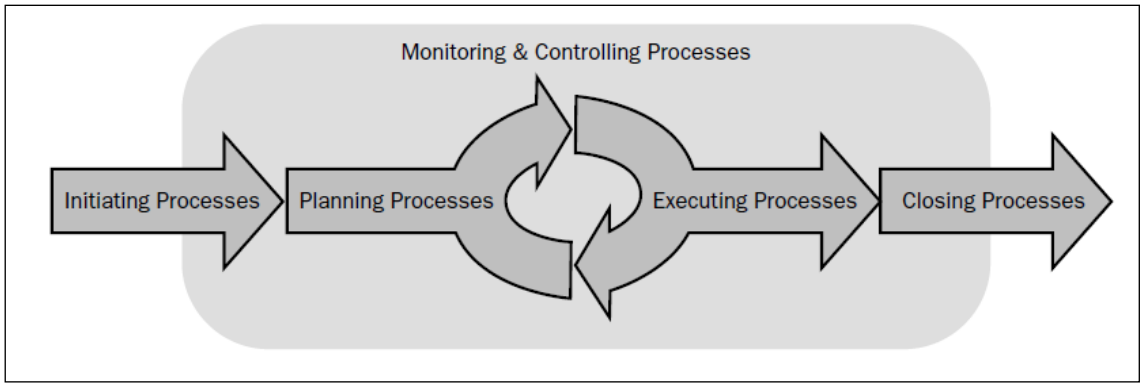


Figure 2.6: Single Phase of Project
Source: PMI (2008:19)

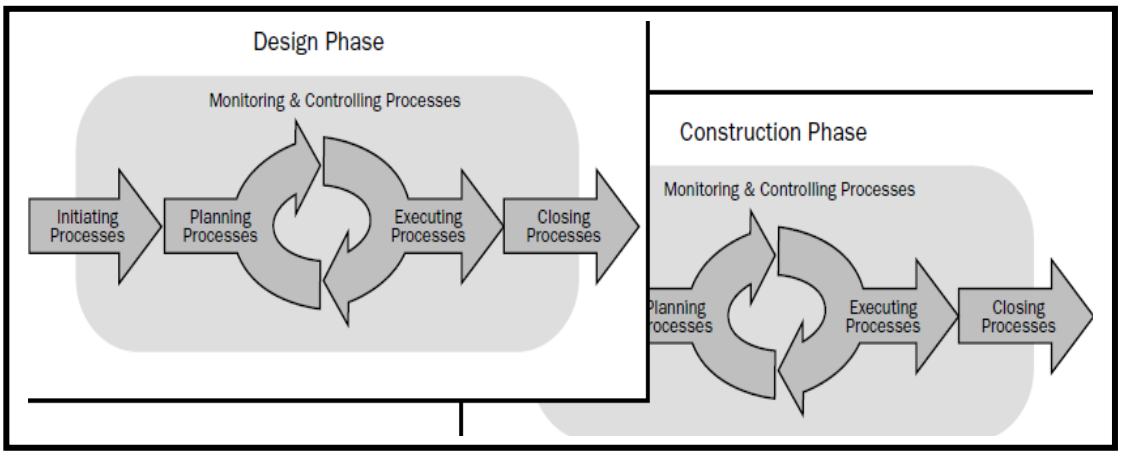


Figure 2.7: A Project with Overlapping Phases
Source: PMI (2008:21)

2.4.4 Project Planning Process

Project planning determines what is to be delivered, how much it will cost, when and how it will be delivered and who will carry it out (APM, 2012:7). Ritz (1994:88) listed several definitions of planning as follows;

1) Planning is a bridge between the experience of the past and the proposed action that produces a favourable result in the future.
2) Planning is a precaution by which undesirable effects or unexpected happenings can be reduced and thereby eliminate confusion, waste, effects and loss of efficiency.
3) Planning is the prior determining and specifying of the factors, forces, effects, and relationships necessary to reach the desired goals.

The first definition stresses on making use of project prior experience, often gained from past mistakes, to avoid repeating them in present endeavor. The second definition cites the advantages of increased productivity by planning the unexpected and undesirable happenings out of existence before starting to work. The third one stress making a conscious effort to find and control the variables in a capital project. Planning is the process where the decision to proceed a project has been made and it is time to be more detailed in describing the project (Clark, 2002). This process requires the project manager to think through the project and remain focused on the end goal, which is the final deliverable. Naylor (1995) highlighted that a poorly thought-out plan will not anticipate many problems and can turn into a crisis. The planning process develops the Project Management Plan (PMP) and the project documents that will be used to carry out the project. Planning and documentation are iterative and ongoing processes as significant changes occurring throughout the project life cycle trigger a need to revisit one or more of the planning processes and possible some of the initiating processes. During this process, all appropriate stakeholders are encourages to be involved to give their inputs towards the planning and developing PMP and project documents (PMI, 2008). Several planning processes should be executed when developing a PMP. There are various different sources of project planning processes that exist. For instance, Rusell and Taylor (2003) identify seven planning processes which include defining project objectives, identifying activities, establishing precedence relationships, time estimates, determining project completion time, comparing project schedule objectives and determining resource requirements to meet the objectives. Meanwhile, Clement and Gido (2006) listed the planning process as defining project objective, determining work elements or activities to be performed, developing a responsibility matrix, defining activities, developing the network plan, cost and resource planning and time estimates. Ritz (1994) suggested that the planning activities for a typical project are including construction execution plan, time plan (field schedules), and money plans (construction budget and cash flow) and resources plan (people, materials, systems and money). This implies that the procedure for the analysis of environmental and social impacts must ensure that any future environmental liabilities and costs, which can result from the implementation of the project, are taken into consideration.

Due to the complexity and various slightly different opinions within this field, PMBOK is chosen as the main source for the purpose of this study as this body of knowledge is recognized as a standard by the American National Standard Institute and continuously

updated by project management practitioners, as well as used by most of the large organizations all around the world (Zwikael, 2009). PMBOK (PMI, 2008) has listed twenty project planning processes as follows;

1. Develop PMP – Process of documenting the action necessary to define, prepare, integrate and coordinate all subsidiary plans.
2. Collect Requirements – Process of defining and documenting stakeholders' needs to meet the project objectives.
3. Define Scope – Process of developing a detailed description of the project and product.
4. Create Work Breakdown Structure – Process of subdividing project deliverables and project work into smaller, more manageable components.
5. Define Activities – Process of identifying the specific actions to be performed to produce the project deliverables.
6. Sequence Activities – Process of identifying and documenting relationships among the project activities.
7. Estimate Activity Resources – Process of estimating the type and quantities of material, people, equipment or supplies required to perform each activity.
8. Estimate Activity Durations – Process of approximating the number of work periods needed to complete individual activities with estimated resources.
9. Develop Schedule – Process of analysing activity sequences, durations, resource requirements and schedule constraints to create the project schedule.
10. Estimate Costs – Process of developing an approximation of the monetary resources needed to complete project activities.
11. Determine Budget – Process of aggregating the estimated costs of individual activities of work package to establish an authorized cost baseline.
12. Plan Quality – Process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance.
13. Develop Human Resources Plan – Process of identifying and documenting project roles, responsibilities, and required skills, reporting relationships, and creating a staffing management plan.
14. Plan Communications – Process of determining project stakeholder information needs and defining a communication approach.

15. Plan Risk Management – Process of defining how to conduct risk management activities for a project.
16. Identify Risks – Process of determining which risks may affect the project and documenting their characteristics.
17. Perform Qualitative Risk Analysis – Process of prioritizing risk for further analysis or action by assessing and combining their probability of occurrence and impact.
18. Perform Quantitative Risk Analysis – Process of numerically analysing the effect of identified risks on overall project objectives.
19. Plan Risk Responses – Process of developing options and actions to enhance opportunities and to reduce threats to project objectives.
20. Plan Procurements – Process of documenting project purchasing decisions, specifying the approach, and identifying potential sellers.

Generally, a PMP contains the following elements, 1) an overview, 2) project objectives, 3) general approach, 4) contractual aspects, 5) schedules, 6) resources, 7) personnel, 8) a risk management plan 9) a marketing strategy and evaluation methods (Meredith and Mantel, 2006). Angus et al. (2000) added another two (2) important elements that should not be forgotten in preparing a project plan; 1) production specification and working and detail drawing. PMP is very important in order to ensures that the objectives of a project are clearly defined so that there is no disagreement later on, to control and measure progress of a project, dealing with any changes that may occur and to cement stakeholders' support over the coming periods of the project.

2.4.5 Sustainability Integration into the Project Planning Process

Planning takes the longest time of the process in project management (Clark, 2002). It is the most important process conducted in managing the whole life of projects (Zwikael et al., 2005; Hayles, 2004; Kerzner, 2003). Zainul Abidin (2009) and Hayles (2004) proclaimed that raising sustainability awareness early in the planning process of a project is very important in order to optimize the influential potential in determining the course of the project. Planning process brings together the relevant stakeholders early throughout the conceptual and design process of the project which allows everyone involved to understand and perform their part in the project (PMI, 2008).

Planning process holds the strategic position to integrate sustainability principles to have the most sustainable effect on the overall project (Zainul Abidin, 2010b; Wu and Low, 2010; Hayles, 2004). Hill and Bowen (1997) proclaimed that sustainability integration in building should start with planning stage of the project and continue throughout its life to its deconstruction and recycling of resources to reduce waste stream during demolition process. The idea has been accepting since long time ago which, sustainability integration during project planning is observed to be a key factor in achieving sustainable product. Muldavin (2010:7) highlighted; 'Building sustainably is fundamentally a process of best practices that leads to sustainable outcomes. It is critically important to get these processes right in order to deliver a successful high performance building. Poor execution of these processes can lead a variety of negative consequences, including underperforming systems, uncomfortable environments, or increased cost.'

2.4.6 Review of the Sustainability Integration Strategies into the Project Planning Process

Planning process has a significant impact on the ability of a construction project to success (Hamilton et al, 1996; Syal et al, 1992). This is the process where the detailed directions are given which would affect the whole course of the project. Success during the detailed design, construction and the rest phase of the project depends highly on the level of effort during this stage (Gibson and Gebken, 2003; Dumon et al, 1997). Thus, this process is seen as the most significant process in which the sustainability principles are integrated for the whole life of building. From literature review, there are 21 strategies to integrate sustainability into the project planning process have been unveiled and to be addressed in developing a framework for integrating sustainability into the project planning process for buildings. The strategies are divided into four main groups namely; 1) sustainable project orientation, 2) integrated project team 3) integrated design process and 4) regulations and code compliances. The strategies were put into the particular categories in which it is considered most important, likely to be mentioned and has most impact. The strategies and the supporters are listed in Table 2.6 (p91) and discussed as follows;

2.4.6.1 Sustainable Project Orientation

Planning process for a sustainable building project is different from the traditional planning process due to its complexity and holistic approach. It held responsible towards delivering sustainable development goals (Molenaar et al., 2009; Yudelson, 2009). Thus, the project should be planned with sustainability orientation approach by implementing two strategies as follows;

1) **Specific sustainability goals and project priorities:** Sustainability goals and project priorities must be considered seriously since the planning process of the early stage of project development (Robichaud and Anantatmula, 2011; CIOB, 2010; Yudelson, 2009). At this stage, the level of understanding and commitment to sustainability may vary among different parties (Halliday, 2008). Thus, how the stakeholders are communicating and how the sustainability inputs are given to the stakeholders ensures this responsibility (CIOB, 2010; Wu and Low, 2010; Molenaar et al., 2009). Problems exist when the project team transfers the performance goals into the following period through the life cycle of project, where there is a high risk of the sustainability baton being dropped throughout the process. As the project moves on, more and more sustainable performance goals are dropped. Ultimately, when the project is handed over to the client, it may far from what has been expected (Liddel, 2006). The problem can be mitigated since the project planning process by ensuring participation and understanding of all the project stakeholders towards sustainability so that the project plan that is delivered is able to be a sustainability guide to the projects whole life and the rest of the project management process (CIOB, 2010).

2) **Sustainable concerns during the establishment of project scope, project charter, drawing, contract and detailed project plan:** Sustainability concerns are essential to be integrated during the establishment of project scope, project charter, drawing, contract and detailed project plan and the rest of project documents. Using this approach to select the best option among alternatives since the early stage of development is vital towards achieving sustainability targets (Zavrl, 2009; Essa and Fortune, 2008). The optimal sustainability performance will then evolve from project decisions made to meet the performance target.

2.4.6.2 Integrated Project Team

Active design professionals' involvement in planning was repeatedly claimed as the key to increase project success (Gibson and Gebken, 2003). To plan for a successful sustainable building project, the stakeholders who are involved in the planning process must fully understand the sustainability issues and interact closely throughout the planning processes of the project. Each project shall have a core integrated project team that shall be cross-functional to accomplish the various tasks of the project. The integrated project team consists of a wide range of specialist and functions including architect, general contractor, stakeholders from the owner's side including project manager, structural engineer/facade consultant (for large building), and others depending on the nature and complexity of the project, the specific sustainability goals sought and local site and community conditions. Sally Wilson is global director of environmental strategy for CB Richard Ellis, the world's largest property management firm. She also brings the perspective of the commercial real estate broker to integrated design team (Yudelson, 2009). The integrated project team approach is consisting of seven strategies as follows;

1) **The project team members are involved and maintained throughout the planning process:** The project team members have to be initiated and maintained throughout the process of project planning towards achieving a sustainable building project (US Department of Health and Human Services, 2008). Bill Reed[1] highlighted that the team also should commits to follow through all the way to the end of construction phase (Yudelson, 2009).

2) **Local community representative is involved in support of the project:** Locally driven coalitions are viable means of improving the status and future well being of communities in which they live. Perkins et al. (2011) believed that an absence or low level of engagement on the part of team members inhibits planning across community sectors. Local community representatives, including a local government planner are suggested to be involved in planning process to support of sustainability integration in building project (Perkin et al, 2011; Luce, 2010). The charrette through planning process encourages feedback from local government planners and other regulatory

[1] Boston-based architect William G.(Bill) Reed. Reed is widely credited with being one of the original co-authors of the USGBC's Leadership in Energy and Environmental Design (LEED) rating system.

agencies in the early stages so that zoning considerations are factored into the site plan in advance. With local government stakeholders involved in the charrette, the project's initial design is more likely to comply with local, state and federal development needs and regulations. Their involvement provides opportunity to represent the local community voices for matters such as amenities, public transport and many more (Sayce et al, 2004).

3) **An integrated design/ sustainability coordinator is appointed as one of the project team members:** The team should assign an integrated design or sustainability coordinator who is a sustainable building specialist, for the project (Muldavin, 2010; US Department of Health and Human Services, 2008; Smith et al, 2006). This person should involve in the planning process from the earliest stage of development and must have experience delivering certified sustainable building project with integrated design process (Muldavin, 2010). Given the highly collaborative nature of this position, the coordinator must be an effective communicator and a good negotiator.

4) **The team members should have the core knowledge of sustainability in building project:** The sustainable development education needs to reach beyond designers and architects for the acceptance of the sustainable building project. There is a need for the project team members to fully understand sustainability knowledge and issues (Luce, 2010). Without a sustainability project knowledge base, they will not be able to evaluate and deliver such projects accurately and effectively. Choi (2009:130) suggested that one of the factors that should be considered when evaluating project proposals is 'experience of design team with sustainable buildings and their ability to deliver products with less cost overruns and change orders'. It would be very difficult for a design team without sustainable building experience and knowledge to build a structure that capitalized on all the social, economic and environmental benefits. A competent project manager is vital to a sustainable project success.

5) **Team members are educated on sustainability issues and the project delivery process:** Continual communications and training for all project personnel are essential during the planning process to ensure the accomplishment of sustainable project goals in a cost effective manner (Mochal and Krasnoff, 2010). There is a need to educate team members and market representatives, such as lenders, appraisers, and brokers, on sustainable development issues throughout this process as they determine

property value and viability (Mochal and Krasnoff, 2010; Choi, 2009; Glavinich, 2008). The project personnel, including vendors also, should be educated to ensure they follow the company's sustainable development methodology and focus on sustainability in their work for the projects (Halliday, 2008). Sustainable building construction costs less than conventionally built structures over their lifetime. However, the lack of access to the knowledge, project's characteristics and materials imposes the initial costs and will lead to a defective delivery process for many developers (Choi, 2009; Smith, 2003).

6) **Team members are selected with sustainable development quality and capability:** Sustainability quality and capability should be considered during the selection of a project manager, consultants, designers, contractors and the team members of a sustainable building project (Doyle et al., 2009; Bogenstätter, 2000). They are selected based on their right attitude, one of being willing to learn and to participate in the new things and process (Yudelson, 2009). The priority is also given to those who are familiar with the product type and market, and having exposure to the project (Bogenstätter, 2000). Difficult situations can often occur on projects where the client has hired the team members who will not commit to participate in a team process or even to attend all the key project meetings. Thus, choosing a team with a portfolio of successful sustainable building projects is also beneficial to ensure the successful of the project (Choi, 2009).

7) **Team members are fully informed on sustainability goals and project priorities:** Sustainability goals and priorities of the project should be informed to the team members at the initial discussion of a new project (Hwang and Ng, 2013). The early planning process of the project generally includes a group discussion about the needs and requirements for the project (Robichaud and Anantatmula, 2011). It must be ensured that the project team members understand the commitment and sustainability objectives of the project (Bal et al. 2013). Potential bidders are to be given an opportunity to understand the vision of the project team and the importance of the project's sustainability aspects in a pre-bid meeting (Doyle et al., 2009).

2.4.6.3 Integrated Design Process

The traditional project management process runs linearly and usually has minimal input from engineering disciplines, operation and maintenance groups or the outside during

the planning process (Doyle et al., 2009; Choi, 2009). Unlike a conventional project, a sustainable building project works best when the expanded group of stakeholders work together to concentrate the majority of their creative efforts very early in the planning process (Prowler, 2012; Muldavin, 2010; Choi, 2009; Smith et al., 2006; Riley et al., 2004). Sustainability integration in building is delivered successfully by applying an integrated design process throughout the project planning process, the process consists of the following strategies;

1) **Involve diverse set of stakeholders on the team:** Depending on the developer's goals and the type of project, an integrated design team will include different combinations of professionals to accommodate the project's specific skills and service needs (Matthiessen and Morris, 2004). This multidisciplinary integrated design approach can be a very effective tool to understand the clients' needs and requirements, evaluate and correct design flaws, determine proper sustainable material usage and installation, and foster communication among all of the stakeholders. The team should also include the operation and maintenance staff that will run the building during occupancy to ensure the buildings are operated and maintained in a sustainable manner. Every stakeholder has to participate during planning process and no one allowed considering just their own special interest (Yudelson, 2009).

2) **Committed and collaborative team throughout the process:** It is crucial for all members of the integrated design team to commit to the integrated design process, to share their knowledge and work together throughout the planning process to ensure that the systems they put in place are complementary (Choi, 2009; Yudelson, 2009; Smith et.al. 2006). Ugwu and Chaupt (2005) highlighted that there is a need to adopt strategies that facilitate collaborative working among project teams, as a prerequisite to achieving sustainability objectives. Rowlinson and Cheung (2012) and Cheung and Rowlinson (2011) believed that sustainability in project and its supply chain can be developed through collaboration, open communication and joint problem solving. The commitments, motivation and attitude of the project team members are critical to ensure that the project attains its desired performance goals (Rowlinson and Cheung, 2012).

3) **Bringing the team together as early as possible:** Bringing all of the team members together as early as possible during the planning process of the conceptual and design stage (Robichaud and Anantatmula, 2011; Zainul Abidin, 2009; Choi, 2009;

Yudelson, 2009) allows the project team to take a whole building approach towards achievement of a sustainable building at lower costs (Lapinski et al., 2006; Beheiry et al., 2006). The team will also have more influence on some of the most significant project decisions, such as site selection, strategic planning, and the preliminary design concepts. Early involvement also allows the project team to create a highly effective analysis of the project and to leverage synergies between various building functions and site characteristics (Bogenstätter, 2000). Perkins et al. (2011) highlighted that how well teams functioned in the early stages is strongly related to the quality of their later preparations for sustainability. Inputs from their collaboration are able to minimize sustainable building costs throughout all phases of a building's lifecycle.

4) **Sustainability and integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan:** It is important to incorporate the requirements for integrated design and the process also the sustainability principles into the project documents including the strategic and comprehensive plan. The cost, benefits and the performance target of a sustainable building and sustainability issues must be documented and communicated to expand the market for a sustainable development (Luce, 2010; The State of Minnesota, 2009; Choi, 2009). The integrated design process could be even more important than the design of the building for delivering a successful sustainable building (Muldavin, 2010).

5) **Do whole building design and system analysis:** Recent research shows that whole building designs or the holistic approach is very important towards delivering a sustainable building project (Hwang and Ng, 2013; Prowler, 2012; Robichaud and Anantatmula, 2011). It requires an integrated design team and all affected stakeholders work together to evaluate the design for the life cycle cost analysis (Doyle et al., 2009; US Department of Health and Human Services, 2008), quality of life, future flexibility, efficiency, overall impact, productivity, post-occupancy evaluation and how the occupants will be enlivened (The State of Minnesota, 2009). It draws from the knowledge pool of the stakeholders across the life cycle of the project. A whole-systems analysis that treats the building as a system and takes into account the interactions and synergies between the different components should be done when possible (Glavinich, 2008; Muldavin, 2009). Although the analysis requires more upfront time than a standard design process, but it can maximize potential of sustainable benefits (Hwang and Ng, 2013).

6) **Commissioning process is added during this process and described in a specific section:** A commissioning process is added during the planning process and described in a specific commissioning section is very important to make sure that all the systems perform as designed (The State of Minnesota, 2009; Halliday, 2008; Glavinich, 2008; Smith et al., 2006). The availability of competent commissioning agent is a key risk factor influencing cost and quality of the project (Yudelson, 2009). The best commissioning can properly diagnose complicated problem, while less experienced commissioning agents may spend more money and not really solve the problem. The commissioning agent should be able to coordinate and collaborate with the architects, engineers and contractors in order to complete commissioning. Since the commissioning agent serves as check on the work of others to ensure the project meets the design intent and perform up to expectations, bringing commissioning agent on in planning process at pre design phase will ensure that any problems that arise can be fixed during the design stage at minimal cost to the owner (Muldavin, 2010).

7) **Planning should reflect all the project stakeholders (internal and external):** Stakeholder engagement is a core element of any sustainable development plan. A project is more likely to be successful especially in the long term, by taking into consideration the expectations of the stakeholders and endeavours to meet their needs (Bal et al, 2013:696). Sayce et al (2004) suggested that the decision making in planning process involved in determining the future life of a building should take into account the needs of both internal and external stakeholders. Internal stakeholder is the group that have a direct legal or financial interest in the building such as owners, occupiers and consultants. The external stakeholder group includes all those with no legal, equitable or no financial interest in the building but who are affected by decisions about it such as shoppers, visitors, local authorities and others public bodies. A truly sustainable development should recognise all the stakeholders in decision making as they have rights, whether or not they are enshrined in legislation. For instances, the investing building owner will frequently take a primary short-term economic view while the planners need to take a long term perspective recognising external stakeholders needs (Sayce et al, 2004).

8) **Design should reflect the end user community:** The design that developed through the sustainability concerns of planning process should consider the user's community needs and fit for purpose. The fact is, buildings which are loved are more

likely to be maintained and to be sustainable (Luce, 2010 and Mochal and Krasnoff, 2010; Sayce et al., 2004). The team should works with prospective occupants or end user to establish their requirements and interiors spaces, adjacencies and other programming requirements (Yudelson, 2009). This can be achieved by involving at least a representative of the end user during planning process (US Department of Health and Human Services, 2008). It is vital to ensure that the project is built with high level of user involvement in the planning process of conceptual and design project phase or the client and designers cannot be expected to produce distinctive and forward looking sustainable buildings.

9) **Effective communication and incorporation of charrette process:** A common challenge in construction projects is a lack of effective communication among various technical experts who tend to use their own tools, protocol, and industry standards for making decisions and tracking information (Sappe, 2007). This situation makes it difficult to manage changes, mitigate risks, and contain costs with a holistic view of the project. Therefore, communicating with stakeholders early during the planning process of the project assures that key groups understand and support the project's sustainable goals (Hwang and Ng, 2013). The most effective way for effective communication and exchanging ideas among the project stakeholders group is the incorporation of charrette at the beginning of the project. This involves regular progress meetings and a multiday charrette during the planning process. Successful charrettes often result in stakeholders feeling included and listened to, even if they do not agree with every aspect of the end product (Robichaud and Anantatmula, 2011; Muldavin, 2010).

2.4.6.4 Regulations and code compliances

Sustainable project often encounter regulation and code compliance problems in meeting broader regulations. Regulation and code compliance problems can occur due to the gap that often exist between the aspirational statements of city leaders or building owners and the realities of day to day implementation of regulation and code compliance with specific building code and building operational personnel. Building codes that were written for conventional developments often do not allow more sustainability systems (Choi, 2009). The risks related to the problem include delays in project completion and additional costs due to delays or design modifications. Thus, it is crucial for a sustainable building project to supports the three principles as follows;

1) **Government policies to encourage sustainable development:** Public and government policies can heavily influence whether a sustainable project get built (Choi, 2009). Governments at all levels can show leadership in sustainable development by including sustainability requirements for all their building projects. Many public buildings have become showcases for successful sustainable building because governments are willing to share their experiences and building performance information. By being a supervisor of sustainable building project, government can use the experience to shape all future land and building development within their authority to be aligned with their sustainability goals.

2) **Compliance with code and regulatory tool to encourage sustainable development:** Regulatory processes and codes that meet the sustainability goals can help to promote sustainability integration practices in building project (Luce, 2010; Muldavin, 2010; Choi, 2009). Codes and ordinances can be used as a regulatory tool to encourage sustainable development by setting clear sustainability criteria that developers need to meet. It is vital to adopt and align codes to meet sustainability goals and use codes, utility fees and process improvements to promote the practices (Choi, 2009). Codes for sustainability practices should be continually developed and improved. This will allows more sustainable building plans to be assessed efficiently and ultimately minimizing developers' frustration with the regulatory process.

3) **Incentive to encourage sustainable development:** Regulatory guidelines and processes are the areas where incentives or allowances can be adjusted to encourage sustainable practices (Muldavin, 2010; Choi, 2009). Monetary or process-oriented incentives can be offered such as to ease the initial cost differential or difficulty factor. Monetary incentives can offset any cost differential or provide savings for choosing a sustainable building, making the adaptation to sustainability more feasible for property owners and developers. It can also be used to fund an integrated design or bring in expertise for consultation. Besides, a well-advertised or marketed incentive can bring positive publicity to the practices, offering developers an alternate design where the developers and the community may both benefit (Choi, 2009).

Table 2.6: Strategies to Integrate Sustainability into the Project Planning Process and the Supporters

Strategies to Integrate Sustainability into the Project Planning Process		Supporters
SUSTAINABLE PROJECT ORIENTATION		
1.	Specific sustainability goals and project priorities	B1; B2; B3; B5; P3; P4; P5; O3
2.	Sustainable concern during the establishment of project scope, project charter, drawing, contract and detailed project plan	B1; B2; B3; P3; P4; P5; P16; P17
INTEGRATED PROJECT TEAM		
3.	The project team members are involved and maintained throughout the planning process	B3; O5
4.	Local community representative is involved in support of the project	B6; P2; P3; P6; O2
5.	An integrated design/ sustainability coordinator is appointed as one of the project's team members	B2; O5
6.	The team should have the core knowledge of sustainable building project	B1; B3; P1; P3; P4; P6; O2; B4; B5; O10
7.	Team members are educated on sustainability issues and the process including vendors	B1; B3; B4; B5; P3; P4; P6; O10
8.	Team members' selection with sustainable development quality and capability	B3; P6; P7; P13; P18; GOV1
9.	Team members are fully informed on sustainability goals and priorities of the project.	B1; B3; P1; P3; P6; P7; P18
INTEGRATED DESIGN PROCESS		
10.	Involve diverse set of stakeholders on the team	B1; B2; B3; P6; P7; P13; P14; O1; O4; O5; O8; O9
11.	Committed and collaborative team throughout the process	B2; B3; P6; P7; P12; P13; P14; O1; O4; O5; O8; O9
12.	Bringing the team together as early as possible during planning process	B2; B3; P2; P3; P6; P7; P8; P10; P11; P13; P14; P15; O1; O4; O5; O8
13.	Integrated design requirements and the process are included into the project documentations, strategic and comprehensive plan.	B2; B3; P6; P7; P13; O1; O2; O4, O5; O8
14.	Do whole building design and systems analysis	B2; B3; B4; P1; P3; P6; P7; P13; O1; O4; O5; O8
15.	Commissioning process is added during this process and described in a specific section	B2; B3; B4; B5; P6; P7; P13; O1; O4; O5; O8
16.	Planning should reflect all the project stakeholders	B1; B2; B3; B6; P4; P6; P7; P13; P18; O1; O2; O4; O5; O8
17.	Design should reflect the end user community	B2; B6; P4; P6; P7; P13; O1; O2; O4; O5; O8
18.	Effective communication and incorporation of charette process	B2; B3; P1; P3; P6; P7; P9; P13; O1; O4; O5; O7; O8
REGULATIONS AND CODE COMPLIANCES		
19.	Government policies to encourage sustainable development	B2; P6; O6
20.	Compliance with code and regulatory tool to encourage sustainable development	B2; P6; O2
21.	Incentive to encourage sustainable development	B2; P6

Note:

Government Documents:
GOV1 = Construction Industry Master Plan Malaysia 2006-2015 (CIDB, 2007a)
Books:
B1 = Code of Practice for Project Management for Construction and Development (CIOB, 2010)
B2 = Value Beyond Cost Savings, How to Underwrite Sustainable Properties (Muldavin, 2010)
B3 = Green Building through Integrated Design (Yudelson, 2009)
B4 = Contractor's guide to green building construction: management, project delivery, documentation and risk reduction (Glavinich, 2008)
B5 = Sustainable Construction (Halliday, 2008)
B6 = Building Sustainability in the Balance: Promoting Stakeholder Dialogue (Sayce et al, 2004)

'Table 2.6, Continued'.

Papers:

P1 = Project Management Knowledge and Skills for Green Construction: Overcoming Challenges (Hwang and Ng, 2013)
P2 = Team factors that predict to sustainability indicators for community-based prevention teams (Perkins et al, 2011)
P3 = Greening Project Management Practices for Sustainable Construction (Robichaud and Anantatmula, 2011)
P4 = Green Project Management: Supporting ISO 14000 Standard through Project Management Process (Mochal and Krasnoff, 2010)
P5 = Project Management and Green Buildings: Lesson from the Rating Systems (Wu and Low, 2010)
P6 = Removing Market Barriers to Green Development: Principles and Action Projects to Promote Widespread Adoption of Green Development Practices (Choi, 2009)
P7 = Building Green-Potential Impacts to the Project Schedule (Doyle, 2009)
P8 = Sustainable Construction in Malaysia - Developers' Awareness (Zainul Abidin, 2009)
P9 = Project management solutions for building owners and developers (Sappe, 2007)
P10 = Examining the Bussiness Impact of Owner Commitment to Sustainability (Beheiry et al., 2006)
P11 = Lean Processes for Sustainable Project Delivery (Lapinski et al, 2006)
P12 = Key Performance Indicators for Infrastructure Sustainability (Ugwu and Chaupt, 2005)
P13 = Sustainable Metrics: A Design Process Model for High Performance Buildings (Riley et al, 2004)
P14 = Design Quality in Pre-project Planning: Applications of the Project Definition Rating Index (Gibson and Gebken, 2003)
P15 = Prediction and optimization of life-cycle costs in early design (Bogenstätter, 2000)
P16= Multicriteria Sustainability Assessment of Residential Buildings (Zavrl, M. S., et al, 2009)
P17= Pre-construction Evaluation Practices of Sustainable Housing Projects in the UK (Essa and Fortune, 2008)
P18= Stakeholder Engagement: Achieving Sustainability in the Construction Sector (Bal et al, 2013)

Others:

O1 = Whole Building Design (Prowler, 2012)
O2 = Project Management and Sustainability (Luce, 2010)
O3 = Sustainable, High Performance Projects and Project Delivery Methods: A State of Practice Report, U.S (Molenaar et al., 2009)
O4 = The State of Minnesota Sustainable Building Guidelines Version 2.1 (The State of Minnesota, 2009)
O5 = Sustainable Buildings Implementation Plan (US Department of Health and Human Services, 2008)
O6 = Pathways to green building and sustainable design: A policy primer for funders, funders' network for smart growth and liveable communities (Beatley, 2008)
O7 = What is a charrette? (NCI, 2007)
O8= Green Building Rating Systems: A Comparison of the LEED and GREEN GLOBES systems in the US (Smith et al., 2006)
O9 = Costing Green: A Comprehensive Cost Database and Budgeting Methodology (Matthiessen and Morris, 2004)
O10 = Building Momentum: National Trends and Prospects for High Performance Green Buildings (Smith, 2003)

The idea of the sustainability integration strategies through project planning process as discussed above is illustrated in Figure 2.8 below.

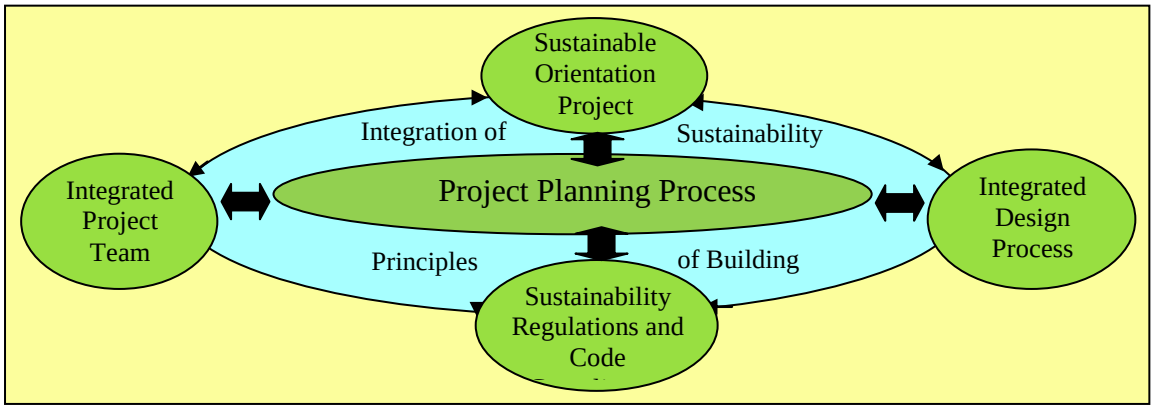


Figure 2.8: Strategies of Integrating Sustainability Principles into the Project Planning Process

2.4.7 Successful Project Performance and Sustainability

The concept of project success is developed to set criteria and standards by which projects can be completed with the most favorable outcomes (Freeman and Beale, 1992). According to PMBOK, in order for a project to be successful, the project team should select appropriate processes required to meet the project objectives, use defined approach that can be adopted to meet requirements, comply with requirements to meet stakeholder needs and expectations and balance the competing demands of scope, time, cost, quality, resources and risk to produce the specified product, service or result (PMI, 2008). APM (2012) further highlighted some factors that are known to contribute to project success include; defining clear goals and objectives, maintaining a focus on business value, implementing a proper governance structure, ensuring senior management commitment and providing timely and clear communication (APM, 2012). The successful accomplishment of the project objective is usually constrained by four factors; project scope, cost, and schedule and user/customer satisfaction (Clement and Gido, 2006). Achieving the set goals for building projects within realistic financial and time constraints, superior planning, design, and construction processes as well as having all the stakeholders' satisfaction are acutely needed for project success (Korkmaz et al., 2010; Clement and Gido, 2006).

Project success means different things to different people. In the early 1990s, project success was considered to be tied to performance measures, which in turn were tied to project objectives (Chan and Chan, 2004). At the project level, success was measured by the project duration, monetary cost and project performance (Navarre and Schaan, 1990). Time, cost and quality are the basic criteria to project success and they are identified and discussed in almost every article on project success, such as that of Belassi and Tukel (1996). Similarly, Lim and Mohamed (1999) emphasized that each industry will have their own unique set of criteria and factors, however they agreed with the standard measures of time, cost and quality. Moreover, they expanded on their definition of success, stating that a project must achieve the project's objective such as performance and safety for a construction industry. In addition to these basic criteria, Pinto and Pinto (1991) advocated that measures for project success should also include project psychosocial outcomes, which refer to the satisfaction of interpersonal relations with project team members. Meanwhile, Chan and Chan (2004) identified nine key performance criteria for measuring project success - time, cost, value and profit, health

and safety, environmental performance, quality, functionality, user expectation and satisfaction and participants' satisfaction. Sadeh et al (2000) divided project success into four dimensions. The first dimension is meeting design goals, which applies to contract that is signed by the customers. The second dimension is the benefit to the end user, which refers to the benefit to the customers from the end products. The third dimension is benefit to the developing organization, which refers to the benefit gained by the developing organization as a result of executing the project. The last dimension is the benefit to the technological infrastructure of the country and of firms involved in the development process. The combinations of all these dimensions give the overall assessment of project success. Apparently, Sadeh et al. (2000) were sharing the same opinions with Lipovetsky et al (1997) who also used a multidimensional approach to measure the success of projects which four dimensions were defined, meeting design goals, benefits to the customer, benefits to the developing organization and benefits to the defense and national infrastructure.

Currently, a study by Al-Tmeemy et al (2011) in line with previous findings (Atkinson, 1999; Sadeh et al, 2000; Lipovetsky, 1997) showed that project success is a multidimensional concept. Specifically, for a building project, At-Tmeemy et al, (2011) concluded that the project is most successful when it is capable in integrating three success dimensions; project management success (achieving cost, time and quality target), product or building targets (functionality, technical requirements and customer satisfaction) and market success (company's competitive advantages, company's reputation, increasing market share and reaching specified revenue and profits). Among the published work relating to the key criteria of successful project performance are concluded in Table 2.7 below.

Table 2.7: Key Criteria of Successful Project Performance

	Success Performance Criteria	Supporters
PROJECT MANAGEMENT SUCCESS		
1.	Cost within budget	B1; B2; B3; P1; P3; P4; P5; P9; P10; P13; P15;P19; P24; P25; P26
2.	Time within schedule	B1; B2; B3; P1; P2; P3; P4; P5; P8; P11; P13; P14; P15; P24
3.	Quality	B1; B2; B3; P1; P2; P3; P4; P5; P9; P10; P15; P16; P18; P20
4.	Satisfaction of interpersonal relations with project team members	B1; B2; P23
5.	Participants' satisfaction	P3; P4; P8; P20; P22
6.	Efficiency of Execution and project termination	P9; P21
PRODUCT/BUILDING SUCCESS		
7.	User satisfaction	B2; B3; P1; P3; P4; P5; P6; P11; P21

'Table 2.7, Continued'.

	Success Performance Criteria	Supporters
8.	Meeting project goal and objective	B1; B2; B4; P1; P4; P5; P7; P10; P12; P13; P14
9.	Technical Performance	P1; P13; P21
10.	Health and Safety	P4; P6; P10; P17; P19; P20; P22
11.	Environmental Performance	P4
12.	Functionality	P1; P4; P13; P17
13.	Benefit to the end user	B2; P1; P7; P9; P12
14.	Benefits to the Stakeholders	P9
15.	Benefit to the developing organization	B1; B2; P1; P5; P7; P12
16.	Benefit to the technological infrastructure	P1; P7; P12; P13
MARKET SUCCESS		
17.	Value and profit or business benefit	B1; P1; P3; P4; P9; P13; P14
18.	Market Share	P1; P3; P13
19.	Competitive advantage and reputation	P1
20.	Personal Growth	P21

Note:

Books:

B1 = APM Body of Knowledge: sixth edition (APM, 2012)
B2 = A Guide to the Project Management Body of Knowledge (PMBOK) fourth edition (PMI, 2008)
B3 = Effective Project Management (Clement and Gido, 2006)
B4 = Mastering Project Management: Key Skills in Ensuring Profitable and Successful Projects (Lake, 2010)

Papers:

P1 = Future Criteria for Success of Building Projects in Malaysia (At-Tmeemy et al, 2011)
P2 = Piloting Evaluation Metrics for Sustainable High-Performance Building Project Delivery (Korkmaz et al., 2010)
P3 = The Logical Framework Method for Defining Project Success (Baccarini, 1999)
P4 = Key Performance Indicators for Measuring Construction Success (Chan and Chan, 2004)
P5 = Current Practice in Project Management: An Empirical Study (White and Fortune, 2002)
P6 = Customer Satisfaction in Home Building (Torbica and Stroh, 2001)
P7 = The Role of Contract Type in the Success of R&D Defence Projects under Increasing Uncertainty (Sadeh et al., 2000)
P8 = Factors Affecting Clients Project Dispute Resolution Satisfaction in Hong Kong (Cheung et al, 2000)
P9 = Project Management: Cost, Time, Quality, Two Best Guesses and a Phenomenon, its Time to Accept Other Success Criteria (Atkinson, 1999)
P10 = Criteria for Project Success: An Exploratory Re-examination (Lim and Mohamed, 1999)
P11 = Evaluation of Project Outcomes (Liu and Walker, 1998)
P12 = The Relative Importance of Project Success Dimensions (Lipovetsky et al, 1997)
P13 = Mapping the Dimensions of Project Success (Shenhar et al, 1997)
P14 = Modelling Project Performance for Decision Making (Alarcon and Ashley, 1996)
P15 = A New Framework for Determining Critical Success/Failure Factors in Projects (Belassi and Tukel, 1996)
P16 = Selection Factors and Success Criteria for Design-build in the US and UK (Songer et al., 1996),
P17 = An Evaluation of Clients' Needs and Responsibilities in the Construction Process (Kometa et al, 1995)
P18 = IT Projects: A Basis for Success (Wateridge, 1995),
P19 = Evaluating the General Conditions of a Construction Contract (Bubashait and Almohawis, 1994)
P20 = Checklist of Critical Success Factors for Building Projects (Parfitt and Sanvido, 1993)
P21 = Measuring Project Success (Freeman and Beale, 1992)
P22 = Critical Success Factors for Construction Projects (Sanvido et al, 1992)
P23 = Determinants of Cross-functional Coorperation in Project Implementation Process (Pinto and Pinto, 1991)
P24 = Design of Project Management System from Top Management's Perspective. (Navarre and Schaan, 1990)
P25= Multicriteria Sustainability Assessment of Residential Buildings (Zavrl, M. S., et al, 2009)
P26= Pre-construction Evaluation Practices of Sustainable Housing Projects in the UK (Essa and Fortune, 2008)

The researcher agreed that a building project is more successful when it is capable in integrating three success dimensions; project management success, building targets and market success as highlighted by At-Tmeemy et al (2011). However, to deliver a successful sustainable project, sustainability principles integration into the whole life cycle of the project and product should also been taken into consideration. Four main criteria that are discussed in almost every article relating project success - on time,

within budget, quality and having stakeholders' satisfaction (without neglecting the other performance criteria as gathered in Table 2.7) are discussed briefly below,

Time - "Time" refers to the duration for completing the project. Project time management includes the processes required to manage timely completion of project (PMI, 2008). A delay in any part of a project can have serious knock-on effects on subsequent activities (Lake, 2010). Alarcon and Ashley (1996) defined effectiveness as a measure of how well the project was implemented or the degree to which targets of time and cost were met from the start-up phase to full production.

Cost - Project cost management includes the processes involved in estimating, budgeting and controlling costs so that the project can be completed within the budget (PMI, 2008). Seeking the optimum balance in the relationship that exist between 'initial cost', 'in use cost' and 'initial carbon cost' since the planning process of early project development stage will promote sustainability in building project.

Quality - Quality is another criterion that is repeatedly cited by previous researchers. The assessment of quality is rather subjective. Quality is defined Parfitt and Sanvido, (1993) as the totality of features required by a product or services to satisfy a given need; fitness for purpose. Nowadays, quality is the guarantee of the products that convinces the customers or the end-users to purchase or use. Project quality management includes the processes and activities of the performing organization that determine quality policies, objectives and responsibilities so that the project will satisfy the needs for which it was undertaken.

Stakeholders' Satisfaction - Liu and Walker (1998) consider satisfaction as an attribute of success. Project success and satisfaction should be viewed from different perspectives of the individual owner, developer, contractor, user and the general public etc. (Lim and Mohamed, 1999). Clement and Gido (2006) argued that projects are successful when all the project stakeholders are having satisfaction with the project.

2.4.7.1 Project Success and Sustainability

There is no specific success criteria model and framework is currently available for the needs of the sustainability in building projects. Moreover, those available frameworks

have shortcomings of taking into full account all of the project's life cycle and rarely align the sustainability concept with both short and long term goals of project (Labuschagne et al, 2005). Even PMBOK, the most popular model of project management was also claimed to be predominantly towards managing the execution function (Morris, 2011). Many omissions have been made by the model such as strategy, value and benefits, people issues, technology management, estimating and various matters relating to procurement (Morris, 2011). BCA (2007) and Hayles (2004) accentuated that sustainability in construction project would improve the project performance. It will be incompetent to judge a sustainable project's success only according to the criteria of cost, time, quality and stakeholders' satisfaction. Thus, besides of those four criteria of a successful project performance, sustainability in building project should also accomplish the criteria of meeting sustainability project goal and objectives and the rest of the criteria (but not limited to) as shown in Table 2.7 (p94). Projects need to be financed and designed from very beginning of planning process with sustainability high on agenda, for it is at this stage when plans can be formulated holistically and where the greatest cost benefits can be derived (CIOB, 2010). The project management practices such as the activities related to sponsorship were also led to maximize project success (Bryde, 2008).

It was found that sustainability principles and the current criteria of successful project performance as tabulated in Table 2.7 are related and parallel. Thus, the researcher expects that a successful sustainable building project can be achieved by accomplishment of the sustainability principles requirements of the project through practicing of a set of efficient integration strategies during the project planning process. The idea is portrayed in Figure 2.9 (p98). Even though the term of 'sustainable' or 'sustainability' are not included clearly in the mentioned criteria of a successful project, however, the sustainability principles are actually there for example; cost within budget, time within schedule, quality, meeting project goal and objective, technical performance, benefit to the technological infrastructure, value and profit or business benefit, functionality, efficiency of execution and project termination.

In project management, sustainability involves both individual and corporate responsibility to ensure the outputs, outcomes and benefits are not only sustainable over their life cycles, but also sustainable during their creation (APM, 2012). Using natural and human resources indiscriminately to achieve growth and financial profit, without

regard to the environment or social cost is no longer acceptable. Even it was proved that thinking sustainably now is the way to build in lower costs and increase value (CIOB, 2010). Sustainability should be considered in many different core areas of project, programme and portfolio management. Projects should be selected to meet sustainable objectives. Sustainable development is an area in continual flux and is rarely without debate and argument. However, every profession needs to consider it as a core aspect of being a professional and ethical person.

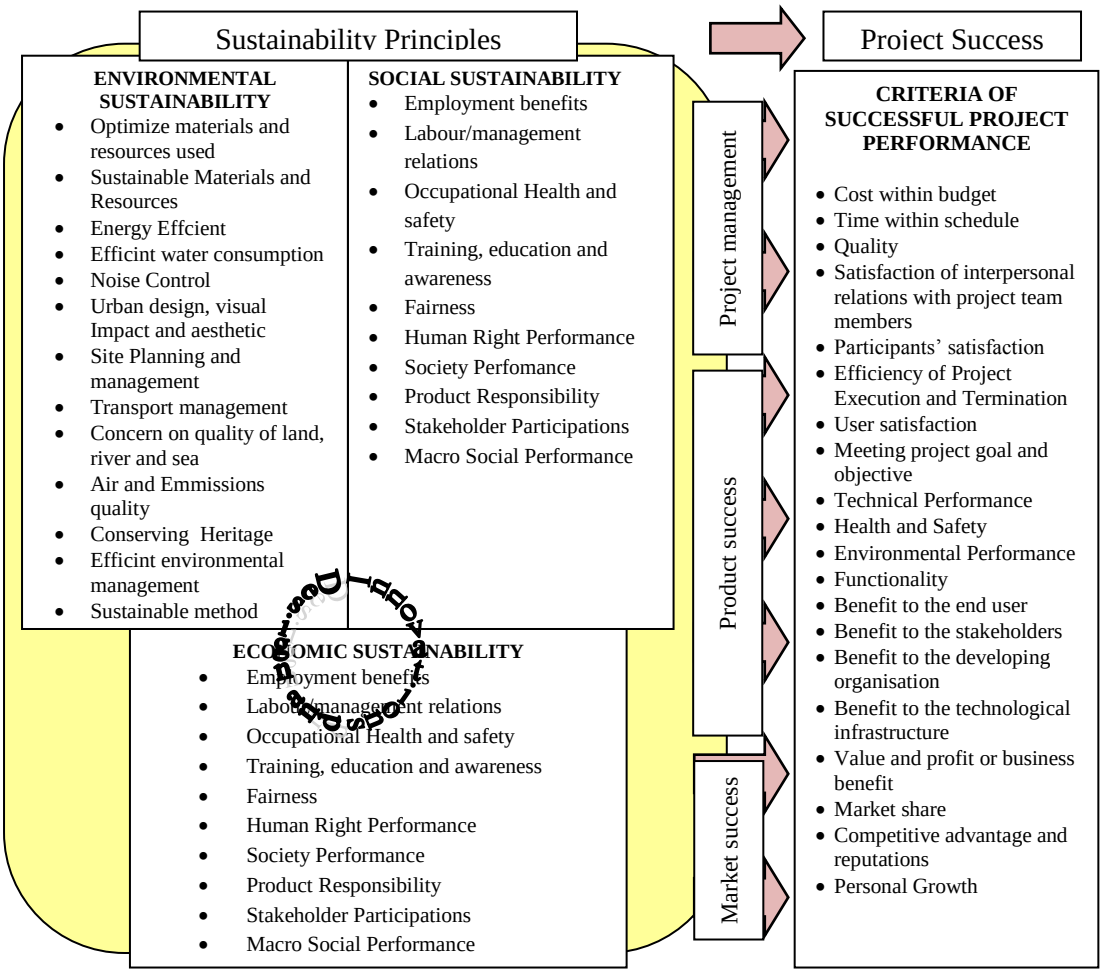


Figure 2.9: Sustainability Principles and Successful Project Performance

2.5 SUMMARY

It was revealed that sustainable development has been debated for decades in an attempt to reconcile conflicts between the TBL aspects. Most importantly, it has been realized that decision makings through planning process to support sustainability in building projects involve in a balanced and holistic approach to the three dimensions of sustainability and should be realized in the design and innovations that are made. Sustainability in building performs as a sustainable product, sustainable in application

and is constructed in a sustainable manner. It should be stressed that the life cycle analysis of a building needs to be carried out in determining whether or not the building is categorized as a sustainable or otherwise. It was argued that the current project life cycle management does not efficiently address the objectives of sustainable development. Social aspects are rarely considered, while environmental factors are typically only addressed by the means of EIAs and BPASs. The sustainable building movement worldwide is being impelled by the success of BPASs. However, the existing BPASs have long been criticized for being limited to the environmental dimensions. These critiques highlight the need to enhance the existing building assessment practice to respond effectively to the new challenges and requirements posed by the sustainability agenda. A clear list of sustainability principles of building and the integration strategies framework is therefore required to ensure that social and environmental considerations receive the same attention as economic factors at the project decision stage especially through the project planning process.

Success criteria models and frameworks that are currently available are not specifically designed for sustainable building projects. However, the researcher expects that a successful project can be achieved by accomplishment of the sustainability principles requirements through a set of efficient integration strategies into the project. An attempt has been made to synthesis and adapts the sustainability concept in the contents of sustainability integration framework to be proposed in the study. To conclude the literature review discussed in this chapter, a theoretical framework of sustainability principles of building, the integration strategies into the project planning process, criteria of successful project performances and their relationship has been formulated and portrayed in Figure 2.10 (p100). The theoretical framework is the starting point for the study towards developing a preliminary framework of integrating sustainability into the planning process of building project as proposed in this study. Adjustments need to be made to the way the stakeholders pursue and think about sustainability in building project that is not merely to technologies and cost reducing but also to attitudes, knowledge, perceptions and determination. Having discovered the sustainability principles and the strategies to integrate the principles into the project planning process towards achieving successful project performance, the question remained unanswered is whether these principles and planning strategies have been addressed in Malaysia. The sustainability practices in Malaysian building projects will therefore explored in the next chapter.

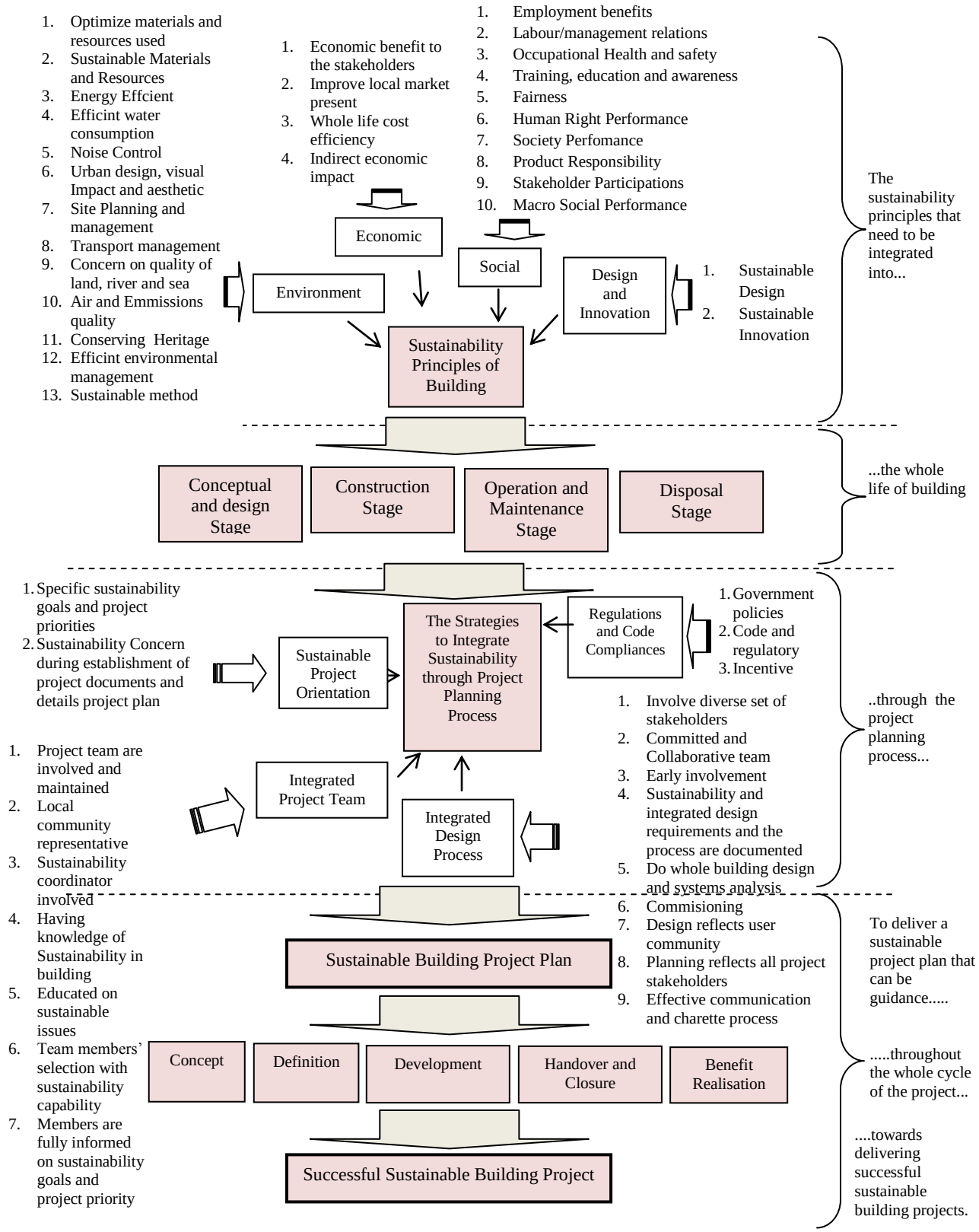


Figure 2.10: Theoretical Framework of Sustainability Principles of Building, the Integration Strategies into the Project Planning Process and their Impact towards Project Success